Meiobenthic communities of the Pomeranian Bay (southern Baltic): effects of proximity to river discharge

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Abstract

The Pomeranian Bay (southern Baltic Sea) is a component of the river Oder (Odra) estuarine system. It receives the Oder's discharge once it has passed through the Szczecin Lagoon, a eutrophic and polluted water body. The discharge has been documented as affecting the hydrography of the pelagic domain as well as the sedimentary environments and the macrozoobenthos of the Bay. This study focused on the distribution of meiobenthic communities in the Bay as investigated with the use of a suite of uni- and multivariate analyses applied to data collected at 14 stations in September 1993. Meiobenthic community characteristics (composition and abundance) are presented in relation to sediment properties (grain size, silt/clay and organic matter content), changing with distance from the major riverine discharge site. The communities studied showed a clear distinction between those associated with organic matter-enriched sediments close to the discharge site and the assemblages living in clean sands, away from the discharge. We conclude that the meiobenthos can be regarded as another compartment of the Pomeranian Bay system responding to the River Oder discharge.

1. Introduction

The effects of riverine discharge on the near- and offshore parts of marine ecosystems are attracting more and more attention worldwide as the importance of exchange processes between land and sea is being realised (*e.g.*, Buscail *et al.*, 1995; Redalje *et al.*, 1994; Santos *et al.*, 1996) and the causes of the degradation of marine environments are being sought. The effects of riverine discharge are manifested in the pelagic and benthic parts of these ecosystems and are detectable in, for instance, the distributions of water temperature, nutrients, and phytal pigments (Radziejewska *et al.*, 1996; Siegel *et al.*, 1996), the enhancement of primary production due to increased nutrient input (Redalje *et al.*, 1994), the organic enrichment of bottom sediments (Buscail *et al.*, 1995), and the characteristic patterns of the composition, abundance and biomass distributions of benthic biota (Powilleit *et al.*, 1995).

In this study, based on a one-time survey, we have focused on the distribution of meiobenthic assemblages in the Pomeranian Bay (southern Baltic) in an attempt to assess the degree to which proximity to riverine discharge affects the abundance and composition of these predominantly sediment-bound organisms. Such studies are aimed at providing a baseline against which one can view subsequent changes resulting from both seasonal phenomena and from long-term natural and anthropogenic processes.

2. Area of study

The Pomeranian Bay (Fig. 1) is a part of the southern Baltic formed by a broad indentation in the coastline and bordering two of the major Baltic basins: the Arkona Basin to the north and the Bornholm Basin

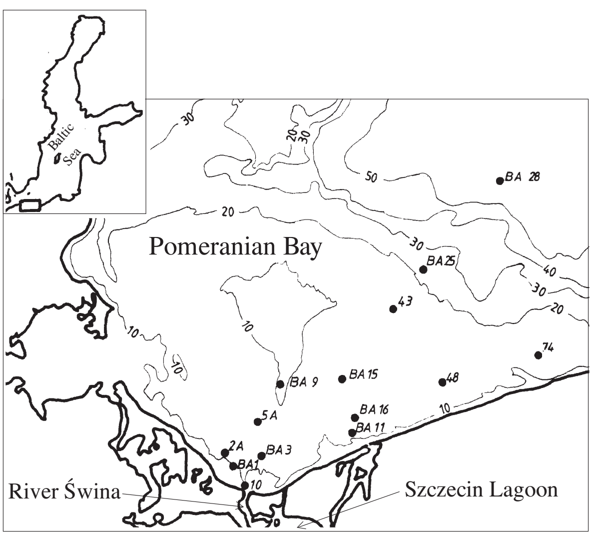

Fig. 1. Location of sampling sites in the Pomeranian Bay

to the east. It is a shallow area (maximum depth *ca* 20 m) of salinity ranging from 7 to 10 PSU (Majewski, 1974). The Bay forms the final link in the River Oder (Odra) estuarine system and receives the Oder discharge via the eutrophic and polluted Szczecin Lagoon and its three outlets. One of the outlets, the River Świna, is responsible for about 70% of the Oder discharge, which totals about 20 km^3 per year (Majewski, 1974). Thus the outlet and its discharge is important in affecting the hydrography and chemistry of the Bay and is to a high degree responsible for the changes in environmental variables in the Bay throughout the year.

The distribution pattern of the river plume is governed by the prevailing wind system (Siegel *et al.*, 1996). Dominant westerly winds in summer, autumn and winter produce an eastward transport along the Polish coast, while the easterly winds prevailing in spring during the period of main freshwater inflow result in the plume being directed westwards and north-westwards in the direction of the Arkona Basin. Consequently, the highest accumulation rates, detectable in the form of increased organic enrichment of the sediment, are typical of the areas in the immediate vicinity and west of the Świna mouth, including the Oder Rinne towards the Arkona Basin (Siegel *et al.*, 1996). Elsewhere, the bottom of the Bay is predominantly sandy, although coarse sands and gravel can be found locally in the southern parts of the Bay.

