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Composition and distribution of intertidal meiofauna of Isfjorden, West Spitsbergen

ABSTRACT: Quantitative data on meiobenthos distribution in four biotopes of the intertidal zone are presented. Differences in taxonomic composition and meiofauna abundance are influenced by the morphology of beaches and their sediment structure.

K e y w o r d s: Arctic, Spitsbergen, tidal zone, meiofauna.

Introduction

Meiofauna of Spitsbergen shores was hitherto poorly investigated, though in Arctic and Subarctic regions the abundance and diversity of meiobenthos are extremely high and the values of biomass are approximately comparable with those of macrofauna. The first information about the nematode assemblages inhabiting tidal flats of West Spitsbergen was published by Gerlach (1965a,b) with some notes on other meiofaunal taxa. Mielke (1974) described 26 species of intertidal harpacticoid copepods from Ny Alesund and Longyearbyen. Then Radziejewska and Stankowska-Radziun (1979) described the distribution of meiofauna in five localities in the intertidal zone of two bays in Bellsund (SW Spitsbergen), where they have found nematodes, turbellarians, oligochaetes and some other groups. Some information on meiobenthic organisms of Spitsbergen is available in the paper by Węsławski *et al.* (1990) where notes on meiofauna of Gipsvika are presented.

This paper presents the results of meiobenthic studies carried out in Isfjorden in June 1991. The description of the abundance and spatial distribution of several taxa is given.

Material and methods

Material was collected in June 1991 in two localities. The first one was situated in the estuary of the river Mimer in the eastern part of Isfjorden, the second – in the Groenfjord near the mouth of the Isfjorden (Fig. 1). Typical morphological forms of the coast in each locality were watt coasts near the river mouth where the fine sand and silt have accumulated (stations B1 – B5 and D1 – D5), and abrasive shelf formed by relatively coarse material at rocky cliffs (stations A1 – A5 and C1 – C5).

Meiobenthic samples were collected with the tube corer of 3.57 cm inner diameter (10 cm^2). Three samples of 10 cm^2 were taken from each station along the transect perpendicular to the shore line. Average number was calculated for 10 cm^2. The number of stations varied in different profiles. In stations B2 and B4 (Mimer river estuary) special samples allowed to study the vertical distribution of organisms in upper 5 cm of the sediment. Data without special reference concerned the first centimeter of sediment which comprised about 70–90% of organisms.

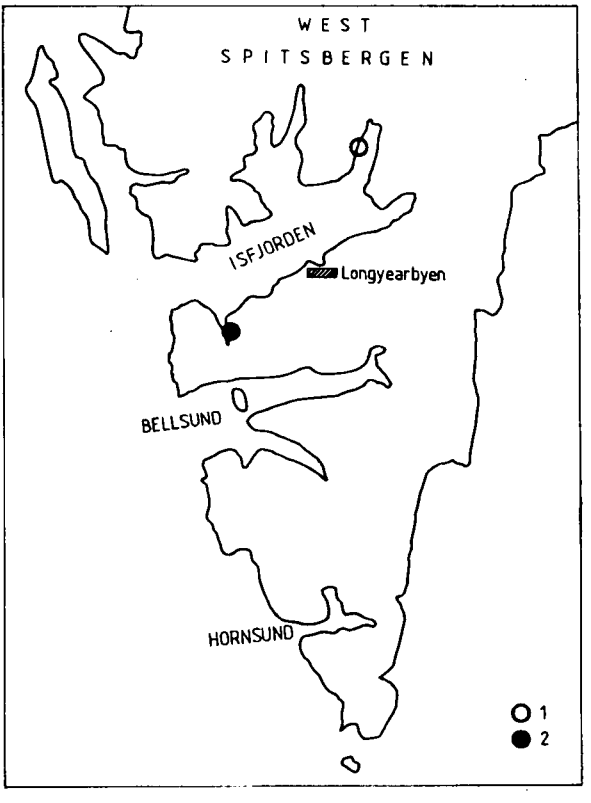

Fig. 1. Situation of studied areas in Isfjorden; 1 – Mimerbukta, 2 – Groenfjord

For the extraction of organisms standard methods of elution after the freshwater shocking were used. After counting in Bogorov's chamber under the stereoscopic microscope (100x) nematodes and tardigrades were separated for further identification. The rest was fixed in 4% formaldehyde.

