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Intertidal zone of Svalbard

2. Meiobenthos density and occurrence

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Abstract The meiobenthos was sampled at 119 localities along 1,500 km of Svalbard shores in the summers 1988–1993. The principal taxa were determined from 5-cm-long sediment cores collected during low tide on soft sediment shores. The density ranged from 0 to $> 10{,}000$ ind/10 cm^2. Nematoda was the most common and abundant taxon. Nematoda and Turbellaria, along with Oligochaeta and Harpacticoida, were typical and the most frequent set of taxa. The occurrence of meiofaunal taxa was weakly correlated with geographical area; the local habitat characteristics were decisive. The most abundant meiobenthos, with mean abundance > 900 ind/10 cm^2 and the biomass about 0.34 g dry wt per 1 m2, was found on the western coast of South Spitsbergen.

Introduction

The coasts of Svalbard have recently been studied by a Norwegian-Polish team with the aim of producing an inventory of coastal biological resources (Węsławski et al. 1993). Little has been published so far on the Arctic coastal meiobenthos in general and the Svalbard meiofauna in particular. The first observations on Nematoda from West Spitsbergen were published by Gerlach (1965a, b), and on Harpacticoida by Mielke (1974). Single localities of meiobenthos were described by Radziejewska and Stańkowska-Radziun (1979, 1985). The present work aims to describe the general occurrence of the intertidal meiofauna, on the basis of the extensive geographical sampling of Svalbard.

The survey was sponsored by the Norsk Polarinstitutt and the Polish Academy of Sciences as part of extensive coastal management programmes.

Materials and methods

Sampling

Samples were collected from the intertidal zone of regions of Svalbard: South Spitsbergen National Park (SSPN) (1988), South East Svalbard Nature Reserve (SENR) (1989), Isfjorden (1991), and the Nordenskjold coast (1993). The coastline under investigation was divided into 136 units, each about 10 km in length. Between one and three sampling points were located in each unit. In all, 119 stations are considered in the present study (Fig. 1). When conditions permitted, a station was sampled at three places (at the high, mean and low watermark). Samples were collected using a steel tube 2.25 cm in diameter. The top 5 cm of the sediment core was preserved in 4% formaldehyde solution. After removal to the laboratory, samples were stained with Rose Bengal. A set of sieves with 1,000, 500, 200, 100 and 50 μm mesh sizes was used in accordance with the method described by Elmgren and Radziejewska (1989). The biomass of the four most common taxa was estimated using results obtained by Widbom (1984) for Nematoda, Turbellaria, and Harpacticoida, and by Faubel (1982) for Oligochaeta.

Organisms passing through the 1,000 μm sieve were considered to be meiobenthos and were analysed for the principal taxa under a low-power stereomicroscope (120 × magnification). The density was expressed as the number of individuals per 10 cm^2 and the biomass in g dry weight 1 m^2 of the bottom surface.

Study area

The physical environment of the study area was described in detail in a previous paper (Węsławski et al. 1993). In general, the western coast of Spitsbergen Island is washed by the warm West Spitsbergen Current, which carries waters of temperature 4–5 °C and oceanic salinity. The eastern coasts of the archipelago are exposed to the cold, less saline waters of the Sorkapp Current and Barents Current (Fig. 1). An ice foot covers the coasts for 3–9 months per year, depending on the exposure of a particular locality. The inner fjord

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basins and sheltered parts of the eastern coast remain frozen for the longest time. The majority of this coast consists of low, gravel beaches where the intertidal zone is 5–10 m wide. Several other types of coast are also represented in the area but together make up less than 20% of the Svalbard coastline (Węsławski et al. 1993).

Results

Fourteen principal taxa were found in the samples analysed: Ciliata, Foraminifera, Rotatoria, Turbellaria, Nematoda, Polychaeta, Oligochaeta, Gastropoda, Bivalvia, Ostracoda, Harpacticoida (all nauplii were assumed to belong to this taxon), Acarina, Tardigrada and Collembola. The most frequent were Nematoda (found at 80% of stations), Turbellaria (72%), Oligochaeta (47%) and Harpacticoida (46%). Nematoda and Turbellaria were present at each station on the Nordenskjold coast and the Van Keuleen fjord. Oligochaeta were also more frequent in these regions. The least frequent (5–7%) were the Rotatoria, Polychaeta, Gastropoda, Tardigrada and Protozoa. The others were present at 14–25% of stations. Collembola were not found in the SSNP and SENR samples. Foraminifera (17%) and Bivalvia (25%) were absent from the Nordenskjold coast. The harpacticoid nauplii (23% overall frequency) were absent from the Nordenskjold coast and the Van Keuleen – Van Mijen fjord region. Acarina (24%) and Ostracoda (24%) were found in all the areas investigated.