During a cruise of r/v 'Baltica' in September 1993, samples of bottom sediment were collected at 14 stations in the Polish part of the Bay (Fig. 1). The characteristics of the stations' environment are summarised in Tab. 1, on the basis of data collected concurrently with biological samples by the Sea Fisheries Institute in Gdynia, Poland. The stations were mostly shallow (10–22 m depth) except for the deepest site BA28 (61 m depth), which was located in an area bordering the Bornholm Deep.

The near-bottom water temperature hovered around 13°C, except at BA28, where the thermocline had produced stratification resulting in a lower temperature (9.4°C). The near-bottom salinity varied from about 7.4 to about 8.9 PSU, while the dissolved oxygen content varied from about 5 (at B28) to about 7.5 ml dm^{-3}. No hypoxia was recorded at the deepest station during the sampling period.

The bottom sediment of the stations consisted basically of sand enriched to a varying degree with a silt/clay fraction and organic matter. The highest silt/clay and organic matter contents were recorded at station 10, closest to the Świna mouth. Although neither the organic matter content nor the grain size of the BA28 sediment were analysed, it was – following visual examination (mud) – also regarded as rich in silt/clay and organic matter.

The stations' environmental data were subjected to the principal component analysis (PCA routine) of the PRIMER package (see below) in order to identify those environmental factors or their combinations that were responsible for most of the variance in the data.

Table 1a. Summary of sampling site characteristics – location and near-bottom water

Station	Geographic position	Depth [m]	Near-bottom water temperature [°C]	Near-bottom water salinity [PSU]	Near-bottom dissolved oxygen content [ml dm^{-3}]
2A	14°12.2′E 54°00.7′N	10	13.80	7.35	7.06
BA1	14°41.1′E 53°59′N	10	13.66	7.39	6.68
10	14°15.8′E 53°56.9′N	10	13.71	7.40	6.44
BA3	14°20.5′E 54°00′N	10.5	13.78	7.36	6.88
5A	14°20′E 54°05′N	13	13.49	7.47	6.55
BA9	14°27.5′E 54°09.8′N	11	13.64	7.57	7.39
BA15	14°40.5′E 54°11′N	13	13.70	7.62	7.06
BA16	14°42.3′E 54°06.2′N	11	13.75	7.55	6.96
BA11	14°43′E 54°02.5′N	10	13.85	7.52	6.48
43	14°52.3′E 54°20.3′N	12	12.78	7.68	7.54
BA25	14°59.5′E 54°25.8′N	22	13.33	7.68	7.04
48	15°04′E 54°10.2′N	15	13.04	7.53	7.46
74	15°27.2′E 54°14.1′N	16	13.34	7.66	6.94
BA28	15°18′E 54°38.5′N	61	9.36	8.94	5.06

Table 1b. Summary of sampling site characteristics – sediment properties

Station	Mean grain size [ϕ units]	Sediment type	Sorting coefficient [ϕ units]	Silt/clay fraction content [%]	Organic matter content [%]
2A	2.10	fine sand	0.5954	0.20	0.52
BA1	2.55	fine sand	0.6133	1.06	0.74
10	3.51	very fine sand	0.5500	12.40	4.30
BA3	2.66	fine sand	0.5932	0.33	0.74
5A	2.52	fine sand	0.5106	0.33	0.46
BA9	2.60	fine sand	0.3637	0.37	0.41
BA15	2.38	fine sand	0.3824	0.07	0.27
BA16	2.45	fine sand	0.3546	0.05	0.22
BA11	2.32	fine sand	0.4650	0.08	0.25
43	2.45	fine sand	0.5530	0.10	0.50
BA25	2.90	fine sand	0.7190	0.07	0.24
48	1.73	medium sand	0.8356	0.10	0.46
74	2.55	fine sand	0.4826	0.10	0.39
BA28	no data	mud	no data	no data	no data

3. Materials and methods

Sediment samples for the study of meiofauna were collected during the above-mentioned September 1993 cruise of r/v 'Baltica' with a 22.4 mm inner diameter corer (Płocki and Radziejewska, 1980), 3 corer samples being taken at each station. The samples were fixed on board with buffered 10% formalin and Rose-Bengal stained (Elmgren and Radziejewska, 1989).

The meiofauna (here taken to be benthic organisms passing through a 1.0 mm mesh sieve and retained on a 0.063 mm one) were separated from the sediment by the shake-and-decant technique (Elmgren and Radziejewska, 1989), which was applied 7–10 times to each sample. The decantation supernatant was passed through a set of sieves (1.0 mm to remove the macrofauna; 0.500; 0.180; 0.090; and 0.063 mm mesh size). The sieving residue was transferred to Petri dishes and examined under a stereomicroscope. Meiobenthic organisms were identified to the lowest taxon possible and counted. The data thus obtained served to determine the abundance of each taxon, the number of taxa, the percentage of each taxon and the total density of the assemblage at each station.

