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Planktic Ostracodes from the Antarctic and Subantarctic Collected by the 1989-1990 Italian Antarctic Expedition

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ABSTRACT. Eleven species of planktic Ostracoda were collected by the Italian Antarctic Expedition of 1989-1990 from the region south of New Zealand in the Southern Ocean to the Ross Sea, Antarctica. Of these species, only *Proceroecia rivoltella* n.sp. (described herein) and *Gigantocypris muelleri* were not recorded by Deevey (1982) from much the same area. Depth distributions are given for the more commonly encountered taxa, *Alacia belgicae*, *A. hettacra*, *Boroecia antipoda*, *Metaconchoecia skogsbergi* and *M. isocheira*. Much of the total Ostracoda density at each station is due to the dominance of *A. hettacra* at lower latitudes and *A. belgicae* at higher latitudes. The near identity with Deevey's records confirms that the planktic ostracodes of far southern latitudes are now reasonably well known, at least to depths less than 1000 m.

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Planktic ostracodes of the antarctic and subantarctic are being studied at the Istituto di Ecologia (University of Parma) as part of the continuing biological program of the Italian 'Progetto Antartide'. Our initial work was done on samples collected in 1987-1988 mainly from the nearshore waters of Terranova Bay, the Ross Sea, in the vicinity of the Italian base. It revealed the predominance at all stations and all depths of *Alacia belgicae* (Mueller, 1906) in a species-poor ostracode fauna which also included *Alacia hettacra* (Mueller, 1906) and *Metaconchoecia isocheira* (Mueller, 1906) (McKenzie *et al.*, 1990; Benassi, Naldi & McKenzie, 1992). We noted that these species are the same as those previously collected in the Ross Sea around the turn of the century (Brady, 1907; Barney, 1921).

This report presents species determinations, description of a new species, and discussion of the planktic ostracodes collected during the 1989-1990 Italian Antarctic Expedition. As such, it supplements previous work on the *RV Eltanin* collections by Deevey (1982). Our primary data – the per sample species list, total Ostracoda density and density for each species – are available as Appendices I and II in another report (Benassi *et al.*, 1992).

Materials and Methods

Zooplankton samples were collected under the supervision of Prof. L. Guglielmo (University of Messina) in the Southern Ocean and Ross Sea, over an extensive area between 51° and 75°S from 25 November 1989 to 12 January 1990 (Figure 1; Table 1 [Appendix]). An Eznet Bioness apparatus equipped with ten 500 µm mesh nets was used, the net mouth area being 0.25 m^2. At each station, samples were collected from nine different depth layers, and an integrated sample from the maximum sampling depth to the surface was also taken. This maximum sampling depth was 1000 m; frequently the bottom depth at a station was much greater than this

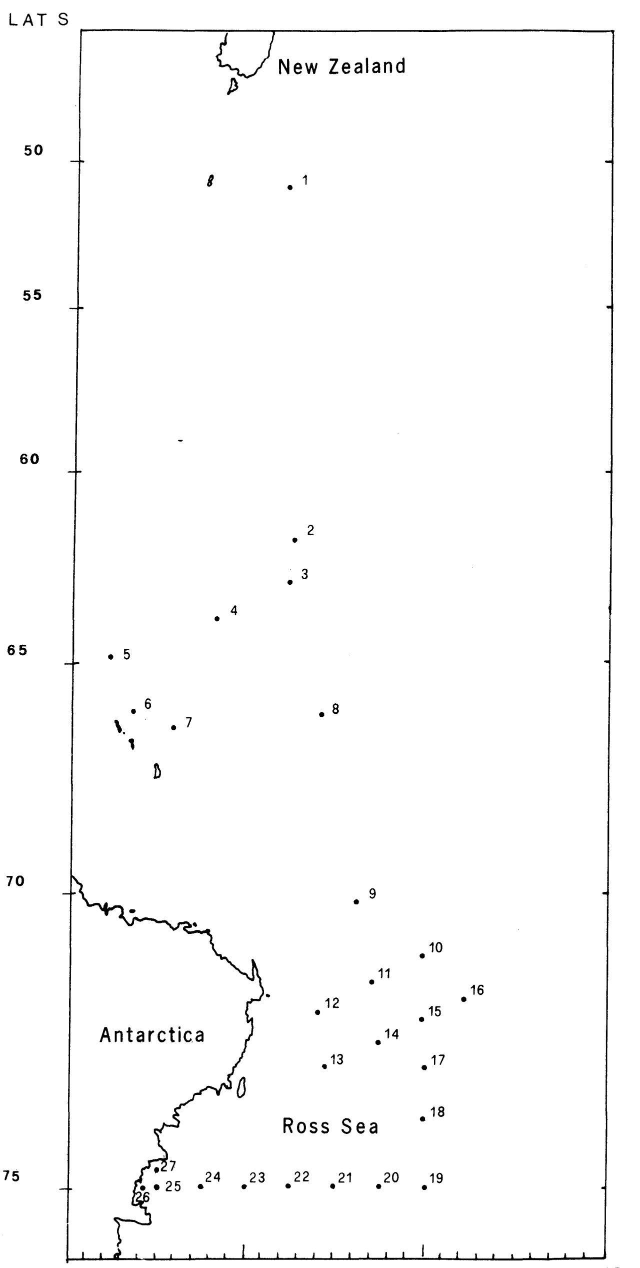

Fig. 1. Locations of sampling stations.

(Table 2 [Appendix]). A total of 572 samples was collected at 58 stations; only 4 of these stations (24, 25, 26 and 27) were located in the sampling area of the 1987-88 Expedition.

Ostracoda were sorted at the Italian Marine Sorting Center, Istituto Scienze Ambientali Marini (University of Genova). We received 346 Ostracoda samples from 48 stations (Table 2 [Appendix]). A total of 6668 specimens were examined individually, and species determinations were made, for juveniles as well as adults, using Mueller (1906), Poulsen (1973), Martens (1979) and Angel (1981). A few poorly preserved or damaged specimens were not identified. The total water volume data was also made available, allowing computations of the density for total Ostracoda and for each species (Table 2 [Appendix]). The presence/absence at each station of the 11 species we identified is summarised in Table 3 (Appendix).

Notes on the Species

Gigantocypris muelleri Skogsberg, 1920. Only one specimen (length 18.02 mm) was found, in sample 7 from station 3, about 69°30'S. According to Angel (1981), this is a bathypelagic species. Its presence south of the Antarctic Convergence seems worth recording, since Deevey (1982) did not find it.

Conchoecissa symmetrica (Mueller, 1906). We identified only four individuals in the samples, from stations 2, 4 and 9 respectively. It is noted as occurring frequently from 33° to 68°S in the south Pacific (Deevey, 1978) and between 47° to 64°S in the southern Indian Ocean (Deevey, 1982).