Dry samples of sediment were analyzed by Osborn granulometric method. Cumulative curves of the sediment composition are presented in Fig. 2.

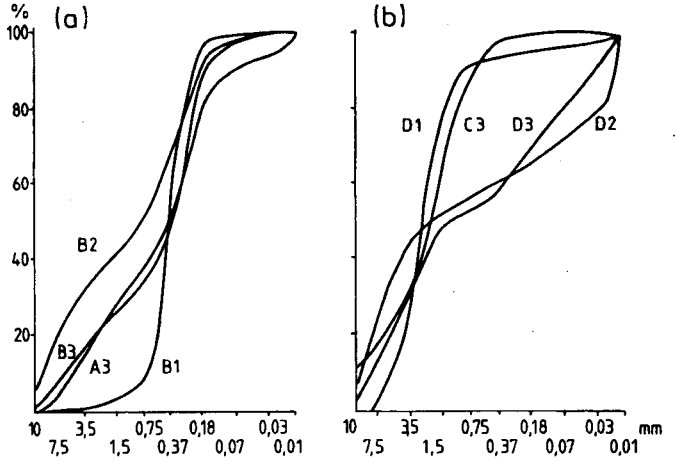

Fig. 2. Sediment composition of abrasion and estuarine coasts in Mimerbukta (a) and Groenfjord (b); vertical axis – share of fractions (%), horizontal axis – diameter of particles (mm)

Results

Meiobenthic populations of the study area were very different. The abundance of organisms varied from 0 up to over 600 individuals per 10 cm^2 (Tab. 1).

At the abrasion shelf in Mimerbukta formed by fine sand small number of nematodes and harpacticoids were present and only in lower horizons. Macrobenthos was almost absent here. Till the end of June the upper tidal zone was covered by ice therefore the distribution of organisms shown in Fig. 3a presents the first stage of seasonal succession in this biotope. In other places the ice was broken earlier and the meiobenthos was already better developed.

The abrasion shelf of Groenfjord (Fig. 3b) is formed by the coarse sand and on 25.06 it was already populated by different meiofaunal taxa. Both complexes, geolittoral and hydrolittoral (Mokijevskij 1969) were present. The first one consisted of the forms of terrestrial origin coming to the tidal zone from the supratidal one and included Collembola and Oligochaeta. The second included all marine interstitial organisms: Turbellaria, Harpacticoida, Ostracoda, Halacaridae and Nematoda (Tab. 1). Collembola and Turbellaria were

Table 1

Abundance of meiofauna in the Isfjorden intertidal zone (ind. per 10 cm²)

Mimerbukta, abrasion shelf

Taxa/Station	A1	A2	A3	A4	A5
Nematoda	0	0.3	2	2	7
Harpacticoida	0	0	0.7	0.7	0.7
Oligochaeta	0	0	0	0	0.3
Turbellaria	0	0.3	0	0	0.3
Ostracoda	0	0	0.3	0	0

Estuary of Mimer river

Taxa/Station	B1	B2	B3	B4	B5
Nematoda	127	167	600	21	367
Harpacticoida	13	33	21	1.3	4
Oligochaeta	21	0.7	0	0	0
Turbellaria	5	0.3	0	0.3	0.3
Collembola	1	1	0	0	0

Groanfjord, abrasion shelf

Taxa/Station	C1	C2	C3	C4	C5
Nematoda	0	0.3	0.7	0.7	2
Harpacticoida	16	2.3	2.7	0	0.7
Oligochaeta	5	0.3	0	0.3	0
Turbellaria	0.7	3.3	15	9	14
Ostracoda	0	0	0	0.7	0
Collembola	40	8	2.7	0.3	3.7
Halacarida	0.3	0	0	0	0

Estuary of Groen river

Taxa/Station	D1	D2	D3	D4	D5
Nematoda	2.7	40	300	250	400
Harpacticoida	0.7	32	23	110	30
Oligochaeta	1	3	0.7	7	0
Turbellaria	0	0.7	7.7	11	3.3
Collembola	0.7	0	0	0	0
Tardigrada	2	40	3	0.7	0

here the dominant taxa. Macrobenthos was presented by few individuals of *Gammarus setosus* Dementieva and *G. oceanicus* Segerstrale. The vertical zonation along the transect was relatively indistinct.