Significance of the differences between the mean densities was tested with the 1-way analysis of variance (ANOVA) supplemented with the *a posteriori* Duncan's multiple range test (Sokal and Rohlf, 1981) to identify those stations responsible for the significant differences. The ANOVA was preceded by testing for homogeneity of variance; the $\log(x+1)$ transformation proved necessary to attain homoscedascity of the data.

The spatial variability in the structure of the Pomeranian Bay meiobenthos was also explored by means of a set of multivariate analyses performed with the PRIMER (Plymouth Routines in Multivariate Ecological Research; Clarke and Warwick, 1994) computer package. The following aspects of the relationships between meiobenthic assemblages at the stations were looked into:

- similarity between the assemblages, explored with the PRIMER's CLUSTER routine utilising the Bray-Curtis similarity coefficient applied to the sum of taxon densities from 3 samples per station, double square root-transformed; the similarity matrix was sorted with the group average strategy (Lance and Williams, 1967) to produce a similarity dendrogram and to identify homogenous groups;
- multidimensional scaling (MDS routine) to produce a 2-dimensional 'map' of sites in which distances between the sites reflect similarities or dissimilarities between the station characteristics (Manly, 1994), in this case, the structure of meiobenthic assemblages.

4. Results and discussion

4.1. Abiotic variables

The following seven environmental variables were included in the principal components analysis: station depth, near-bottom water temperature, salinity, dissolved oxygen content, sediment mean grain size, organic matter and silt/clay content. As no grain size data were available for BA28, that station had to be excluded from the analysis.

Fig. 2 shows the 2-dimensional PCA projection of stations distributed within a 7-dimensional space produced by the variables handled by the analysis. The PC1 axis was found to explain 50% of the variation in the data; the axis was formed mainly by a combination of sediment silt/clay and organic matter content. The PC2 axis, which explained a further 25% of the variation, was a combination of the mean grain size and depth. The analysis divided the stations into two basic groups, the division being brought about mainly by PC1: group I was formed by station 10 located in the immediate vicinity of the riverine input site (*cf.* Fig. 1), the remaining stations being clustered in group II.

Thus it turned out that the most important parameter differentiating the Pomeranian Bay sites consisted of a combination of factors evidencing organic enrichment in the sediment and probably related to the input of

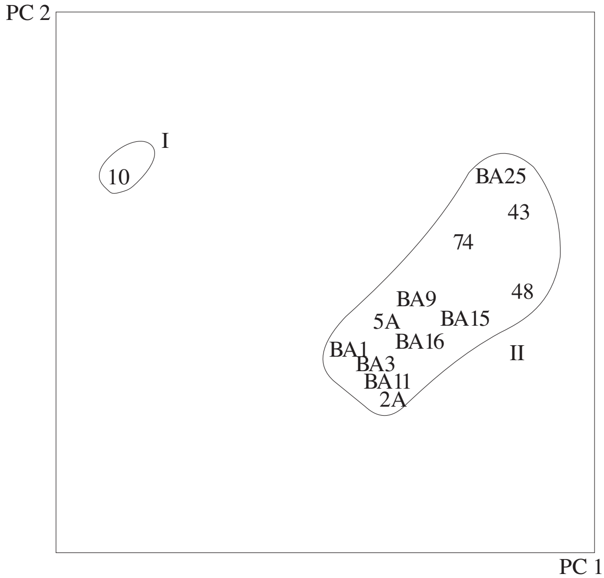

Fig. 2. PCA diagram of sampling stations

allochthonous organic matter. This is compatible with the results of earlier studies (Majewski, 1974; Kubiak, 1980; Poleszczuk *et al.*, 1995), which demonstrated that the riverine run-off into the Bay affected not only the temperature and salinity patterns, but was responsible for considerable organic enrichment of the water column, the organic matter being deposited in the sediment along the route of river plume movement in the Bay.

4.2. Meiobenthos

The meiobenthic assemblages at the stations visited during this study consisted of 5–13 taxa (including copepod nauplii treated as a separate 'taxon') (Tab. 2 and 3). The highest taxon richness (13 taxa) was recorded at the off-shore shallow-water stations 5A and BA9, while the lowest number of taxa occurred at the deepest station BA28.