Boroecia antipoda (Mueller, 1906). This species was fairly abundant in a large number of samples from station 2 (63°S) to station 17 (73°S). According to Angel (1981), it is a mesopelagic species reported from all oceans at austral latitudes. Deevey records it from 49° to 77°28'S at depths up to 5190 m (Deevey, 1982, table 1).

Alacia belgicae (Mueller, 1906). As noted earlier, this was the predominant species among those collected in Terranova Bay, the Ross Sea, during the 1987-1988 Italian Antarctic Expedition. In 1989-1990, it occurred from station 10 (about 71°S) to the Ross Sea stations (75°S) and was numerically dominant from station 16 to station 27. Deevey (1982) reports its presence from 63° to 78°S.

Alacia hettacra (Mueller, 1906). Like the previous species, it was reported from the Ross Sea by McKenzie *et al.* (1990). In 1989-1990, it was found in almost all the stations and was clearly dominant between station 2 (62°S) and station 11 (72°S). Deevey (1982) cites its occurrence from 50°04' to 78°S.

Discoconchoecia elegans (Sars, 1865). This species occurred in nine samples from four stations (1, 2, 3 bis and 4). It is a mesopelagic, transoceanic and cosmopolitan species (Angel, 1981) recorded up to 65°S by Deevey (1983). We foreshadow here that *D. elegans* was the predominant species collected in the Straits of Magellan by the 1991 Italian Antarctic Expedition.

Pseudoconchoecia serrulata (Claus, 1874). This species was found only at stations 1 and 2 but occurred in considerable numbers. It is a mesopelagic species (Angel, 1981), reported in the south Pacific between 40° and 68°S (Deevey, 1978) and in the southern Indian Ocean between 34° and 64°S (Deevey, 1982).

Obtusoecia antarctica (Mueller, 1906). It occurred only at station 1 in two samples and in a small number of individuals. We follow Martens (1979) and Deevey (1982) in ascribing the species to Mueller, although in Deevey's final report (Deevey, 1983) it appears as the more familiar *O. obtusata* (Sars, 1866) *antarctica* Mueller. Deevey (1983, table 1) records it between 36° to 65°S. Additionally, McKenzie (unpublished data) has found it off south-western Australia in latitudes dominated by the West Wind Drift, as part of collections made by *SS Diamantina* during the International Indian Ocean Expedition of the 1950-1960s.

Proceroecia rivoltella n.sp. [*cf.* Systematic Description].

Metaconchoecia skogsbergi (Iles, 1953). A few individuals of this species were reported in samples collected from the Ross Sea during 1987-1988 (McKenzie *et al.*, 1990). In the 1989-1990 collections, it occurred frequently from station 1 (51°S) to stations 14 and 15 (about 73°S).

Metaconchoecia isocheira (Mueller, 1906). Reported as a common species in the Ross Sea by McKenzie *et al.* (1990). In the 1989-1990 Expedition, it was found frequently from 64°S (station 4) to 75°S (Ross Sea stations). Angel (1981) considers it an upper mesopelagic species at austral latitudes in all the oceans and Deevey (1983) records it from 61° to 70°S at 0 to 2000 m.

Systematic Description

Halocypridae

Conchoeciinae

Proceroecia Kock, 1992

Type species. *Proceroecia microprocera* (Angel, 1971).

Amended diagnosis. Conchoeciine genus in which the shells are small to moderate sized (up to 1.8 mm in length), relatively thin and fragile, striated, with asymmetric compound glands in the usual places (ie, posterodorsal in the LV, posteroventral in the RV), but lacking lateral corner glands and with dorsomedial glands only in the males, plus abundant medial glands along virtually the entire free margins of the valves. Usually, the RV carries a minute posterodorsal spinule.

In the soft anatomy: 1. The cap of the frontal organ in males carries long hairs ventrally and is more or less rounded terminally; in females, the frontal organ is long and slender, the cap is indistinctly jointed from the stem and is adorned with short prickly hairs ventrodistally.

2. The female antennule is short and without a dorsal bristle on the second segment; the 'e' bristle of the male has an armature consisting of biserial slender or blade-like, backwards-directed spinules.

3. The pipe bristles of the antennal endopod are relatively long in females but much shorter in males; both male endopod clasping organs are recurved strongly and stout proximally, the right one being better developed.

4. The masticatory pad of the mandible coxale is subrectangular, densely spinulose, undivided and straight-edged ventrally; the mandible exopod is well developed, its basal part resembling a cocked pistol in lateral profile; the first endopod segment of the mandible endopod carries at most only 2 (usually none or 1) long annulate ventral bristles, with or without up to 3 associated minute setules, usually set on a lunate ventrodistal bulge.

5. The furca is without a dorsal bristle.

Remarks. Poulsen (1973) included the 'procera' group of Mueller (1906) in his very broad interpretation of the genus *Paraconchoecia* Claus, 1891, based on a perceived general similarity in the masticatory pad of the mandible coxale.

The type species of *Paraconchoecia* is *Paraconchoecia oblonga* (Claus, 1890). We note further that *P. gracilis* (Claus, 1890), another of the four species including *oblonga* that were originally assigned to *Paraconchoecia* by Claus (1891), is generally regarded as a junior synonym of *Conchoecia elegans* Sars, 1866, which was made the type species of a new genus *Discoconchoecia* by Martens (1979).

In the strict sense, *Paraconchoecia* comprises only *P. oblonga*, *P. spinifera* (Claus, 1890) and *P. allotherium* (Mueller, 1906). It is simply differentiated from *Proceroecia* by having smooth (not striated) valves, and three or four ventral bristles without associated minute setules on the first endopod segment of the mandible which, unlike the case in *Proceroecia*, does not display a more or less lunate ventrodistal bulge.

Discoconchoecia Martens, 1979 is most easily distinguished from *Proceroecia* by the disc-like armature of the male antennule 'e' bristle, and by the fact that the first endopod segment of the mandible has two or three ventral bristles without any associated minute setules.

All other species brought by Poulsen (1973) into the aegis of *Paraconchoecia*, and thereby associated with *Proceroecia* by having a similar undivided, ventrally straight-edged masticatory pad on the mandible coxale, have four ventral bristles without any associated minute setules on the first endopod segment of the mandible; apart from several other differentiating features, including size, type of reticulation, positions of the asymmetric compound glands, shape of the male clasping organs, etc.

Additionally, *Proceroecia* species (= 'procera' group of Mueller, 1906) are identified rather readily by the mandible exopod, with its distinctive cocked-pistol lateral profile basally and long pilose extruding bristle, a feature which also provides a convenient name for our new species.

