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Meiobenthic bristle worms (*Polychaeta*) of the western Black Sea shelf

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Abstract

The species composition, frequency and quantitative distribution of polychaetes (larvae, adult forms) which in size belong to meiobenthos have been studied. Thirty four species of polychaetes, six of which belong to eumeiobenthos have been discovered. In species composition the Bulgarian shelf (33 species) differs significantly from the Romanian (22 species) and Ukrainian (21 species). The mean density of assemblages is higher on the Bulgarian shelf. Maximum indices of abundance occur at a 15 m depth.

Keywords: Black Sea, western shelf, meiobenthos, polychaetes, eumeiobenthos, pseudomeiobenthos.

Introduction

The western Black Sea shelf (WBS) is of special interest for ecological research. Very diverse environmental conditions from the Dnieper-Bug area to Burgas Bay related to the level of impact of river runoff of the Dnieper, Dniester and Danube are observed.

The dynamics of hydrological and hydrochemical parameters determine the marked variability of characteristics of sea bottom invertebrates. The present day state of meiobenthic polychaetes was analyzed. Small (up to 2-5 mm) meiobenthic invertebrates of different water bodies have been described by Mare 1942, Hulings and Gray 1971. The term meiobenthos in scientific literature has been introduced much later than the terms benthos and plankton. The former was proposed by Peterson in 1911

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and the latter by Hensen in 1887. Although the term meiobenthos was introduced in 1942 (Mare 1942), organisms in this benthic category were first intensively studied in the 1960s. It is known that the meiobenthic community includes permanent and temporary components. Each is characterized by a certain amount of large taxonomic groups (Bougis 1950, McIntyre 1969). According to Chislenko (1961) the permanent component was named eumeiobenthos, and the temporary pseudomeiobenthos. Both names have been used by the authors. When studying marine meiobenthos, it is mostly the permanent component. A detailed study of pseudomeiobentos has not yet been carried out. Usually it plays a significant role in the formation of biodiversity, quantitative indices and production (Thorson 1966, Galtsova 1991, Vorobyova 1999). In most cases when ascribing polychaetes to pseudomeiobenthos, the presence of larvae and juvenile polychaetes which later pertain to macrozoobenthos has been considered. Small adult individuals also occur which in size are true eumeiobenthic organisms (Vorobyova, Bondarenko 2007, 2008). Unfortunately, special studies on the ecology of eumeiobenthic Black Sea polychaetes have not been conducted.

Material and Methods

Samples of meiobenthos were taken in September 2003 on board the Bulgarian R/V "Akademik" on the Bulgarian, Romanian and Ukrainian parts of the northwestern Black Sea shelf were taken (Table l). On 11 transections bottom sediments were sampled at depths of 15, 25, 35, 45, 65, 90, 110 and 125 m. The samples were taken with a multicorer, washed through a system of sieves the bottom of which had a 90 μm mesh diameter, fixed with 40 % formaldehyde and stained with Bengal rose dye. A total of 72 samples were taken. Two keys (Marinov 1977, Kiseleva 2004) were used to identify the polychaetes.

Table 1. Sampling stations (station number, coordinates) in the western Black Sea.