The mean total meiobenthic densities varied widely from about 548 ($\pm$ 167) indiv. (10 cm^2)$^{-1}$ at BA25 to about 3494 ($\pm$ 494) indiv. (10 cm^2)$^{-1}$ at station 10, closest to the Lagoon's discharge (Tab. 2, Fig. 3). The densities recorded did not deviate much from the values reported in other studies on the southern Baltic meiofauna (Radziejewska, 1992; Szymelfenig, 1990). Generally, those stations situated closest to the Świna mouth (10, BA1) were populated by the most abundant meiobenthic assemblages (Tab. 2; Fig. 3). As shown by the results of 1-way ANOVA (Tab. 4), the stations differered significantly ($p < 0.001$) in their mean meiobenthic abundances.

Table 2. Mean total densities (± standard deviation) [indiv. $(10\ \mathrm{cm}^2)^{-1}$] of the meiobenthos at the Pomeranian Bay stations

Taxon	2A	BA1	10	BA3	5A
Hydrozoa	0	0	0	0	0
Turbellaria	64.85 ± 15.64	23.89 ± 6.44	52.05 ± 10.35	22.19 ± 9.69	18.77 ± 5.33
Gastrotricha	17.07 ± 16.46	16.21 ± 5.33	17.07 ± 10.35	27.31 ± 3.91	22.19 ± 9.69
Nematoda	872.11 ± 277.03	1541.97 ± 123.74	2883.41 ± 419.41	844.80 ± 376.93	522.24 ± 217.24
Oligochaeta	9.39 ± 7.82	8.53 ± 3.91	29.01 ± 11.54	0	4.27 ± 7.39
Polychaeta	12.80 ± 6.77	33.28 ± 11.16	199.68 ± 57.64	11.95 ± 1.48	9.39 ± 5.33
Ostracoda	7.68 ± 7.68	0.85 ± 1.48	46.08 ± 33.28	0	0.85 ± 1.48
Harpacticoida	11.09 ± 5.91	3.41 ± 1.48	13.65 ± 7.82	0	34.13 ± 37.30
Copepoda nauplii	2.56 ± 2.56	0.85 ± 1.48	0	0	7.68 ± 7.68
Amphipoda	0	5.12 ± 6.77	9.39 ± 8.32	0	2.56 ± 4.43
Isopoda	0	0	0	0	5.12 ± 5.12
Halacaroidea	25.60 ± 13.55	95.57 ± 33.80	208.21 ± 77.92	1.71 ± 0.85	0.85 ± 1.48
Tardigrada	0	0	0	0	1.71 ± 2.96
Kinorhyncha	0	0	23.04 ± 4.43	0	0
Gastropoda	6.83 ± 3.91	0.85 ± 1.48	2.56 ± 4.43	0.85 ± 1.48	0
Bivalvia	2.56 ± 2.56	0.85 ± 1.48	10.24 ± 6.77	0	5.12 ± 0.00
Total meiobenthos	1032.54 ± 267.89	1731.38 ± 135.69	3494.00 ± 494.33	908.81 ± 377.32	634.88 ± 252.95
No. of taxa	11	12	12	6	13

Table 2. (continued)

Taxon	BA9	BA15	BA16	BA11	43
Hydrozoa	0	0	0.85 ± 1.48	0	0
Turbellaria	28.16 ± 11.74	35.84 ± 17.92	66.56 ± 38.23	41.81 ± 27.13	41.81 ± 15.00
Gastrotricha	55.47 ± 30.96	26.45 ± 15.43	23.89 ± 23.09	11.09 ± 10.66	3.41 ± 3.91
Nematoda	939.52 ± 115.14	937.81 ± 126.90	787.63 ± 532.73	594.77 ± 192.60	767.15 ± 200.01
Oligochaeta	0.85 ± 1.48	0	0	1.71 ± 1.48	3.41 ± 5.91
Polychaeta	11.09 ± 8.99	5.97 ± 5.91	8.53 ± 5.33	5.97 ± 6.44	10.24 ± 9.23
Ostracoda	0	0	0	0	1.71 ± 2.96
Harpacticoida	29.01 ± 30.33	2.56 ± 2.56	3.41 ± 2.96	0.85 ± 1.48	7.68 ± 4.43
Copepoda nauplii	4.27 ± 3.91	4.27 ± 5.33	0.85 ± 1.48	0.85 ± 1.48	0.85 ± 1.48
Amphipoda	0.85 ± 1.48	0	0	0	0
Isopoda	0.85 ± 1.48	0	0	0	0
Halacaroidea	1.71 ± 1.48	0.85 ± 1.48	0	0	1.71 ± 1.48
Tardigrada	0.85 ± 1.48	8.53 ± 2.96	12.80 ± 11.16	0.85 ± 1.48	0
Kinorhyncha	0	0	0	0	0
Gastropoda	12.80 ± 5.12	0	0	0	0
Bivalvia	25.60 ± 21.87	0.85 ± 1.48	5.97 ± 5.33	0.85 ± 1.48	1.71 ± 2.96
Total meiobenthos	1111.03 ± 107.52	1023.13 ± 152.41	910.49 ± 591.39	658.75 ± 196.99	839.68 ± 217.69
No. of taxa	13	9	9	9	10

