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MACROZOOBENTHOS OF THE COASTAL ZONE IN THE REGION OF SŁOWIŃSKI NATIONAL PARK

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Abstract

The present qualitative and quantitative study on macrozoobenthos was conducted in 1998 in the coastal zone of the Baltic Sea adjacent to the Słowiński National Park (SNP). The macrozoobenthos of this zone exhibited quantitative scarcity (12 species) and low content of the wet mass. More frequent were only *Oligochaeta, Pygospio elegans*, and *Batyporeia pilosa*. Because of a better specific diversity, density, and wet mass of the macrozoobenthos in the zone outside 1 nautical mile limit, the author suggests widening the proposed marine protected zone of the SNP giving it the status of marine Landscape Park up to 3 nautical miles.

Key words: Marine protected areas, macrozoobenthos, coastal zones.

INTRODUCTION

The Baltic Sea has been considered one of the most polluted and eutrophicated seas of the world. This situation prompted international-scale efforts aimed at protection of the Baltic-Sea environment. The principal role in the protection of this sea has been played by the Helsinki Convention. The Convention has been in effect since 1974 obliges the Baltic countries to monitor this body of water and to limit its pollution and eutrophication. The Working Group for the Protection of Nature and Biodiversity recommends, among other steps, expansion of protective measures in the Baltic Sea area. The protective measures are aimed chiefly at protection of seals and porpoises of the coastal zone and creation of the Baltic System of Protected Areas (BSPA). There has been a great emphasis on such actions not only regarding the protection of the endangered species, but also on the protection of their habitats and preservation of the ecological processes occurring in such habitats. The Polish

program of Baltic Protection under the framework of BSPA assumes the creation of marine protected areas in the territory of: the Landscape Park of the Sandbar of Vistula Lagoon, the "Kępa Redłowska" reserve, the Coastal Landscape Park, Słowiński National Park, and Woliński National Park. It suggested also protection of the Słupsk Bank (Warzocha and Herbich 1998). Contrary to the common approval of the intensive actions on land the creation of marine protected areas in Poland encounters great difficulties and lack of understanding. Despite the fact that Baltic waters under the jurisdiction of Poland constitute some 11% of its territory, there has hitherto been only one marine protected area approved for Woliński National Park.

The aim of the present paper has been to characterize the macrozoobenthos of the coastal zone of the Baltic Sea adjacent to Słowiński National Park. This coastal zone, according to the BSPA program is to receive the status of a marine protected area. This area has been inadequately studied and the description of the macrozoobenthos will be useful for determination of the natural values of this region and for future comparative studies (monitoring).

MATERIAL AND METHODS

The present survey of the macrozoobenthos was conducted from May to September 1998 in the 3-nautical-mile-wide coastal zone adjacent to Słowiński National Park. The sampling sites were designated on three profiles perpendicular to the shoreline in the distance of 0.25, 0.5, 1.0, 2.0, and 3.0 nautical miles from the shore (Fig. 1). The respective profiles were set between the following geographical coordinates:

Area of Rowy (profile I)	- 54°40'64" N and 17°03'67" E
	- 54°42'45" N and 17°03'05" E
Area of Czołpino (profile II)	- 54°43'77" N and 17°13'69" E
	- 54°46'66" N and 17°13'47" E
Area of Łeba (profile III)	- 54°46'12" N and 17°31'33" E
	- 54°48'50" N and 17°31'40" E

At each site the bottom was sampled with a van Veen sampler of the working area of 0.1 m^2. Each sample was composed of two loads of the sampler. A total of 15 macrozoobenthos samples were collected (30 sub-samples). The material collected was rinsed on a benthos sieve of 1 mm mesh size. The findings were conserved in 5% solution of formaldehyde (formalin). In the laboratory the benthic animals were sorted under a microscope and their quantities were related to 1 m^2 of the bottom.

