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Report on rotifers from Barentsøya, Svalbard (78°30' N)

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Altogether 16 plankton and 18 submerged moss samples, from 18 different water bodies on Barentsøya, were analyzed for their rotifer content. The samples were collected on 29 August 1985. Sixty-three taxa of rotifers are reported, 17 of which represent new records for Svalbard, and 13 are new for the high arctic fauna. Wide-ranging taxa are dominant. Variations in surface area, pH and ionic composition seem important in controlling the communities. *Lecane piepelsi* n.sp. is described.

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1. INTRODUCTION

Barentsøya (78°30'N, 76°21'E) is an island of the High Arctic, that lies in the south-eastern part of the Norwegian archipelago of Svalbard (Fig. 1). Its land area is about 1300 km^2, of which more than a third is covered by permanent ice, notably Barentsjøkulen (Lock *et al.* 1978). Lying to the east of Spitsbergen, the principal landmass of the archipelago, it is excluded from the moderating effect of the warm currents from the southwest. No data on rotifers are available for this island, except for an occasional record by Richard (1898), who found *«Polyarthra platyptera»* and *«Notholca* voisin de *N. acuminata»* near «la Pointe Changing» (N-E Storfjorden).

The present paper deals with rotifers from aquatic samples and submerged mosses, collected on the Talaveraflya on 29.08.1985, on the occasion of a biological expedition of the Antwerpen University to Svalbard.

2. MATERIALS AND METHODS

Eighteen water bodies on the Talavera foreland (Figs. 1 and 2), in the south-western part of the island, were sampled. Plankton was collected with a plankton net (40 μm mesh width), by a horizontal haul from the shore. Permanently submerged mosses from the littoral zone were squeezed. The samples were preserved immediately after collection with 4% formalin.

No 42 : Andsjøen : lakelet, surface ca 3.2 ha, depth 40cm+, substratum stony-sandy.

No 43 : pool on dolerite sill, 20 x 6 m, depth 15-30 cm, substratum stony-muddy.

No 44 : pool on dolerite, ca 0.1 ha, depth 30-40 cm, substratum stony-muddy.

No 45 : small pool, 6 x 0.4 m, depth 15 cm, bottom covered with mosses. No plankton samples taken.

No 46 : pool in moss tundra, 20 x 6 m, depth 30-40 cm, substratum sandy, water colour light brownish.

No 47 : pond in moss tundra, 25 x 8 m, depth 50 cm+, substratum muddy, water turbid and brown.

No 48 : pool in moss tundra, 4 x 2.5 m, depth 30-40 cm, substratum muddy, water weakly stained brown.

No 49 : pool in moss tundra, 10 x 20 m, depth 30-40 cm, bottom muddy, covered with large patches of moss.

No 50 : pool in moss tundra, 5 x 0.6 m, depth 5 cm, bottom covered with mosses. No plankton samples taken.

No 51 : pool in moss tundra, 10 x 5 m, depth 15-20 cm, bottom muddy, half of its surface covered by mosses.

No 52 : pool between dolerite dykes, 17 x 25 m, depth 30-40 cm, substratum muddy with large stones.

No 53 : pool near No 52, 6 x 15 m, depth 30 cm, substratum muddy.

No 54 : pool near No 53, 23 x 8 m, depth 40-50 cm+, substratum muddy.

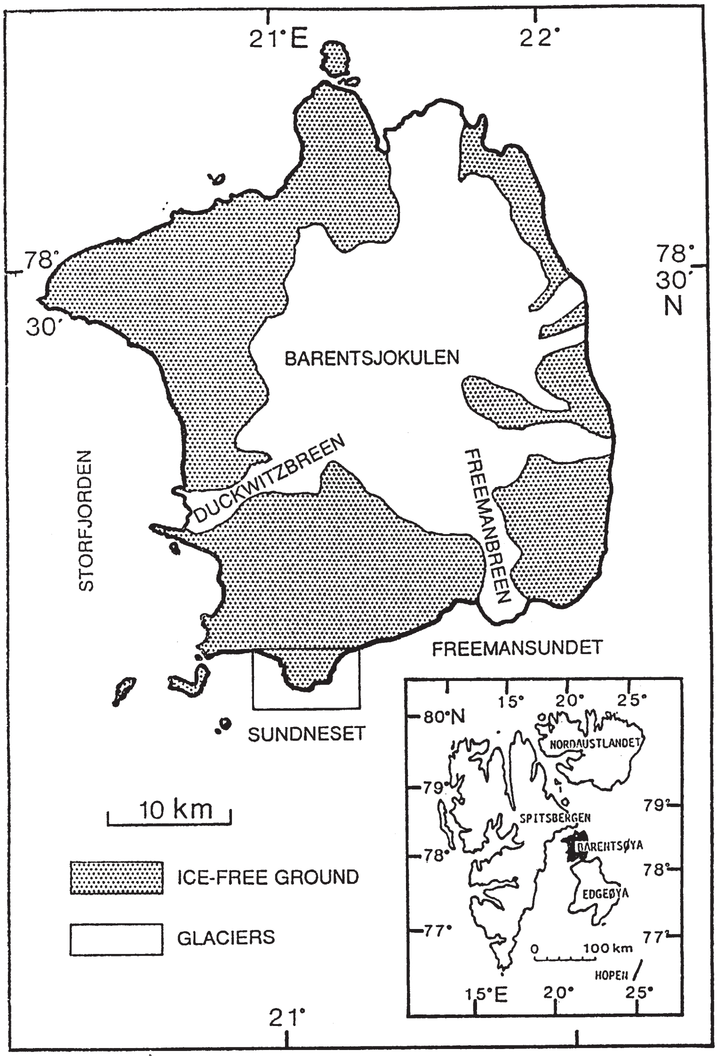

Fig. 1. Map of Barentsøya with sampling area indicated.

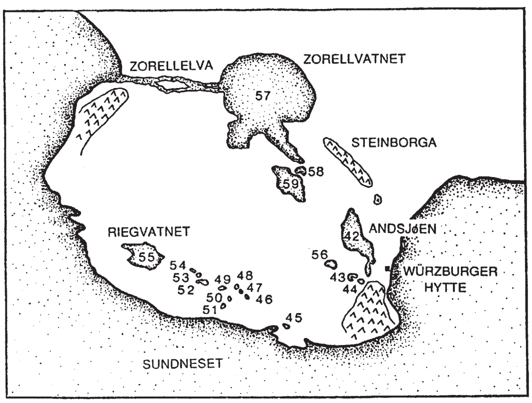

Fig. 2. Map of sampling area. Numbers 42-59 indicate the localities investigated.

No 55 : Riegvatnet : lakelet, surface ca 2.4 ha, depth 50 cm+, bottom sandy-stony.

No 56 : pool on dolerite sill, surface ca 0.2 ha, depth 20-30 cm, substratum sandy-stony.

No 57 : Zorellvatnet : lake, surface ca 23.7 ha, depth at sampling locality 40 cm, substratum sandy-stony.

No 58 : pool in moss tundra, surface ca 0.2 ha, depth 30-40 cm, bottom stony-muddy.

No 59 : large pool near No 58, surface ca 2.3 ha, depth 20-30 cm, substratum muddy.

The underlying geological formation of the study area is formed by upper Triassic beds. The upper strata consist of shales, siltstones and sandstones. These strata are intruded by dolerites, forming sills and dykes of appreciable thickness and extent (Lock *et al.* 1978, Winsnes & Worsley 1981). Base-poor substrates are almost completely lacking.

Semi-quantitative numbers for zooplankton were calculated taking into account the length of the haul and the diameter of the net opening.

The diversity index (H) of the rotifer communities was calculated using the Shannon-Wiener formula

$$H = -\sum_{i=1}^{S} (p_i (\log_2 p_i).$$

where S is the number of species, and p_i is the number of individuals in the ith species.

Community dominance indices were assessed by the formula D.I. = 1OO $(n_1 + n_2)/N$, where D.I. is the dominance index equal to the percentage of the total standing crop, contributed by the two most important species (McNaughton 1967).

Similarity between the rotifer assemblages of the different water bodies studied, was measured by Jaccard's coefficient of association $S_j = p/(p + m)$, where p = frequency of positive matches and m = frequency of mismatches. The coefficients were clustered using the average linkage method (Bonham-Carter 1967).

3. RESULTS AND DISCUSSION

3.1. Physico-chemical information

Basic information on the physico-chemistry of the surface waters studied on Barentsøya, is summarized in Table 1. The samples were taken between 12 p.m. and 19 p.m. The sky was overcast with clouds and the temperature of the air varied from 2.5 to 4.5°C. The waters were always very clear, except for Nos. 46, 47 and 48, which were brown-coloured. Transparency was up to the bottom, with the exception of pond 47 that had a transparency reading of 35 cm. Water temperatures varied from 4.0° to 6.0°C. There was a tendency for higher temperatures (x = 5.5°C, min.-max. = 4.5-6.0°C) in the smaller water bodies, with a surface less than 0.05 ha, than in those with a surface greater than 0.1ha (x = 4.4°C, min.-max.= 4.0°-5.0°C). This agrees with the observations of Rakusa-Suszczewski (1963) that in polar regions the smaller the pond, the warmer it gets.

All waters were fairly alkaline, and generally reached pH-values above 8.0. The relatively high values were probably due to the nature of the substrate, and to an intensive photosynthetic activity by the mosses and algae in the weakly buffered media.

Table 1: Physico-chemical information on surface water.

Sample N°	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Water temperature (°C)	4.0	4.5	5.0	6.0	5.5	4.5	6.0	5.5	6.0	6.5	5.5	5.5	4.5	4.0	4.5	4.5	4.5	4.5
pH	8.14	8.08	8.15	7.55	8.78	9.15	9.64	8.76	7.38	8.80	8.41	8.96	8.49	8.95	8.44	8.31	8.45	9.14
Conductivity 25°C ($\mu S.cm^{-1}$)	197	298	223	341	150	174	165	266	167	184	175	152	146	172	232	119	367	544
Chloride (mg $Cl^-.l^{-1}$)	39.4	50.4	43.5	21.6	15.0	18.6	18.3	13.6	13.8	13.8	15.6	9.9	13.2	14.4	29.6	8.6	30.6	45.0
Sulphate (mg $SO_4^{2-}.l^{-1}$)	7	9	9	30	32	44	26	25	18	17	17	17	24	22	22	20	34	76
Nitrite (µg $NO_2^-.l^{-1}$)	2.0	5.5	3.5	4.0	2.0	5.0	5.5	3.5	11.0	3.0	6.0	1.5	3.0	2.5	3.0	2.0	0.5	0.0
Nitrate (µg $NO_3^-.l^{-1}$)	70	100	60	150	70	150	120	70	120	60	100	60	100	70	0	40	0	0
Orthophosphate (µg $PO_4^{3-}.l^{-1}$)	50	25	40	60	90	50	90	50	190	70	380	90	160	90	90	90	90	90
Total hardness (°d)	2.5	4.1	2.5	7.3	2.4	2.9	2.7	6.1	4.3	3.2	3.7	3.2	2.8	3.3	3.5	2.4	7.0	16.8
Calcium (mg $Ca^{2+}.l^{-1}$)	11.2	16.1	9.2	37.1	11.5	13.6	13.3	30.2	24.1	16.8	19.6	16.8	14.4	16.8	15.6	12.3	29.8	45.4
Magnesium (mg $Mg^{2+}.l^{-1}$)	3.9	8.1	5.2	9.1	3.5	4.4	3.5	7.9	4.0	3.8	4.0	3.7	3.5	4.3	5.9	2.8	12.2	20.7
Sodium (mg $Na^+.l^{-1}$)	24.4	32.4	28.0	18.8	12.8	17.4	15.8	13.4	9.8	7.4	11.4	8.7	10.4	12.0	21.7	6.4	20.2	35.0
Potassium (mg $K^+.l^{-1}$)	7.1	2.3	2.0	1.0	0.9	0.9	0.5	0.8	0.3	0.2	0.7	0.6	0.7	1.1	2.4	1.2	1.7	2.6

The mineral content varied considerably and a conductivity range of 146-544 $\mu S.cm^{-1}$ (K25°C) was measured. The waters were oligo-ionic (K_{25} ($\mu S.cm^{-1}$) $\leq$ 220) to β-mesoionic (22O $\leq K_{25}$ ($\mu S.cm^{-1}$) $\leq$ 550). Accordingly mineralization was low to fairly marked; pool 45 and 58, 59 showed a medium mineralization. The values for Cl^-, SO^{2-}_4, NO_3^-, PO^{3-}_4, Ca^{2+}, Mg^{2+}, Na^+ and K^+ were fairly low and normal for natural fresh waters (e.g. Rodier 1975). The order of frequency of the ions in most samples was $SO_4 >$ Cl; Ca > Na > Mg > K. Total hardness varied from very soft to very hard.