Proceroecia includes at least the following species: *P. rivoltella* n.sp.; *P. procera* (Mueller, 1894); *P. brachyaskos* (Mueller, 1906); *P. decipiens* (Mueller, 1906); *P. vitiazi* (Rudjakov, 1962); *P. macroprocera* (Angel, 1971); *P. microprocera* (Angel, 1971); *P. hoensis* (Poulsen, 1973). Recently, Angel (personal communication, June 1992) has provided a lengthy list of occurrences determined as *P. brachyaskos* in deep waters of the Atlantic Ocean at tropical latitudes. The mandibular endopod (first segment) of this taxon needs to be rechecked as it may well represent yet another species of *Proceroecia*.

***Proceroecia rivoltella* n.sp.** McKenzie & Benassi

Figs 2-3

Dimensions. HOLOTYPE, Museum of Natural History, University of Parma reg. no. 994/1, male, length [L] 1.49 mm, height [H] 0.725 mm, breadth [B] 0.675 mm, length to base of shoulder [S] 0.85 mm (Sample 6/3).

PARATYPES, Australian Museum P42286 – damaged female, L 1.42 mm, H 0.705 mm, S 0.825 mm (Sample 6/3); mature male, L 1.53 mm, H 0.765 mm, B 0.69 mm, S 0.86 mm (Sample 6/3). Other paratypes held in the working collections, Oceanographic Unit, Institute of Ecology, University of Parma – female, length 1.55 mm, height 0.705 mm, breadth 0.650 mm, length to base of shoulder 0.90 mm (Sample 7/3 bis); ovigerous female, L 1.59 mm, H 0.76 mm, B 0.710 mm, S 1.00 mm (Sample 6/2); damaged female, L 1.585 mm, H 0.745 mm, B 0.745 mm, S 0.98 mm (Sample 7/3 bis); damaged male, L 1.40 mm, H 0.63 mm, B 0.59 mm, S 0.84 mm (Sample 7/3 bis); juvenile female, L 1.235 mm, H 0.59 mm, B 0.59 mm, S 0.775 mm (Sample 7/3 bis); juvenile female, L 1.235 mm, H 0.59 mm, B 0.55 mm, S 0.78 mm (Sample 7/3 bis); juvenile male, L 1.27 mm, H 0.55 mm, B 0.49 mm, S 0.805 mm (Sample 5/2); juvenile male, L 1.18 mm, H 0.51 mm, B 0.51 mm, S 0.745 mm (Sample 10/2).

Description. *Shell* (Fig. 2B-C) of the male regularly shaped; greatest height posterior of the middle and about 45-50% of the length; surface ornamented distinctively by concentric striations; rostrum arched with a rounded tip, incisure moderately deep and rounded, opening out towards the broadly rounded anteroventral margin; no selvage bulge; ventral margin evenly convex, with a slight protrusion posteroventrally (at the site of the asymmetric compound gland) in the RV, this protrusion not present in the LV; posterior margin broadly and evenly rounded; dorsal margin weakly concave from the posterodorsal area to the base of the shoulder, but straight to weakly convex from this point to the rostrum (the shoulder, therefore, is only moderately developed); greatest shell length is measured from the tip of the rostrum to level with the mid-posterior; greatest breadth posteromedial, ranging from a little less than to equal the height; asymmetric compound glands in the usual positions (posteroventral in RV, posterodorsal in LV); lateral corner glands absent; dorsomedial glands in the males only, opening posterodorsally on the posterior margin; the ventral and posterior margins, from below the incisure posteriorly, are lined with numerous small subcircular medial glands.

Antennule (Fig. 2G-H). Both right (R) and left (L) antennules united proximally with the shaft of the frontal organ, which is further linked to them by a simple circlet attached mediodorsally to the second segment of each antennule (the arrangement is best observed in ventral view); scattered erythrophores can be seen in the ventral part of the first segment of each antennule and at the region of juncture with the stalk of the frontal organ. First and second antennule segments without any bristles; comparative lengths 330 µm and 250 µm respectively; terminal segment (or segment complex) short and bearing 5 bristles but no dorsal bristle. The 'a' bristle is a 'pipe' bristle, slightly broadened at its base and S-shaped proximally with a length of about 365 µm, the 'b' bristle is comparatively short and annulate with a length of 315 µm, the 'c' bristle is a very short (100 µm or less) 'pipe' bristle which is broadened basally; the 'd' bristle is longer and bent abruptly at about 75% of its length from its base, its total length being 585 µm; the 'e' bristle is very long (845 µm) and ornamented with a double row of 12-13 blade-like spines, pointing upwards and backwards along the bristle, plus 7-8 uniserial similar spines more proximally, this bristle also is annulate and flexes outwards where its ornament of spines terminates. The 'e' bristle armature is reminiscent of *P. brachyaskos* (Mueller, 1906).

Frontal organ (Fig. 2E-F). Shaft about 450 µm in total length, with a distinct suture about medially (proximal part 225 µm, more distal part 215 µm); distally of this suture about 40-50 µm it is attached by a simple circlet to the inner dorsal margin of the second segments of the R and L antennules; cap has a length of 215 µm, is clearly separated from the shaft, and displays a well-rounded tip; in ventral view shape is digital and completely regular, but viewed laterally is seen to be slightly bent towards the front; bears scattered hairs ventrally.

Antenna (Fig. 2J-L). Muscular protopod has the characteristic halocyprid wedge-like shape and is 725 µm in length; exopod modified as a natatory structure, with the first segment about 255 µm long while segments 2-8 (all very short) total about 140 µm in length; the natatory bristles are up to 785 µm in length and are characteristically annulate and feathered; the endopod first segment is about as high as it is long (length 150 µm) with a conical processus mamillaris proximally, and a lunate bulge distally on which latter are the 'a' and 'b' bristles; the 'b' bristle is about a third again as long as the 'a' bristle, both are annulate and appear to be adorned with minute hairs; second segment of the endopod is relatively short (about 65 µm), carrying 7 bristles; the 'e' bristle is minute, the 'c' and 'd' bristles both are short, the 'h', 'i' and 'j' bristles are sensory