Station number	Coordinates		Station number	Coordinates	
	Latitude, N	Longitude, E		Latitude, N	Longitude, E
Varna Transect (VA)			35SG065	44°35'06"	30°05'81"
01VA015	43°12'24"	27°58'54"	34SG090	44°20'17"	30°30'85"
64VA020	43°11'58"	28°07'03"	33SG110	44°16'61"	30°36'15"
02VA025	43°07'06"	28°10'00"	32SG125	44°47'60"	30°36'75"
03VA035	43°05'88"	28°14'28"	Constantza Transect (CT)		
04VA045	43°05'03"	28°16'98"	22CT015	44°09'09"	28°41'68"
05VA065	43°03'81"	28°23'28"	23CT025	44°09'09"	28°47'78"
06VA090	43°02'00"	28°16'97"	24CT035	44°07'83"	28°46'23"
07VA110A	43°00'88"	28°32'64"	25CT045	44°05'07"	29°02'01"
08VA125	43°00'63"	28°33'11"	26CT065	43°58'22"	29°30'10"
Burgas Transect (BG)			27CT090	43°47'74"	29°59'78"
09BG015	42°27'93"	27°31'13"	28CT110	43°45'87"	30°03'98"
10BG025	42°27'90"	27°40'70"	29CT125	43°45'28"	30°07'38"
11BG035	42°26'98"	27°49'00"	Odessa Transect (OD)		
12BG045	42°27'00"	27°57'05"	50OD025	46°24'95"	30°49'19"
13BG065	42°28'60"	28°05'09"	54OD25	46°22'56"	30°59'61"
Cap Kaliakra Transect (CK)			55OD035	46°10'94"	30°56'32"
14CK015	43°20'96"	28°26'94"	Dnieper Transect (NE)		
15CK025	43°20'93"	28°27'60"	53NE015	46°27'25"	30°56'95"
16CK035	43°19'97"	28°27'91"	51NE025	46°29'58"	30°49'96"
17CK045	43°18'87"	28°29'15"	52NE025	46°26'61"	30°39'65"
18CK065	43°16'51"	28°32'35"	Zhebrian Bay Transect (ZB)		
19CK090	43°11'00"	28°41'00"	44ZB015	45°31'02"	29°54'90"
20CK110	43°09'80"	28°41'86"	45ZB025	45°29'10"	30°22'23"
Sulina Transect (SU)			Phyllophora field Transect (PH)		
40SU015	45°04'25"	29°44'05"	56PH025	45°47'77"	31°00'47"
41SU025	45°04'00"	29°48'31"	Dniester Transect (DN)		
42SU035	45°02'19"	30°03'81"	49DN015	45°58'71"	30°33'15"
43SU045	44°57'06"	30°16'05"	48DN025	45°44'26"	30°31'64"
63SU065	44°48'75"	30°38'59"	47DN035	45°34'07"	30°56'84"
62SU090	44°41'07"	31°00'82"	46DN045	45°25'99"	31°04'62"
Sf. Gheorghe Transect (SG)			57DN065	44°57'82"	31°30'02"
39SG015	44°49'82"	29°38'85"	58DN090	44°45'24"	31°35'93"
38SG025	44°49'41"	29°39'52"	59DN110	44°43'59"	31°35'49"
37SG035	44°48'82"	29°40'40"	60DN125	44°42'74"	31°36'18"
36SG045	44°44'05"	29°49'01"			

Results and Discussions

In the study area 34 polychaete species were encountered of which 6 species were representatives of eumeiobenthos. The remainder was made up of juvenile individuals of macrozoobenthic forms at the larval stage deposited from the pelagic zone, and continuing development at the sea bottom in the pseudomeiobenthos. Besides, some representatives of Terebellida, lacking a pelagic stage in their life cycle were discovered on the Bulgarian shelf (31 species). On the Romanian shelf 22 species of polychaetes were encountered and on the Ukrainian 21 species. It is evident (Table 2) that there are 15 common species for all three areas.

Polychaete frequency 89.66% is quite high. This pertains to macrozoobenthic forms of larvae (P- 86.57%) which illustrate the total frequency index. Eumeiobenthic species occurred in 50% of the samples, with some species having a frequency in a range of 1.74- 24.14%.

Only 6 species of eumeiobenthic polychaetes have been recorded on the western Black Sea shelf. For the Black Sea as a whole at present there are about twenty species, the majority of which inhabit a narrow coastal zone to a depth of less than 10 m.

Vigtoniella zaikai; a species which was recently encountered in the Black Sea. Its adult individuals are ascribed to the lower sublittoral south east of Crimea at 130 m and 150 m depths. Metatrochophores and nektochaetes have been observed in all seasons in the 100- 150 m layer in the central area of the sea (Sergeeva et al. 1997, Kiseleva 2004). Representatives of this species were encountered only at two stations at depths of 110 and 125 m.

Syllides longocirrata; 3-5 mm maximum body length, inhabit sandy-gravelly, sandy, silty-sandy and silty-shelly sediment at 1-50 m depths (Kiseleva 2004). It was recorded in small numbers (its density near Sevastopol, not exceeding 5 ind./m^2). In the study area on the shelf the frequency was 18.97% and the mean density of assemblages 214 ind./m^2. Maximum aggregations of *S. longocirata* were observed in the Dniester area.

Table 2. Species composition of meiobenthic polychaetes on the western Black Sea shelf.