3.2. Faunal assemblages

The results of the plankton and moss surveys are given in Tables 2 and 3.

Plankton

The dominant zooplankters were the Rotifera (average 60% of the total number of individuals of zooplankton), Copepoda Calanoida (20%) and Cladocera (16%). The cladocerans were represented by three species, with *Daphnia pulex* Leydig predominating (up to c. 6 ind.l^{-1} in No 43). The densities of the Calanoida (mainly *Eurytemora raboti* Richard), amounted to 7 ind.l^{-1} in N° 48. The rotifers displayed the highest species richness (41 taxa) and density (up to c. 112 ind.l^{-1} in No 54), and contributed from 2 to 99.7% (average 60%) of the total zooplankton number. Bdelloids (x = 3%, min.-max.= 0.1-7.9%) were scarcer than monogononts (x = 58%, min.-max.= 2.3-99.6%), as could be expected from their habitat preference.

Odd specimens of substrate-dependent species of microturbellarians, Cyclopoida, Harpacticoida, Tardigrada, Gastrotricha and Nematoda were sparsely found in the plankton. They were probably washed out from the moss and benthos, by the mixing of the shallow water due to wind action. Chironomid larvae were regularly seen free-swimming.

The level of primary production affects the number of species of phyto- and zooplankton present in arctic waters, allowing five steps to be recognized with increasing eutrophication (Hobbie 1984). Extremely oligotrophic waters show no zooplankton at all and few phytoplankton species. Increasing quantities of food or algal nutrients, allow more niches to be filled, and phyto- and zooplankton species numbers increase. The most «eutrophicated» waters are characterized by an assemblage of rotifers, calanoids, cyclopoids and cladocerans. The plankton assemblages (Table 2) and the nutrient concentrations (Table 1) found in this study, show that the waters studied on Barentsøya agree fairly well with this scheme.

Submerged moss

The moss communities contained at least eleven taxonomic groups (Table 3). Next to the groups in common with the plankton, species belonging to the Oligochaeta, Ostracoda and Hydracarina were encountered. The most abundant taxa were the Rotifera (averaging 67% of the total number of individuals of zooplankton) and Nematoda (18%). Cladocera (7%), Tardigrada (4%) and Copepoda (2%) were numerically less important. In contrast to the plankton, the moss samples were characterized by higher relative densities for bdelloids (28 vs. 3%), Tardigrada (4 vs. 0.3%), Gastrotricha (2 vs. <0.1%) and Nematoda (18 vs. 2%), and smaller percentages for monogononts (39 vs. 58%), Cladocera (7 vs. 16%) and Copepoda (2 vs. 20%). The Cladocera were represented by four species, with *Chydorus sphaericus* O.F.M. as most abundant. The copepod picture was dominated by the Cyclopoida and Harpacticoida.

3.3. Annotated list of rotifers

A list of the species found during this study is given below. Nomenclature follows Koste (1978) with minor modifications. The numbers and abbreviations following the species name, refer to the sample number, the nature of the sample (plankton/submerged mosses), and the abundance.

Abundance: - not present; r = individual specimens or rare; f = frequent, more than 5% of recorded rotifers; m = many, more than 20% of rotifers recorded; a = abundant, more than 50% of rotifers recorded; + = empty lorica.

Svalbard records : numbers bracketed refer to the literature: 1 = Amrén 1964c; 2 = Bryce 1897; 3 = Bryce 1922; 4 = De Smet 1988; 5 = De Smet 1990; 6 = De Smet *et al.* 1987; 7 = De Smet *et al.* 1988; 8 = Olofsson 1918; 9 = Pejler 1974; 10 = Summerhayes & Elton 1923; 11 = Thomasson 1958; 12 = Thomasson 1961. Taxa and formae marked with an asterisk are new for the Svalbard archipelago.

Table 2: The percentage composition (number of individuals) of invertebrate taxa in plankton samples.

Sample N°	42	43	44	46	47	48	49	51	52	53	54	55	56	57	58	59
ROTIFERA	73.1	6.1	95.3	98.4	2.7	57.3	58.2	34.2	97.6	8.9	99.7	76.9	88.1	98.6	6.7	62.4
Bdelloidea	5.1	3.2	1.8	0.2	0.4	6.8	4.6	7.9	0.4	3.4	0.1	2.8	1.0	0.2	1.6	3.3
Monogononta	68.0	2.9	93.5	98.2	2.3	50.5	53.6	26.3	97.2	5.5	99.6	74.1	87.1	98.4	5.1	59.1
CLADOCERA	2.1	90.0	3.5	0.5	25.0	1.0	10.7	15.8	0.7	86.9	0.1	11.5	7.2	0.5	3.2	1.2
COPEPODA	23.5	0.4	1.0	1.0	72.1	39.9	15.8	34.2	0.2	0.7	<0.1	10.7	4.6	0.8	88.5	31.9
Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	0.5	-
Cyclopoida	2.2	-	<0.1	-	-	1.0	-	2.6	-	-	-	-	-	<0.1	-	-
Calanoida	0.9	0.4	1.0	1.0	72.1	35.0	11.7	31.6	0.2	0.7	<0.1	10.7	3.9	<0.1	88.0	31.3
nauplii	20.3	-	-	-	-	3.9	4.1	-	-	-	-	-	0.7	0.7	-	0.6
NEMATODA	0.6	2.9	0.1	<0.1	0.2	1.0	9.7	10.5	0.8	2.1	0.2	0.3	0.2	0.1	0.2	2.2
TARDIGRADA	0.3	0.4	-	<0.1	-	-	2.6	-	0.1	-	<0.1	0.2	-	<0.1	1.1	0.8
GASTROTRICHA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
TURBELLARIA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2
DIPTERA	0.4	-	<0.1	<0.1	-	1.0	3.1	5.3	0.6	1.4	<0.1	0.4	-	-	0.2	0.2

Table 3: The percentage composition (number of individuals) of invertebrate taxa in submerged moss samples.

Sample N°	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
ROTIFERA	80.0	62.4	59.5	84.5	54.9	87.3	76.6	65.0	67.6	46.3	76.6	69.8	70.1	62.0	57.4	72.0	54.5	53.0
Bdelloidea	59.0	41.9	42.9	45.3	5.9	30.4	5.6	1.9	36.7	22.4	55.7	14.0	26.9	42.1	19.4	27.6	19.7	8.0
Monogononta	21.0	20.5	16.6	39.2	49.0	56.9	71.0	63.1	30.9	23.9	20.9	55.8	43.2	19.9	38.0	44.4	34.8	45.0
CLADOCERA	0.2	0.7	12.3	-	32.6	1.3	-	20.7	20.0	1.6	0.1	8.4	1.7	1.9	0.6	14.0	0.4	8.0
OSTRACODA	0.2	0.7	0.8	-	0.2	0.8	0.5	0.3	0.4	0.1	0.6	0.9	-	2.0	0.5	-	0.7	-
COPEPODA	0.7	2.4	1.4	3.6	1.6	5.0	3.1	6.3	6.8	0.4	0.5	0.9	-	2.1	0.6	0.9	0.2	1.6
Harpacticoida	0.2	2.4	1.0	0.2	-	-	-	-	1.6	-	-	-	-	1.4	0.4	0.1	0.1	-
Cyclopoida	0.5	<0.1	0.3	2.4	0.2	0.3	1.6	4.1	4.4	0.2	0.2	0.9	-	0.5	-	0.8	-	0.4
Calanoida	-	-	0.1	-	1.2	4.7	0.1	-	-	-	-	-	-	0.2	0.2	-	0.1	0.8
nauplii	-	-	-	1.0	0.2	-	1.4	2.2	0.8	0.2	0.3	-	-	-	-	-	-	0.4
NEMATODA	8.9	28.7	19.6	1.3	5.9	2.6	-	4.7	1.8	41.6	16.0	16.0	24.7	26.8	34.0	11.6	37.4	34.3
TARDIGRADA	9.2	3.6	6.1	10.6	2.5	2.9	1.0	2.6	3.1	6.0	6.3	2.6	3.3	4.2	5.3	1.2	4.1	2.8
GASTROTRICHA	0.9	1.4	0.1	-	2.3	-	18.1	0.3	0.2	3.6	-	1.4	0.1	0.5	1.0	0.1	2.4	-
TURBELLARIA	-	-	0.1	-	-	-	0.1	-	0.1	0.1	0.1	-	-	-	0.3	-	0.1	-
OLIGOCHAETA	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	-	-
HYDRACARINA	-	-	-	-	-	0.3	-	-	-	-	-	-	-	0.2	-	-	-	-
DIPTERA	-	-	0.3	-	-	0.3	0.6	0.1	-	0.2	-	-	0.1	0.2	0.4	0.1	0.2	0.4

BDELLOIDEA

Bdelloidea indet.: 42f/a, 43a/a, 44r/a, 45a, 46r/f, 47f/m, 48f/f, 49f/r, 50a, 51m/m, 52r/a, 53m/m, 54r/m, 55r/a, 56r/m, 57r/m, 58m/m, 59f/f.

MONOGONONTA

Family Epiphanidae

Rhinoglena frontalis (Ehrenberg, 1853): 54r/-.
Bjørnøya (4).

Family Brachionidae

**Keratella testudo* (Ehrenberg, 1832): 55-/+.

Notholca foliacea (Ehrenberg, 1838): 42r/+, 43f/r, 44r/r, 46r/r, 47m/r, 48m/f, 49f/f, 50f, 51-/+, 52r/r, 53m/r, 54r/r, 55f/r, 56f/r, 57r/r, 58a/f, 59m/f.
Bjørnøya (4,9), Edgeøya (7), Nordaustlandet (11), Spitsbergen (1,8,12).

Notholca latistyla (Olofsson, 1918): 57r/-, 58r/-.
Bjørnøya (4), Edgeøya (7), Hopen (5), Spitsbergen (1,8).

Notholca latistyla f. *amreni* De Smet & Bafort, 1990:59r/-.
Hopen (5), Spitsbergen (1).

Notholca marina (Focke, 1961): 42r/-, 43r/-, 44r/-, 46r/-.
Spitsbergen (1 partim?).

Notholca acuminata var. *extensa* Olofsson, 1918: 42f/-, 43f/-, 44r/-, 46r/-.
Spitsbergen (8).

Notholca squamula (O.F. Müller, 1786): 57r/+.
Edgeøya (7), Hopen (5), Nordaustlandet (11), Spitsbergen (1, 8, 12).

Family Euchlanidae

Euchlanis deflexa (Gosse, 1851): 44-/r, 45f, 46-/r, 47-/r, 49-/r, 50r, 53-/r.
Bjørnøya (4), Spitsbergen (3, 8, 10).

Euchlanis dilatata Ehrenberg, 1832: 53-/r.
Bjørnøya (4), Nordaustlandet (11), Spitsbergen (8,10).

Euchlanis meneta Myers, 1930: 43-/r, 49r/r, 51f/r, 55-/r, 56-/r.
Bjørnøya (4), Nordaustlandet (11), Spitsbergen (8).