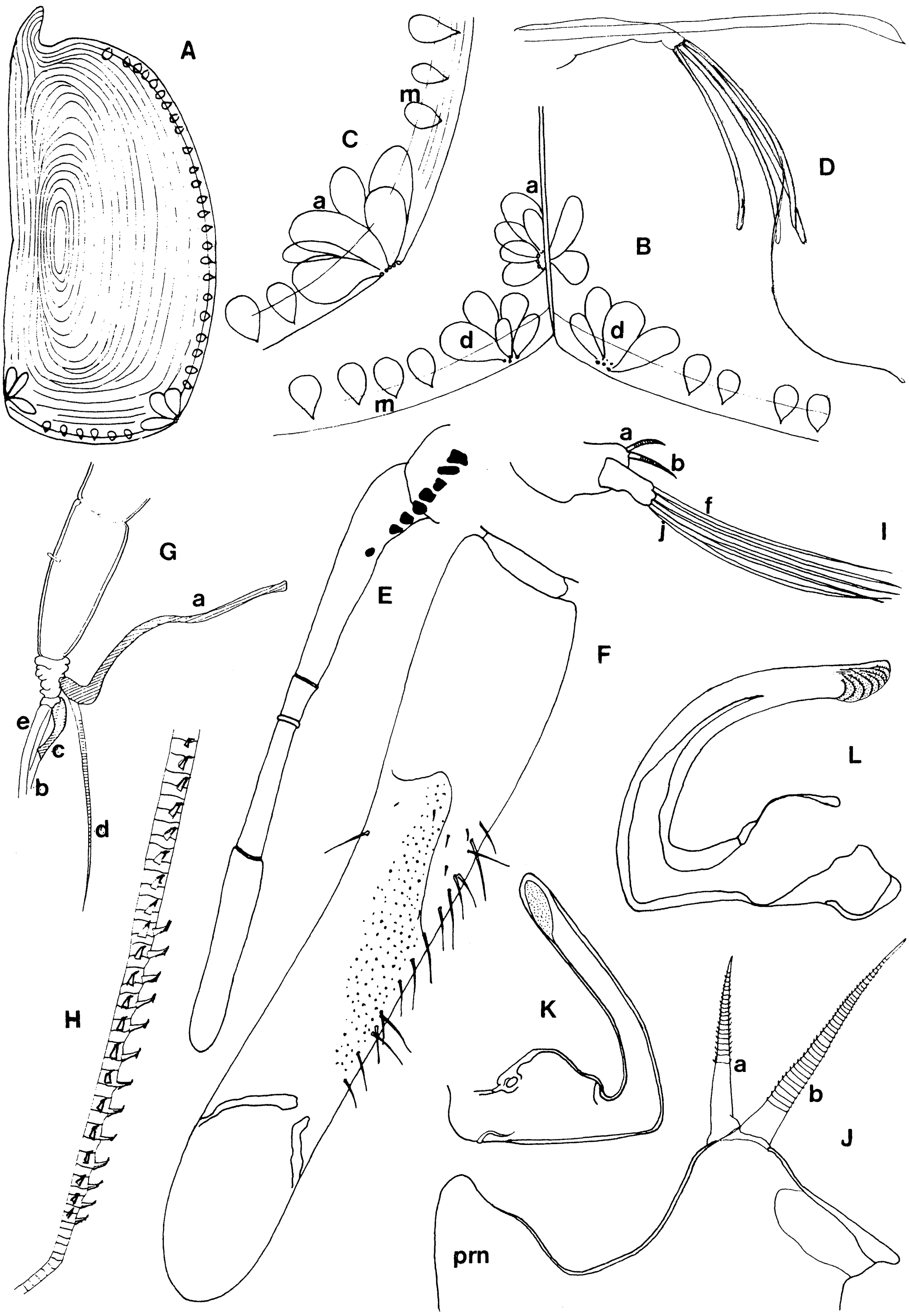

Fig. 2. A – shell of adult ovigerous female, x40 (paratype, sample 7/3 bis); B – posterior of adult male shell, LV asymmetric compound gland (a), dorsomedial glands (d), medial glands (m), x125 (holotype, sample 6/3]; C – posteroventral margin of adult male RV, asymmetric compound gland (a), medial glands (m), x125 (holotype). *All subsequent figures are of the same female paratype and male holotype*. D – female A1 (antennule) and frontal organ, x125; E – male frontal organ (ornament of cap not shown), indicating position of erythrophores, x125; F – male frontal organ cap, detail, x500; G – male A1, detail of location of terminal bristles, 'a' and 'c' are 'pipe' bristles, 'b' is unusually short (good specific character), 'd' and 'e' are long, x125; H – male A1 (antennule), detail of 'e' bristle armature, x500. I – female A2 endopod, showing 'a', 'b', and 'f'-'j' bristles, x125; J – male A2 endopod, processus mamillaris (pm) and 'a', 'b' bristles, x500; K – male A2 left (L) clasping organ, x500; L – male A2 right (R) clasping organ, x500.