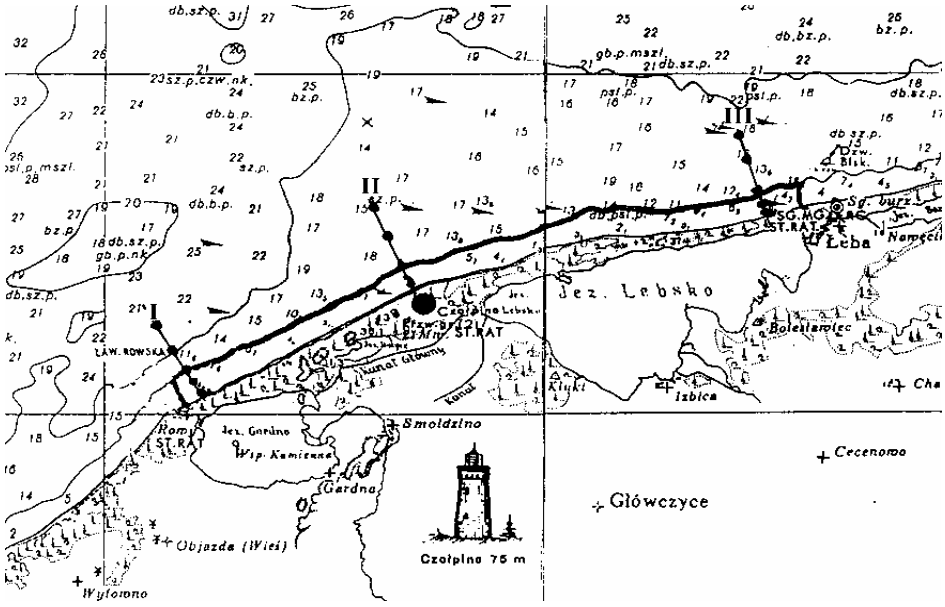

Fig. 1. Profiles and sampling sites in the 3-mile-wide coastal zone adjacent to Słowiński National Park (1998)

The animals were identified under a dissecting microscope and divided into individual taxonomic groups. To determine the wet mass, the animals of the respective groups were weighed on a laboratory balance (WPE 60) to the nearest 0.01 mg. The values of the wet mass were related to 1 m^2 of the bottom. *Pygospio* were weighed following the removal of their external tubes (houses). The bivalves were weighed with water present in their mantle cavity. Before the determination of the wet mass the animals were dried on a blotting paper.

Water transparency was determined using a Secchie disc (30 cm in diameter) to the nearest 1 cm.

The position of the sampling sites was determined using a GPS device. The depth was measured using a sonic sounder of a ship. The survey was conducted on board the ship "Hydrograf" of the Marine Authority at Słupsk (Urząd Morski in Słupsk).

RESULTS

A total of 12 taxa of the macrozoobenthos was recorded in the 3-mile-wide coastal zone adjacent to Słowiński National Park. They were represented by: *Oligochaeta*, *Polychaeta*, *Crustacea*, and *Bivalvia*. The density dominant was *Batyporeia pilosa*, while *Oligochaeta* and *Pygospio elegans* were subdominants (Tabs. I–IV). Far less

dense were *Hediste diversicolor* and *Macoma baltica*. The remaining taxa occurred sporadically and their density ranged from 0.7 to 3.3 ind./m^2. The biomass dominants (wet mass) in the zone studied were bivalves *Macoma baltica* (x-6.10 g/m^2). Moderate values of the wet mass ranging from 0.28 to 0.47 g/m^2 were represented by: *Hediste*, *Mytilus*, *Pygospio*, and *Batyporeia*. The remaining taxa represented small values of the wet mass (0.01–0.15 g/m^2)(Tab. IV). The highest frequency among all macrozoobenthos taxa from the coastal zone under study was represented by *Pygospio elegans* (F = 80%). On the respective profiles the frequency of this species ranged from 60 to 100%. Less frequent were *Oligochaeta* (F = 60%) and *Batyporeia*
(F = 60%). Frequencies oscillating around 50% were observed for *Hediste*, *Macoma*, and *Marenzelleria*. The remaining taxa occurred sporadically and their frequency (F) was around 13% (Tab. IV). The frequency of the above-mentioned taxa on the individual profiles was variable (Tabs. I, II, III). Also the range, mean density, and the wet mass of the respective taxa on the profiles studied was diversified (Tab. IV).