Family Mytilinidae

Mytilina mucronata (O.F. Müller, 1773): 42-/r, 43f/f, 44-/r, 46-/f, 47+/f, 48f/f, 49r/f, 51f/r, 52r/r, 53f/r, 54r/r, 55-/r, 56+/f, 57+/-, 58r/f.
Bjørnøya (4), Edgeøya (7), Nordaustlandet (11), Spitsbergen (8).

Lophocharis oxysternon (Gosse, 1851): 43f/-, 49f/-.
Bjørnøya (4), Spitsbergen (8).

Family Colurellidae

Colurella adriatica Ehrenberg, 1831: 42r/f, 44+/r, 45f, 47+/-, 48+/r, 49-/r, 50f, 51+/-, 52-/r, 53-/f, 54r/+, 55+/r, 56+/r, 57r/f, 59+/r.
Bjørnøya (4), Edgeøya (7), Hopen (5), Spitsbergen (2,8).

Colurella colurus (Ehrenberg, 1830): 45-/r, 57r/-.
Bjørnøya (4), Spitsbergen (6,8,10).

Colurella hindenburgi Steinecke, 1917: 42r/r, 43-/r, 44-/r, 47-/r, 49r/r, 53-/r, 55-/r, 56-/r, 57-/r, 58-/r, 59-/r.
Bjørnøya (4), Edgeøya (7), Spitsbergen (12).

Colurella obtusa Gosse, 1886: 42-/r, 43-/r, 44-/r, 45+, 49-/r, 50r, 52-/r, 53+/f, 54r/-, 56-/f, 57-/f, 58-/f, 59-/f.
Bjørnøya (4), Spitsbergen (8).

Colurella uncinata (O.F. Müller, 1773): 45r, 46-/r, 47-/r, 48-/r, 49r/r, 51-/r, 52r/r, 57-/r.
Bjørnøya (4), Edgeøya (7).

Lepadella acuminata (Ehrenberg, 1834): 42r/-, 44r/r, 46+/-, 48-/r, 49r/r, 51+/r, 52r/r, 53-/r, 54r/r, 55+/+, 56r/r, 57+/-, 58+/r, 59r/r.
Bjørnøya (4), Edgeøya (7), Spitsbergen (8).

Lepadella minuta (Montet, 1918): 42-/r, 43-/r, 44-/f, 45r, 47-/r, 48-/r, 49r/r, 50r, 51-/r, 52-/r, 53-/f, 54-/r, 55-/f, 56-/f, 57r/r, 58-/f, 59-/r.
Bjørnøya (4).

Lepadella ovalis (O.F. Müller, 1786): 44-/r, 45r, 46-/r, 47-/r, 50r, 51-/r, 52r/r, 54r/-, 55-/r, 56-/r.
Bjørnøya (4).

Lepadella patella (O.F. Müller, 1786): 42+/r, 43f/f, 44-/r, 45f, 46-/r, 47-/r, 48+/r, 49r/r, 50f, 51-/r, 52r/r, 53f/r, 55+/r, 56r/r, 57r/r, 58-/r, 59-/r.
Bjørnøya (4), Edgeøya (7), Hopen (5), Nordaustlandet (11), Spitsbergen, (2,3, 8,10,12).

Lepadella quadricarinata (Stenroos, 1898): 42+/r, 46-/r, 47-/r, 48-/f, 49m/f, 51m/r, 52r/r, 53-/f, 54r/r, 55r/r.
Bjørnøya (4), Spitsbergen (8).

**Lepadella triba* Myers, 1934: 45r, 50r.
Lepadella triptera Ehrenberg, 1830: 42r/r, 43+/-, 44-/r, 45r, 49-/r, 50r, 51-/r, 55-/r, 56-/r, 58+/r, 59r/-.
Bjørnøya (4), Nordaustlandet (11).

Family Lecanidae
**Lecane piepelsi* nov. spec.: 50r, 56-/r.

Family Proalidae
Bryceella stylata (Milne, 1886): 50r, 56-/r.
Spitsbergen (2).
**Wulfertia ornata* Donner, 1943: 58-/r.
**Proales fallaciosa* Wulfert, 1937: 55-/r.

Family Notommatidae
**Monommata* sp.: 57-/r, 59-/r.
**Itura aurita* var. *intermedia* (Wulfert, 1935): 59r/r.
Eosphora najas Ehrenberg, 1830: 44-/r, 50r, 51-/r, 52r/-, 54r/-.
Bjørnøya (4).
Resticula nyssa Harring & Myers, 1924: 44-/r, 45r, 51-/r, 52-/r.
Bjørnøya (4).
**Notommata glyphura* Wulfert, 1935: 42-/r, 43f/-, 44r/r, 46r/-, 51-/r, 55r/r, 56r/f, 57r/-, 58-/r, 59r/f.
**Cephalodella biungulata* Wulfert, 1937: 46-/r.
Cephalodella catellina (O.F. Müller): 42-/r, 44-/r, 46r/r, 47r/r, 48f/r, 49-/r, 51-/r, 52r/r, 53f/r, 54r/r, 55-/r, 56-/r, 57-/r, 58-/r, 59-/r.
Bjørnøya (4), Edgeøya (7).
Cephalodella evabroedi De Smet, 1988: 44-/r, 47-/r, 48-/r, 51-/r, 52-/r, 59r/-.
Bjørnøya (4).
Cephalodella gibba (Ehrenberg, 1838): 43-/f, 44-/r, 45r, 46-/r, 47-/r, 48r/r, 49r/f, 50r, 51-/r, 52r/r, 53f/r, 54-/r, 55-/r, 56-/r, 57-/r, 58-/f, 59+/f.
Bjørnøya (4), Edgeøya (7), Hopen (5), Spitsbergen (8).
**Cephalodella glandulosa* Koch-Althaus, 1962: 51-/r.
Cephalodella hoodi (Gosse, 1896): 47-/r, 50r.
Bjørnøya (4).
Cephalodella intuta Myers, 1924: 43-/r, 44-/r, 49-/f, 51-/r, 52-/r, 53-/r, 55-/r, 59-/f.
Edgeøya (7).
**Cephalodella megalocephala* (Glascott, 1893): 46-/r, 51-/r, 53-/r.
**Cephalodella rotunda* Wulfert, 1937: 44-/r, 45r, 46-/f, 47-/f, 48f/m, 49-/r, 51-/m, 52-/r, 53-/r, 54-/f, 55-/r, 56-/f, 57/f, 58-/r, 59-/f.
**Cephalodella* sp.: 58-/r.
Cephalodella ventripes var. angustior Donner, 1949: 43-/r, 44-/r, 45r, 46-/f, 47-/r, 48f/r, 49f/r, 50f, 51-/r, 52r/r, 53-/r, 54-/r, 55-/r, 56-/r, 57r/f, 58-/r, 59-/f.
Bjørnøya (4).

Family Trichocercidae
**Trichocerca cavia* (Gosse, 1886): 49r/f, 50r, 51-/r, 53-/r, 54-/r.
**Trichocerca intermedia* (Stenroos, 1898): 42-/+, 43-/r, 44-/r, 46-/r, 51-/r, 52r/r, 53-/r, 56-/r.
Trichocerca longistyla (Olofsson, 1918): 42r/-, 44r/r, 55r/-.
Spitsbergen (8).
Trichocerca rattus (O.F. Müller, 1776): 43-/r, 50f, 57r/r.
Bjørnøya (4), Spitsbergen (8).
Trichocerca relicta (Donner, 1950): 42r/-, 43-/r, 44-/r, 46r/f, 47-/f, 48r/f, 49r/r, 51-/r, 52r/-, 53-/r, 54r/r, 55r/r, 56r/f, 58-/f, 59r/r.
Bjørnøya (4), Spitsbergen (8).
Trichocerca uncinata (Voigt, 1902): 42-/r, 44-/r, 46-/f, 49-/r, 52r/r, 53-/r, 54-/m, 55-/r, 57-/r.
Bjørnøya (4), Edgeøya (7), Nordaustlandet (11), Spitsbergen (8).
Trichocerca weberi Jennings, 1903: 42r/-, 43-/r, 49r/r, 50r, 51-/r, 52-/r, 53-/r, 54-/r, 57r/r.
Bjørnøya (4), Edgeøya (7).

Family Synchaetidae
Polyarthra dolichoptera (Idelson, 1925): 42a/r, 43+/-, 44a/-, 46a/r, 47a/-, 48m/-, 49m/-, 51f/r, 52a/r, 53-/r, 54a/r, 55a-/, 56a/-, 57a/r, 58f/r, 59f/r.
Bjørnøya (4,9), Edgeøya (7), Nordaustlandet (11), Spitsbergen (1,12).
Polyarthra dolichoptera f. *aptera* (Hood, 1895): 48r/-, 52r/-.
Spitsbergen (1).
**Polyarthra dolichoptera* f. *proloba* (Albertova, 1960): 54a/-.

Family Dicranophoridae
**Dicranophorus forcipatus* (O.F. Müller, 1786): 57-/r, 58-/r, 59-/r.

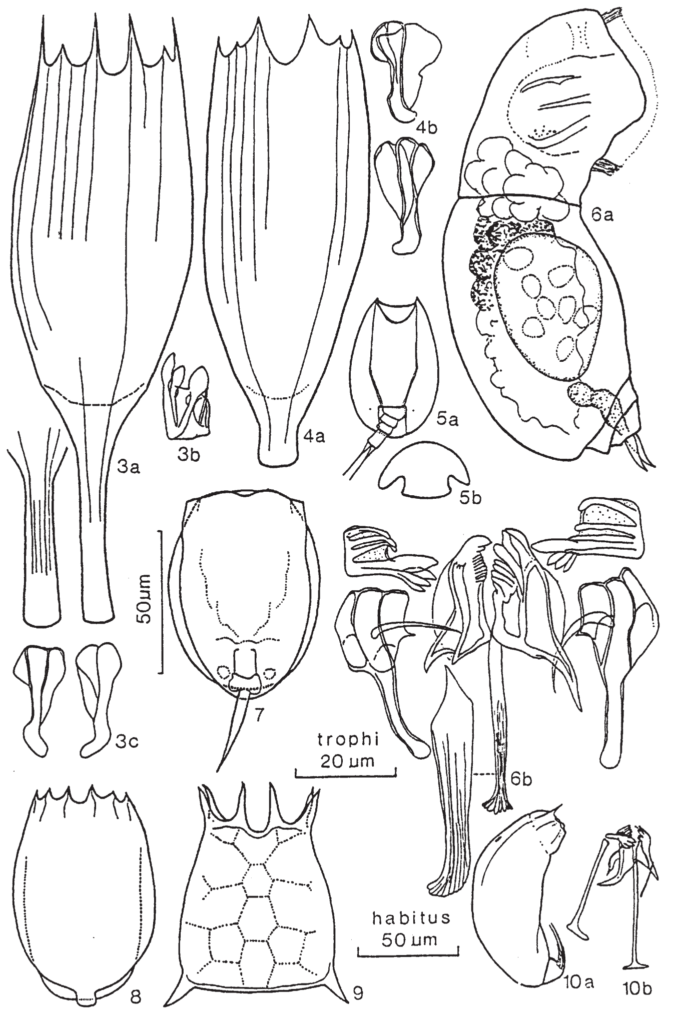

Fig. 3a-c *Notholca acuminata* var. *extensa;* 4a-b *Notholca marina;* 5a-b *Lepadella triba;* 6a-b *Notommata glyphura;* 7 *Lecane piepelsi;* 8 *Notholca latistyla* f. *amreni;* 9 *Keratella testudo;* 10a-b *Trichocerca intermedia.*

Encentrum cf. *marinum* (Dujardin, 1841): 45-/r.
Spitsbergen (10).
**Encentrum mustela* (Milne, 1885): 51f/-, 52-/r, 53-/r, 57-/r.