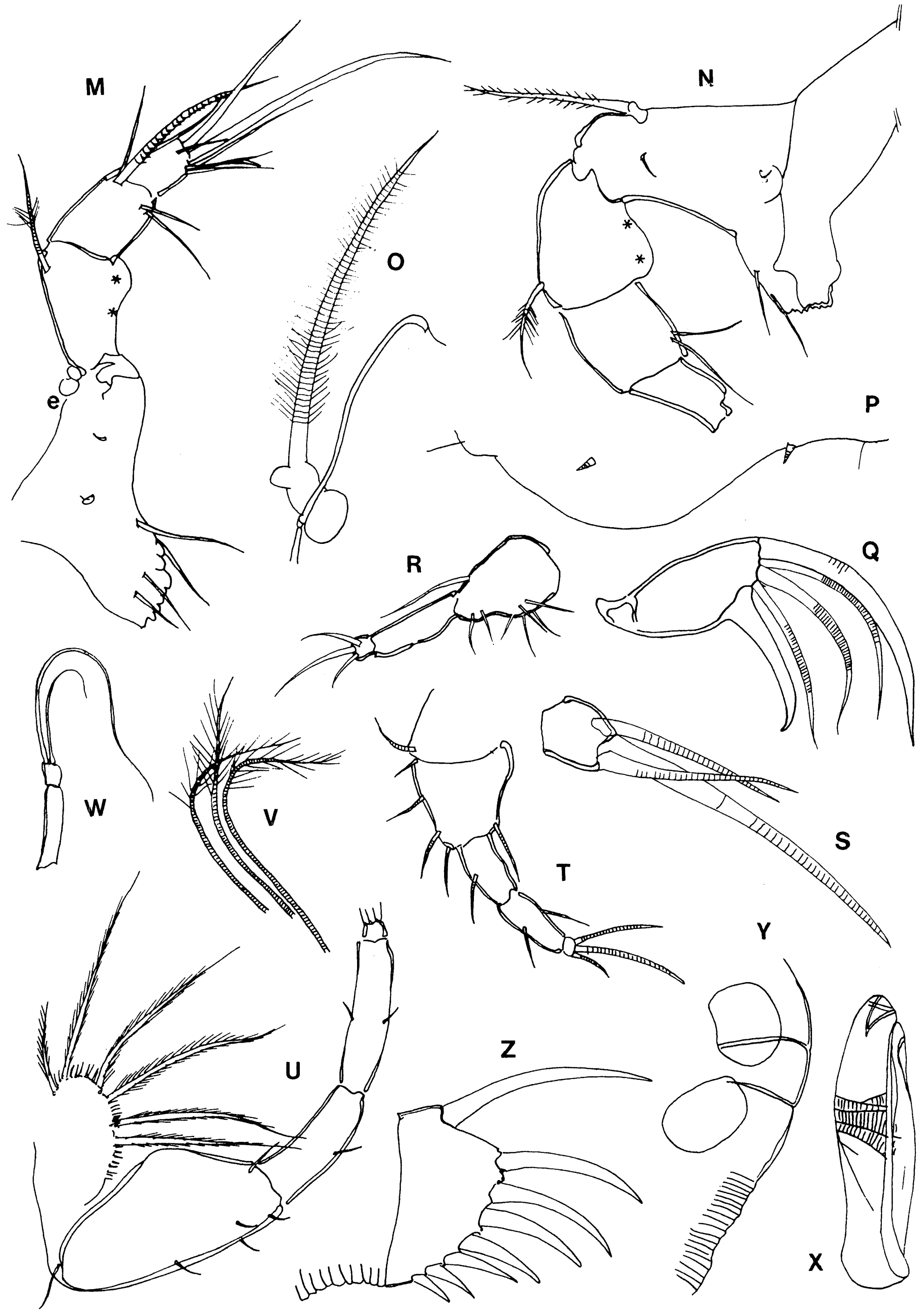

Fig. 3. M – female mandible, basale and endopod, showing location of exopod (e) and sites of minute setules (*) of the ventral first endopod segment, x125; N – male mandible general view, coxale, basale and endopod, showing minute epipodial bristle on medial hump of basale (near the coxale), exopod, and sites of minute setules (*) of the ventral first endopod segment, x125; O – male mandible, exopod showing the pistol-like proximal part and setal pilosity, x500; P – male mandible, detail of lunate bulge of ventral first endopod segment and its 2 minute setules x500; Q – male maxillule, second endopod segment (the 'hand'), detail of terminal claws and bristles, x500; R – female P1 exopod, x125; S – male P1 exopod third segment, detail of terminal bristles, x500; T – female P2 exopod, x125; U – male P2 epipod (detail of some Strahlen) and exopod (terminal bristles not shown), x125; V – male P2, detail of ends of reflexed terminal bristles, x125; W – female P3, x125; X – penis, x125; Y – female posterior of body, showing large eggs, x125; Z – male furca, x125.

bristles and subequally long (150 µm), the 'f' bristle measures about 685 µm and the 'g' bristle is distinctly longer (785 µm), both the 'f' and 'g' bristles are annulate and smooth; the clasping organ is dimorphic on the R and L antennae; the R antennal endopod is larger and curved back regularly and strongly; the L antennal endopod has a generally similar shape but is reflexed more acutely and is smaller; on both organs (R and L) tip is weakly retrousse and rounded terminally; on the R organ it bears several ventral corrugations which form an oval pad; whereas on the L organ the oval pad occurs but is minutely spinulose and does not show any corrugations.

Mandible (Fig. 3N-P). Coxale masticatory pad consisting of a densely-hirsute squared-off plate; above it what appear to be 2 minutely spinulose overlapping flaps; more proximally and laterally is a rounded structure off which radiate 4 rather broad-based subacuminate molar claws, behind these is a dense cluster of many (over 20) annulate spikes (the overall appearance is rather like a pincushion); proximal tooth list, below the masticatory pad, has a broad and flat anterior tooth followed after a brief gap by 4 conical teeth, then becoming denticulate and tapering away and up to the rear; median tooth list has a prominent pointed anterior tooth, the list then becomes denticulate and ends posteriorly with 2 stout teeth rather close together; distal tooth list begins anteriorly with a blade-like tooth then becomes denticulate and ends with a relatively powerful pointed tooth; the triangular anterior condyle is well chitinised; overall length of the coxale, from its base to the upper condyle is about 240 µm. Basale wedge-shaped, oriented at right angles to the coxale and highest proximally at its meshing with the coxale, its length is 275 µm; the basis is dentate and has a well-developed ventral tooth; on the anterior side of the basis are 2 moderately long annulate bristles set well apart, about level with the higher but set medially are 2 shorter annulate bristles, and medially, towards the juncture with the first endopod segment is a small annulate bristle. Epipod a minute bristle extruding from an oval depression on the epipodial hump, near the coxale. Exopod distinctive; shaped like a cocked pistol proximally but terminating as a rather elongate pilose bristle. Endopod 3-segmented; first endopod segment 140 µm in length with a single annulate dorsodistal bristle, adorned medially by radiating spiky hairs, plus a prominent lunate bulge ventrodistally which bears 2 minute setules; second segment 100 µm long, with 2 unequal smooth annulate ventrodistal bristles, plus 3 unequal annulate dorsodistal bristles, 2 of them slender and smooth, the third powerful with spiky hairs; third segment 90 µm long and carrying 7 annulate terminal bristles – 1 rather short and smooth and set mediodorsally, 3 longer, slender and smooth, set ventrodistally, another like these but hirsute and set medioventrally, and 2 powerful but unequal bristles (the larger about one third longer than the smaller), both adorned with stiff spiky hairs.

Paragnath. Widest proximally and linguiform, clothed distally on its inner surface with 9-10 long hairs.

Front of the head. Conical in lateral view, trending anteroventrally; rounded in front, gently convex ventrally and gently concave dorsally; in lateral view 275 µm long and 315 µm high. Viewed from below it is broad and flat in front; posterior part of the upper lip has a small central notch in the median element, while the rake-like processes on either side each have 2 relatively coarse inner teeth and a row of 6-8 similarly sized outer teeth.

Maxillule (Fig. 3Q). First endite with 7, mainly spine-like, terminal bristles, the anteriormost adorned with spiky hairs; second endite with 8-9 mainly spine-like terminal bristles, the anteriormost subfalcate, plus 2 more proximal bristles on the inner side; additionally, there are 1-2 longish bristles set just above the margin of the palp but projecting downwards along it; palp (endopod) first segment quite wide with respect to its length, carrying 5 unequal dorsal annulate bristles and 3 annulate ventral bristles, plus at least 1 annulate median bristle; second segment hand-shaped and directed backwards, with 5 curved unequal terminal bristles, 3 of these coarser and claw-like, the intervening 2 slender.

P1 (Fig. 3S). Subpediform; epipod tripartite with 3 sets of Strahlen numbering 5, 5 and 5 respectively from upper to lowermost; protopod rectangular; first endite with 1 short and 1 long annulate bristle, well separated, the latter hirsute; second endite with 3 bristles, 1 short and claw-like, the other 2 unequal but both are annulate and carry long hairs; endopod uni-segmented, plump, with 5 terminal bristles (2 more powerful than the rest and claw-like), plus 3 annulate bristles on the inner side of the ventral endopod; exopod 3-segmented; first segment with 3 proximoventral, 2 medioventral, 2 ventrodistal and 1 dorsodistal bristles (the latter being largest); second segment with 2 medioventral bristles; third segment with 3 unequal terminal bristles; lengths of the segments 140 µm, 130 µm and 20 µm respectively.