Table 2. (continued)

Taxon	BA25	48	74	BA28
Hydrozoa	0	0	0.85 ± 1.48	0
Turbellaria	62.29 ± 26.65	76.80 ± 35.19	5.97 ± 6.44	2.56 ± 4.43
Gastrotricha	19.63 ± 8.99	58.03 ± 44.73	6.83 ± 9.69	7.68 ± 13.30
Nematoda	424.95 ± 140.76	370.35 ± 232.87	741.55 ± 273.48	718.49 ± 252.16
Oligochaeta	7.68 ± 13.30	4.27 ± 2.96	2.56 ± 2.56	0
Polychaeta	0.85 ± 1.48	9.39 ± 6.44	8.53 ± 3.91	2.56 ± 4.43
Ostracoda	5.97 ± 5.33	0	0	0
Harpacticoida	17.92 ± 6.77	11.09 ± 1.48	4.27 ± 7.39	0
Copepoda nauplii	0.85 ± 1.48	3.41 ± 3.91	0.83 ± 1.48	0
Amphipoda	0	0	0	0
Isopoda	0	3.41 ± 5.91	0	0
Halacaroidea	0	8.53 ± 3.91	0	0
Tardigrada	5.97 ± 5.33	12.80 ± 17.92	0.83 ± 1.48	0
Kinorhyncha	0	0	0	0
Gastropoda	0	0	0	0
Bivalvia	1.71 ± 2.96	0	0	1.71 ± 1.48
Total meiobenthos	547.82 ± 166.48	558.08 ± 351.72	772.22 ± 260.18	733.00 ± 263.77
No. of taxa	10	10	9	5

Table 3. Percentage (mean ± standard deviation) composition of the meiobenthos at the Pomeranian Bay stations

Taxon	2A	BA1	10	BA3	5A	BA9	BA15
Hydrozoa	0	0	0	0	0	0	0
Turbellaria	6.71 ± 3.07	1.41 ± 0.49	1.51 ± 0.38	2.69 ± 1.21	3.10 ± 0.76	2.48 ± 0.85	3.40 ± 1.31
Gastrotricha	1.51 ± 1.11	0.94 ± 0.29	0.49 ± 0.33	3.57 ± 2.08	3.78 ± 1.73	4.91 ± 2.65	2.59 ± 1.61
Nematoda	83.61 ± 5.16	89.06 ± 1.40	82.54 ± 0.35	91.72 ± 4.65	81.86 ± 1.50	84.61 ± 6.87	91.82 ± 3.77
Oligochaeta	0.91 ± 0.81	0.58 ± 0.23	0.86 ± 0.41	0	0.47 ± 0.82	0.08 ± 0.14	0
Polychaeta	1.38 ± 1.03	1.85 ± 0.51	5.85 ± 2.10	1.58 ± 0.98	1.91 ± 1.76	0.95 ± 0.72	0.61 ± 0.63
Ostracoda	0.84 ± 0.79	0.05 ± 0.09	1.27 ± 0.80	0	0.14 ± 0.24	0	0
Harpacticoida	1.21 ± 0.91	0.19 ± 0.07	0.38 ± 0.19	0	4.48 ± 3.56	2.63 ± 2.72	0.23 ± 0.22
Copepoda nauplii	0.28 ± 0.33	0.05 ± 0.09	0	0	1.49 ± 1.32	0.38 ± 0.33	0.37 ± 0.43
Amphipoda	0	0.32 ± 0.43	0.27 ± 0.25	0	0.65 ± 1.13	0.08 ± 0.13	0
Isopoda	0	0	0	0	0.81 ± 0.71	0.08 ± 0.13	0
Halacaroidea	2.64 ± 1.52	5.47 ± 1.78	5.84 ± 1.35	0.25 ± 0.27	0.14 ± 0.24	0.15 ± 0.13	0.07 ± 0.12
Tardigrada	0	0	0	0	0.28 ± 0.48	0.08 ± 0.14	0.83 ± 0.26
Kinorhyncha	0	0	0.67 ± 0.20	0	0	0	0
Gastropoda	0.63 ± 0.27	0.05 ± 0.08	0.06 ± 0.11	0.18 ± 0.31	0	1.17 ± 0.49	0
Bivalvia	0.28 ± 0.33	0.05 ± 0.09	0.31 ± 0.22	0	0.90 ± 0.37	2.39 ± 2.00	0.07 ± 0.12

Table 3. (continued)