Profile I (Rowy area) (Fig. 1) yielded 10 taxa of macrozoobenthos. The density dominants were oligochaetes. They were not observed in the shallow waters and they became distinctly more abundant on the depths below 10 m on the sites between 1 and 3 miles, reaching the maximal density 3 miles from the shore (1470 ind./m^2) (Tab. I). Isopods of the genus *Batyporeia* were a subdominant. Contrary to the oligochaetes they occurred on rather shallow waters (depth of 4–10 m) and in the proximity of the shore (0.25 and 0.5 miles).

Table I

Density (ind./m^2) and frequency (F) of macrozoobenthos in the coastal zone of the Baltic Sea near Rowy on profile I

	Distance from the shore in nautical miles					x	F (%)
Takson	0.25 Mm	0.5 Mm	1.0 Mm	2.0 Mm	3.0 Mm		
Oligochaeta gen. sp.	0	0	20	210	1470	340	60
Hediste diversicolor	0	0	0	0	100	20	20
Marenzelleria viridis	0	0	0	10	0	2	20
Pygospio elegans	0	30	190	60	0	56	60
Harmathoe sarsi	0	0	0	0	50	10	20
Batyporeia pilosa	400	15	0	0	0	83	40
Corophium volutator	0	0	0	0	40	8	20
Mytilus edulis	0	0	0	0	20	4	20
Macoma baltica	0	0	10	30	20	12	60
Cardium glaucum	0	0	0	0	10	2	20
Total	400	45	220	310	1710		
Number of taxonomic unit	1	2	3	4	7	10	

x mean density

Table II

Density (ind./m^2) and frequency (F) of macrozoobenthos in the coastal zone of the Baltic Sea near Czołpino on profile II

Takson	Distance from the shore in nautical miles					x	F (%)
	0.25 Mm	0.5 Mm	1.0 Mm	2.0 Mm	3.0 Mm		
Oligochaeta gen. sp.	0	60	10	660	2920	744	80
Hediste diversicolor	0	10	30	50	360	90	80
Marenzelleria viridis	0	0	0	0	20	4	20
Pygospio elegans	0	240	440	1140	1970	758	80
Batyporeia pilosa	720	400	0	70	10	240	80
Macoma baltica	0	0	20	0	0	4	20
Mya arenaria	0	0	0	0	20	4	20
Total	720	710	50	1920	5300		
Number of taxonomic unit	1	4	4	4	6	7	

x mean density

Table III

Density (ind./m^2) and frequency (F) of macrozoobenthos in the coastal zone of the Baltic Sea near Łeba on profile III

Takson	Distance from the shore in nautical miles					x	F (%)
	0.25 Mm	0.5 Mm	1.0 Mm	2.0 Mm	3.0 Mm		
Oligochaeta gen.sp.	30	0	0	20	0	10	40
Hediste diversicolor	0	0	50	60	0	22	40
Marenzelleria viridis	0	0	0	10	0	2	20
Pygospio elegans	170	20	184	550	30	191	100
Batyporeia pilosa	1490	2170	220	0	0	776	60
Gamarus sp.	0	0	0	10	0	2	20
Macoma baltica	0	0	10	10	0	4	40
Cardium glaucum	0	0	10	0	0	2	20
Total	1690	3880	474	660	50	1230	
Number of taxonomic unit	3	2	5	6	1	8	

x mean density

Table IV

Range of quantities and frequency (F) of macrozoobenthos in the 3-mile-wide coastal zone of the Baltic Sea adjacent to the SNP (Rowy, Czołpino, Łeba) in 1998