P2 (Fig. 3U-V). Subpediform, reflexed backwards and upwards; epipod tripartite with 3 sets of Strahlen numbering 7 (one small), 5 and 5 respectively; endopod with a single distal bristle; exopod 4-segmented; first segment with at least 4 small medioventral and ventral bristles plus 1 dorsodistal bristle; second segment with 1 small medioventral bristle; third segment with a small bristle medially on each side; fourth segment with 3 long flexuous annulate terminal bristles which are clothed with long hairs distally and have a length of 650 µm; lengths of the exopod segments are 235 µm, 160 µm, 175µm and 20 µm respectively. The sex dimorphism of this limb is characteristic for all halocyprids.

P3. Reduced and 2-segmented; second segment smaller, but slightly more expanded than the first segment, and carrying 2 very unequal terminal bristles, the much-longer of them whip-like and strongly recurved.

Penis (Fig. 3X). Finger-shaped, relatively wide, and 245 µm in length, with a few (4-5) medial transverse muscle bands.

Furca (Fig. 3Z). Lamellar and bearing 8 claws, the first of these is the largest and separated from the others by a distinct gap, the second and third claws are subequal, the fourth to eighth claws reduce regularly in size.

Female. *Shell* (Fig. 2A) resembles that of the male, but does not have posteroventral dorsomedial glands. Female antennules do not have a circlet connecting them with the frontal organ (Fig. 2D); each antennule carries 5 terminal bristles of which 4 ('a'-'d') are 'pipe' bristles and subequally long, while the 'e' bristle is longer and slender with fine lateral hairs. The cap of the frontal organ in the female is not clearly differentiated from the stalk, terminates in a pointed tip and is finely pilose ventrally. On the endopod of the female antenna [Fig. 2I], setae 'c' and 'd' are missing; 'e' is minute and 'f' is only slightly longer than 'g', 'h', 'i' and 'j', all ('f'-'j') are sensory; and there is no clasping organ. The mandible (Fig. 3M), maxillule and P1 (Fig. 3R) are all similar to those of the male, except that the epipod of the P1 carries fewer Strahlen, 4, 3 and 4, although their arrangement remains tripartite. The P2 in the female (Fig. 3T) is again very similar to that in the male but smaller, also the bristles of exopod segments 1, 2 and 3 are all stronger than in the male, and the 3 terminal bristles of the fourth segment are unequal, the strongest being claw-like; on the first exopod segment of the P2 the chaetotaxy is 2 medioventral, 2 ventrodistal and 1 dorsodistal. The P3 (Fig. 3W) and furca resemble those of the male. Adult females are easily recognised through the translucent valves because they are usually ovigerous; when first formed the eggs are small and densely packed, when released they about double their volume (large eggs) (Fig. 3Y).

Etymology. *Rivoltella* (Italian) = pistol, for the shape of the proximal mandible exopod.

Remarks. As noted earlier, the new species belongs among a small group of conchoeciines, the '*procera*' group of Mueller (1906) [see also Angel, 1971] which Poulsen (1973) brought into *Paraconchoecia* Claus, 1891. Reprising, this species group is characterised by asymmetric compound glands in the usual conchoeciine position, the absence of lateral corner glands, the occurrence of posterodorsal dorsomedial glands only in males, abundant medial glands along virtually the whole free margin below the incisure, the absence of a dorsal bristle on the furca, the occurrence of at most two annulate bristles with or without associated minute setules on a prominent ventral bulge of the first endopod segment of the mandible, and a straight-edged, densely hirsute masticatory pad on the mandible coxale.

Our new species shares these features but is readily distinguished from others in the group by the single long annulate bristle and two minute setules on the lunate bulge of the first endopod segment of the mandible and the relatively short 'b' bristle of the male antennule (these features are readily observed at ordinary binocular magnification by removing the antenna from one side of the animal). Of the other '*procera*' group species, *P. procera*, *microprocera* and *macroprocera* all have one long annulate bristle ventrally on the first mandible endopodite segment, but no minute setules (Angel, 1971), *P. brachyaskos* has one and *P. decipiens* has two long annulate ventral bristles (Poulsen, 1973), but no minute setules; *P. vitiazi* Rudjakov, 1962 has one such bristle plus three minute setules (Angel, 1971); *P. hoensis* Poulsen, 1973 has neither long annulate bristles nor setules (Poulsen, 1973). In all these other species, the 'b' bristle of the male antennule is nearly as long as the 'd' and 'e' bristles.

It is interesting to note that our most southerly record of *P. rivoltella* (about 71°S) was taken at 200 to 160 m in near surface waters; whereas the specimens found at 68°35'S were collected at 800 to 700 m depth; and the specimens from about 66°S were taken at depths between 1000 and 700 m. Since the Antarctic Convergence in this part of the Southern Ocean oscillates between 60° and 65°S, *P. rivoltella* probably follows antarctic water down the gradient at the boundary region. Now that it has been described and differentiated from other species in the 'procera' group, therefore, we expect that *P. rivoltella* will be determined in the deepwater zooplankton of the southern oceans at more northerly latitudes and, indeed, could become an index for tracing the movement of antarctic water into these latitudes.

Discussion

Our data allow a more detailed analysis of depth distributions for the species we identified. First we considered the set of 11 stations (2 to 15 bis) located between about 62° and 73°S (Table 2). The highest density values at these stations were observed for *Alacia hettacra* between 100-300 m, for *Boroecia antipoda* between 300-600 m and for *Metaconchoecia skogsbergi* between 500-600 m. A second set of 17 stations (11 bis to 27) between about 71°30' and 75°S was analysed similarly. Results showed that the highest densities were observed for *Alacia belgicae* between 100 and 500 m, *A. hettacra* between 0 and 300 m, and *Metaconchoecia isocheira* from 200 and 500 m. Thus, it appears that at higher latitudes and inshore *Alacia belgicae* dominates over *A. hettacra* at most depths, and *M. isocheira* is the other common species; whereas offshore and at lower latitudes (but still about 62°S or greater). *A. hettacra* dominates the surface waters while *M. skogsbergi* and *B. antipoda* take over at middle depths.

The maximum density values of total Ostracoda at each station are given in Table 3. They exceed 100 individuals/100 m^3 in 20 of the 48 stations. As indicated by the analysis of depth distributions given above, these densities are accounted for mainly by *A. hettacra* at lower latitudes and *A. belgicae* at higher latitudes.

