Ann. Limnol. 37 (1) 2001 : 9-20

Some Rotifera from Ile Amsterdam (Terres Australes et Antarctiques Françaises), with description of *Brachionus amsterdamensis* sp. nov. (Monogononta : Brachionidae)

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Keywords : Rotifera, Brachionidae, *Brachionus amsterdamensis*, new species, Amsterdam Island, subantarctica.

A preliminary study of the rotifer fauna of Ile Amsterdam (T.A.A.F.), southern Indian Ocean, yielded seven taxa. *Brachionus amsterdamensis* sp. nov. is described. Information on the morphology of the trophi of *Brachionus dimidiatus* is presented.

Quelques rotifères de l'Ile Amsterdam (T.A.A.F.), avec description de *Brachionus amsterdamensis* n.sp. (Monogo-nonta : Brachionidae)

Mots-clés : Rotifera, Brachionidae, *Brachionus amsterdamensis*, espèce nouvelle, Ile Amsterdam, subantarctique.

L'étude préliminaire de la faune des rotifères de l'Ile Amsterdam (T.A.A.F.), Océan Indien du Sud, a révélé 7 taxons. *Brachionus amsterdamensis* n.sp. est décrit. Des données morphologiques sur les trophi de *Brachionus dimidiatus* sont présentées.

1. Introduction

Ile Amsterdam (37°47'S-77°34'E) is a small volcanic island (9x7 km), situated in the central region of the Southern Indian Ocean at about equal distances from Madagascar, Australia and the Antarctic Continent (Fig. 1). According to Stonehouse (1982) the island belongs to the warm temperate zone of the subantarctic region. It shows a mean annual temperature of 13.8°C, with mean minimum and maximum temperatures of 11.2°C in August and 17.0°C in February respectively. The annual precipitation amounts of 1114 mm, and is lowest during the austral summer (February-March). Permanent waterbodies are very rare and almost exclusively restricted to the Caldeira and mountain plateau (Plateau des Tourbières) at the W-SW part of the Island (Frenot & Valleix 1990). The other areas almost completely lack permanent waters due to the steepness of the slopes (S-SE) or tremendous permeability by the many lava tunnels, holes and fissures (N-NE).

The only published records on the rotifer fauna of Ile Amsterdam are by Richters (1907) who reported the bdelloids *Rotaria sordida* (sub *Callidina longirostris* Jans.) and *Callidina* sp., and the monogonont *Euchlanis* sp. from mosses.

During a short stay on the island on 12 February 1998, we took the opportunity to collect samples in the area around the base Martin-de-Viviès. It was a rainy day, and it had been raining the day before, so we could sample some temporary wet environments also. The rotifers found are listed and discussed below.

2. Material and methods

All samples were collected in the northern part of the island, around the base Martin-de-Viviès (Fig. 1). Both natural habitats, i.e. pools, water-filled depressions in rock (lithotelms), terrestrial moss cushions, and artificial waterbodies such as drinking-troughs and a cistern were sampled. The different sampling spots

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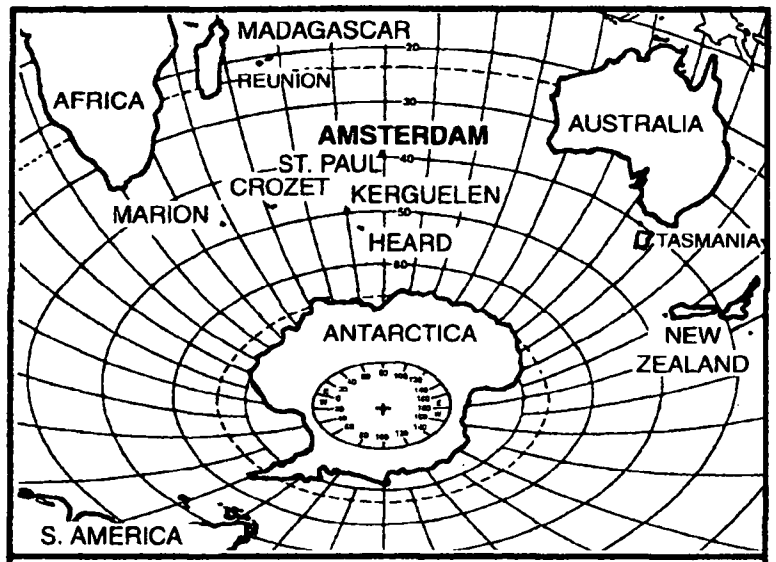
Article available at http://www.limnology-journal.org or http://dx.doi.org/10.1051/limn/2001007



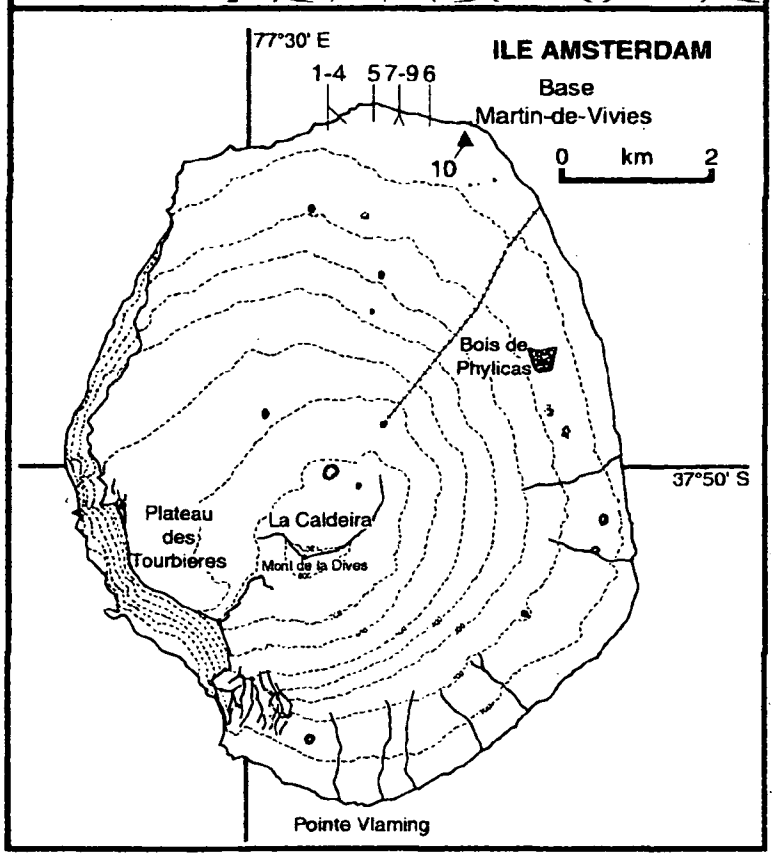


Fig. 1. Map of Ile Amsterdam with location of sampling spots.