Taxonomic unit	Coastal zones (3 miles)															$\bar{x}$		
	Rowy area					Czołpino area					Łeba area							
	density (ind./m^2)		wet mass (g/m^2)		F	density (ind./m^2)		wet mass (g/m^2)		F	density (ind./m^2)		wet mass (g/m^2)		F			
	zakres	$\bar{x}$	zakres	$\bar{x}$	%	zakres	$\bar{x}$	zakres	$\bar{x}$	%	zakres	$\bar{x}$	zakres	$\bar{x}$	%	ind./m^2	g/m^2	F (%)
Oligochaeta gen.sp.	0-1470	340	0-0.52	0.14	60	0-2920	744	0-1.39	0.38	80	0.30	10	0-0.01	0.04	40	364	0.18	60
Polychaeta																		
Nereis diversicolor	0-100	20	0-1.12	0.22	20	0-360	90	0-4.22	1.09	80	0-60	22	0-0.34	0.11	40	44	0.47	47
Marenzelleria viridis	0-10	2	0-0.02	0.004	20	0-20	4	0->0.01	>0.01	20	0-10	2	0-0.12	0.16	20	2.6	0.05	20
Pygospio elegans	0-190	56	0-0.12	0.04	60	0-1970	758	0-1.46	0.61	80	20-550	191	>0.01-1.08	0.27	100	335	0.30	80
Harmothoe sarsi	0-50	10	0-0.12	0.02	20	0	0	0	0	0	0	0	0	0	0	3.3	0.01	
Total *Polychaeta*		88		0.28			852		1.7			215		0.54		385	0.83	
Amphipoda																		
Batyporeia pilosa	0-400	83	0-0.62	0.13	40	0-720	240	0-0.93	0.33	80	0-2170	776	0-1.30	0.39	60	366	0.28	60
Corophium volutator	0-40	8	0-0.44	0.09	20	0	0	0	0	0	0	0	0	0	0	2.6	0.03	7
Gammarus sp.	0	0	0	0	0	0	0	0	0	0	0-10	2	0-0.12	0.02	20	0.7	0.01	
Total *Amphipoda*		91		0.22			240		0.33			778		0.41		369	0.32	
Bivalvia																		
Mytilus edulis	0-20	4	0-5.16	1.03	20	0	0	0	0	0	0	0	0	0	0	1.3	0.34	7
Macoma baltica	0-30	12	0-27.7	10.22	60	0-20	4	0-37.6	7.52	20	0-10	4	0-2.8	0.58	40	6.7	6.10	40
Mya arenaria	0	0	0	0	0	0-20	4	0-2.26	0.45	20	0	0	0	0	0	1.3	0.15	7
Cardium glaucum	0-10	2	0-0.96	0.19	20	0	0	0-0	0	0	0-10	2	0-0.34	0.07	20	1.3	0.08	13
Total *Bivalvia*		18		11.44			8		7.97			6		0.65		10.6	6.67	
Grand total		537		12.08			1844		10.38			1009		1.64				
Number of tax. units		10					7					8					12	

A meaningful density was also represented by *Pygospio elegans* (Tab. I). The remaining taxa reached densities below 20 ind./m^2. Bivalves: *Macoma*, *Mytilus*, and *Cardium* were recorded in low numbers and only on distant sampling sites (2 and 3 miles from the shore at depths of 20–24 m). The most pronounced quantitative scarcity of the macrozoobenthos on profile I was reported at the site located 0.5 mile from the shore (depth of 8 m). The highest qualitative abundance (7 taxa) and the highest density of macrozoobenthos were observed on the profile I, at the site located 3.0 m from the shore (Tab. I).

The wet mass of the macrozoobenthos was the most abundant on profile I, compared to the other profiles studied (tab. IV). The reason for that was the more abundant occurrence of *Macoma baltica*.

The highest mean density of macrozoobentos was recorded on profile II (Czołpino) (Fig. 1) with the maximum at 3 miles from the shore - 5300 ind./m^2. Qualitatively-the species diversity was smaller compared to profile I. A total of 7 taxa, out of 12 inhabiting the area under study, was reported from profile II. On a shallow site of this profile - depth of 4.5 m (0.25 mile from the shore) only *Batyporeia pilosa* was found. Here it reached here its maximum of abundance (Tab II). On the farther sites, 4 taxa were observed. On the site located 3.0 miles from the shore there the highest species diversity was recorded - 5 out of 7 taxa known to occur on this profile. Also the highest density of macrozoobenthos was observed on this site (Tab. II). The density dominant on profile II were *Pygospio*, followed closely by the remaining *Oligochaeta*. *Batyporeia pilosa* were a subdominant here and it occurred across the whole stretch of the profile (3.0 miles inclusive). *Hediste* in the area of Czołpino reached the highest density and frequency compared to the remaining profiles (Tab. IV). Worth mentioning was the quantitative - qualitative scarcity of bivalves with only 2 species recorded (*Macoma* and *Mya*).