Taxon	Bulgaria	Romania	Ukraine
Phyllodoce mucosa Oerstéd, 1843	+	+	+
Eulalia viridis (Linné, 1767)	+	+	
Eumida sanguinea (Orstéd, 1843)	+	+	+
Phyllodocidae	+		
Nephtys hombergii Savigny, 1818	+	+	+
Nephtys sp.	+		
Harmothoe imbricata (Linnaeus, 1767)		+	+
H. reticulata (Claparède, 1879)	+	+	
Harmotoe sp.	+	+	+
Vigtorniella zaikai (Kisseleva, 1992) ▲	+		+
Neanthes succinea (Frey et Leuch, 1847)	+	+	+
Nereis sp.	+	+	
Platynereis dumerilii (Audouin et M.-Edwards, 1834)			+
Syllides longocirrata Oerstéd, 1845▲	+	+	+
Exogone gemmifera Pagenstecher, 1862▲	+	+	+
Sphaerosyllis bulbosa Southern, 1914▲	+	+	+
Microphthalmus sczelkowii Metschnikow, 1865▲	+		
Pseudomalacoceros tridentata (Southern, 1914)	+		
Aonides paucibranchiata Southern, 1914	+	+	+
Spio filicornis (O.F.Muller, 1776)	+	+	+
Pygospio elegans Claparède, 1863	+		
Polydora limicola Annenkova, 1934	+	+	+
P. antennata Claparède, 1868	+	+	
Prionospio cirrifera Wiren, 1883	+	+	+
Aricidea claudiae Laubier, 1967	+		
Notomastus profundus Eisig, 1887	+		
Heteromastus filiformis (Claparède, 1864)	+	+	+
Capitella capitata (Fabricius,1780)	+	+	+
Clymenura clypeata (Saint-Joseph, 1894)	+		
Terebellides stroemi Sars, 1835	+	+	
Melinna palmata Grube, 1870	+	+	+
Lagis neapolitana (Claparède, 1868)	+		+
Oriopsis armandi (Claparède, 1864) ▲	+	+	+
Pomatoceros triqueter (Linné, 1767)			+

▲ – eumeiobenthic species

Exogone gemmifera; length up to 4 mm. In the Black Sea it is encountered from 0 up to 105 m depths. In significant amounts it was observed in the summer on sandy-gravelly sediments in the Karadağ area (Kiseleva 2004). According to our observations adult individuals which are carnivores occur from April until August. Their frequency was 24.14%. At a depth of 45 m they were not recorded. The average density is 323 ind./m^2.

Sphaerosyllis bulbosa; length up to 6 mm. In the Black Sea it is encountered from 5 m to 105 m depths on diverse sediments. Maximum aggregations of this species were recorded on silty sediments near the western Crimean coast with a density of 8 000 ind./m^2 (Kiseleva 2004). In our samples polychaetes were recorded in all three areas of the western shelf. The highest density 10-3 950 ind./m^2 was noted on the Bulgarian shelf. The average density on the entire shelf was 310 ind./m^2.

Microphthalmus sczelkowii; length of 2-5 mm, with pale yellow color and brown spots. It inhabits in diverse Black Sea sediments, occurring at 10- 30 m depths (Vinogradov 1949, Marinov 1977). Along the Crimean coast in the summer it forms significant aggregations at a 20 m depth-1 950 ind./m^2 (Kiseleva 2004). They are phytophages feeding on algae (Fauchald, Jumars 1970). They were encountered once in the Burgas transection at a depth of 45 m.

Oriopsis armandi; 2-4 mm length which sometimes reach a 6 mm length and are frequent in silty sediments at depths to 150 m (Kiseleva 1981, 1985). According to our data *O. armandi* reached 4 000 ind./m^2 in Phaseolina mud. This species was recorded at 35-90 m depths on the Bulgarian shelf at the Varna and Burgas transections making up 239 ind./m^2 at a 35m depth. At a 45 m depth it was noted at all three transections. The minimum amount was registered at Kaliakra Cape (255 ind./m^2), maximum at the Varna transaction 3 949 ind./m^2 and average 940 ind./m^2.

At a 65 m depth *O. armandi* was encountered at 5 transactions on the Bulgarian and Romanian shelves (127-255 ind./m^2). Their density on the Bulgarian shelf varied in a wide range from 940 to 3 312 ind./m^2. For the 65 m depth the mean density was 983 ind./m^2. At greater depths these

polychaetes were recorded only at one station (Ukrainian shelf) with a very low density 127 ind./m^2. Maximum aggregations were observed at 45-65 m depths.

The Ukrainian shelf is a good illustration of species diversity (Figure 1).

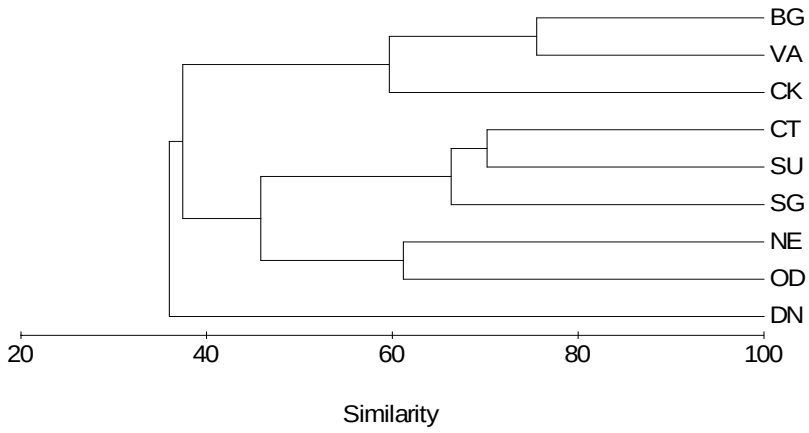

Figure 1. A dendrogram of the Brey-Curtis similarity coefficient of the transections: BG, VA, CK-Bulgarian shelf; CT, SU, SG-Romanian shelf; NE, OD, DN-Ukrainian shelf