Two other biotopes were rather complicated, heterogenous both in physical conditions and population distribution (Fig. 4 a,b). The coasts of Mimer and Groen rivers mouthes both have two different parts: the beach consisting of

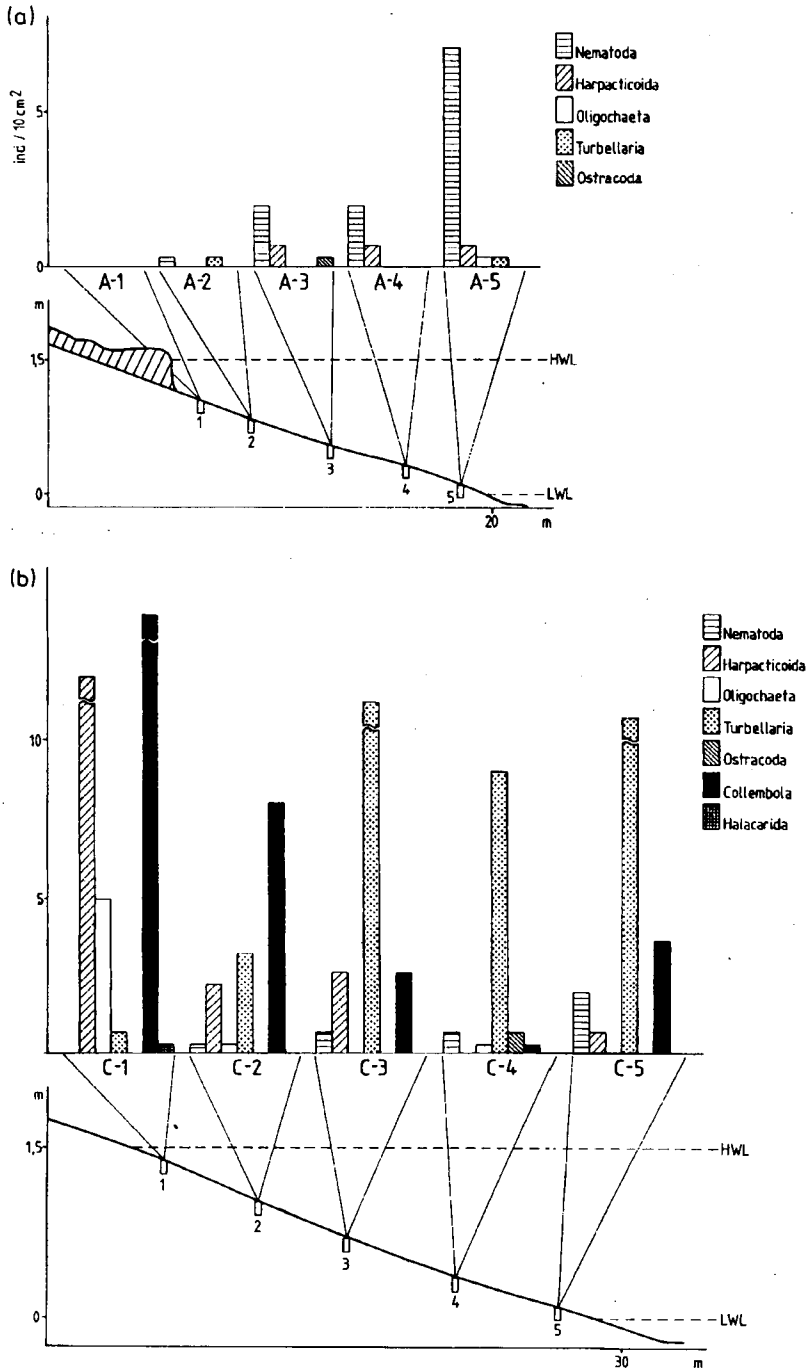

Fig. 3. Meiobenthos composition in the investigated profiles; a) Mimerbukta, abrasion shelf (hatching shows the ice position), b) Groenfjord, abrasion shelf; LWL – low water level, HWL – high water level