Profile II in the area west of Łeba (Fig. 1) yielded 8 taxa, with - similarly as on profile II-the density - wide dominant was *B. pilosa*. *Pygospio* was a subdominant (Tab. III) and only on this profile they occurred on all sampling sites (F = 100%). The average density of the remaining taxa was small and could be regarded as rare with the exception of *Hediste* (Tab. IV). The values of the wet mass of macrozoobenthos on II was 18 times lower, compared to that of profile I characterized by the highest wet mass of macrozoobenthos in the entire area of study (Tab. IV).

DISCUSSION

The quantitative survey of the higher taxa of the macrozoobenthos of the coastal zone of the Baltic Sea adjacent to Słowiński National park revealed, that there is a defined balance in respect to the density of the animals. The densities for the major taxa are fairly similar (*Oligochaeta* - 364 ind./m^2; *Polychaeta* - 385 ind./m^2;

and *Amphipoda* - 369 ind./m^2). The surveyed area exhibited low density of *Bivalvia* - as low as 10.6 ind./m^2. The average wet mass of the above-mentioned taxa shows distinct variability, compared to the density of macrozoobenthos: *Oligochaeta* - 0.18 g/m^2, *Polychaeta* - 0.83 g/m^2, *Amphipoda* - 0.32 g/m^2, and *Bivalvia* - 6.67 g/m^2. It is evident from this data that bivalves show the greatest importance in the macrozoobenthos in the studied coastal area (up to 3 miles) because of their highest value of their wet mass and despite their low density. A significant role is played by polychaetes, while small importance can be attributed to the representatives of *Oligochaeta* and *Amphipoda*.

Oligochaeta

Among the oligochaetes the most important is *Enchytraeus albidus* Henle, constituting about 70% of the *Oligochaeta* studied. Also observed were some forms that were originally freshwater and because of their euryhaline range they tolerate salinity up to 7‰. Oligochaetes as detritus feeders play a significant role in transformation of organic substances, in particular in transformation of planktonic algae settled on the bottom. They provide a not very abundant food base for fish fry and for adult benthophagous fishes. The density of *Oligochaeta* exceeds 2.3 times the average density of this group for the entire Polish coastal zone (Warzocha 1995). The density of *Oligochaeta* is diversified not only in different parts of the area studied (Tabs. I, II, III) but it also differs during individual years. The average density of *Oligochaeta* on profile III in 1997 was as many as 63 times higher than that observed in 1998. Comparison of the oligochaetes density in the studied area of SNP and in the coastal zones of the Wieprza and Słupia estuaries (Piesik unpublished) indicates that *Oligochaeta* find for themselves convenient conditions for development which is confirmed by their relatively high density (Tab. VI).

A characteristic feature of the studied *Oligochaeta* is the fact, that they avoid settling in the waters more shallow than 10 m. Their densities there are low, while in the depth of 10–20 m their density decidedly increases (Tabs. I, II, III). In the proposed 1-mile coastal zone of SNP this group does not play any role and reaches the mean density of as few as 20 ind./m^2 (0.005 g/m^2), while on the 3 mile sites the density increases to 1463 ind./m^2 (0.63 g/m^2) (Tab. VII).

Polychaeta

In the surveyed area the polychaetes were represented by 4 species typical for the coastal zone of the Baltic Sea. Among them, of greatest importance was *Hediste diversicolor* and *Pygospio elegans*. The latter species inhabits tube-like „houses" additionally loaded with sand grains, and is regarded as a filter eliminating bioseston. *Pygospio* is also known as a predator attacking oligochaetes. In the presently studied area the densities of *P. elegans* were 1.1 times lower, compared to the mean density of this species in the Polish coastal zone (Warzocha 1995). The densities of this species, however, were higher compared to other sites in the central area of the Polish Baltic coast (Piesik, unpubl.). For instance they were higher

compared to the Darłowo area and significantly higher compared to the Ustka area (Tab. VI). In the proposed 1-mile coastal zone of the SNP, this species attains the lowest densities, while on 2- and 3 miles its density significantly rises (Tab. VII). *P. elegans* constitutes a meaningful food base for benthophagous fishes and through filtration of the water it utilizes excessively appearing bioseston and contributes to purification of the water.