Fig. 1. Carte de l'île Amsterdam avec localisation des points d'échantillonages.

and the nature of the samples are shown in Table 1. Plankton was obtained by filtering variable amounts of water through a net of 40 µm mesh width. Benthic-epilithic material was collected by scraping the substrate with a PVC-bottle. The moss samples had a volume of about 100 cm^3. All samples were fixed and preserved in 3 % formalin.

At the time of sorting, moss and substrate samples were rinsed with filtered water, and the resulting suspension subsequently sieved on a series of sieves

Table 1. List of sampling spots and nature of samples.

Tableau 1. Différents types de prélèvements et caractéristiques des récoltes.

1. Water-filled lithotelm on lava flow, diameter c. 20 cm ; moss and water.
2. Water-filled lithotelm on lava flow, diameter c. 20 cm ; moss and water.
3. Water-filled lithotelm on lava flow, diameter c. 15 cm ; moss and water.
4. Water-filled lithotelm on lava flow, diameter c. 25 cm ; sand, organic debris and water.
5. Terrestrial moss on bottom of lava tube.
6. Pool : Mare aux Eléphants, 6x5 m, average depth 30 cm, substrate sandy, pH 7.2, conductivity 1870 μScm^{-1} ; plankton.
7. Rain-water puddle, 3x2 m, depth 15 cm, substrate sandy ; plankton.
8. Iron drinking-trough, c. 2 m diameter, wet depth 20 cm ; plankton and sediment.
9. Iron drinking-trough, c. 2 m diameter, wet depth 20 cm ; plankton and sediment.
10. Open concrete cistern near meteo, pH 8.0, conductivity 160 μScm^{-1} ; Aufwuchs scrapings from wall.

(1 mm and 40 µm mesh width). The fraction on the 40 µm sieve was washed into a centrifuge tube (80 ml) and allowed to settle out. Microscopical examination of the deposit showed that rotifer density was still extremely low and we had to recur to a supplementary extraction method. The procedure followed is a modification of the mechanical extraction method developed for Tardigrada by Hallas (1975) : (1) the supernatant water in the centrifuge tube is removed by suction and thrown away, (2) 60 ml of a 50 % sucrose solution is added to the deposit, (3) the resulting suspension is allowed to settle for 3-4 minutes, (4) the supernatant (containing rotifers) is decanted into another centrifuge tube (80 ml), and deionised water is added till the top of the tube, (5) after mixing, the suspension is allowed to settle again, (6) the supernatant is removed by suction, and plenty of water is added again to the deposit containing rotifers, (7) repeat step (6).

Rotifers were examined and drawn using a Leitz Orthoplan microscope with drawing tube. Preparation of the trophi for light and scanning electron microscopy was done following De Smet (1998b) using NaOCl solution. For scanning electron microscopy a Philips SEM 515 operated at 20 kV was used.

3. Results

A list of the Rotifera found at the different sampling spots is presented in Table 2. Since Bdelloidea were deformed beyond identification, they are treated as a gross taxonomic group. The Monogononta were represented by 6 species belonging to 5 families. One of these, a *Brachionus*, is new to science.

Table 2. List of the Rotifera found at the different sampling spots.

Tableau 2. Liste des rotifères récoltés dans les différents types de prélèvements.

Bdelloidea indet. : 1, 2, 3, 4, 7, 8, 9, 10
Brachionidae
Brachionus amsterdamensis sp. nov. : 6
Colurellidae
Colurella sp. : 5
Dicranophoridae
Encentrum lutra Wulfert, 1936 : 1, 2, 4
Lecanidae
Lecane arcuata (Bryce, 1891) : 1, 2, 3
L. tenuiseta Harring, 1914 : 10
Notommatidae
Cephalodella catellina (O.F. Müller, 1786) : 7, 9

The descripton of the new species and comments on the other taxa are as follows.

Bdelloidea indet.

Bdelloids were present in almost all samples and mostly at fairly high numbers.

***Brachionus amsterdamensis* sp. nov.** (Figs. 2-16, 17a-20a)

Material examined

Holotype : a parthenogenetic female in a permanent, glycerin glass slide mount deposited in the Koninklijk Belgisch Instituut voor Natuurwetenschappen (K.B.I.N.), Brussels, reg. nr.

Paratypes : one slide with three paratypes in K.B.I.N. and the Laboratory for Animal Ecology, R.U.G., Gent, Belgium each ; slides with parthenogenetic females, amictic and resting eggs, trophi, and males, and 8 stubs each with one trophi preparation for SEM in the Department of Biology, R.U.C.A.

Type locality

Shallow pool, called Mare aux Eléphants, behind rocky shore, nearby ocean, Ile Amsterdam, southern Indian Ocean.