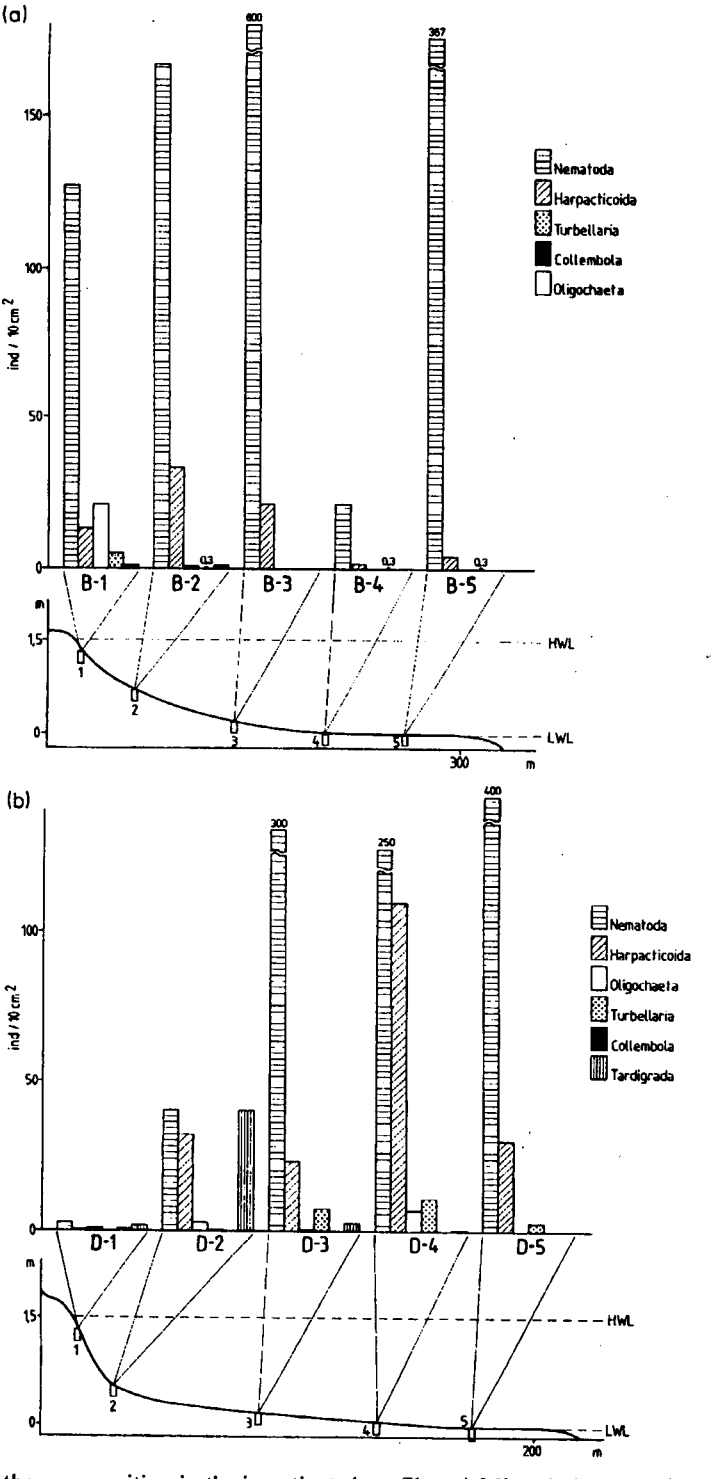

Fig. 4. Meiobenthos composition in the investigated profiles: a) Mimerbukta, estuary, b) Groenfjord, estuary. Other designations — as in Fig. 3

Table 2

Share of fine sediment fraction (<0.1 mm) in estuarine coasts

	Mimer estuary (transect B) %	Groen estuary (transect D) %
beach	2.15	4.67
bend	5.9	33.71
watt	18.02	32.93
	22.72	64.96
	14.25	58.47

relatively coarse sediments and the watt, where fine sand and silt had accumulated. The share of fine fractions (<0.1 mm) seems to be a good marker to recognize these parts (Tab. 2).