Taxon	BA16	BA11	43	BA25	48	74	BA28
Hydrozoa	0.09 ± 0.16	0	0	0	0	0.14 ± 0.24	0
Turbellaria	7.69 ± 2.56	6.66 ± 5.26	5.06 ± 1.49	11.49 ± 3.23	14.76 ± 2.38	0.96 ± 1.03	0.28 ± 0.48
Gastrotricha	2.27 ± 2.60	1.83 ± 2.00	0.52 ± 0.68	3.48 ± 0.68	9.68 ± 2.02	1.10 ± 1.57	0.84 ± 1.46
Nematoda	86.49 ± 5.48	89.89 ± 4.17	91.37 ± 1.37	77.63 ± 5.47	66.50 ± 1.04	95.41 ± 2.74	98.30 ± 2.17
Oligochaeta	0	0.25 ± 0.23	0.38 ± 0.65	1.21 ± 2.09	0.77 ± 0.18	0.41 ± 0.41	0
Polychaeta	0.96 ± 0.40	0.80 ± 0.74	1.20 ± 0.87	0.13 ± 0.23	1.61 ± 0.69	1.08 ± 0.23	0.28 ± 0.48
Ostracoda	0	0	0.19 ± 0.32	1.37 ± 1.49	0	0	0
Harpacticoida	0.30 ± 0.29	0.15 ± 0.27	0.86 ± 0.37	3.34 ± 0.92	2.67 ± 1.80	0.68 ± 1.18	0
Copepoda nauplii	0.06 ± 0.10	0.10 ± 0.17	0.08 ± 0.14	0.13 ± 0.23	0.46 ± 0.42	0.08 ± 0.14	0
Amphipoda	0	0	0	0	0	0	0
Isopoda	0	0	0	0	0.36 ± 0.62	0	0
Halacaroidea	0	0	0.18 ± 0.15	0	1.64 ± 0.27	0	0
Tardigrada	1.11 ± 1.01	0.16 ± 0.28	0	0.92 ± 0.83	1.55 ± 1.78	0.14 ± 0.24	0
Kinorhyncha	0	0	0	0	0	0	0
Gastropoda	0	0	0	0	0	0	0
Bivalvia	1.02 ± 1.23	0.16 ± 0.82	0.17 ± 0.29	0.27 ± 0.47	0	0	0.30 ± 0.30

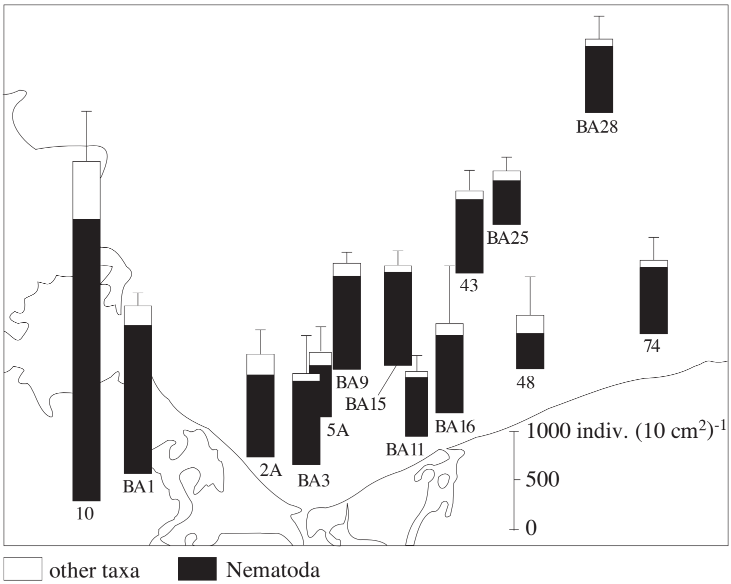

Fig. 3. Mean total densities of the Pomeranian Bay meiobenthic communities and the proportion of nematodes

Table 4. Results of 1-way ANOVA

Variable	Transfor-mation	Sources of variation	Degrees of freedom	Sum of squares	Mean square	F
Total meio-benthos density	$\log(x+1)$	between stations	13	1.9188	0.1476	5.27 (p<0.001)
		error	28	0.7930	0.0280	
		total	41	2.7118		

Duncan's multiple range test identified two stations (10 and BA1, *i.e.*, closest to the major riverine discharge site) as those responsible for significance of the differences.

On the basis of data collected from a rather limited area of the Bay (up to 10 miles off shore), Radziejewska (1984) reported a decrease in meiobenthic densities with distance from the Świna mouth, while a similar decrease was found in the long-shore distribution of sediment-bound bacteria, meiobenthos and macrobenthos (Radziejewska *et al.*, unpubl.). A characteristic pattern of macrobenthic biomass, reflecting the direction of riverine water impact, was recorded by Powilleit *et al.* (1995) in their Bay-wide study.

The meiobenthic assemblages in the Bay, like the meiobenthos in other areas of the southern Baltic (Szymelfenig, 1990) and elsewhere (*e.g.* Guidi-Guilvard and Buscail, 1995; Heip *et al.*, 1988) were dominated by nematodes (Tab. 3), which made up from about 66.5 (station 48) to about 98% of all meiofauna at a station. The Turbellaria and the Gastrotricha proved to be of some numerical importance at certain stations as well.