Family Flosculariidae
Ptygura sp.: 42-/r, 44-/r, 51-/r, 56-/r, 57-/r, 58-/r, 59r/r.
Bjørnøya (4), Edgeøya (7).

Family Collothecidae
Collotheca campanulata (Dobie, 1849): 46r/-, 48r/-, 49r/r.
Edgeøya (7).
Collotheca ornata ornata (Ehrenberg, 1832): 44-/r, 46-/r, 48-/r, 49-/f, 52r/r, 55r/-, 58-/r, 59-/r.
Collotheca ornata cornuta (Dobie, 1849): 52r/-, probably also in other localities.
Hopen (5).
Collotheca sp. 1: 53-/r, 54-/r.
Edgeøya (7).
Collotheca sp. 2: 46-/r, 47-/f, 48-/r.
Collotheca sp. 3: 49-/r, 51-/r.

3.4. Remarks on selected species

Poorly known or problematical taxa, and species new to Svalbard are briefly discussed separately, with notes on taxonomy and distribution.

The abbreviations used are : le = length; wi = width; he = height; lo = lorica; bo = body; to = toe; tr = trophi; f = fulcrum; m = manubrium; r = ramus; u = uncus.

Bryceella stylata
This species with palearctic distribution, has been reported from Spitsbergen by Bryce (1897) sub *Stephanops stylatus* Milne.
Dimensions: bole (contracted) 100 μm, tole 18 μm, trle 18 μm (f 4 μm, r 13 μm, m 11 μm, u 8 μm).

Cephalodella biungulata (Fig. 11a-b)
A single specimen in submerged moss. The typical toes with furcated end, were slightly curved upwardly and not straight as described by Wulfert (1937). Their length (75 μm) was also smaller than is usual (88-112 μm) for the species. Uncinal tooth with broadening, its shaft with a large semi-circular lamella. A probably widely distributed species.
Dimensions: bole 152 μm, bohe 105 μm, tole 75 μm, trle 54 μm (f 33 μm, r 18 μm, m 32 & 35 μm, u 18 μm).

Cephalodella evabroedi (Fig. 20a-b)
C. evabroedi was present in submerged moss from five pools and once in plankton. It has been recorded once only in littoral plankton samples and filamentous algae on stones, from a pool and a lakelet on Bjørnøya, Svalbard (De Smet 1988).
Dimensions: bole (contracted) 87 μm, tole 34 μm, trle 33 μm (f 21 μm, m 24 μm, u 11 μm).

Cephalodella glandulosa (Fig. 21a-c)
Two specimens in submerged moss from a single locality. The left ramus tip of the animals studied, displayed three teeth, and not two, as given by Koch-Althaus (1962). So far as we know, the species has only been reported from *Chara* vegetation in the Lake Stechlin (Germany).
Dimensions: bole (contracted) 115 μm, tole 26 μm, trle 28-32 μm (f 18 μm, left r 11 μm, right r 12 μm, m 16 μm, left u 8 μm, right u 6 μm).

Cephalodella megalocephala (Fig. 22a-b)
Found in submerged moss at three localities. Cosmopolitan; on mud flats, in psammon and periphyton of fresh and brackish waters.
Dimensions : bole 135 μm, tole 28 μm, trle 38 μm (f 21 μm, m 18 μm).

Cephalodella rotunda (Fig. 18a-c)
This is, together with *C. catellina, C. gibba* and *C. ventripes* var. *angustior,* among the most abundant and most frequently encountered *Cephalodella* species (present at 15 of the 17 localities). Almost exclusively periphytic in Europe; known from alkaline ditches in meadows, periphytic in peat bogs, etc.
Dimensions: bole 60-65 μm, bohe 37-40 μm, tole 20-23 μm, trle 20-22 μm (f 13-14 μm, m 13-14 μm, r 10-12 μm, u 5-6 μm).

Cephalodella sp. (Fig. 19a-c)
A single specimen that could not be identified to species level. A relatively small species. Toes slightly curved upwardly. Fulcrum with basal apophyse, rami without alulae , posterior of manubria axe-shaped.
Dimensions: bole 90 μm, tole 23 μm, trle 20 μm (f 14 μm, m 13 μm, r 7 μm, u 5 μm).

Dicranophorus forcipatus (Fig. 15a-d)
This cosmopolitan species was found in submerged moss from the Zorellvatnet and two pools situated in the neighbourhood of each other.
Dimensions: bole (contracted) 180 μm, lowi 135 μm, lohe 115 μm, tole 75-82 μm, trle 74 μm (f 20 μm, r 46 μm, m 56 μm, u 34-36 μm, le pleural rod 34 μm).

Encentrum cf. *marinum* (Fig. 17)
A single specimen from a small pool. The toes and trophi are similar to that of *E. marinum.* The latter species is marine and meso-euryhalobic, and known from brackish coastal waters, inland saline and alkaline fresh waters with decaying mud. Palearctic, nearctic and arctic regions (Koste, 1978). Summerhayes & Elton (1923) reported its probable occurrence (sub *Encentrum* ? *raptor* Gosse) in brackish communities and tidal ponds on Spitsbergen.
Dimensions: bole 80 μm, tole 22 μm, trle 19 μm (f 7 μm, m 14 μm, r 8 μm, intramallei 3.2 μm).

Encentrum mustela (Fig. 13)
A coldstenothermous cosmopolitan. Found on four occasions in plankton and submerged mosses.
Dimensions: bole 162 μm; tole 15 μm, trle 32-34 μm (f 11 μm, m 22 μm, r 12-14 μm, u 14-15 μm).

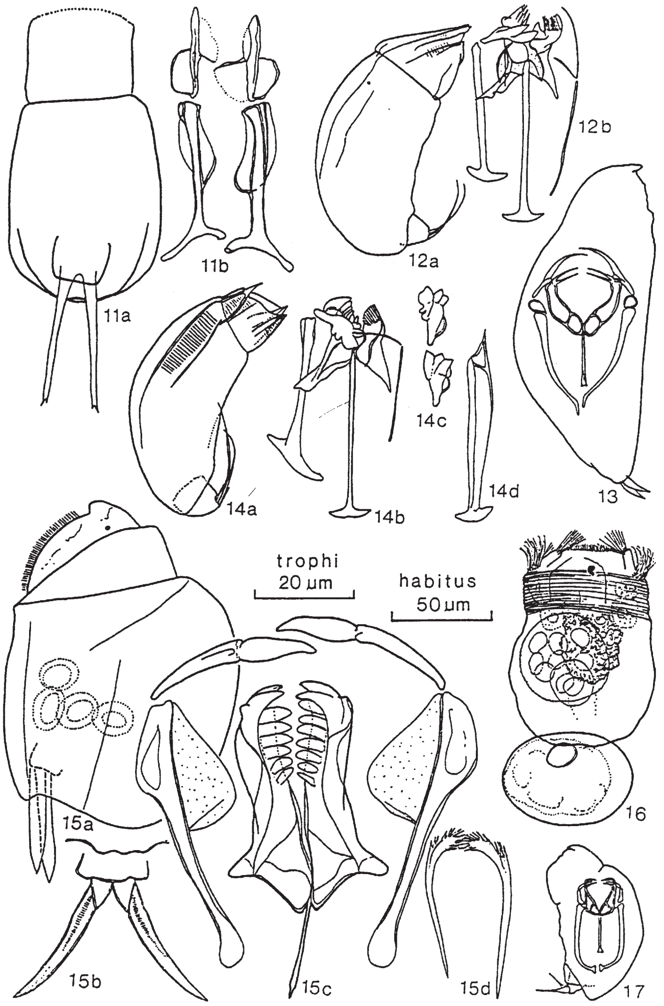

Fig. 11a-b *Cephalodella biungulata;* 12a-b *Trichocerca cavia;* 13 *Encentrum mustela;* 14a-d *Trichocerca longistyla;* 15a-d *Dicranophorus forcipatus;* 16 *Polyarthra dolichoptera* f. *aptera;* 17 *Encentrum* cf. *marinum.*

Itura aurita var. *intermedia* (Fig. 25a-b)
Three individuals belonging to the var. *intermedia,* were found in submerged moss and plankton from a pool. They showed the characteristic asymmetrical trophi, with enlarged right parts, and manubria with two-pointed internal lamellae. The species is known from ponds, brooks and the shore of slow-flowing eutrophic waters. Europe and North Africa.

Dimensions: bole (contracted) 115 µm, tole 16 µm, trle 40 µm (f 17 µm, r 21-22 µm, m 30-34 µm, u 17-19 µm).

Keratella testudo (Fig. 9)
The presence of empty loricae of this widespread species, suggests that it has its development earlier in the season.

Dimensions: lole 82 µm, lowi 77 µm, postero-lateral spines 16 µm, antero-median spines 20 µm.

Lecane piepelsi (Fig. 7)
In submerged mosses from pool 50 and 56 we came across an apparently new species of *Lecane.*

Diagnosis: a relatively small *Lecane* belonging to the subgenus *Monostyla.* The species is near to *Lecane closterocerca,* but of more slender shape. Anterior margins convex, the ventral one with narrow and shallow sinus.

Description: lorica elongately oval. Anterior margin of dorsal plate convex; anterior margin of ventral plate convex with narrow and shallow sinus. Lateral edges of anterior margin receding at an obtuse angle. Ventral plate narrower and longer than dorsal one. Both plates rounded posteriorly. Foot not projecting beyond the lorica. First foot joint rather broad and parallel-sided, the second joint more or less transversely oval. Coxal plates rounded. Toe long and slender, parallel-sided for about 1/3 to 1/2 its length, tapering to a slender acute point, slightly decurved posteriorly. A transverse ventral surface marking in front of the foot and two to four longitudinal folds.

Dimensions (5 individuals): le dorsal plate 67-72 μm, wi dorsal plate 43-54 μm, le ventral plate 70-75 μm, wi ventral plate 43-47 μm, tole 28-32 μm, depth of ventral sinus 1.5-2 μm.

Holotype: loricate female, mounted in glycerine and deposited at the Museum of the Koninklijk Belgisch Instituut voor Natuurwetenschappen Brussel.

Paratype: a series of 4 animals mounted in glycerine and deposited with the author.

Type locality: Talaveraflya, Barentsøya, Svalbard, 29.08.1985.

Lepadella triba (Fig. 5a-b)
Four specimens of this wide-spread, but rare species were found in submerged mosses. The species has e.g. been reported from Belgium, Germany, Sweden, U.S.A. (Maine), Canada (Ontario) and Senegal. The specimens encountered show a ventral plate that narrows with a kink at one third of its end; the length of the toes ranges from 20 tot 23 μm, which is shorter than usual: 32 μm after Myers (1934) and Carlin (1939), 30-33 μm after Koste (1978). The terminal foot joint (8-10 μm) is also shorter (14 μm after Myers, 1934).

Dimensions: lole 71-75 μm, lowi 45-47 μm, largest wi of ventral plate 24-27 μm, lohe 23-27 μm, tole 20-23m, le terminal fo joint 8-10 μm, fo opening 15-20 x 14-17 μm, depth of dorsal sinus 5-7 μm, depth of ventral sinus 10-13 μm.

Monommata sp. (Fig. 23a-c)
Single specimens in submerged mosses from the Zorellvatnet and a large pool. Rami without inner teeth, unci two-teethed, fulcrum straight rod-like, manubrium displaying a large lamella on one side. A wide-spread genus, hitherto not recorded from Svalbard.

Dimensions: bole 96 μm, tole 102 & 73 μm, tr le 16 μm (f 8 μm; m 11 μm, r 10 μm).

Notholca latistyla
Both the nominate type, which has a caudal appendage that becomes broader more or less terminally with angular corners, and f. *amreni* (Fig. 8), which has a caudal appendage that more or less progressively decreases in width displaying rounded corners, were found in plankton on three occasions. The nominate type predominated. An arctic species.