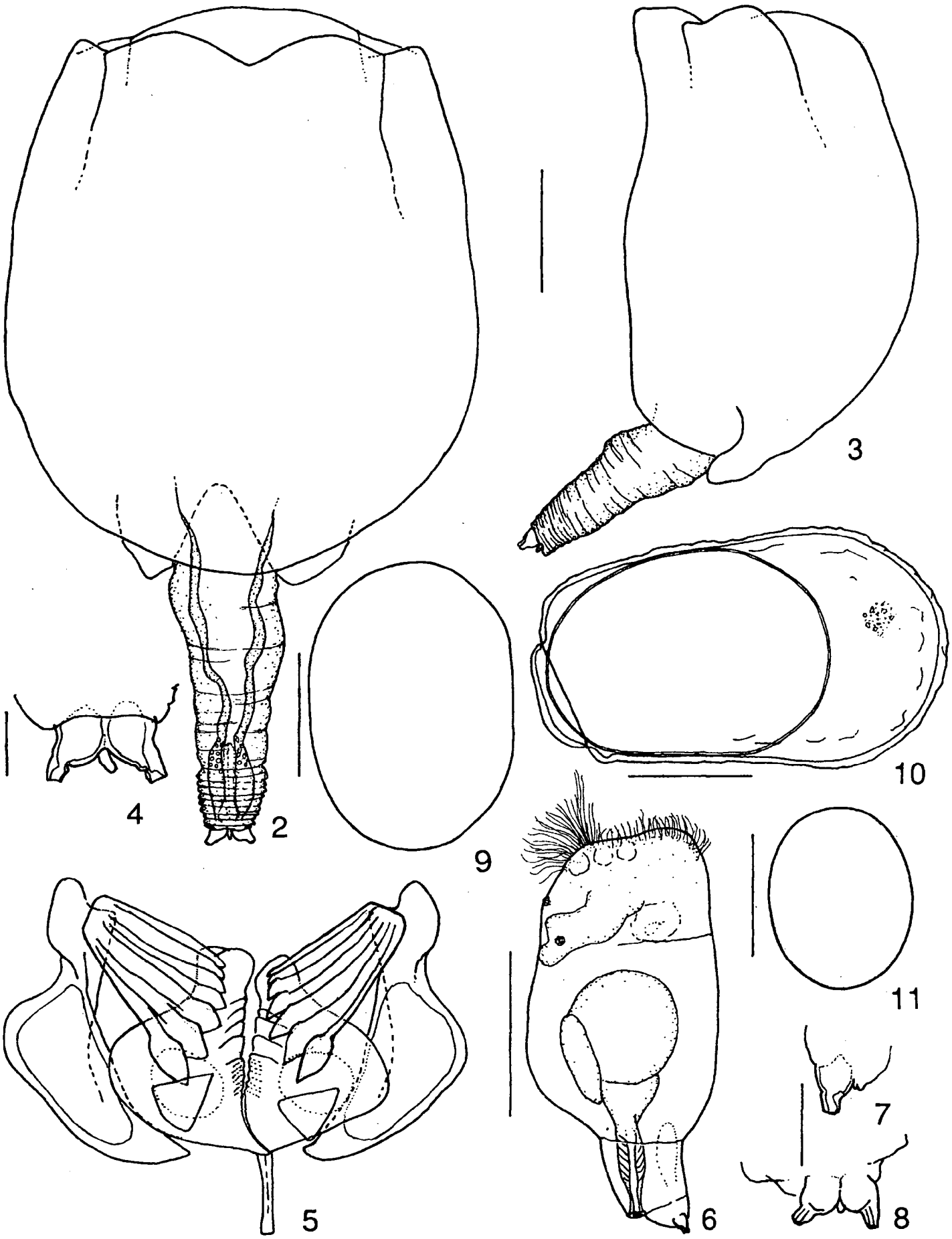
Differential diagnosis

Brachionus amsterdamensis sp. nov. can be confused with *B. dimidiatus* (Bryce, 1931) f. *inermis* Schmarda, 1854, as both show a spineless antero-dorsal margin. The soft lorica, foot opening with broad-based spines, bulbous toes, evenly zig-zag-shaped reinforced ridge at the inner margin of the rami, brush-like subunci, and manubria without pronounced dorsally recurved posterior end and conspicuous dorsal crest easily distinguish the new species from *B. dimidiatus* f. *inermis*.

Description

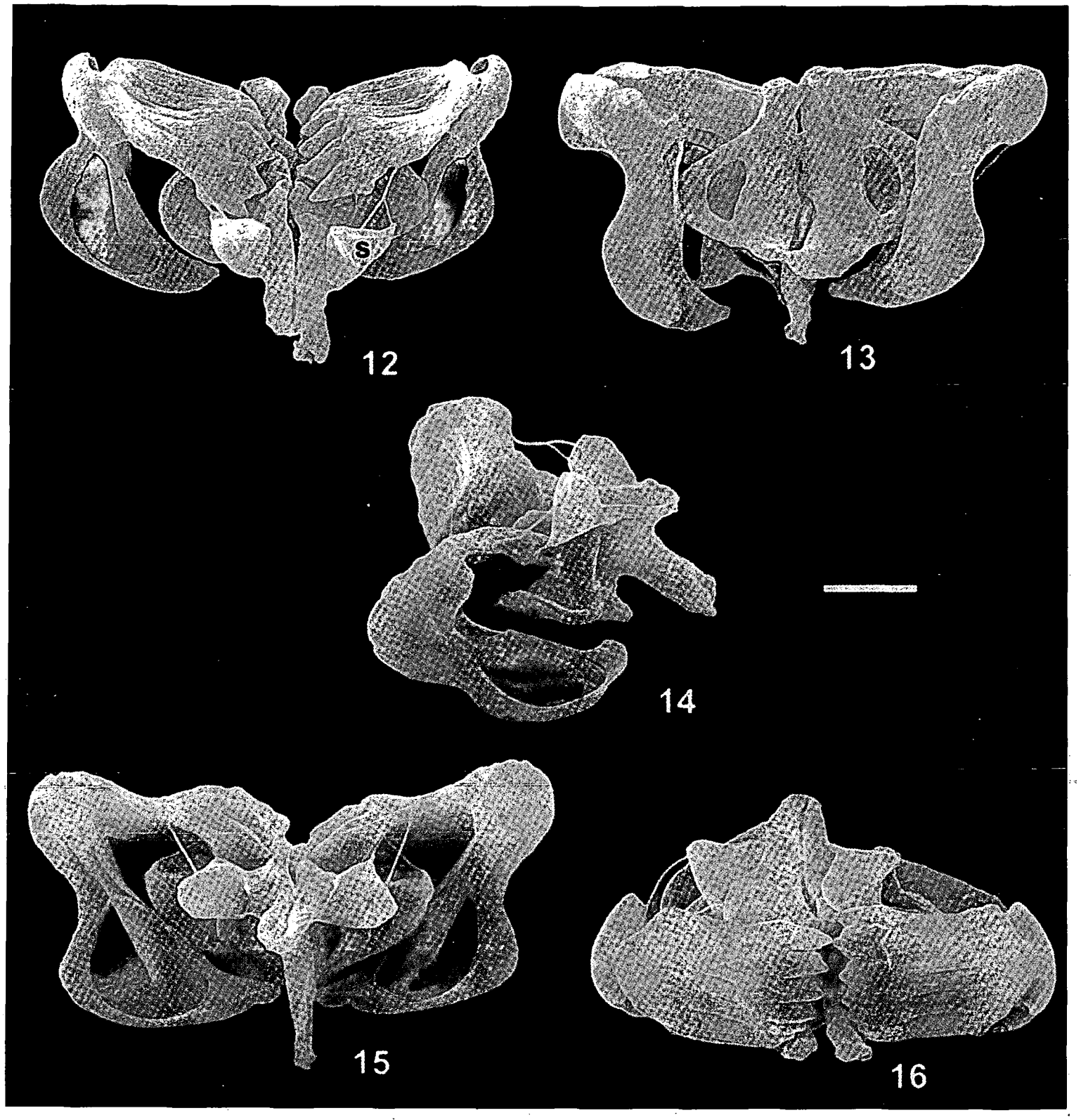
Female (Figs. 2-5). Parthenogenetic and mictic females indistinguishable by external morphology. Lorica very soft, flexible, smooth. Body saccate in dorsal view, greatest width near the middle ; the body is fairly high, in lateral view with flattened ventral margin and arched dorsal margin ; the length/width ratio varies from 1.20 to 1.31 (average 1.26, N = 20). Anterior margins without conspicuous spines. Dorsal margin with two broad and shallow, evenly curved median elevations separated by shallow notch medially, and a pair of more or less pronounced bluntly rounded lateral processes ; median elevations laterally delimited by short longitudinal fold. Ventral margin weakly and evenly convex, or with more elevated median part delimited by longitudinal folds in more contracted specimens. Lateral antennae dorso-laterally, in distal half of lorica. Foot opening postero-ventral, flanked by two broad-based bluntly pointed spines. Foot retractile ; annulated, especially posterior part ; ending in short toes. Toes bulbous with short tubular tip, no claws. A conspicuous caudal papilla dorsally between the toes. Pedal glands long, tubular, extending into trunk, ducts separated over whole their length, posteriorly with cylindrical reservoirs. Vitellarium with 8 nuclei.