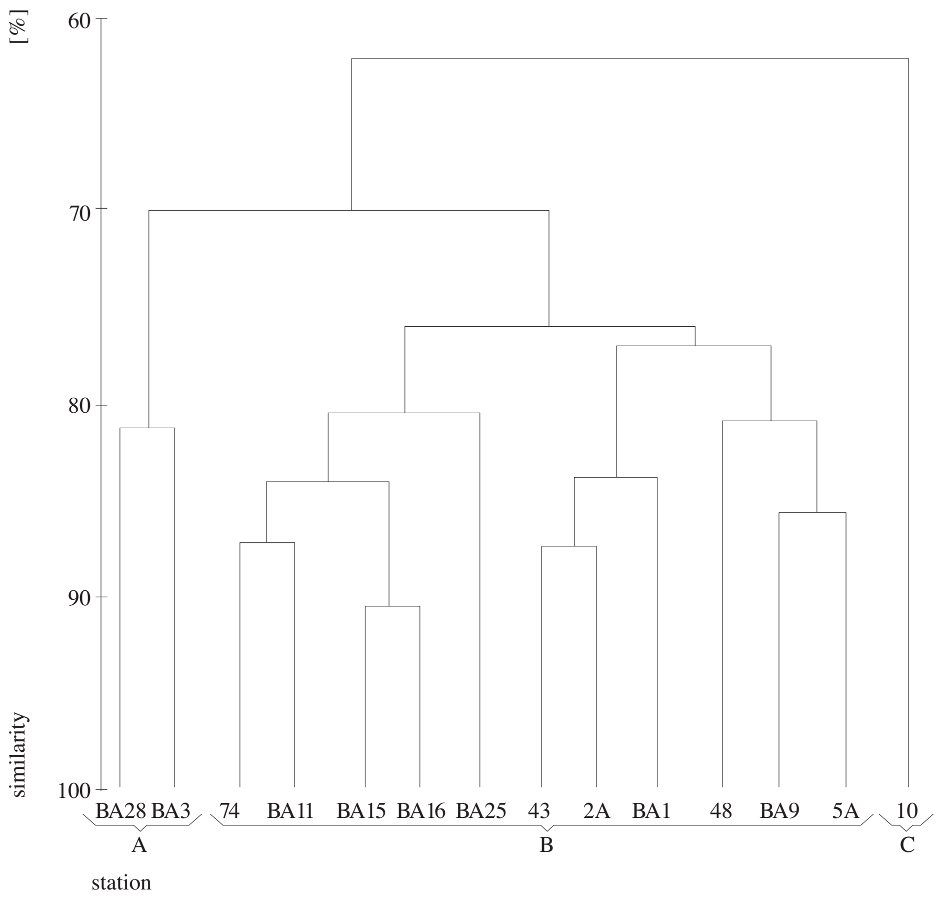

Fig. 4. Similarity dendrogram of meiobenthic densities at the Pomeranian Bay stations

The similarity dendrogram (Fig. 4) demonstrated a generally high similarity between the meiobenthic assemblages in the Bay, as the station clusters began to emerge at a similarity level of about 60%. However, at the 70% level, 3 groups of stations (A, B, C) could be separated: group A, with the highest average similarity (80.85%), consisting of 2 stations (BA3 and BA28) with the lowest number of taxa and the highest proportion of nematodes (about 92–98% of total density; Tab. 3); group B, branching off at the 78.03% similarity level, consisting of the remaining stations except station 10 (mean total densities at those stations were very variable (Tab. 2) and the communities consisted of high numbers of taxa (9–13)); and group C, consisting solely of station 10 inhabited by abundant meiofauna made up of a high number of taxa (Tab. 2).

The results of the similarity analysis were projected onto the station map (Fig. 5). As can be seen from this, the Bay is inhabited by a more or less homogenous assemblage of meiobenthos, typically represented by the group B stations. The spatial effect of riverine discharge is evident in the location of the group A (disregarding BA28) and C stations in the zone immediately adjacent to the Lagoon's outlet and to the north of it, which is consistent with the river plume dynamics discussed by Siegel *et al.* (1996).