Hediste diversicolor (nereis) is a species having a major importance in the Baltic Sea as a food base for fishes. This polychaete is an omnivore feeding mainly on detritus and sometimes also conducting a predatory life style. The density of *H. diversicolor* in the studied area is about 4 times lower, than the average value for the Polish coastal zone of the Baltic (Warzocha 1995) (Tab. V). Compared to the adjacent coastal area of Darłowo its densities were 4 times lower and compared to the Ustka area they were similar. Similarly, as the oligochaetes and *P. elegans*, this species does not reach high densities in more shallow coastal waters up to 10 m (x-10 ind./m^2) while on 3 miles the density increases to 153 ind./m^2 (Tab. VII). Because of these reasons this species will not have any important role in the proposed 1-mile marine zone of the SNP. It is possible that this species competes with an American newcomer - *Marenzelleria viridis*, which is not yet very numerous in the presently studied area (Tab. IV). *Harmothoe sarsi* is an interesting, rarely encountered oligochaete species. It is, however, a typical item of the macrozoobenthos of the coastal zone of the Baltic Sea (Tab. IV).

Amphipoda

The amphipods were represented in the studied area only by 3 species (*Batyporeia pilosa, Corophium volutator*, and *Gammarus* sp.). Among them the highest density was exhibited by *B. pilosa*, with the frequency (F) of 60% attained a mean density of 336 ind./m^2 (0.28 g/m^2). In the studied area the density of this species was 4 times higher than the average for the Polish coastal zone (Warzocha 1995) (Tab. V). This crustacean is one of the few species adapted to life in shallow waters subjected to strong currents and wave activity. It can live on the so-called moving sandy bottom. For these reasons *B. pilosa* reached its highest density (902 ind./m^2) and wet mass in the zone less than 10 m deep, while on the 3 mile sites its density dropped down to 3.3 ind./m^2. The high density of *B. pilosa* in the 1-mile zone indicates that this species along with *Macoma baltica* will play the most important role in the proposed marine zone of the SNP (Tab. VII). The other species of amphipods occurred sporadically and they do not play any major role in the area studied.

Table V

Comparison of the average density and frequency of macrozoobenthos in the Polish coastal zone (up to the depth of 20-25 m) of the southern Baltic (Warzocha 1995) and in the 3-mile coastal zone adjacent to Słowiński National Park (SNP)

Taxonomic units	Polish coastal waters (Warzocha 1995)		Coastal waters of the SNP	
	L (osobn./m^2)	F (%)	L (osobn./m^2)	F (%)
Nemertini n.d.	1	6	0	0
Harmothoe sarsi	2	12	3,3	7
Hediste diversicolor	166	94	44	47
Pygospio elegans	411	78	335	80
Oligochaeta n.d.	159	74	364	60
Halicryptus spinulosus	5	6	0	0
Hydrobia sp.	1758	74	0	0
Mytilus edulis	199	58	1,3	7
Cerastoderma lamarcki	170	58	1,3	13
Macoma baltica	428	93	6,7	40
Mya arenaria	266	77	1,3	7
Diastyli rathkei	17	27	0	0
Mesidotea entomon	2	17	0	0
Pontoporeia affinis	2	12	0	0
Corophium volutator	224	62	2,6	7
Bathyporea pilosa	90	35	366	60
Gammarus salinus	33	40	0,7	7
Crangon crangon	1	8	0	0
Marenzelleria viridis	0	0	2,6	20

Bivalvia

The bivalves in the studied area exhibited quantitative scarcity and the selection of species was typical for the coastal zone of the southern Baltic Sea. Compared to the average density of the bivalves along the Polish shores (Warzocha 1995) the presently reported density of bivalves was:

for *Macoma baltica* - 64 times lower,
for *Mytilus edulis* - 153 times lower,
for *Cardium glaucum* - 130 tomes lower,
and for *Mya arenaria* - 59 times lower.