Trophi malleate (Figs. 5,12-16, 17a-20a) with all the characteristics of the genus as described by Segers et al. (1993). Rami broad, rounded externally, slightly asymmetrical : right somewhat larger ; inner margins with uniform zig-zag like reinforced ridge (Fig. 17a : rr), composed of fused skleropili, ridge complementary to the subunci and unci teeth ; satellites (Markevich 1989 ; anterior processes after Segers et al. 1993 ; central membranous structures after Kleinow et al. 1990) prominent (Fig. 12 : s), connected to rami by ligaments, and resting on a triangular (right) (Fig 17a : sr)



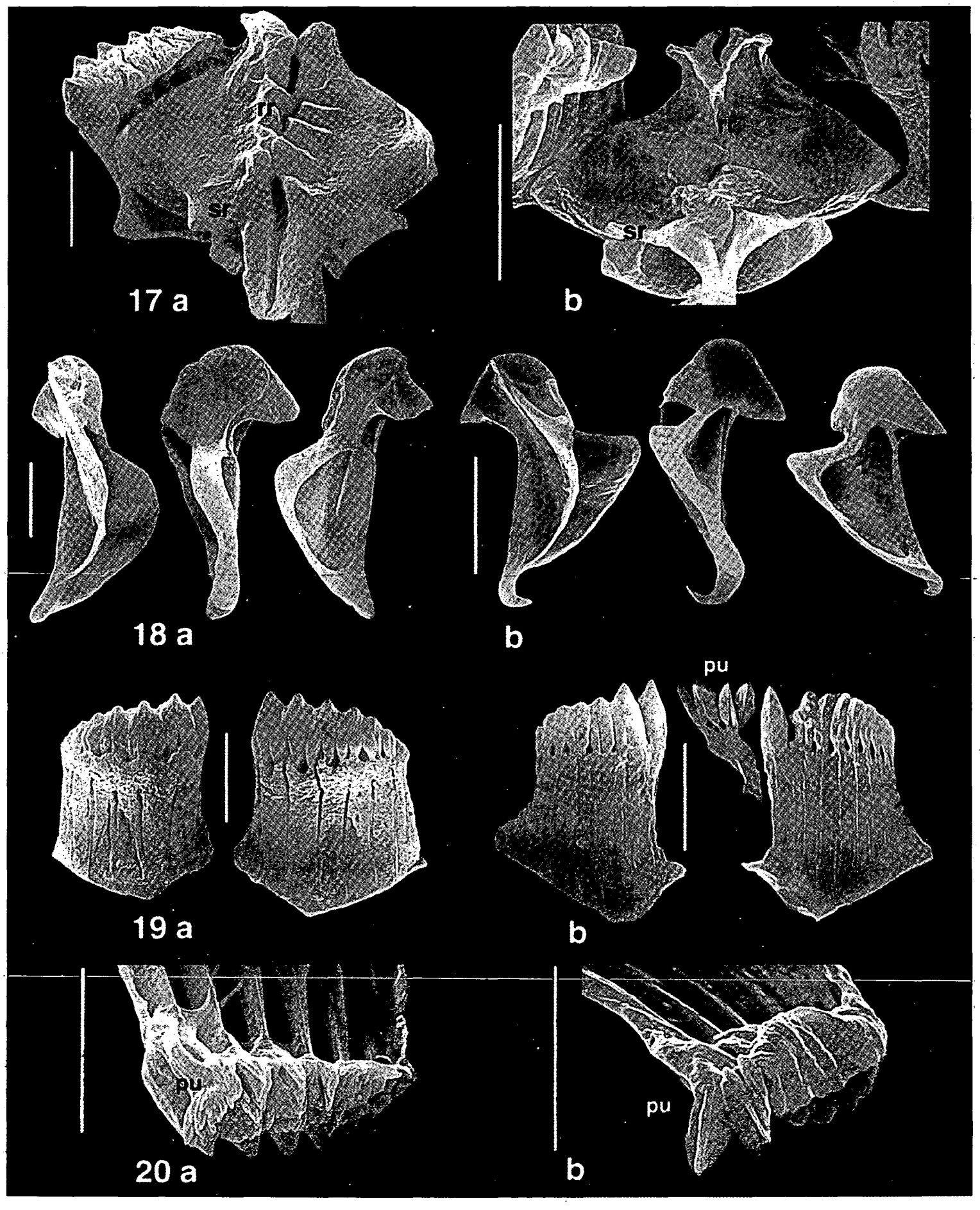
Figs. 2-11. *Brachionus amsterdamensis* sp. nov., 2-5. female. 2. dorsal view, 3. lateral view, 4. toes, dorsal view, 5. trophi, ventral view; 6-8. male. 6. lateral view, 7. toe, lateral view, 8. toes, dorsal view; 9-11. eggs. 9. subitaneous egg, 10. resting egg, 11. male egg. Scale bars : 2, 3, 6, 9-11 : 50 µm, 4, 5, 7, 8 : 10 µm.

Figs. 2-11. *Brachionus amsterdamensis* n.sp., 2-5. femelle. 2. vue dorsale, 3. vue latérale, 4. orteils, vue dorsale, 5. trophi, vue ventrale; 6-8. mâle. 6. vue latérale, 7. orteil, vue latérale, 8. orteils, vue dorsale ; 9-11. œufs. 9. œuf amictique, 10. œuf de durée, 11. œuf mâle. Echelle : 2, 3, 6, 9-11 : 50 µm, 4, 5, 7, 8 : 10 µm.



Figs. 12-16. *Brachionus amsterdamensis* sp. nov., complete set of trophi, SEM photographs. 12. ventral view, 13. dorsal view, 14. lateral view, 15. ventro-caudal view, 16. ventro-apical view. s : satellite. Scale bar : 10 µm.

Figs. 12-16. *Brachionus amsterdamensis* n.sp., jeu complet de trophi, MEB photographies. 12. vue ventrale, 13. vue dorsale, 14. vue latérale, 15. vue ventro-caudale, 16. vue ventro-apicale. s : satellite. Echelle : 10 µm.



Figs. 17-20. Trophi of *Brachionus amsterdamensis* sp. nov. (a) and *B. dimidiatus* (b). 17. rami, ventral view, 18. manubrium, dorsal, lateral and ventral view, 19. unci, outer view, 20. subuncus. rr : reinforced ridge, sr : satellite ridge, pu : preuncinal teeth. Scale bars : 17a,b-20a : 10 µm, 20b : 5 µm.