Dimensions: nominate type: lole 90 μm, lowi 59-64 μm, lohe 50 μm, caudal appendage 8-12 μm; f. *amreni:* lole 101 μm, lowi 70 μm, lohe 55 μm, caudal appendage 9 μm.

Notholca marina (Fig. 4a-b)
Notholca acuminata was splitted into two subspecies by Focke (1961), on the basis of field and laboratory investigations: the freshwater specialist *N. acuminata lacustris,* and *N. acuminata marina,* characteristic of salt and brackish waters. In the laboratory however, Focke succeeded in cultivating the marine form in fresh water for some hundred generations, and the lacustrine form also survived for several generations in sea water. Björklund (1972) considered the two forms to be separate species on the basis of biometrical analysis. The latter author also reported *N. acuminata* from sea water and rock-pools, at salinities varying from 1.0 to 7.2‰. *N. acuminata* and *N. marina* are considered to be found only in fresh water, or in salt water, respectively by Ruttner-Kolisko (1974) and Koste (1978). Following Kutikova (1980), *N. marina* is to be found in salt and brackish water only, whereas *N. acuminata* occurs in salt and fresh water.

We obtained *Notholca* specimens with short posterior extension from four water bodies close to each other (loc. 42, 43, 44, 46). They were classified as *N. marina* after Focke (1961) and Björklund (1972), on the basis of the more or less discontinuously set-off posterior extension which was generally widening at the end, the length of the antero-dorsal spines which are generally smaller than in *N. acuminata,* the convexly curved posterior margin of the ventral plate, and the simply bent end of the manubrium. The chemical composition, viz. the low chloride va-

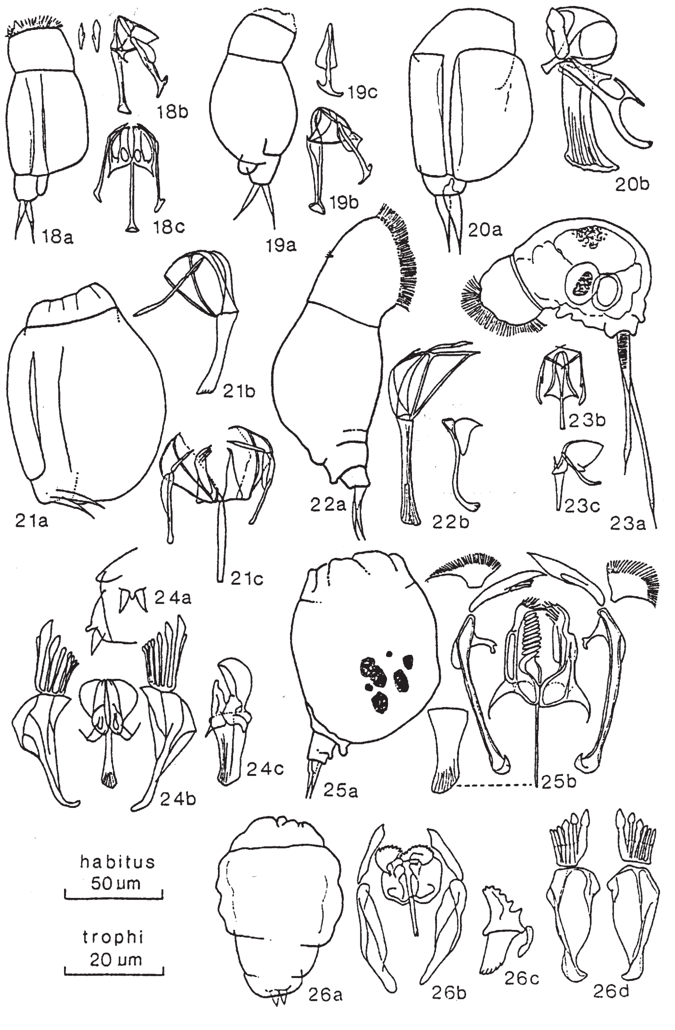

Fig. 18a-c *Cephalodella rotunda;* 19a-c *Cephalodella* sp.; 20a-b *Cephalodella evabroedi;* 21a-c *Cephalodella glandulosa;* 22a-b *Cephalodella megalocephala;* 23a-c *Monommata* sp.; 24a-c *Proales fallaciosa;* 25a-b *Itura aurita* var. *intermedia;* 26a-d *Wulfertia ornata.*

lues of 15.0-50.4 mg $Cl \cdot l^{-1}$, of the waters where they were found, is typical for fresh waters.

Dimensions: total le 225 μm, bole 184 μm, lowi 81 μm, le antero-median spine 21 μm, le antero-lateral spine 18 μm, le posterior extension 20 μm, trle 28 μm (f 7 μm, m 20 & 24 μm, r 17-21 μm, u 14 & 16 μm).

Notholca acuminata var. *extensa* (Fig. 3a-c)
In the same waters where we collected *N. marina,* we also observed specimens (frequent in loc. 42, 43 and rare in loc. 44, 46) with a long posterior extension, described as *Notholca acuminata* var. *extensa* by Olofsson (1918). The latter author collected var. *extensa* in a «Strandlagune» at Klaas Billen Bay, on Spitsbergen, and although the water was «dem Geschmack nach ganz süss», he considered it to be a brackish-water form (p. 288, 631, 633). Studying the trophi, which were not described by Olofsson, we found them identical to those of *N. marina:* the manubria are not crutched as in *N. acuminata* but simply bent terminally. Other characters, such as the terminally widening posterior extension that is generally set off from the lorica, make us believe that var. *extensa* could belong to the group of *N. marina.* We are now studying *extensa* material from Edgeøya (Svalbard) and hope to draw some conclusions in the future. Besides the observations

from Svalbard, specimens referred to *N. acuminata* var. *extensa* have been reported e.g., from the brackish Waterneversdorfer Binnensee, Holstein, Germany (Meuche 1939) and Lake Ontario, Canada (Nauwerck 1978).

Dimensions: total le 303-320 μm, lole 165-176 μm, lowi 77-90 μm, le antero-median spine 29-32 μm, le antero-lateral spine 24-26 μm, le posterior extension 97-110 μm, trle 26 μm (f 4 μm, m 20 & 24 μm, u 15 & 18 μm).

Polyarthra dolichoptera
Animals belonging to f. *proloba,* which displays a bulge in the ventral body wall that contains the mastax, were found once. Specimens without fins (Fig. 16), showing reduced internal organs (f. *aptera*) were present in two pools at low numbers. They were carrying amictic eggs. The presence of *aptera* forms as late as 29 August is puzzling, since they normally belong to the first generation emerging from resting eggs. Amrén (1964a,c) intensively studied *P. dolichoptera* in some ponds on Spitsbergen between 1 July and 13 August, and occasionally on 28 August and 11 September. The first *aptera* specimens appeared on 2 July, and on 3 August the first generation was dead. No *aptera* forms were recorded later on in the season. Olofsson (1918) sampled different water bodies on Spitsbergen between 9 July and 12 September. During this period he collected *P. dolichoptera* (sub *P. trigla* Ehrbg., that should be identical to *P. dolichoptera* on Spitsbergen after Amrén (1964c)) in most of the waters. The *aptera* forms developed between 15 July and 26 July. On the following sampling dates he only noted specimens with foliate appendages until 13 August, when again *aptera* forms were disclosed. Subsequent generations displayed foliate appendages. Other arctic reports of the f. *aptera* are noted by Nogrady & Smol (1989), who found this form throughout the season until the end of July, on Cape Herschel, Ellesmere Island, N.W.T. Canada (latitude 78°37'N). These authors have seen *aptera* forms in the first week of July. De Smet & Bafort (1990) observed the form at low numbers, at the end of the season (21 August) on Little Cornwallis Island, N.W.T. Canada (75°35'N). Finally it must be remembered that already Hood (1895), who described f. *aptera* from Scottish lakes, found it numerously in spring, and on one occasion also noticed a few examples with both amictic male eggs and resting eggs in August. From the above observations it is clear that the main development of the *aptera* form takes place at the beginning of the season. A second, less important development sometimes occurs at the end of the season. One can imagine that this second development is triggered by temporary changes in the environmental conditions, which are reverse to their normal seasonal evolution (e.g., when the seasonally decreasing temperature is interrupted by a period with high temperatures, cloudiness and light conditions, etc.)

Proales fallaciosa (Fig. 24a-c)
A few specimens of this cosmopolitan species were found in submerged moss from Riegvatnet. The left and right uncus both had seven teeth (seven and five to six respectively, after Koste (1978)).

Dimensions: bole 274 μm, trle 26 μm (f 14 μm, r 13 μm, m 23 & 25 μm, u 16 μm).

Trichocerca cavia (Fig. 12a-b)
Once in plankton, otherwise moss dwelling (5 localities). The left uncus displayed three to four blunt teeth and not a single one, as mentioned by Koste (1978). A cosmopolitan, periphytic species.

Dimensions: lole 120-144 μm, lohe 52 μm, tole 32-35 μm, trle 44 μm (f 31 μm, r 17 μm & 18-20 μm, left m 27-30 μm, right m 20-24 μm, left u 12 μm, right u 11-15 μm & 6 μm).

Trichocerca intermedia (Fig. 10a-b)
Rare in submerged moss at eight localities, once planktonic. Known from stagnant and slow running waters, between vegetation and in psammon. Wide-spread.

Dimensions: lole 100 μm, lohe 35 μm, tole 26 μm, trle 29 μm (f 22 μm, r 13 & 11 μm, left m 20 μm, right m 8 μm, left u 6 μm).

Trichocerca longistyla (Fig. 14a-d)
This species was described from Spitsbergen sub *Diurella longistyla* by Olofsson (1918), who collected it between the vegetation of several waters. Since then, it has been reported from the southern island of Novaya Zemlya (Idelson 1925) and the Torneträsk area in Northern Swedish Lapland (Pejler 1962). We encountered it on three occasions in plankton and once in submerged mosses on Barentsøya.

The body is moderately short and thick.

The head sheath is not clearly marked off from the body. A well-developed antero-dorsal tooth is present. The antero-ventral margin has two pointed folds. On the dorsal side there is a ridge, running to about half of the body from the anterior end. Toes of unequal length, the right one about 3/4 of the left one. The left toe is about 40% of the body length. Toes curved towards the body. The structure of the virgate trophi was not described by Olofsson (1918). They are highly asymmetrical. The left manubrium is strongly developed, with conspicuous axe-shaped end; a small knob on the anterior side of the largest part of the axe. Right manubrium thin, rod-like and somewhat longer than half the length of the left one. Both rami carry alulae, left alula two-pointed. Suprarami present. The fulcrum is straight and crutched. Right uncus one-toothed, thin; left uncus displaying three broad teeth.

Dimensions: (5 individuals) bole 130-148 μm, bohe 47-55 μm, le left to 50-62 μm, le right to 36-45 μm, trle 45-52 μm (f 32-34 μm, left r 21-22 μm, right r 14-18 μm, left m 33 μm, right m 18 μm, left u 11 μm, right u 11 μm).

Wulfertia ornata (Fig. 26a-d)
Ten specimens in submerged moss from a pool. A rare species known hitherto only from ponds and shallow waters in S. Moravia, Czechoslovakia (Donner 1943), Central Germany (Wulfert 1960) and Sueva, Romania (Rudescu 1960).

Dimensions: bole (contracted) 92 μm, tole 9 μm, trle 30 μm (f 8 μm, r 11 μm, m 23 μm, u 12 μm).