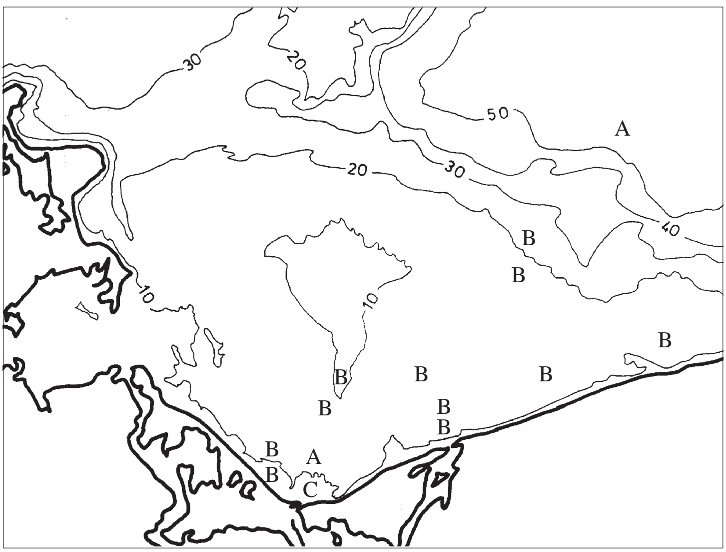

Fig. 5. Projection of similarity dendrogram results onto the station map

The MDS ordination of stations (Fig. 6) resembles the dendrogram projection onto the actual station map (Fig. 5), again indicating stations 10 and BA28 as those most distant, in terms of their meiobenthic communities, from the typical Pomeranian Bay meiofauna represented by the group B stations. The ordination leads to the conclusion that the location of sampling sites in the Pomeranian Bay, *i.e.* their proximity to riverine discharge, plays a key role in the similarity or dissimilarity of meiobenthic communities, as the station 10 community is, in the ordination, closest to those of stations

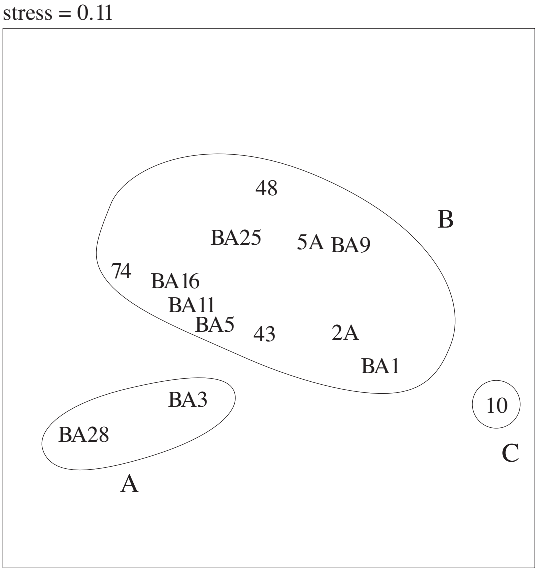

Fig. 6. Two-dimensional MDS plot of the meiobenthic abundances at the Pomeranian Bay stations. The stress value indicates the degree of compatibility between a 2-dimensional plot and the multidimensional structure of the data; a stress close to 0.1 corresponds to a good ordination (Clarke and Warwick, 1994)

BA1 and 2A. In fact, these two stations were situated very close to each other; this pattern demonstrates a difference between the meiofauna in the western part of the area and the remainder of it, like the pattern of macrobenthic distribution reported by Powilleit *et al.* (1995).

The distribution of meiobenthic communities in the Pomeranian Bay described here, with the most abundant and most similar communities occurring in the immediate vicinity of the riverine discharge and to the west of it allows one to conclude that the organic enrichment of the sediment resulting from riverine discharge played a key role in controlling the meiofaunal densities. The increase in the abundance of meiobenthos in organic-rich sediments has been explained primarily by the enhancement of those meiofaunal trophic groups that rely on this type of food resource, the enhancement being evidenced, *i.a.* as an increase in the reproduction rate (Gee *et al.*, 1985; Widbom and Elmgren, 1988). In the Pomeranian Bay, it is primarily the free-living nematodes dominant at each station that can be regarded as a taxon whose abundance is enhanced by the increased load of sedimenting seston. As demonstrated by Szulwiński (unpubl.), nematodes occurring at the southern Baltic stations with organic-rich sediments are represented mainly by the trophic groups of detritivores and epistrate feeders. To gain more insight into the responses of nematodes to different habitat types, the taxonomic and trophic composition of this taxocene in the Pomeranian Bay is currently being studied at our laboratory.

The suite of uni- and multivariate analyses employed in this study has demonstrated that proximity to the riverine water discharge site and the resultant organic enrichment of the sediment controlled the spatial distribution of meiobenhic communities in the Pomeranian Bay. It could be seen that the distribution of the meiofauna responded to the riverine plume dynamics in the Bay and followed the deposition pattern of seston introduced into the Bay by the plume. As there is evidence of macrobenthic communities following a similar pattern (Powilleit *et al.*, 1995), the entire benthic system of the Bay seems to be controlled by the discharge. It remains to be seen to what extent this impact is supplemented by inputs of organic matter from the water column which, due to enhanced primary production in the Bay (Renk *et al.*, 1991), could prove quite considerable at times.

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