Undoubtedly, more species would have been taken if the sampling program had incorporated depths greater than 1000 m and stations located in lower latitudes. Also, the relatively large mesh size (500 μm) probably favoured the escape of small species (for example in *Metaconchoecia*) and of small juveniles in larger species.

Our material included only one station (station 1, about 51°S) at a latitude less than around 62°S. Of the 59 halocyprid species reported by Deevey (1982, table 1) from much the same area all but 12 can be discounted, with respect to our material, on the grounds of their usual occurrence either at greater depth or at lower latitudes. Neverthless, it might appear surprising that *Conchoecilla chuni* (Mueller, 1906), *Procerocia brachyaskos* (Mueller, 1906) and *Gaussicia edentata* (Mueller, 1906) were not taken in 1989-1990.

With respect to these three species, only the absence of the first-named (*C. chuni*) is hard to explain because Deevey (1982) finds it a common species, and earlier (Deevey, 1978) had referred to records by Poulsen from New Zealand waters. On the *RV Eltanin* cruises 27, 32 and 51, which took place during the austral summers of 1967, 1968 and 1972 respectively, it occurred in a total of 19 samples from the same sector (New Zealand to the Ross Sea, 164°30'E to 180°) traversed by the Italian 1989-1990 Expedition, but not below 64°S (Deevey, 1982, table 2). Only 5 stations of the 1989-1990 Italian program were located north of this latitude. The non-occurrence of *C. chuni* at these stations remains surprising since it is normally a shallow-living species (to about 400 m) during summer and is a characteristic southern hemisphere taxon. We note, however, that prior to Deevey's report it had not been recorded below 55°S (Angel, 1981:557).

The absence of *Proceroecia brachyaskos* and *Gaussicia edentata*, on the other hand, is not really surprising. Both are deeper water species. Although Deevey (1982, table 1) gives their depth ranges as 0 to 5190 m and 0 to 2780 m respectively she makes it clear that for reasons discussed by her (limitations of field procedures and collecting gear) these "...are therefore not necessarily reliable for some species'' (Deevey, 1982:132). For *P. brachyaskos* in particular she notes that it was taken only in one 0 to 1300 m haul and, "may have been a contaminant in the deepest tow obtained" (Deevey, 1982:147). Thus, a more appropriate depth range for *P. brachyaskos* is probably below 1000 m and not as deep as 5000 m. For Angel (1981) it is a lower mesopelagic and bathypelagic species in latitudes up to about 56°30'S. Likewise, Angel (1981) records *G. edentata* as a lower mesopelagic taxon; and Deevey (1983) gives its depth range as 1000 to 2000 m and farthest latitude south (in the Pacific) as 56°S. In the sector traversed by the Italian 1989-1990 Expedition, *G. edentata* was only collected by *RV Eltanin* in one sample at about 63°30'S on cruise 27 in the austral summer of 1967 (Deevey, 1982, table 2). Note also that our new species *P. rivoltella*, because it belongs to the '*procera*' group of Mueller (1906) (*cf.* Poulsen, 1973), prior to our description might well have been determined as *P. brachyaskos* by previous authors, eg, Deevey (1982) and Hartmann (1986). Thus, it can be summarised that the Italian 1989-1990 program collected virtually the same suite of species over the same area to 1000 m depth as surveyed previously by earlier expeditions, including the cruises of *RV Eltanin*.

This result confirms Deevey's opinion that antarctic and subantarctic ostracodes can now be said to be reasonably well known (Deevey, 1983:409). In a general review of the state of knowledge of Recent Myodocopida, Chavtur (1993) supports such an assessment, qualifying it only by his comment that present understanding of the systematics of such genera as *Metaconchoecia* and *Discoconchoecia* may hide several new species under the old species names.

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APPENDIX

Table 1. Stations at which zooplankton samples were collected during the 1989-1990 Italian Antarctic Expedition: giving date, mean latitude/longitude, and sampling duration.

Station	Date	Latitude S	Longitude E	Time (hrs)
1	25.11.89	50°56.69'	171°57.76'	1548-1641
2	29.11.89	61°57.89'	172°13.56'	0927-1058
3	01.12.89	63°05.43'	171°57.00'	0847-0955
3 bis	01.12.89	62°58.94'	172°03.66'	1427-1504
4	03.12.89	63°56.57'	168°04.44'	2121-2240
5	05.12.89	64°52.72'	161°54.04'	1038-1210
6	06.12.89	66°05.15'	163°36.24'	1637-1725
7	17.12.89	68°35.55'	176°25.10'	1748-1810
7 bis	17.12.89	68°35.95'	176°26.25'	1847-2012
8	22.12.89	70°40.70'	178°07.60'	0806-0845
8 bis	22.12.89	70°36.95'	178°15.45'	0932-1107
9	21.12.89	70°10.95'	176°23.95'	1313-1437
9 bis	21.12.89	70°10.60'	176°25.65'	1527-1608
10	23.12.89	71°12.00'	179°42.50'	1502-1547
10 bis	23.12.89	71°08.95'	179°53.85'	1630-1802
11	24.12.89	71°37.10'	176°53.85'	1640-1718
11 bis	24.12.89	71°40.20'	176°59.85'	1800-1843
12	25.12.89	72°10.00'	173°57.85'	1434-1508
12 bis	25.12.89	72°12.90'	174°00.10'	1546-1656
13	26.12.89	73°09.35'	174°23.60'	0822-0909
13 bis	26.12.89	73°12.85'	174°23.70'	0951-1027
14	27.12.89	72°44.30'	177°28.35'	0818-0859
14 bis	27.12.89	72°44.10'	177°13.70'	1402-1534
15	28.12.89	72°20.30'	179°53.60'	0821-0855
15 bis	28.12.89	72°19.35'	179°49.45'	0933-1103
16	29.12.89	71°56.90'	177°45.85'	0817-0853
16 bis	29.12.89	71°58.90'	177°55.05'	0931-1050
17	30.12.89	73°09.70'	179°57.35'	0902-0947
17 bis	30.12.89	73°09.80'	179°53.15'	1028-1057
18	31.12.89	73°58.85'	179°56.90'	0825-0854
19	01.01.90	75°00.75'	179°55.85'	1035-1133
19 bis	01.01.90	75°00.60'	179°59.70'	1218-1245
20	02.01.90	74°59.50'	177°30.55'	0815-0847
20 bis	02.01.90	74°59.15'	177°30.70'	0938-1003
21	03.01.90	74°59.40'	175°00.75'	0823-0858
22	04.01.90	75°00.35'	172°30.10'	0811-0914
22 N	03.01.90	74°59.50'	172°35.20'	2300-0002
22 P	04.01.90	74°59.00'	172°32.70'	1617-1724
23	05.01.90	74°59.00'	170°00.80'	0824-0909
23 bis	05.01.90	74°59.85'	170°01.90'	1006-1038
24	06.12.90	74°59.25'	167°27.60'	0828-0927
24 bis	06.01.90	74°58.25'	167°30.35'	1009-1039
25	07.01.90	74°57.50'	165°21.00'	1220-1351
25 bis	07.01.90	74°56.15'	165°22.40'	1434-1511
26	08.01.90	74°56.90'	164°13.45'	1459-1557
26 bis	08.01.90	74°56.70'	164°12.95'	1637-1710
27	12.01.90	74°46.40'	164°53.80'	1101-1210
27 bis	12.01.90	74°46.60'	164°54.80'	1250-1356