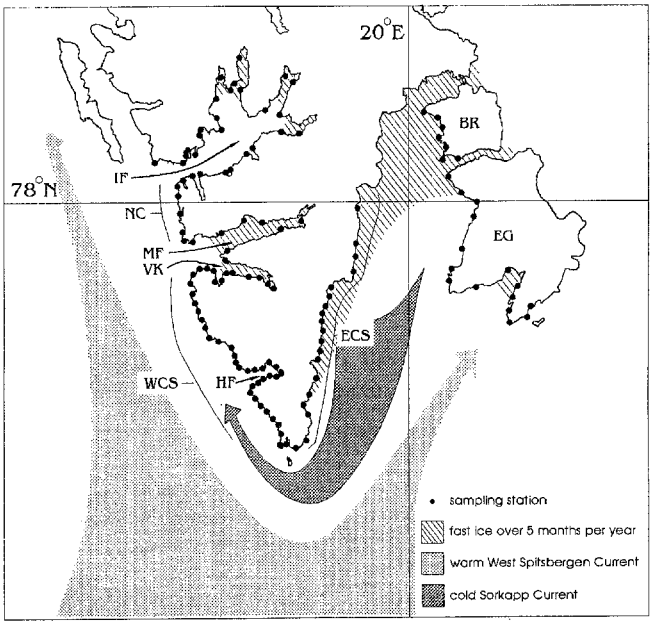

Fig. 1 Investigated area of Svalbard. South East Svalbard Nature Reserve: *BR* Barentsøya, *EG* Edgeøya, *ECS* eastern coast of South Spitsbergen; South Spitsbergen National Park: *WCS* western coast of South Spitsbergen, *HF* Hornsund, *VK* Van Keuleen, *MF* Van Mijen, *NC* Nordenskjold Coast, *IF* Isfjorden

The mean number of taxa found at one station was 3.5 for all areas (Table 1) and the mean abundance of meiobenthos in the area was 407 ind/10 cm^2 (Table 2). The density and taxonomic set were highly diversified among the stations. The maximum density was 14,800 ind/10 cm^2; by contrast, the density of meiobenthos at 77 stations was less than 100 ind/10 cm^2 (Table 3). The same holds true for Nematoda and Turbellaria. The highest abundance of Nematoda was 6,500 ind/10 cm^2 and of Turbellaria 500 ind/10 cm^2. Oligochaeta and Harpacticoida were characteristic of stations of low density, i.e. below 50 ind/10 cm^2.

The mean biomass of the four most common meiofaunal taxa (Nematoda, Turbellaria, Oligochaeta, Harpacticoida) was about 0.34 g/m^2 (Table 4, Fig. 2). Turbellaria had the highest mean biomass in all areas (0.14 g/m^2). The biomass of Nematoda changed in the widest range from 0 to 3.7 g/m^2 per station.

The low muddy-sandy beach and watt (intertidal flat) supported the highest meiobenthos density (over 500 ind/10 cm^2). Nematoda and Harpacticoida were the most abundant in those localities. The oligochaets were equally numerous in the watt and sandy-gravel beaches. The turbellarians were most numerous on low gravel beaches. The watt coasts were the most diversified, with the maximum number of taxa and the highest densities (10 taxa, 2,200 ind/10 cm^2). Neither

Table 1 Number of stations represented with given number of melobenthos taxa

Site	Number of taxa											Mean number of taxa
	0	1	2	3	4	5	6	7	8	9	10	
	1	13	25	25	21	13	9	8	3		1	3.52
Isfjorden		3	5	6	6	5	7	2	2		1	4.38
Nordenskjold coast				1	2		1					4.25
Van Mijen				1	1	3						4.40
South Spitsbergen		8	13	15	7	4		3	1			3.06
Western coast		7	11	10	4	3		3	1			3.05
Van Keuleen			2	2		1						3.00
Hornsund		2	1	2		1						2.50
Eastern coast		1	2	5	3	1						3.08
Barentsøya			3		3			1				3.57
Edgeøya	1	2	4	2	2	1	1	2				3.27