The dominant group in both localities were Nematoda, while Harpacticoida occupied the second place. In Mimerbukta watt the highest density of nematode population was noted (600 ind/10 cm²). In the beach the nematode population was relatively less abundant, harpacticoids, on the contrary, were more numerous, especially in the lower part of the beach near the beach/watt boundary („bend" in Blome (1983) model of zonation). Oligochaeta and Collembola inhabited only the beach and avoided the watt. Turbellaria in small numbers were distributed uniformly over the whole intertidal zone with some preference to the upper beach. Macrobenthos was represented by small number of *Pseudalibrotus littoralis* (Krøyer), infauna was not found here.

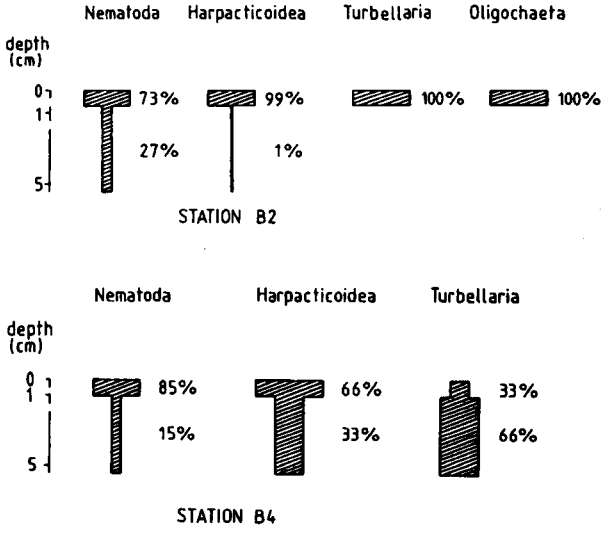

Fig. 5. Vertical distribution of main taxa in the sediment of two stations in Mimerbukta; B2 – relatively well sorted coarse sand of beach, B4 – poorly sorted fine sand of watt

Vertical distribution of organisms in the sediment is shown in Fig. 5. Oligochaeta inhabited only the upper sediment layer, nematodes and harpacticoids penetrated deeper. The share of nematodes below the uppermost 1 cm layer in relatively well sorted coarse sand (st. B2) approached to 30% of total population abundance. Turbellarians were found in both layers in st. B4 and only in uppermost one in st. B2.

The largest number of harpacticoids was found in the watt of Groen river estuary (over 100 ind. per 10 cm^2). The nematode abundance was here also significant. The third group with large number of individuals were Tardigrada, represented by *Halobiotus arcturulius* Crisp et Kristensen, 1983, which prefered the lower part of the beach but in small number were distributed in the whole intertidal. Collembola were clearly connected with the upper beach whereas Oligochaeta inhabited also the watt of the Groen river estuary. Macrobenthos was also absent here.

Discussion

Radziejewska and Stankowska-Radziun (1979) emphasized the difference between boreal (Norwegian coasts) and Spitsbergen areas in the distribution of meiobenthos and its taxonomic composition. This would consist in the dominance of Turbellaria instead of Nematoda in most Spitsbergen biotopes. Perhaps it is true in the case of abrasion beach which is formed by poorly sorted sand. In fine and muddy flats the numbers of nematodes and harpacticoids were completely comparable with their abundance in tidal zone of Barents and White Sea shores (*see, i.a.* Galcova 1976). So we cannot call the Spitsbergen intertidal meiofauna as an undeveloped or a reduced one. All common taxa are present here and even such rare group in other areas as Tardigrada appears in larger numbers. The relatively small number of meiobenthic organisms can be due to the high heterogeneity of sediments. Many investigators when studying the relation between meiobenthic abundance and granulometric characters of the sediment (*i.a.* Wieser 1959) have noted that in poorly sorted sand the abundance of interstitial forms depends on the amount of fine fractions which fill up the interstices. These differences do not prevent to include the West Spitsbergen coasts into the Subarctic province as it was stated by Gurjanova, Zacks and Ušakov (1925) and Gerlach (1965b).