Table 2. Bottom depth, maximum sampling depth and number of ostracode samples examined for each station. IS = ostracode density for the integrated sample (collected from the maximum sampling depth to the surface). MX = maximum ostracode density among the samples from different depth layers. Both densities as individuals per m^3. * = no integrated sample; ** = only an integrated sample.

Station	Bottom	Maximum Depth (m)	No. of Samples	IS	MX
1	517	400	9	11.5	90.9
2	4230	1000	9	14.2	916.8
3	2150	800	5	4.7	22.6
3 bis	3220	200	7	154.6	405.1
4	3125	1000	8	3.8	35.7
5	3130	1000	10	1.8	35.3
6	2700	1000	9	5.3	100.7
7	3505	200	7	17.8	50.0
7 bis	3530	1000	9	13.3	37.6
8	3350	1000	8	29.5	112.6
8 bis	3390	1000	9	*	85.6
9	3285	1000	9	11.6	51.2
9 bis	3290	200	7	16.7	128.8
10	1325	200	10	9.3	71.2
10 bis	1340	1000	10	7.1	39.3
11	940	200	8	7.7	100.0
11 bis	845	800	9	2.8	58.4
12	685	200	5	11.0	18.2
12 bis	575	500	8	22.7	13.0
13	315	280	3	2.4	6.5
13 bis	310	100	1	0.7	**
14	1575	200	6	27.4	97.2
14 bis	1545	1000	9	2.0	258.4
15	2120	200	7	22.8	96.1
15 bis	2140	1000	9	1.5	34.9
16	760	200	9	53.8	325.3
16 bis	750	700	9	28.3	160.9
17	535	450	9	2.4	49.8
17 bis	530	100	2	11.2	8.0
18	280	250	2	4.2	5.8
19	460	400	9	3.2	135.6
19 bis	460	100	5	5.8	11.8
20	390	350	8	4.1	34.5
20 bis	390	100	1	1.6	**
21	300	250	7	6.1	18.7
22	545	500	7	12.6	147.6
22 N	540	450	8	15.1	140.2
22 P	550	500	10	48.2	263.4
23	345	300	10	49.3	185.4
23 bis	345	100	3	103.3	15.2
24	520	450	10	105.4	305.1
24 bis	545	100	4	0.9	22.9
25	885	800	10	92.3	189.3
25 bis	880	200	5	103.4	34.0
26	635	400	10	69.3	378.0
26 bis	590	100	3	15.1	16.8
27	735	600	10	67.7	376.1
27 bis	835	100	4	*	33.6

Table 3. Distribution of the 11 ostracode species in the sampling area. GM = *Gigantocypris muelleri*; CS = *Conchoecissa symmetrica*; BA = *Boroecia antipoda*; AB = *Alacia belgicae*; AH = *Alacia hettacra*; DE = *Discoconchoecia elegans*; PS = *Pseudoconchoecia serrulata*; OA = *Obtusoecia antarctica*; PR = *Proceroecia rivoltella*; MS = *Metaconchoecia skogsbergi*; MI = *Metaconchoecia isocheira*. X = present.

Stn	GM	CS	BA	AB	AH	DE	PS	OA	PR	MS	MI
1	-	-	-	-	-	X	X	X	-	X	-
2	-	X	X	-	X	X	X	-	-	X	-
3	X	-	X	-	X	-	-	-	-	-	-
3 bis	-	-	-	-	X	X	-	-	-	-	-
4	-	X	X	-	X	X	-	-	-	X	X
5	-	-	X	-	X	-	-	-	X	X	X
6	-	-	X	-	X	-	-	-	X	-	-
7	-	-	-	-	X	-	-	-	-	-	-
7 bis	-	-	X	-	X	-	-	-	X	X	X
8	-	-	-	-	X	-	-	-	-	-	X
8 bis	-	-	X	-	X	-	-	-	-	X	-
9	-	X	X	-	X	-	-	-	-	X	X
9 bis	-	-	X	-	X	-	-	-	-	–	X
10	-	-	X	-	X	-	-	-	X	-	-
10 bis	-	-	X	X	X	-	-	-	-	X	-
11	-	-	X	-	X	-	-	-	-	-	-
11 bis	-	-	X	X	X	-	-	-	-	X	X
12	-	-	-	X	-	-	-	-	-		-
12 bis	-	-	X	X	X	-	-	-	-	X	X
13	-	-	-	X	-	-	-	-	-	-	-
13 bis	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	X	X	-	-	-	-	-	X
14 bis	-	-	X	X	X	-	-	-	-	X	-
15	-	-	-	X	X	-	-	-	-	-	X
15 bis	-	-	X	X	X	-	-	-	-	X	X
16	-	-	-	X	X	-	-	-	-	-	X
16 bis	-	-	X	X	X	-	-	-	-	-	X
17	-	-	X	X	X	-	-	-	-	-	X
17 bis	-	-	-	X	-	-	-	-	-	-	-
18	-	-	-	X	-	-	-	-	-	-	-
19	-	-	-	X	X	-	-	-	-	-	X
19 bis	-	-	-	X	X	-	-	-	-	-	-
20	-	-	-	X	X	-	-	-	-	-	X
20 bis	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	X	X	-	-	-	-	-	X
22	-	-	-	X	X	-	-	-	-	-	X
22 N	-	-	-	X	X	-	-	-	-	-	X
22 P	-	-	-	X	X	-	-	-	-	-	X
23	-	-	-	X	X	-	-	-	-	-	X
23 bis	-	-	-	X	-	-	-	-	-	-	X
24	-	-	-	X	X	-	-	-	-	-	X
24 bis	-	-	-	X	-	-	-	-	-	-	X
25	-	-	-	X	X	-	-	-	-	-	X
25 bis	-	-	-	X	-	-	-	-	-	-	-
26	-	-	-	X	X	-	-	-	-	-	X
26 bis	-	-	-	X	-	-	-	-	-	-	-
27	-	-	-	X	-	-	-	-	-	-	X
27 bis	-	-	-	X	-	-	-	-	-	-	X