Table 2 Mean abundance of melobenthos taxa (ind/10 cm^2) with number of stations of occurrence (*A* mean abundance taxa, *N* number of stations with given taxon presence)

	Total	Protozoa	Foraminifera	Rotatoria	Turbellaria	Nematoda	Polychaeta	Oligochaeta	Gastropoda	Bivalvia	Ostracoda	Harpacticoida (naupli)	Harpacticoida	Acarina	Tardigrada	Collembola
Site																
A	407	< 1	7	< 1	39	162	41	18	< 1	14	4	69	52	1	< 1	< 1
N	119	8	20	2	86	95	5	56	5	30	28	27	55	28	6	20
Isfjorden	247	< 1	6	< 1	23	113	< 1	30		< 2	1	22	43	2	< 1	< 2
	37	2	15	2	29	29	1	24		8	11	13	23	13	2	13
Nordenskjold coast	74				35	22		13					<1	< 1		< 1
	4				4	4		4					1	2		2
Van Mijen	112				21	59		22			< 2		5	3		3
	5				5	5		4			2		3	1		2
South Spitsbergen	718	< 1	12		65	263	97	9	< 2	30	8	145	87	< 1	< 1	
	51	3	2		32	43	3	16	5	18	12	14	18	6	1	
Western coast	905	< 1	16		43	453	125	11	< 1	30	10	189	110	< 1		
	39	2	2		25	33	3	14	4	11	10	12	13	4		
Von Keuleen	190				116	11		9			< 3		<1			
	5				5	5		3			1		1			
Hornsund	124				87	16	< 1		1	4	< 1	<2	13	< 1		
	6				5	2	1		2	2	1	2	1	2		
Eastern coast	112	< 1			51	7		< 1	6	32	1	<1	13	< 1	< 1	
	12	1			7	10		2	1	7	2	2	5	7	1	
Barentsøya	25		< 1		11	4		6		< 1	< 1		2	< 1	< 1	< 1
	7		3		6	3		2		3	1		2	2	2	3
Edgeøya	113	1		12	73	< 1	20		< 1	< 1		6	1	< 1		
	15	3		10	11	1	6		1	2		8	4	7		

Table 3 Number of stations related to meiobenthos densities in main taxa

Number of ind/10 cm^2	Total meiobenthos	Nematoda	Turbellaria	Oligochaeta	Harpacticoida
0	1	22	34	63	54
1–10	17	43	27	33	30
11–50	38	24	35	15	21
51–100	18	10	12	2	2
101–500	31	13	9	5	10
501–1000	7	3	2	1	
1001–10000	5	4			2
> 1000	2				

low meiobenthos diversity, abundance nor biomass was related to any particular coast type.

Discussion

The number, diversity and biomass of interstitial meiobenthos of the Svalbard littoral zone show considerable variability. The density range (0–14,800 ind/10 cm^2), number of taxa (0–10), and biomass (0–7.5 g/m^2) were surprisingly high. This is linked more to specific microhabitat conditions than to the geographical sub-region in question. The fine sediment biota of the watt coasts had the highest density and the largest number of common taxa (Fricke and Flemming 1983; Hennig et al. 1983; Kholodov and Kisseleva 1985).

South Spitsbergen beaches generally displayed a low meiobenthos density (below 500 ind/10 cm^2) and diversity (3–8 taxa per sample). The highest mean meiobenthos abundance (905 ind/10 cm^2) and biomass (0.57 g/m^2) were observed along the West Spitsbergen coast, and are probably associated with the more favourable climatic conditions of that region (Węsławski et al. 1993). The Hornsund and Van Keuleen fjords were poor in meiobenthos, which may reflect the abrupt changes in environmental conditions typical of the fjord littoral. The long-lasting fast and pack ice in summer may scour the intertidal fauna there. The same ice conditions are observed along East Svalbard coasts, which are accordingly very poor in meiofauna. In general, the Svalbard intertidal meiofauna was as abundant as in other comparable localities in the North Pole region (Galtsova 1971; Galtsova and Platonova 1980; Feder and Paul 1980).