Figs. 17-20. Pièces des trophi de *Brachionus amsterdamensis* n.sp. (a) et *B. dimidiatus* (b). 17. rami, vue ventrale, 18. manubrium, vue dorsale, latérale et ventrale, 19. unci, vue extérieure, 20. subuncus. rr : rebord renforcé, sr : rebord satellite, pu : dent préuncinale. Echelle : 17a,b-20a : 10 µm, 20b : 5 µm.

or crescent-shaped (left) ridge of the rami postero-ventrally ; openings of rami cavities large, typical for the genus. Fulcrum short, as usual for the genus. Unci (Fig. 19a) 7-8 teeth ; shafts and teeth almost completely fused ; right teeth broader than left ; left teeth gradually decreasing, right first tooth smaller than second, thereafter gradually decreasing in length ; distal margin of uncusplate V-shaped, shortest section of V ventral, ratio longest : shortest section c. 2-1.5. Subunci (Fig. 20a) brush-like, composed of 5-6 groups of skleropili placed in rows at the inner side of the uncus teeth ; the skleropili become fused the closer they are to the uncus teeth : the nearest row consists of platelets with 3-4 lobed free margin. Preuncinal teeth (Fig. 20a : pu) broom-shaped, composed of c. 25 skleropili. Manubria (Fig. 18a) with sickle-shaped external margin curving inwardly ; crest on dorsal surface medium high.

Subitaneous egg (Fig. 9) ellipsoid, carried attached, usually one, rarely two per female. Male egg (Fig. 11) ellipsoid, up to 3 per female. Resting egg (Fig. 10) kidney-shaped, yellow-brownish, with hard shell ornamented by irregular and weak granulation ; hatching furrow very near to the top.

Male (Figs. 6-8). No trace of trophi present. Eye on brain. Testis globular, with prostate glands. Foot present, ending in two short bulbous toes with cylindrical tip. A small papilla dorsally between toes.

Measurements

Parthenogenetic female. Lorica length 174-263 µm, lorica width 138-193 µm, antero-median elevation 7-16 µm, antero-lateral elevation 2-6 µm, toes 7-14 µm ; trophi 34-46 µm, rami 25-28 µm, fulcrum 10-13 µm, uncus 23-25 µm, manubrium 32-37 µm. Subitaneous egg (lxhxw) 103-118x70-82x70-80 µm, male egg 70-79x56-65x58-60 µm, resting egg 168-182x88-105x90-96 µm.

Male (slightly contracted). Total length 120-125 µm, toes 6-7 µm.

Etymology

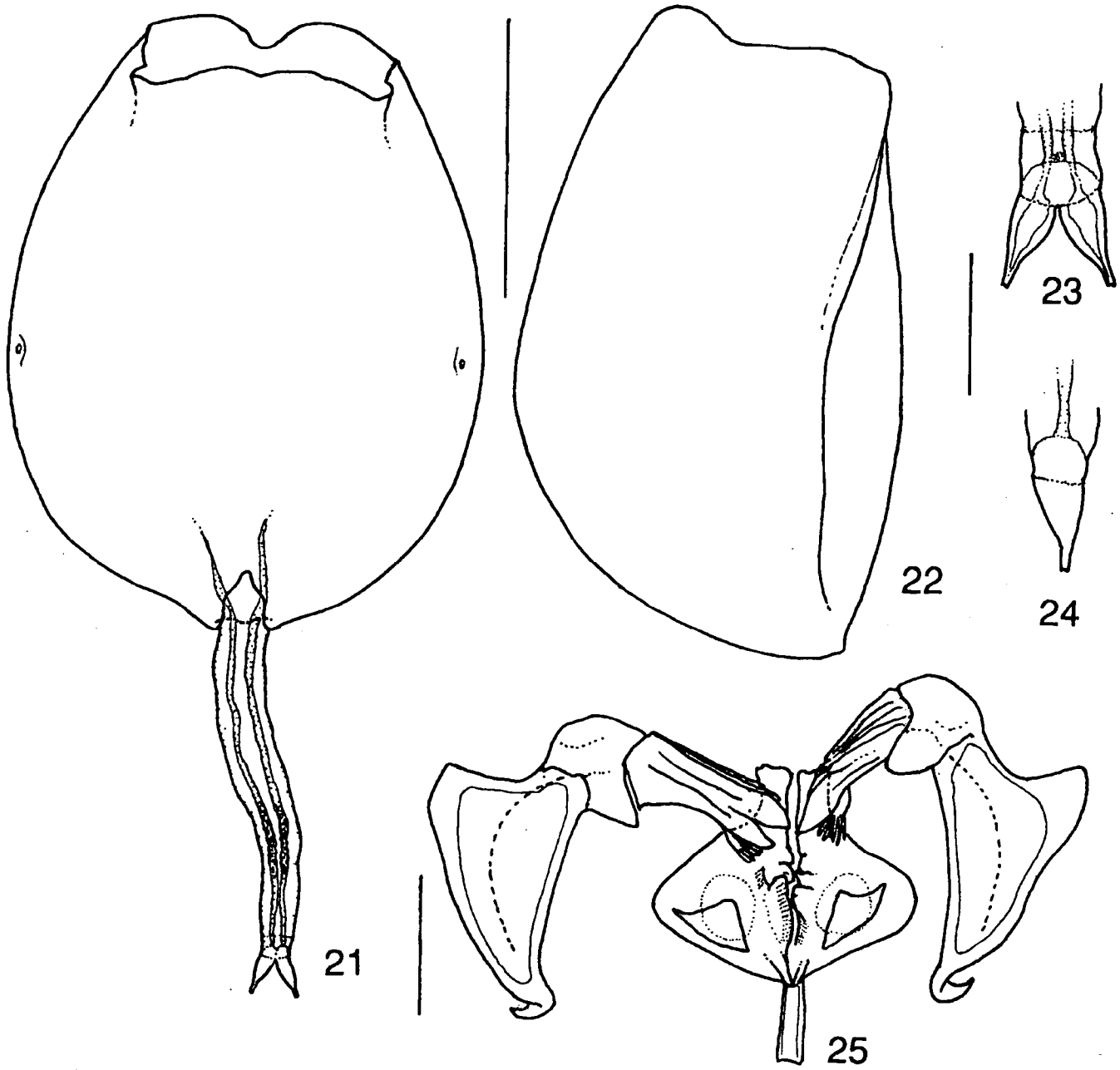
The specific name refers to Ile Amsterdam, to which the species appears endemic.