3.6. Eggs

Eggs were found in *Collotheca* spp. and *Polyarthra dolichoptera.* As regards *P. dolichoptera* amictic, male eggs and resting eggs were present in varying quantities in the different water bodies (see Table 4). Also the average number of eggs per female and stage of embryonic development, showed a lot of variation. The differences are assumed to be primarily the result of environmental variations between the different ponds and genetic variations between populations. Amrén (1964 a,b) observed a decrease in the production of amictic eggs and an increase in that of the resting eggs early in the season. Nogrady & Smol (1989) have seen *aptera* forms carrying simultaneously a normal single amictic egg and a resting egg inside, in the first week of july. Both authors also noticed the collapse of populations relatively early in the season (the third week of july with at least 3-4 weeks of ice-free conditions remaining). Amrén (1964b) speculates it could be an adaptation to avoid the risk of catastrophic decimation, if the drying out or freezing takes place earlier than normal. By only using the first part of the season for their development, rotifers also should avoid competition with entomostracans, which should develop less quickly and attain maximum population densities later on in the summer. The limited results on egg numbers for Barentsøya show that the production of different egg types was still relatively high on August 29 and that the production of amictic eggs generally exceeded that of the resting eggs. It thus seems that in some cases intensive production continues until conditions become unfavourable, and the early formation of resting eggs and collapse of populations is probably not a universal polar phenomenon as suggested by Nogrady & Smol (1989).

Table 4: *Polyarthra dolichoptera:* number of individuals (Ind.l^{-1}) and number of amictic (Amict. E.), resting (Rest. E.) and male eggs (Male E.) eggs per litre.

Locality	Ind.l^{-1}	Amict.E.	Rest.E.	Male E.
42	3.2	1.8	1.3	0.5
44	16.4	17.0	5.2	0.3
46	34.2	12.2	28.4	4.0
47	0.1	--	--	--
48	0.5	1.1	0.2	1.1
49	0.5	0.8	--	0.3
51	0.1	0.1	--	0.1
52	10.7	7.8	13.2	5.1
54	112.0	58.2	22.3	11.5
55	5.4	2.3	0.8	1.6
56	12.0	0.1	0.5	0.1
57	48.7	4.4	<0.1	0.2
58	<0.1	--	--	--
59	1.7	0.8	--	--

3.7. Rotifer food

We were able to identify the food items in the stomach of three taxa. *Trachelomonas* sp. (Euglenophyta) and pennate diatoms were observed in *Collotheca* spp. In *Dicranophorus forcipatus* we noticed *Lepadella patella* and *Encentrum mustela.* The intestine of moss-dwelling *Eosphora najas* contained bdelloids and *Colurella* spp., whereas specimens from plankton were found to eat *Polyarthra dolichoptera.*

3.8. Parasitism

Microsporid protozoans were observed in at least 12 species: *Cephalodella catellina, Colurella adriatica, C. colurus, C. uncinata, Lepadella acuminata, L. patella, L. quadricarinata, Mytilina mucronata, Notholca foliacea, Polyarthra dolichoptera, Trichocerca relicta* and *T. uncinata.* The most frequently occurring endoparasite, attacking all 12 species mentioned above, was a *Plistophora asperospora*-like organism. It was not rare to find up to six different hosts to be infected at one and the same locality by this parasite, although in general only one to three of them shared high infection percentages of 39% to 50%. In non-arctic regions *Plistophora* epidemics usually affect only one species, even though several hosts are available (Ruttner-Kolisko 1977), and always take place at population maximum (Miracle 1977). The proportion of infected individuals depends on the density of individuals still uninfected or susceptibles, being higher in more crowded situations (Miracle 1977). The rotifer densities are generally extremely low in the Arctic, and it looks as if the observed *Plistophora,* rather than being specific for one particular rotifer, is attacking different species simultaneously. The currently found *Plistophora asperospora* mainly occurs at high water temperatures (Budde 1927) and its cysts should not develop below 15°C; the parasite itself survives well only above that temperature (Ruttner-Kolisko 1977). The differences in host specificity and temperature tolerance displayed by the *Plistophora*-like organism observed in Barentsøya, are evidence that it belongs to a cold-adapted strain, or, in spite of its morphological resemblance, is a distinct species.

At loc. 54 and 55 the immediate eggs of *Polyarthra dolichoptera* contained sporangia remembering those of *Olpidium gregarium* Now. (Phycomycetes). Infestation was of striking severity at loc. 54, with an infection percentage of 83%.

At loc. 55 and 57 epizoic flagellates, colonial in habit *(Codonosiga?),* were found on *Polyarthra dolichoptera.* They were always attached to the posterior part of the body, between the lateral antennae. Infestation amounted to 53% at loc. 57.

3.9. Rotifer community characteristics

Species richness

In the present study, we list 63 rotifer taxa, of which 62 belong to the Monogononta and one to the Bdelloidea. Fifty-eight monogonont taxa have been identified to species level. The minimum number of species encountered per water body is 16 and the maximum 31 : plankton 6-18, submerged moss 15-29 (Table 5). These figures agree with the general observation of a depauperated high arctic fauna (Table 6). However, we are convinced by our own experience, that the species richness of the Arctic and High Arctic will prove to be much higher as could be expected from the older literature. As a matter of fact we believe that, seen the generally extremely low population densities, sampling efforts have often been inadequate to get a real impression of the species richness.

The loricate-illoricate ratio was 71-29%. Chengalath & Koste (1989) found a strong preponderance of loricate rotifers (19 species or 90%) over the illoricate ones (2 species or 10%) in the high arctic localities on Bathurst Island, and suggested that some species, especially illoricates, are dipersed very slowly from areas in which they survive. However, the data from other high arctic localities, recorded in Table 6, do not speak in favour of this idea, the ratios being comparable to those from lower latitudes.

Density

Semi-quantitative data are only available for the plankton. As there probably occurred some clogging of the plankton net, the numbers obtained must be considered as minimal. The total number of individuals was extremely low and varied from < 1 ind.l^{-1} to 112 ind.l^{-1} (loc. 43, 47, 53, 58 : < 1 ind.l^{-1}; loc. 42, 48, 49, 51, 59 < 5 ind.l^{-1}; loc. 55: 5-10 ind.l^{-1}; loc. 44, 52, 56: 10-20 ind.l^{-1}; loc. 46: 34 ind.l^{-1}; loc. 57: 49 ind.l^{-1}; loc. 54: 112 ind.l^{-1}). *Polyarthra dolichoptera* was the most numerous monogonont, and usually accounted for more than 95% of the densities found. It reached a maximum density of 112 ind.l^{-1} at loc. 54.

Amrén (1964c) thoroughly investigated ponds and lakes on Spitsbergen, and found planktonic rotifer amounts up to 2500 ind.l^{-1} in some ponds of the coastal plain, and up to 200 ind.l^{-1} at some depths in the Kongress-

Table 5: Species richness (N), species diversity (H), dominant species and dominance index (D.I.) of the rotifer fauna from plankton and submerged moss.

Plankton					Submerged moss				
Loc.	N	H	Dominant species	D.I.	Loc.	N	H	Dominant species	D.I.
42	13	1.29	Polyarthra dolichoptera N. acuminata var. extensa	85.6%	42	16	1.54	Bdelloidea Colurella adriatica	83.6%
43	9	2.13	Bdelloidea N. acuminata var. extensa	70.6%	43	15	1.96	Bdelloidea Lepadella patella	73.8%
44	8	0.35	Polyarthra dolichoptera Notholca foliacea	97.9%	44	27	1.93	Bdelloidea Lepadella minuta	78.0%
45	-	-	-	-	45	16	2.13	Bdelloidea Lepadella patella	73.1%
46	9	0.05	Polyarthra dolichoptera Notholca foliacea	99.7%	46	19	3.47	Cephalodella ventripes M.mucronata,T.relicta	47.1%
47	6	1.62	Polyarthra dolichoptera Notholca foliacea	81.8%	47	18	3.01	Bdelloidea Mytilina mucronata	52.1%
48	12	2.97	Polyarthra dolichoptera Notholca foliacea	44.0%	48	17	3.14	Cephalodella rotunda Mytilina mucronata	44.3%
49	18	3.12	Polyarthra dolichoptera Lepadella quadricarinata	52.6%	49	26	3.94	Collotheca ornata Notholca foliacea	26.9%
50	-	-	-	-	50	19	2.37	Bdelloidea Colurella adriatica	66.4%
51	8	2.29	Lepadella quadricarinata Bdelloidea	61.6%	51	29	2.72	Bdelloidea Cephalodella rotunda	69.6%
52	17	0.47	Polyarthra dolichoptera Cephalodella catellina	96.2%	52	24	1.87	Bdelloidea Lepadella patella	76.9%
53	7	2.29	Bdelloidea Notholca foliacea	61.6%	53	26	3.88	Bdelloidea Lepadella quadricarinata	35.7%
54	13	0.03	Polyarthra dolichoptera Bdelloidea	99.9%	54	17	2.34	Bdelloidea Trichocerca uncinata	75.5%
55	11	0.82	Polyarthra dolichoptera Notholca foliacea	94.0%	55	22	2.06	Bdelloidea Lepadella minuta	73.8%
56	9	0.73	Polyarthra dolichoptera Notholca foliacea	98.3%	56	22	3.28	Bdelloidea Lepadella minuta	49.2%
57	15	0.11	Polyarthra dolichoptera Notholca foliacea	99.4%	57	21	2.89	Bdelloidea Colurella adriatica	53.9%
58	7	1.52	Notholca foliacea Bdelloidea	86.2%	58	21	3.02	Bdelloidea Lepadella minuta	50.8%
59	13	1.46	Polyarthra dolichoptera Notholca foliacea	90.3%	59	21	3.69	Cephalodella gibba Bdelloidea	32.3%

Table 6: Monogonont rotifer species richness and percentage composition of loricate and illoricate taxa in high arctic freshwater habitats.

Locality	Middle latitude and longitude	Species richness	% Loricate	% Illoricate	Author
Barentsøya	78°30'N, 76°21'E	62	71	29	This paper
Nordaustlandet	79°08'N, 24°00'E	17	76	24	Thomasson (1958)
Edgeøya	77°05'N, 22°00'E	22	76	24	De Smet et al. (1988)
Spitsbergen	78°45'N, 16°00'E	55	82	18	Bryce (1897, 1922), Murray (1908), Olofsson (1918), Summerhayes & Elton (1923), Thomasson (1958, 1961), Amrén (1964a-c), De Smet et al. (1987)
Hopen	76°31'N, 25°01'E	13	69	31	De Smet (1990)
Bjørnøya	74°30'N, 19°00'E	52	78	22	Pejler (1974), De Smet (1988)
Franz Josef Land	81°00'N, 55°00'E	15	80	20	Retowski (1935)
Novaya Zemlya	73°00'N, 55°00'E	63	84	16	Idelson (1925), Gorbunow (1929), Retowski (1935)
Ellesmere Island	79°30'N, 81°00'W	31	71	29	Nogrady & Smol (1989)
Bathurst Island	75°40'N, 100°00'W	21	90	10	Chengalath & Koste (1989)
Little Cornwallis Island	75°35'N, 96°30'W	50	74	26	De Smet & Bafort (1991)
Devon Island	75°00'N, 86°00'W	64	72	28	De Smet (unpublished)
Total number of species		171	113 (66%)	58 (34%)	

vatnet. In other ponds and lakes, the population density of zooplankton on the whole was considerably lower, and as a rule less than 1 ind.l^{-1}. Information from the Canadian High Arctic also shows that rotifer densities are extremely low. McLaren (1964) found only *Keratella hiemalis* at densities of < 1-29 ind.m^{-3} and a few *K. cochlearis* in Lake Hazen, and 5 to 7 unidentified rotifers per m^{-3} in Skeleton pond on Ellesmere Island (latitude 81°50'N). During their study of the production of zooplankton in Char Lake, Cornwallis Island (latitude 75°N), Rigler et al. (1974) only encountered *Keratella cochlearis,* at densities smaller than 10 ind.l^{-1}. Nogrady & Smol (1989) reported (without providing any quantitative data) that the rotifer densities from five high arctic ponds at Cape Herschel (Ellesmere Island) were extremely low. It is clear that rotifer production in the High Arctic is generally low. This could be the result of a shortage of food (Amrén, 1964a,c), as the quantity of small monads, detritus and bacteria seems to be constantly rather low (Morgan & Kalff 1972; Willén 1980). Competition for food and predation also plays a major role in determining rotifer biomass. There was a varying degree of importance of the Rotifera, Cladocera and Calanoida in the plankton of the different water bodies studied. The comparison of the respective densities (Fig. 27) demonstrates a strong evidence for the limiting of rotifer abundance by cladoceran and calanoid competition (Spearman rank correlation $r = -0.76$, $p<0.002$).