The existing data of macro- and meiobenthos abundance in coastal zone of Spitsbergen indicate the importance of meiofauna in polar seashore ecosystems. In boreal zone the share of meiobenthos can reach up to 3% of macrofauna biomass and about 1–2% of energy flow passes through tidal communities (Gerlach 1971, Galcova 1984). At Spitsbergen shores where macrofauna is absent or reduced, the role of meiobenthic organisms in transformation and recycling of the organic matter in the storm toss of sea weeds is exceptionally high.

The character of distribution of higher taxa over the intertidal zone is influenced by the morphological type of the coast. Thus two models of vertical distribution of Spitsbergen tidal meiofauna can be presented. The clinal substitution of dominant forms one by another is characteristic for the abrasion shelf with the continuous slope and fluent gradient of sediment properties. The boundaries between tidal horizons are indistinct. Such kind of zonation was described by Gerlach (1965a).

Rather distinct boundaries are present in estuarine shores separating two zones. After Schmidt (1972) and Strel'cov and Agarova (1976), we call them beach and watt. Significant differences in sediment composition and humidity predict the distinctions in taxonomic composition. More accurate definition and establishing of subunits in the watt itself can be found only after determination of the material to the species level.

Węsławski *et al.* (1990) have studied meiofauna in six stations in Gipsvika, a part of Isfjorden situated in-between our study areas. These authors have also found that the nematodes were the organisms dominating the meiobenthos especially in stations situated at the river mouth. Turbellarians were usually less numerous but equally frequent being more abundant in abrasive shelf. Locally in sheltered places, high share or even dominance of Oligochaeta was noted. It is interesting that in the materials of Węsławski *et al.* (1990) Collembola were absent and Harpacticoida played insignificant role. On the other hand in their samples Foraminifera and Rotatoria were found and these groups were lacking in our materials. These differences obtained in the studies of neighbouring areas of Isfjorden show that further thorough investigations are needed.

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Streszczenie

W pracy przedstawiono skład i pionowe rozmieszczenia meiobentosu arktycznego litoralu w zatokach Mimerbukta i Gronfjord (Isfjorden, Spitsbergen: Rys. 1).

Badania wykonano w czerwcu 1991 r. na czterech przekrojach. Dwa przekroje były położone na brzegach abrazyjnych (Rys. 3a i b), zaś dwa następne – na brzegach akumulacyjnych w estuariach rzek (Rys. 4a i b). Skład granulometryczny osadów badanych stanowisk przedstawia Rys. 2.

W meiobentosie odnotowano przedstawicieli takich taksonów wyższego rzędu, jak: Turbellaria, Nematoda, Oligochaeta, Harpacticoida, Ostracoda i Halacarida, a także rzadko spotykanych w borealnym litoralu – Tardigrada (tab. 1).

W litoralu abrazyjnym stwierdzono również znaczny udział Collembola, które przechodzą z supralitoralu do niższych horyzontów. W litoralu abrazyjnym z osadami o grubym ziarnie przeważały Turbellaria lub Collembola (Rys. 3a i b). Nematoda i Harpacticoida były szczególnie liczne w dolnej części litoralu akumulacyjnego (Rys. 4a i b).

Stwierdzono brak ostrych granic w rozmieszczeniu meiobentosu w litoralu abrazyjnym, natomiast w litoralu akumulacyjnym zaobserwowano wyraźną różnicę pomiędzy fauną plaży i mulistych mielizn („watt"), co tłumaczyć należy wyraźnie odmiennym składem osadów w tym drugim przypadku (Tab. 2).

Pionowe rozmieszczenie meiobentosu w dwu stanowiskach drugiego przekroju przedstawia Rys. 5.