Comments

B. amsterdamensis sp. nov. belongs to the group of *Brachionus*-species (Segers et al. 1993) displaying the apomorphic sickle-shape of the manubria and satellites on the rami. Superficially it resembles the rare but widespread *B. dimidiatus* f. *inermis* which mainly inhabits soda waters (Pourriot et al. 1967, Koste 1978, Koste & Shiel 1987). Nevertheless, both taxa are readily distinguished by their external morphology and structure of the trophi. *B. amsterdamensis* has a soft lorica with small, bluntly rounded anterolateral processes, a foot opening flanked by broad-based blunt spines, and robust bulbous toes with prominent papilla between, whereas *B. dimidiatus* f. *inermis* (Figs. 21-24) has a rigid lorica, its foot opening is terminally flanked by very short, blunt prominences, and the toes (see also Koste 1999) are fairly slender and conical without papilla between. *B. amsterdamensis* is larger also than *B. dimidiatus* f. *inermis* (for dimensions of *B. dimidiatus* f. *inermis* see e.g. Koste & Shiel 1987, Koste 1999). Body length and width of the former are about twice the measurements of the latter, whereas the dimensions of the different egg types are about one third larger.

Striking differences are noted also for the trophi, the different parts of which are larger in *B. amsterdamensis*. For comparison of the trophi (Figs. 17b-20b, 25-30) we used specimens of *B. dimidiatus* from Lake Nakuru, Lake Simbi and Lake Turkana, Kenya. No differences were found between the typical *dimidiatus* and its formae *inermis* and *quartarius*. The median edge of the rami of *B. dimidiatus* (Fig. 17b : rr) is adorned with a shallow and irregularly shaped zig-zag like reinforced ridge (fairly high and regular in *B. amsterdamensis*). Posterior margin of rami satellites (Fig. 26 : s) relatively longer in *B. dimidiatus*, and resting on linear ridges (Fig. 26 : sr). The unci of *B. dimidiatus* (Figs. 19b) are of more slender build, with 7-9 teeth, and the sections of the V-shaped distal margin of the uncusplate are more unequal : ratio longest :shortest section c. 2-1. The subunci (Fig. 20b) of *B. dimidiatus* are plate-shaped, with 4-5 broad ridges (rows of skleropili in *B. amsterdamensis*), and the preuncinal teeth (Fig. 19b : pu) are well developed, forming a broom of c. 20 characteristic leaf-shaped sklerites provided with a seam (a small brush of skleropili in *B. amsterdamensis*). The manubria of *B. dimidiatus* (Fig. 18b) are rather broadly triangular instead of sickle-shaped as in *B. amsterdamensis*, and show a prominent dorsal crest and conspicuous, dorsally recurved cauda which is lacking in *B. amsterdamensis*.

The soft, smooth lorica with foot opening flanked by broad-based, blunt spines suggests that *B. amsterdamensis* sp. nov. might be related to the cosmopolitan *B. calyciflorus* Pallas,1766. However, the latter always shows anteromedian and anterolateral spines (Koste 1978, Koste & Shiel 1987) which, even when greatly reduced, still measure 13-15 and 10-12 µm respectively (Kuckzynski 1991). The toes of the new species are stouter with pronounced bulbous base compared to the



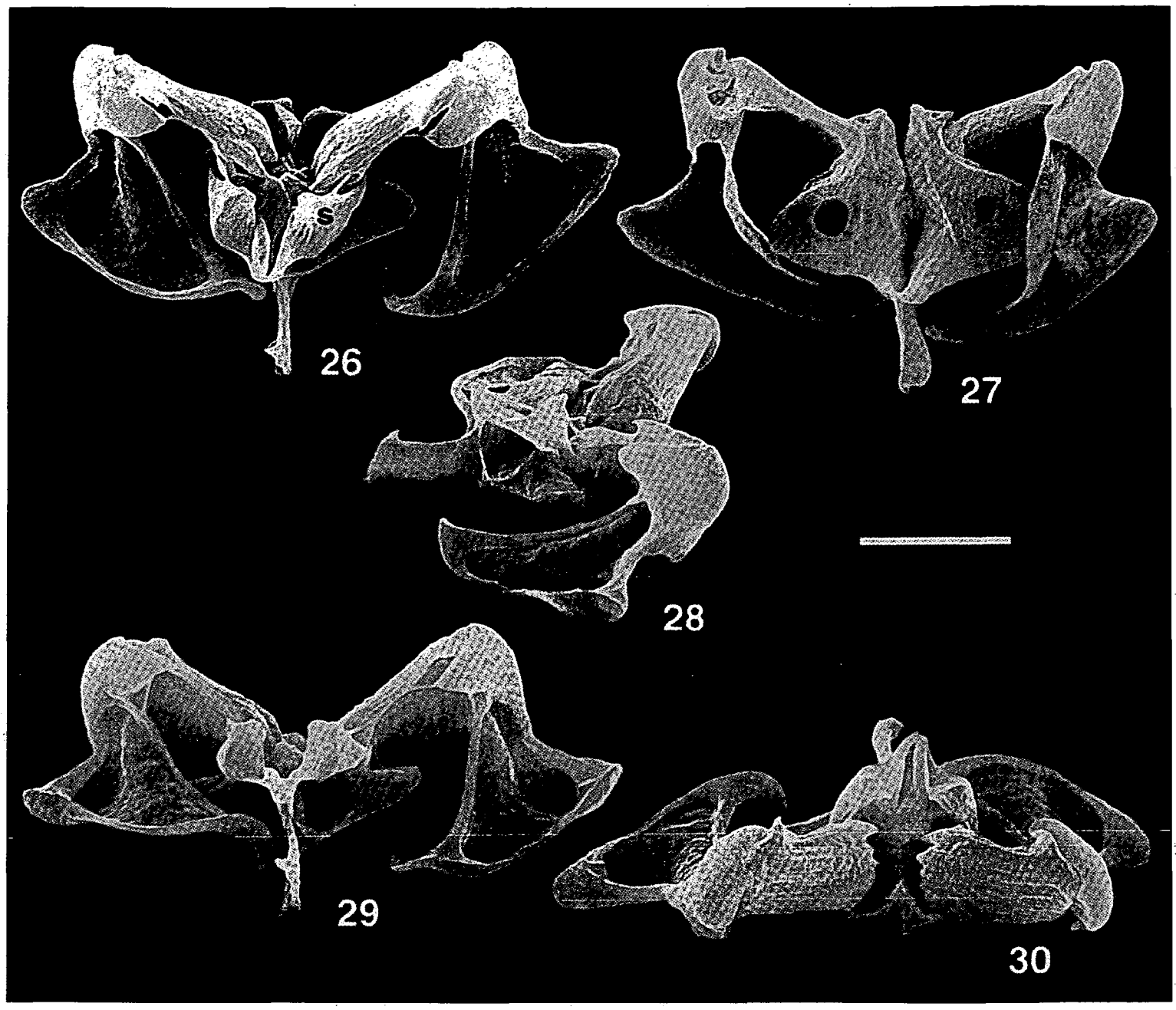
Figs. 21-25. *Brachionus dimidiatus* f. *inermis* female. 21. ventral view, 22. lateral view, 23. toes, dorsal view, 24. toe, lateral view, 25. trophi, ventral view. Scale bars : 21,22 : 50 µm, 23-25 : 10 µm.