Species diversity

The species diversity (Shannon-Wiener) was rather low (Table 5) for the planktonic rotifer assemblages, and varied from 0.03 to 3.12 (average 1.24). The moss assemblages were more diverse, with values ranging between 1.54 and 3.94 (average 2.74). Low species diversity indices are characteristic for stressed situations. The higher diversities of the moss assemblages, must probably be ascribed to the more heterogeneous and complex environment of the moss habitat.

Community dominance

The dominance index (Table 5) is obviously higher for plankton (mean D.I. = 82.5%,

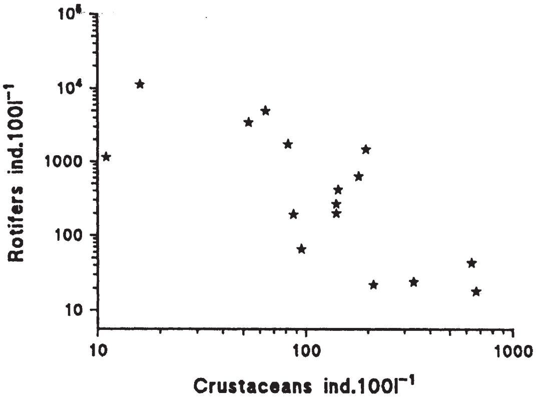

Fig. 27. Relationship between rotifer density and crustacean density.

range 44.0-99.9%) than for moss (mean D.I. = 59.1%, range 26.9-83.6%). Six taxa contributed to the dominance indices of the plankton, with *Polyarthra dolichoptera* as most abundant (12 times upon 16 water bodies) and *Notholca foliacea* as second most abundant one (9/16). Dominance indices for the moss assemblages were determined by 13 taxa, with Bdelloidea dominant in 14 of the 18 water bodies, and 4 other species dominant only once. Ten species behaved as second most dominant, none being dominant more than 4 times. The high constancy of the dominant species, in the physico-chemically and morphometrically differing water bodies, suggests that the dominance is primarily achieved by competitive superiority. Dominance defined by the community index (Fig. 28) is inversely related to the species richness and the species diversity (Shannon-Wiener index). This relationship is highly significant for the diversity ($r = 0.96$, $p<0.001$), but weak for the species richness ($r = 0.50$, $p<0.001$). These results prove that the relationship between the dominance and the concept of species diversity, which has been shown valid for many plant and animal species, also holds for rotifers.

Species composition and habitat

The following species were encountered in the plankton only: *Rhinoglena frontalis, Notholca latistyla, N. squamula, N. marina, N. acuminata* var. *extensa* and *Lophocharis oxysternon.*

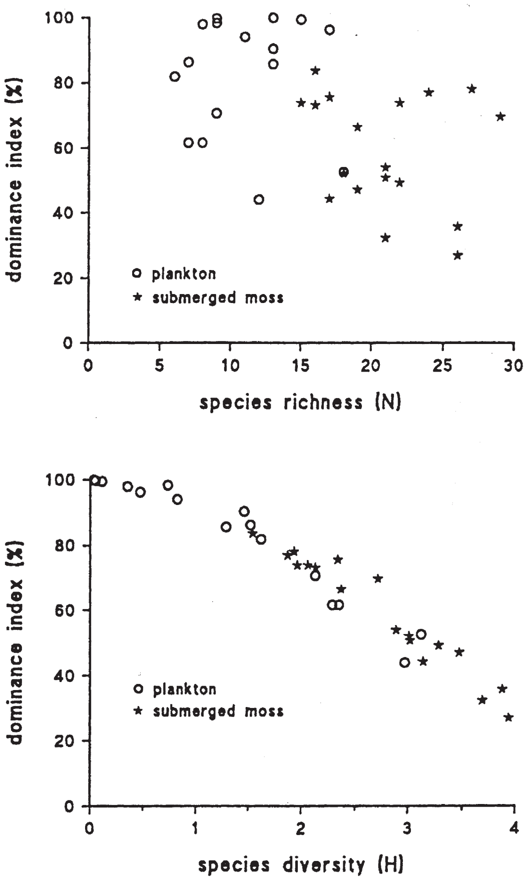

Fig. 28. Relationship between dominance and species richness, and between dominance and species diversity, in the rotifer assemblages of plankton and submerged moss.

Species mainly occurring in plankton, but also encountered in submerged moss were: *Notholca foliacea* and *Polyarthra dolichoptera.*

The following taxa were exclusively found in the submerged mosses: *Euchlanis deflexa, E. dilatata, Lepadella triba, L. piepelsi, Bryceella stylata, Wulfertia ornata, Proales fallaciosa, Monommata* sp., *Resticula nyssa, Cephalodella biungulata, C. glandulosa, C. hoodi, C. intuta, C. megalocephala, Cephalodella* sp., *Dicranophorus forcipatus, Encentrum* cf. *marinum, Collotheca* sp. 1, 2, 3.

Half of the number of taxa was especially found in submerged mosses, but likewise occurred in the plankton: Bdelloidea, *Euchlanis meneta, Mytilina mucronata, Colurella adria-*

tica, C. colurus, C. hindenburgi, C. obtusa, C. uncinata, Lepadella acuminata, L. minuta, L. ovalis, L. patella, L. quadricarinata, L. triptera, Itura aurita var. *intermedia, Eosphora najas, Notommata glyphura, Cephalodella catellina, C. evabroedi, C. gibba, C. rotunda, C. ventripes* var. *angustior, Trichocerca cavia, T. intermedia, T. longistyla, T. rattus, T. relicta, T. uncinata, T. weberi, Encentrum mustela, Ptygura* sp., *Collotheca campanulata* and *Collotheca ornata.* The frequent occurrence of these periphytic-benthic taxa in the plankton, is probably partly due to the shallow depth of the water bodies and their rapid convection and wind mixing. Likewise, and as has already been suggested by Amrén (1964c), some species may appear as a plankton form in the absence of competition by planktonic species.

Rotifer assemblages

Cluster analyses were made of Jaccard's coefficients, relating 16 plankton and 18 submerged moss assemblages of 41 and 57 rotifer taxa respectively. The dendrograms in Fig. 29 show respectively, clusters of all plankton and all submerged moss assemblages. The overall degree of similarity is rather low, which is inherent on the used coefficient that ignores negative matches.

The dendrogram for the plankton assemblages contains three groups, defined at a similarity level greater than 0.2, which is higher than the mean expected value of association (Sj = 0.1). The assemblage of loc. 51 (dominant and subdominant taxa: Bdelloidea, *Lepadella quadricarinata, Encentrum mustela, Euchlanis meneta, Mytilina mucronata)* shows the lowest similarity to the other assemblages, which cluster in two groups at a similarity level near 0.3. The latter two groups are strongly surface-dependent. The first one contains, with the exception of the assemblages of loc. 43 and 46 (surface of each of them 120 m^2), the assemblages of the seven large water bodies, the surface of which is varying from 0.1 ha (loc. 44) to 23.7 ha (loc. 57). The most important taxa with high constancy are *Polyarthra dolichoptera, Notholca foliacea,* Bdelloidea, *Lepadella acuminata* and *Notommata glyphura.* The second cluster is formed by the assemblages from the smaller water bodies with a surface varying from 10 m^2 (loc. 48) to 425 m^2 (loc. 52). Its characteristic (sub-)dominant and almost constantly

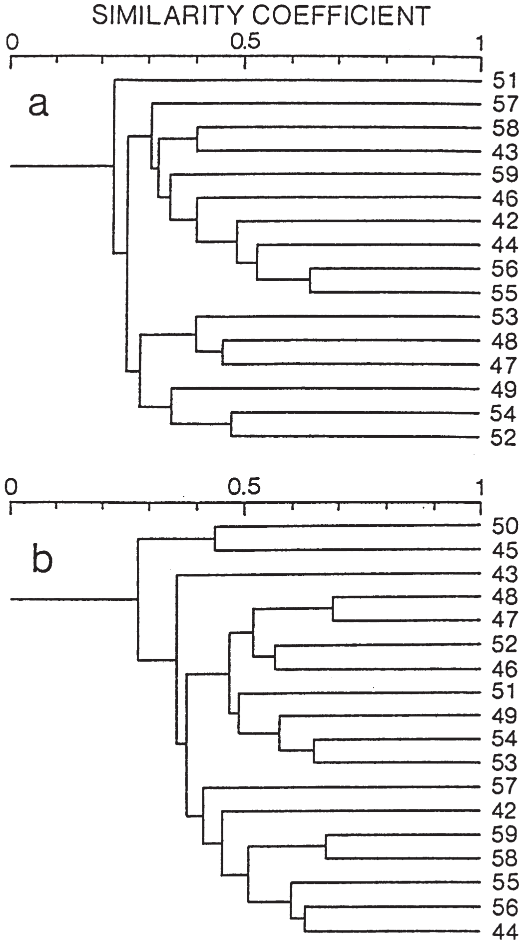

Fig. 29. Dendrograms resulting from the clustering of the rotifer assemblages of plankton (a) and submerged moss (b).

present taxa are *Polyarthra dolichoptera, Notholca foliacea,* Bdelloidea, *Mytilina mucronata* and *Cephalodella catellina.*

The dendrogram of the submerged moss assemblages shows four, fairly well-defined groups, at a similarity level greater than 0.3. The cluster level is higher than the mean expected value of association (Sj = 0.1). The first group, which shows the lowest similarity to the other three groups, is formed by the assemblages of the very shallow and small pools 45 (surface 2.4 m^2, depth 15 cm) and 50 (surface 3 m^2, depth 5 cm) The Bdelloidea, and to a lesser extent *Colurella adriatica* and *Lepadella patella,* reach important values in this grouping. A second assemblage of the

Table 7: Constancy (C) and individual dominance (D) of rotifers in plankton and submerged moss of the smaller water bodies.

PLANKTON	C = 1	C = 0.76—0.99	C = 0.51—0.75	C = 0.21—0.50	C < 0.2
D > 50%		*P. dolichoptera*			
D > 20%					
D = 5.1—20%					
D = 1.1—5.0%					
D = 0.1—1.0%	Bdelloidea *M. mucronata* *N. foliacea*	*C. catellina*	*C. gibba*	*C. ventripes* *L. quadricarinata*	*C. rotunda*
D < 0.1%			*L. patella* *T. relicta*	*C. campanulata* *C. adriatica* *C. obtusa* *C. uncinata* *E. najas* *L. acuminata* *L. ovalis*	*Collotheca* sp. *C. hindenburgi* *E. meneta* *I. aurita* *L. minuta* *L. oxysternon* *R. frontalis*

SUBMERGED MOSS	C = 1	C = 0.76—0.99	C = 0.51—0.75	C = 0.21—0.50	C < 0.2
D > 50%					
D > 20%	Bdelloidea				
D = 5.1—20%	*C. rotunda* *M. mucronata*		*T. uncinata*		
D = 1.1—5.0%	*C. catellina* *C. gibba* *C. ventripes* *L. quadricarinata* *N. foliacea*	*L. minuta* *L. patella*	*C. adriatica* *T. cavia*	*C. intuta* *C. ornata*	
D = 0.1—1.0%			*C. uncinata* *E. deflexa* *L. acuminata* *T. weberi*	*C. evabroedi* *C. megalocephala* *Collotheca* sp. 1 *Collotheca* sp. 2 *Collotheca* sp. 3 *C. hindenburgi* *C. obtusa* *L. ovalis* *R. nyssa* *T. intermedia*	*C. hoodi* *E. mustela*
D < 0.1%			*P. dolichoptera*	*E. meneta* *L. triptera*	*C. glandulosa* *C. biungulata* *C. campanulata* *E. najas* *N. glyphura* *Ptygura* sp.

shallow (15-30 cm) and small (surface area 120 m^2) pool 43 is set off at a similarity level of 0.35 Its most important taxa are Bdelloidea, *Cephalodella gibba, Lepadella patella* and *Mytilina mucronata.* The remaining two clusters, defined at 0.4 similarity, contain respectively the assemblages of water bodies with small surface area, ranging from 10 m^2 (loc. 48) to 425 m^2 (loc. 52) and those with a large surface varying from 0.1ha (loc. 44) to 23.7ha (loc. 57). The quantitatively important taxa, displaying a high constancy of occurrence, in the cluster of the assemblages originating from the smaller bodies of water are: Bdelloidea, *Cephalodella rotunda, Mytilina mucronata, Lepadella quadricarinata, Cephalodella ventripes, Notholca foliacea, Cephalodella gibba, C. catellina, Tricho-*

Table 8: Constancy (C) and individual dominance (D) of rotifers in plankton and submerged moss of the larger water bodies.