The average densities of the bivalves in the adjacent areas of the Central Coast of Poland were as follows (Piesik, unpublished):

	Darłowo area	Ustka area	Present survey
	Density (ind./m^2)		
Macoma baltica	2.0	9.3	6.7
Mytilus edulis	246	1067	1.3
Mya arenaria	0	7.8	1.3
Cardium glaucum	2	12.0	1.3

Tab VI

Range of quantities and frequency (F) of macrozoobenthos in the 3-mile-wide coastal zone of the Baltic Sea near Darłowo and Ustka (Piesik, unpublished) and in the zone adjacent to SNP

Takson	Darłowo area			Ustka area			SPN area		
	$\bar{x}$ ind./m^2	density ind./m^2	F %	$\bar{x}$ ind./m^2	density ind./m^2	F %	$\bar{x}$ ind./m^2	density ind./m^2	F %
Oligochaeta gen. sp.	125.0	0-1216	12	0.0	0	0	364.0	0-2920	60
Pygospio elegans	246.0	0-1136	50	1369.0	0.8930	58	335.0	0-1970	80
Hediste diversicolor	170.0	0-912	50	50.3	0-350	75	44.0	0-360	47
Marenzelleria viridis	0.0	0	0	6.1	0-70	17	2.6	0-20	20
Harmothoe sarsi	0.0	0	0	0.7	0-8	8	3.3	0-50	7
Inne *Polychaeta*	0.0	0	0	2.5	0-30	8	0	0	0
Balanus improvisus	0.0	0	0	10.4	0-125	8	0.0	0	0
Corophium volutator	0.0	0	0	2.3	0-20	17	2.6	0-40	7
Batyporeia pilosa	242.0	0-816	75	9.1	0-64	42	0.7	1-10	7
Gammarus sp.	6.0	0-48	12	6.7	0-80	8	366.0	0-2170	60
Mesidotea entomon	1.0	0-32	12	0.0	0	0	0.0	0	0
Crangon crangon	0.0	0	0	0.7	0-8	8	0.0	0	0
Isopoda	0.0	0	0	0.8	0-16	8	0.0	0	0
Macoma baltica	2.0	0-16	12	9.3	0-48	33	6.7	0-30	40
Mytilus edulis	246.0	0-816	50	1067.0	0-12776	17	1.3	0-20	7
Mya arenaria	0.0	0	0	7.8	0-40	25	1.3	0-20	7
Cardium glaucum	2.0	0-16	12	12.0	0-100	33	1.3	0-10	13
Hydrobia sp.	8.0	0-64	12	25.0	0-100	58	0	0	0
Total	1048			3032			1128		
Number of taxonomic unit	10			16			12		

Tab. VII

Density and wet mass of the macrozoobenthos in three zones (1.0, 2.0, and 3.0 nautical miles) in the coastal waters in the area of Słowiński National Park

Coastal zones	*Oligochaeta*		**Hediste diversicolor**		*Marenzelleria viridis*		*Pygospio elegans*		*Harmathoe sarsi*		*Bathyporeia pilosa*		*Corophium volutator*		*Gammarus sp.*		*Macoma baltica*		*Mytilus edulis*		*Mya arenaria*		*Cardium glaucum*		Total		Number of taxonomic unit
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
0.25-1.0 Mm	13.3	+	10	0.22	0	0.0	141	0.21	0	0.0	601	0.37	0	0.0	0	0.0	4.4	4.74	0	0.0	0	0.0	1.1	0.03	1157	5.57	6
2.0 Mm	296.0	0.18	36.0	0.22	6.6	0.04	583.3	0.57	0	0.0	23.3	0.02	0	0.0	3.3	0.04	13.3	7.06	0	0.0	0	0.0	0	0.0	958	8.13	7
3.0 Mm	1463.0	0.63	153.3	1.78	6.6	+	666.7	0.32	16.7	0.04	3.3	+	13.4	0.15	0	0.0	6.7	9.23	6.7	1.72	6.7	0.75	3.3	0.32	2340	14.94	11
– x	360	0.16	44	0.47	2.7	0.15	335	0.31	3.3	0.01	366	0.27	2.6	0.03	0.7	0.01	6.6	6.10	1.3	0.34	1.3	0.15	1.3	0.08			

A – density (ind./m^2)
B – wet mass (g/m^2)
+ – wet mass > 0,01

It is evident from the above data that except for *M. edulis* the density of the bivalves in the coastal zone of the central coast of the Polish Baltic Sea is similar to the presently surveyed area of SNP. Their another common feature is their low frequency. The present data indicate that in the proposed 1-mile zone of t SNP (down to 10-m depth) the bivalves except for a few *Macoma baltica* and *Cardium glaucum* did not occur in the areas more shallow than 2 m (Tab. VII). Because of the low density and low wet mass the bivalves do not play any major role as a food base for benthophagous fishes. They neither have a visible role in purifying the water through elimination of phytoplankton.