Figs. 21-25. *Brachionus dimidiatus* f. *inermis* femelle. 21. vue ventrale, 22. vue latérale, 23. orteils, vue dorsale, 24. orteil, vue latérale, 25. trophi, vue ventrale. Echelle : 21,22 : 50 µm, 23-25 : 10 µm.

more conical toes in *B. calyciflorus*. A papilla between the toes is present in both species, although it has been overlooked in *B. calyciflorus* by most authors.The ducts of the pedal glands of *B. amsterdamensis* sp. nov. are separated the whole of their length, as was noted also for *B. calyciflorus* by e.g. de Beauchamp (1909), Stossberg (1932) and ourselves. According to Weber (1898) and Koste (1978) on the contrary, these ducts are fused to a single duct before the reservoirs in *B. calyciflorus*, and it remains to be settled whether this are erroneous observations or a case of inter-population variability. The trophi of the new species are very similar to those of *B. calyciflorus* and the other *Brachionus* species (exclusive of the above described trophi of *B. dimidiatus*) studied by S.E.M. so far (see e.g. Kleinow et al. (1990), Markevich (1989), Segers et al. (1993)). Since we actually do not know whether the small differences in trophi morphology between these species are taxonomically relevant, they can not be used in the affiliation of the new species.

Distribution and ecology

The new species is known from the type locality only. It was very abundant on 12 February 1998 in the



Figs. 26-30. *Brachionus dimidiatus*, complete set of trophi, SEM photographs. 26.ventral view, 27. dorsal view, 28. lateral view, 29. ventro-caudal view, 30. ventro-apical view. s : satellite. Scale bar : 10 µm.

Figs. 26-30. *Brachionus dimidiatus*, jeu complet de trophi, MEB photographies. 26. vue ventrale, 27. vue dorsale, 28. vue latérale, 29. vue ventro-caudale, 30. vue ventro-apicale. s : satellite. Echelle : 10 µm.

plankton of a shallow permanent pool with muddy-sandy bottom, called «Mare aux Eléphants».The water was very turbid and coloured greenish by phytoplankton bloom. The pool is used as a bathing place by sub-antarctic fur seal and elephant seal, who add large quantities of organic material, as well as mineral salts. Physicochemical information on the water is limited. At the moment of sampling, the water was neutral (pH 7.2) and showed excessive mineralization (conductivity 1870 μScm^{-1}). Further information on the water is given by Pierre & Noel (1971) who reported water temperatures of 8-25°C over the year, a pH varying between 5 and 8 (frequently 6), a resistivity of about 1250 $\Omega\ cm^{-1}$, and a level of chlorine ions of about 175 mgl^{-1}. Preliminary information on the diatoms of the pool (Van de Vijver & Beyens 1999) revealed fairly high densities of polysaprobic species tolerating large osmotic fluctuations.

No other rotifer taxon was found at the moment of sampling. *Brachionus amsterdamensis* sp. nov. coexisted with cladocerans (*Macrothrix* sp.), cyclopoid copepods and ostracods.

Examination of the gut content of *B. amsterdamensis* sp. nov. showed that it is feeding on *Scenedesmus* spp. and detritus.

***Colurella* sp.** (Fig. 33)

A single specimen from aerophytic moss, reminding *C. hindenburgi* but larger.

Lorica length 84 µm, lorica height 48 mm, lorica width 32 µm, toes 29 µm.

Cephalodella catellina (O.F. Müller) (Figs. 32, 38)

Typical specimens (see De Smet 1998a) ; vitellarium with 8 nuclei. Present at low numbers in plankton of rain-water puddle and drinking-trough.

Total length 84-145 µm, toes 16-20 µm.

C. catellina is a cosmopolitan element. It was found in the subantarcic at the islands of Kerguelen (Russell 1959, De Smet, unpubl.), Macquarie (Dartnall 1993), Signy (Dartnall & Hollowday 1985) and Crozet (De Smet, unpubl.). It was also reported from the antarctic King George Island (Janiec 1996, Janiec & Salwicka 1996).

Encentrum lutra Wulfert (Figs. 31, 39)

This species was not uncommon amongst submerged mosses and in organogenous sediment of lithotelms. Animals seen marginally smaller than the normal size range reported for the species (De Smet & Pourriot 1997).

Total length 150-195 µm, toes 14-16 µm.

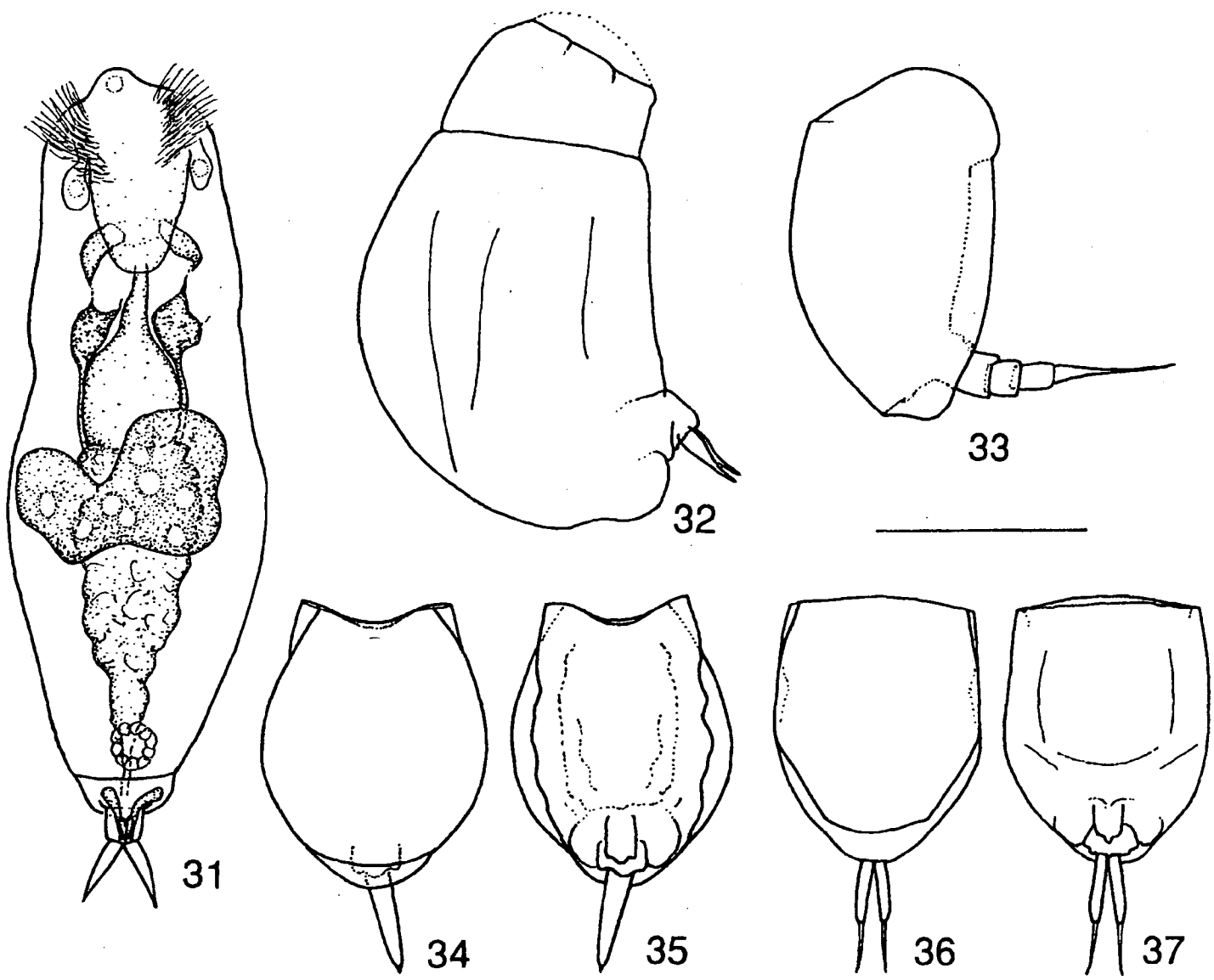
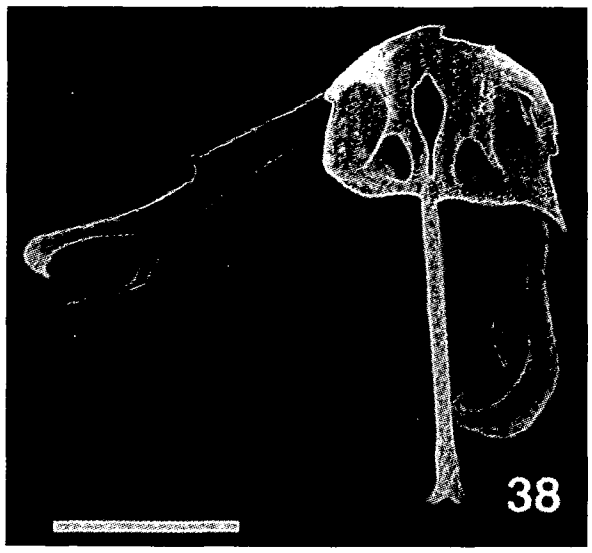