PLANKTON

	C = 1	C = 0.76—0.99	C = 0.51—0.75	C = 0.21—0.50	C < 0.2
D > 50%	*P. dolichoptera*				
D > 20%					
D = 5.1—20%					
D = 1.1—5.0%	Bdelloidea *N. foliacea*				
D = 0.1—1.0%		*N. glyphura*		*N. acuminata*	
D < 0.1%		*L. acuminata*	*C. adriatica* *T. relicta*	*L. patella* *L. quadricarinata* *L. triptera* *M. mucronata* *N. latistyla* *T. longistyla* *T. weberi*	*C. catellina* *C. evabroedi* *C. gibba* *C. ventripes* *Collotheca* sp. *C. campanulata* *C. colurus* *C. hindenburgi* *L. minuta* *L. oxysternon* *N. marina* *N. squamula* *Ptygura* sp. *T. rattus*

SUBMERGED MOSS

	C = 1	C = 0.76—0.99	C = 0.51—0.75	C = 0.21—0.50	C < 0.2
D > 50%	Bdelloidea				
D > 20%					
D = 5.1—20%	*C. hindenburgi* *L. minuta*				
D = 1.1—5.0%	*C. catellina* *L. patella* *N. foliacea*	*C. gibba* *C. rotunda* *C. ventripes* *C. adriatica* *N. glyphura*	*M. mucronata* *T. relicta* *T. uncinata*		
D = 0.1—1.0%		*C. obtusa* *Ptygura* sp.	*L. acuminata* *L. triptera* *P. dolichoptera*	*C. intuta* *C. ornata* *E. meneta* *L. ovalis* *T. intermedia*	*E. mustela* *T. rattus* *T. weberi* *W. ornata*
D < 0.1%				*D. forcipatus* *L. quadricarinata* *Monommata* sp.	*B. stylata* *C. evabroedi* *Cephalodella* sp. *C. uncinata* *E. najas* *E. deflexa* *E. dilatata* *I. aurita* *L. piepelsi* *P. fallaciosa* *R. nyssa* *T. longistyla*

cerca relicta, Lepadella patella and *L. minuta*. The cluster concerning the larger water bodies is characterized by the (sub-)dominant and highly constant Bdelloidea, *Lepadella minuta, Colurella hindenburgi, Notholca foliacea, Lepadella patella, Cephalodella catellina, C. rotunda, Colurella adriatica, Cephalodella gibba, C. ventripes, Notommata glyphura, Colurella obtusa* and *Ptygura* sp.

Comparing the dendrograms of the plankton and moss assemblages, it is clear that each of the two main groups of the respective dendrograms, is composed of assemblages originating from the same series of water bodies (the assemblage of pool 46 excepted), e.g. with small ($\leq$425 m^2) and large surface areas ($\geq$0.1ha). The differences displayed by the assemblages for surface area are significant $p<0.05$ for plankton, resp. $p<0.001$ for moss (Mann-Whitney U-test). The group of the smaller water bodies is characterized by significantly higher values for temperature ($p<0.1$ both plankton and moss), pH ($p<0.1$), nitrite ($p<0.1$) and nitrate nitrogen ($p<0.05$ for plankton; $p<0.01$ for moss). The second group, containing the larger waters, has significantly higher concentrations of chlorides ($p<0.1$), sodium ($p<0.1$) and potassium ($p<0.02$ for plankton; $p<0.001$ for moss).

A detailed species survey of the two main groupings is shown in Tables 7 and 8. The taxa are classified according to their constancy (C), i.e. the ratio of the number of samples with the investigated species , to the number of all samples collected in the respective type of water body, and their relative individual dominance (D), which is the ratio of the number of specimens of the investigated species, to all specimens collected in the given type of water body. It follows from the tables that the more constant species are usually also the more numerous ones, and most of the plankton and moss samples have the same dominant and subdominant taxa respectively. The groupings are primarily distinguished by quantitative differences of the (sub-)dominants and qualitative differences in the composition of the rare species.

Any significant difference in species richness, species diversity, number of individuals and dominance index between the two main groups of the respective cluster dendrograms, could not be demonstrated. A more detailed analysis by canonical community ordination on rotifer samples from Svalbard is in progress.

Biogeographical remarks

The present contribution adds 17 species (see Annotated list of rotifers) to the rotifer fauna of Svalbard. The occurrence of several species is an extension of their known range to the High Arctic, e.g. *Cephalodella biungulata, C. glandulosa, C. megalocephala, C. rotunda, Dicranophorus forcipatus, Encentrum mustela, Itura aurita* var. *intermedia, Lepadella triba, Notommata glyphura, Proales fallaciosa, Trichocerca intermedia, Wulfertia ornata.*

The majority of the rotifer taxa found are common and cosmopolitan or widely distributed inhabitants of ponds and the littoral region of lakes. Only *Notholca latistyla, Lecane piepelsi, Cephalodella evabroedi* and *Trichocerca longistyla* are restricted to the Arctic. This preponderance of rotifers with wide distributional area is a general phenomenon in the Arctic. Because species living at high latitudes are exposed to annual ranges of climatic conditions, exceeding that experienced by organisms at low latitudes (Stevens 1989), natural selection should have favoured species which are less restricted in their habitat use and have broad latitudinal ranges.

The reproductive strategies of rotifers are strongly oriented towards achieving maximum dispersal: they produce drought and digestion resistant stages, passively dispersed by wind and birds; being parthogenetic, a single female can give rise to progeny; a rapid maturation following hatching from the egg and a short generation time, keeps the probability of elimination of eggs and young populations through predation low. Despite these qualities, altogether only 171 monogonont rotifer taxa (113 loricate and 58 illoricate) have been reported from the High Arctic, which is c. 8% of the actually known number of species of the world. In the present study we found 62 monogononts. This low species richness is mainly determined by the severity of the physical environment (e.g. low temperature, a short ice-free period, low primary production) and fits the rule (e.g. Fisher 1960, Pianka 1966, Green 1972) that species richness is lowest in fluctuating and cold climates associated with high latitudes, and increases into climates of relatively high and constant temperatures (much of the tropics).

Regions with stable climates should allow the evolution of finer specializations and adaptations, resulting in «smaller» niches and more species occupying a unit space of habitat (Krebs 1978). Moreover species richness is thought to be dependent on the time available for speciation and dispersal. Biota developed in an uninterrupted way, and thus older, display a higher species richness than younger ones (Fisher 1960). In contrast to the broad tropical belt, which has probably been the most constant feature of the earth, extensive changes of land and sea, polar wandering, shift of land masses etc. occurred in the polar regions, resulting in the profound climatic effects in polar and temperate regions. The climatic changes were paralleled with mass extinctions and gradual re-evolution.

During the last glaciation, ice from the severely glacierised Nordaustlandet filled Storfjorden and overrode Barentsøya in its southerly passage (Charlesworth 1957). The present-day fauna must be the result of post-Pleistocene dispersal from southerly latitudes and arctic refuges. The colonization by rotifers of the newly exposed aquatic habitats following deglaciation, probably occurred along three main pathways: inoculation from cryoconite holes on glaciers, passive dispersal from nunataks and other refuges within the ice-edge, and passive introduction by wind and birds from circumpolar lands. Steinböck (1936) speculated that some organisms probably persisted during the Pleistocene in cryoconite holes. These holes are small, water-filled depressions on glaciers, inhabited by algae, ciliates, tardigrades, rotifers, etc., which often develop to considerable densities. Studying a restricted number of cryoconite holes on Spitsbergen (De Smet & Van Rompu, unpublished) we observed 2 bdelloid and 5 monogonont rotifer species, among other organisms. It is likely that, when deposited by retreating glaciers, these cryoconite-inhabiting species could have functioned as an inoculum for the newly exposed aquatic habitats. Some species probably persisted during the Pleistocene in mosses growing in the most favourable, sheltered and moist localities of nunataks (mountain tops, crests etc. within the ice-sheet, which remain snow-free through the wind action) and other refuges (e.g. warm springs) that were never completely ice-covered on the neighbouring island of Spitsbergen. Through passive dispersal of their resting eggs, they added to the colonization of Barentsøya. Resting eggs of rotifers could also be introduced from lower latitudes, through passive transport by the wind or adhered to the feet, bill and plumage (occasionally also in the gullets) of aquatic birds (e.g. Maguire 1959, 1963; Schlichting 1960; Sides 1973). Nowadays only few bird species of Barentsøya (Mehlum 1990) can be considered as potential vectors of rotifer eggs, on the basis of their migratory behaviour, biology and bond to freshwater habitats in the nesting and wintering areas. These species are the Pink-footed goose, Brent goose, Ringed plover and to a lesser extent Barnacle goose and Grey phalarope. The other species are more maritime and pelagic or winter especially in the coastal waters or tidal zone (e.g. Red-throated diver, Common eider, Arctic tern). The chance for resting eggs, transported by birds, to end up in a suitable freshwater environment on Barentsøya and in the High Arctic in general, seems rather limited. During spring arrival, some of the bird species may have to stay in the ocean for several weeks (Mehlum 1990), while waiting for the freshwater ponds on the tundra to become ice-free and the ground to become dry enough for nest building, whereas other species often arrive before the tundra is clear of snow (snow usually melts in June, though in some years it persists until early July). Most of the resting eggs deposited on the snow, will be removed by the flooding and scouring during the short spring runoff following snow melt. Findings furthermore indicate that waterfowl play a major role in the dispersal of organisms for short distances, but fewer organisms are transferred when distance between bodies of water increases (Schlichting 1960).

The preceding remarks are evidence that the rotifer community in the High Arctic has a complex history. Among the primary factors involved are: the availability of suitable niches in the physically harsh environment, the specific dispersal capabilities, the probability of successful long-distance transport, the distance to the locations in which populations survived the Pleistocene, the presence of refugia, the time for dispersal into the deglaciated area, and the time for speciation and evolutionary adaptation to the environment since the last glaciation.

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SAMMENDRAG

Hjuldyr (Rotifera) fra Barentsøya, Svalbard (78°30'N).

Totalt ble 16 plankton og 18 mose-prøver fra 18 forskjellige vann på Barentsøya analysert for innhold av hjuldyr. Prøvene ble innsamlet 29 august 1985. Hjuldyr fra 63 forskjellige taxa ble funnet, hvorav 17 representerer nye funn for Svalbard og 13 er nye funn for den høy-arktiske fauna. Taxa med stor utbredelse dominerte i prøvene. En ny art *Lecane piepelsi* n.sp. er beskrevet. Variasjoner i overflatearealet, pH og ionesammensetningen synes å være viktige faktorer som påvirker samfunnene.

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