Table 4 Mean biomass of the most common melofaunal taxa (dry weight, g/m^2)

Site	Nematoda	Turbellaria	Oligochaeta	Harpacticoida	Total
	0.076	0.137	0.930	0.038	0.344
Isfjorden	0.036	0.066	0.164	0.44	0.311
Nordenskjold coast	0.007	0.096	0.070	0.001	0.174
Van Mijen	0.024	0.063	0.077	0.016	0.178
South Spitsbergen	0.142	0.241	0.048	0.053	0.484
Western coast	0.185	0.258	0.061	0.070	0.576
Van Keuleen	0.006	0.521	0.009	0.019	0.555
Hornsund	0.014	0.230		0.016	0.259
Eastern coast	0.003	0.183	0.006		0.188
Barentsøya	0.002	0.027	0.035	0.003	0.067
Edgeøya	0.024	0.044	0.110	0.005	0.183

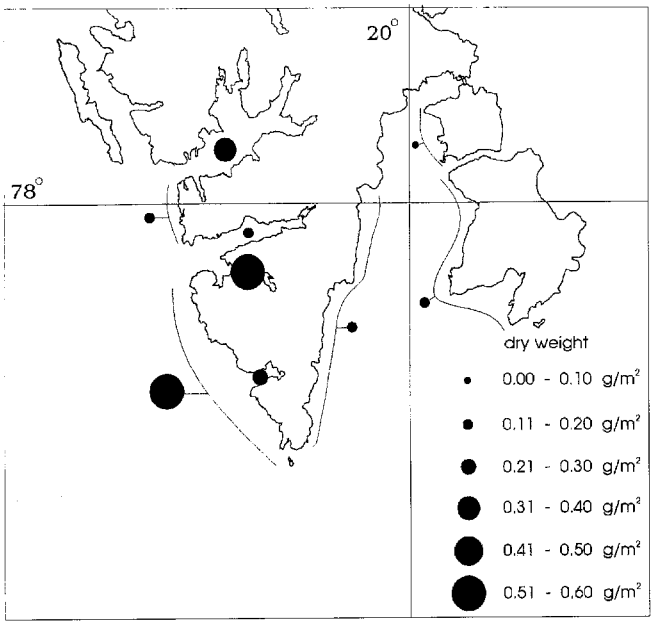

Fig. 2 Mean total biomass of the most common meiofaunal taxa

The high abundance was not accompanied by a high biomass and a high number of taxa per sample. The Isfjorden samples were the lowest in density but the richest in taxa. The Nematoda predominated in the abundant samples from the SSNP area, which were poor in taxa but had the highest biomass of the four main taxa. Nematodes were predominant in the whole area, with the exception of areas of lower salinity (Hornsund, Van Keuleen, the eastern coast of South Spitsbergen), where the turbellarians were dominant, and where the biomass of turbellarians was extremely high. Among the nematodes one can expect species with short life-cycles (Juario 1975; Nicholas 1984), so high densities are possible under favourable conditions. Gerlach (1965a) found 50 species of Nematoda in the NW Spitsbergen intertidal area, distributed unevenly through a number of microhabitats.

Similar numbers of meiobenthic taxa occur in other localities in Northern Europe (Artl 1977; Munro et al. 1978; Jończyk and Radziejewska 1984; Witte and Zijlstra 1984). Comparison with literature data is difficult, since very little is known about the Svalbard meiobenthos. Data from single localities studied in Van Keuleen and Hornsund fjords (Radziejewska and Stańkowska-Radziun 1979; Radziejewska and Stańkowska-Radziun 1985) confirm the great variability of the meiobenthos in the microbiota. The densities reported in those studies (0–4,100 ind/10 cm^2) are similar to those found in our survey, as is the rank of taxa frequency from Nematoda to Turbellaria, Oligochaeta and Harpacticoida.

Summing up the results, one can state that the summer meiobenthos from the Arctic intertidal zone was as abundant numerically as in the temperate zone. The occurrence of taxa was similar to that found in other areas. The biomass of meiobenthos obtained for Svalbard beaches (average 0.34 g/m^2) is greater than that in the tropical sandy beach (0.024–0.06 g/m^2, Munro et al. 1978). In the temperate zone the meiofauna biomass ranges from 0.27 to 0.52 g/m^2 (in the Scottish beach, Munro et al. 1978). The highest values, 1.13 g/m^2, are given for the tidal flat in the Netherlands (Witte and Zijlstra 1984). Considering the relatively low biomass and density of the macrobenthos of the Svalbard intertidal zone (Węsławski et al. 1993), the meiobenthos can play an elevated ecological role, as has been observed in other intertidal beaches (McLachlan 1977; Koop and Griffiths 1982).

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