Fig. 31. *Encentrum lutra*, ventral view. Fig. 32. *Cephalodella catellina*, lateral view. Fig. 33. *Colurella* sp., lateral view. Figs. 34-35. *Lecane arcuata*. 34. dorsal view, 35. ventral view. Figs. 36-37. *Lecane tenuiseta*. 36. dorsal view, 37. ventral view.

Fig. 31. *Encentrum lutra*, vue ventrale. Fig. 32. *Cephalodella catellina*, vue latérale. Fig. 33. *Colurella* sp., vue latérale. Figs. 34-35. *Lecane arcuata*. 34. vue dorsale, 35. vue ventrale. Figs. 36-37. *Lecane tenuiseta*. 36. vue dorsale, 37. vue ventrale.



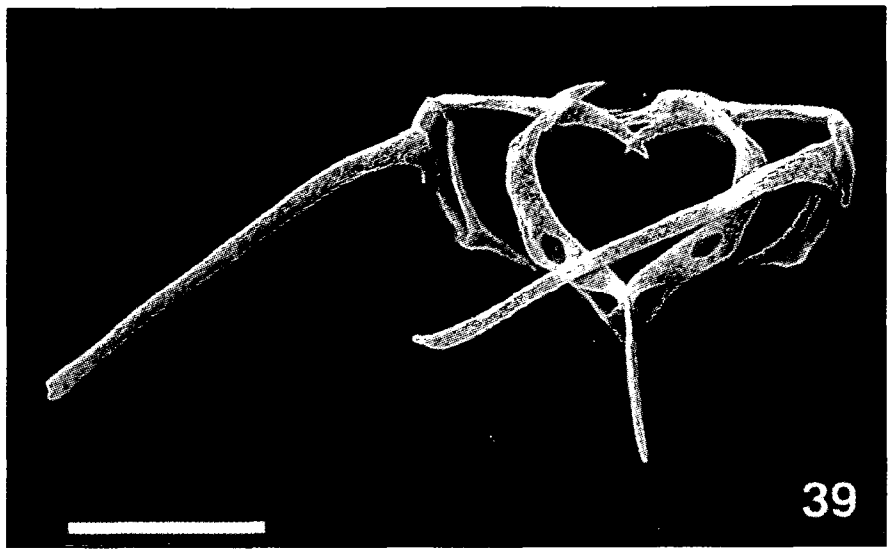


Fig. 38. *Cephalodella catellina*, trophi SEM, ventral view. Scale bar : 10 µm.
Fig. 38. *Cephalodella catellina*, trophi MEB, vue ventrale. Echelle : 10 µm.
Fig. 39. *Encentrum lutra*, trophi SEM, dorsal view. Scale bar : 10 µm.
Fig. 39. *Encentrum lutra*, trophi MEB, vue dorsale. Echelle : 10 µm.

E. lutra is known from diverse aquatic and semi-aquatic habitats, and one of the regular inhabitants of damp aerophytic mosses. So far it was recorded only from Europe, S. America (De Smet & Pourriot 1997) and Molodezhnaya (Enderby Land), east Antarctica (Kutikova 1991). It was also found at the Crozet and Kerguelen islands (De Smet, unpubl.).

Lecane arcuata (Bryce) (Figs. 33, 35)

L. arcuata was rare amongst submerged mosses from the lithotelms.

Dorsal plate length 63 µm, width 52 µm, ventral plate length 68 µm, width 39 µm, toe 25 µm.

It is a common species with worldwide distribution, more frequent in temperate regions (Segers 1995). Known to live between filamentous algae and submerged mosses of even the smallest puddle. The species was not previously recorded from the subantarcic.

Lecane tenuiseta Harring (Figs. 36, 37)

A single specimen of this species was found in Aufwuchs of a cistern.

Dorsal plate length 57 µm, width 49 µm, ventral plate length 62 µm, width 49 µm, toes 29 µm, claws 12 µm.

According to Segers (1995) *L. tenuiseta* is one of the most common, eurytopic and cosmopolitan Lecanidae. Subantarctic records from the Kerguelen (De Smet, in press) and Crozet (De Smet, unpubl.) islands only.

Acknowledgments

This study was possible thanks to the logistic and financial support of the «Institut Français pour la Recherche et la Technologie Polaires». It is part of the Terrestrial Ecology Program Biosol N° 136 (Dr. Y. Frenot, Université de Rennes, Station Biologique Paimpont). Dr. H. Segers is acknowledged for providing specimens of *Brachionus dimidiatus* f. *inermis* from Lake Turkana, Kenya.

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