It is evident from the data of Tab. VII that in the proposed 1-mile zone of SNP a qualitative scarcity of the macrozoobenthos (6 species) was observed, while in the 3-mile zone a total of 11 species were observed. Also the density of the macrozoobenthos was 2 times higher in the 3-mile zone, compared to the proposed marine zone of SNP. The values of the wet mass are also lower than these of the sites at 2 miles and 3 miles (Tab. VII). In view of the species diversity of the macrozoobenthos an option should be considered for extending the 1-mile marine zone of SNP to 3 miles. The status of the discussed marine protected area of SNP also needs reconsideration. None of the recorded animals of the macrozoobenthos is a legally protected species and all of them are common for the coastal zone of the southern Baltic Sea. They are not very abundant, which could have been a reason for distinguishing this area among the others in the Polish coastal zone as a specific habitat requiring protection. The scarcity of macrozoobenthos in the presently surveyed area can be used as an argument suggesting that the marine zone of SNP is subjected to weak-impact anthropogenic factors and it can be protected as on almost undisturbed environment of the marine coastal waters. Taking this into account the author suggests to create a 3-mile-wide marine protected area having a status of a marine landscape park serving as a northern buffer zone of Słowiński National Park. Such a solution will provide a legal protection, with in certain limits and will mitigate the conflicts with fishermen.

The efforts towards creation of a marine protected area (BSPA) should be accelerated. The currently observed lack of interest in this problem is a cause for concern.

CONCLUSIONS

1. A total of 12 species of macrozoobenthos was recorded in the 3-mile zone of the Baltic Sea adjacent to Słowiński National Park. The species collected, belonged to *Oligochaeta*, *Polychaeta*, *Amphipoda*, and *Bivalvia*.
2. The highest density in the presently surveyed area represented *Batyporeia pilosa* (x - 366 ind./m^2), representatives of *Oligochaeta* (x - 364 ind./m^2) and *Pygospio elegans* (x - 335 ind./m^2). A moderate density was represented by *Hediste diversicolor* (x - 44 ind./m^2). The average density of the remaining species was low and it ranged from 1.3 to 6.7 ind./m^2).

3. The mean value of the wet mass of macrozoobenthos in the studied coastal area was low and it amounted to 7.82 g/m^2. The highest value of the wet mass represented bivalves *Macoma baltica* (6.10 g/m^2) despite their low density (0.01–0.47 g/m^2).
4. The presently surveyed area has been colonized by a polychete spread to the Baltic Sea form America-*Marenzelleria viridis*. It did not represent intensive development yet (density-2.6 ind./m^2, wet mass-0.05 g/m^2, F = 20%).
5. Among the three zones studied: up to 1 mile, 2 miles and 3 miles, the highest species diversity (11 species), density (2340 ind./m^2) and wet mass (14.94 g/m^2) were observed 3 miles from the shore. The species diversity and the wet mass increased along with the rising distance form the shore.
6. Taking into account the lowest species diversity and the wet mass of the macrozoobenthos in the 1-mile zone with only *Batyporeia pilosa* intensively developed, it is suggested to widen the proposed protected area adjacent to Słowiński National Park to 3 miles. Such a decision would greatly increase the richness of macrozoobenthos and indirectly-also the other ecological formations in the protected zone.
7. Taking into account the presence in the surveyed area of typical Polish coastal zone bottom fauna and lack of legally protected macrozoobenthos species the present author postulates to create a 3-mile-wide protected area having the status of a Landscape Park, serving as a northern buffer zone of SNP. The surveyed area should be protected as an area only slightly influenced by anthropogenic factors, which is indicated by the scarcity of macrozoobenthos formations.

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