Larval frequency varied in a wide range. Most frequent were juveniles of the following species: *Heteromastus filiformis* (P-43.10%), *Prionospio cirrifera* (P-37.93%), *Neanthes succinea* (P-36.21%), *Melinna palmata* (P-29.31%), *Nephtys hombergii* (P-25.86%), *Polydora limicola* (P-25.86 %), *Aricidea claudiae* (P-24.14%) and the remainder from 1.74% to 18.97% frequency.

Mean density indices of polychaetes on the Bulgarian shelf (average 13 360 ind./m^2) varied at different transections from 3 785 to 17 287 ind./m^2. Maximum aggregations were characteristic for *A.claudiae* (mean 8 283 ind./m^2), *M.palmata* (mean 840 ind./m^2), *S.bulbosa* (mean 752 ind./m^2), *O.armandi* (mean 710 ind./m^2) and *P.cirrifera* (mean 503 ind./m^2).

Two of the 5 species belong to eumeiobenthos. It should be emphasized that in the Romanian and Ukrainian shelf areas eumeiobenthic species

are less frequent than in the Bulgarian and are not significant in the total polychaete density. On the Bulgarian shelf it is a mean 15.69% of the total polychaete density.

On the Ukrainian shelf the mean total density of polychaetes was 7 988 ind./m^2. A maximum was noted at the Dniester transection (12 038 ind./m^2). Here maximum aggregations were characteristic for *P.limicola* (mean 3 691 ind./m^2). Maximum aggregations in the estuarine Dniester area at a depth of 15 m were 54 904 ind./m^2. For *P.cirrifera* there was a mean 1 641 ind./m^2 and a maximum- 11 465 ind./m^2 also in the Dniester area at a 15 m depth. For *N.succinea* a mean 1 079 ind./m^2 and a maximum 5 350 ind./m^2 were also registered there.

On the Romanian shelf the mean total density of larval polychaetes was somewhat lower than on the Bulgarian (2 651 ind./m^2) and varied from 1 619 ind./m^2 for the Sf. Georghe transection to 4 246 ind./m^2 at the Sulina transaction. High density aggregations were characteristic for some species. For *N. succinea* at some stations it reached 2 166-3 694 ind./m^2. For *P. antennata* (mean 225 ind./m^2) at Sta. 42 SU035 it was 1 783 and at Sta.43 SU 035- 3 822 ind./m^2.

Seven species of larval polychaetes on the entire western Black Sea shelf form relatively large aggregations in which two are eumeiobenthic species.

The meiobenthic polychaetes have been ranked according to total density (Table 3). Leading species are *A.claudiae*, *P.limicola*, *P.cirrifera*, *N.succinea* and *M.palmata*. These species prefer silty substrates able to withstand high organic levels.

The results of the analysis of vertical distribution of polychaetes have shown that species diversity and density vary according to depth (Figure 3). Most of the polychaete species have been encountered at 15-65 m depths. The maximum mean density was characteristic for the 15 m isobaths (Figure 2).

Table 3. Features of the meiobenthic Polychaeta in the western Black Sea. F%: frequency, D_d: dominance, D_{avg}: average density, D_{eco}: ecological density, R_{kD}: rank of species according to density.

Taxon	F %	D_D %	D_{avg}	D_{eco}	Rk_D
Phyllodoce mucosa	15.52	0.50	40.63	262	16
Eulalia viridis	3.45	0.04	2.93	85	31
Eulalia sanguinea	15.52	0.50	40.27	259	17
Phyllodocidae	5.17	0.14	10.98	212	24
Nephtys hombergii	25.86	0.99	80.17	310	15
Nephtys sp.	1.72	0.03	2.20	64	32
Harmothoe imbricata	5.17	0.16	13.18	255	22
H. reticulata Claparede	3.45	0.05	4.39	127	29
Harmothoe sp.	10.34	0.30	24.16	234	19
Vigtorniella zaikai	3.45	0.11	8.79	255	25
Neanthes succinea	36.21	6.76	548.72	1 516	4
Nereis sp.	10.34	0.37	28.19	294	18
Platynereis dumerilii	1.72	0.11	8.79	510	25
Syllides longocirrata	18.97	2.64	214.14	1 129	11
Exogone gemmifera	24.14	3.98	323.23	1 339	6
Sphaerosyllis bulbosa	20.69	3.79	307.49	1 486	7
Microphthalmus sczelkowii	1.72	0.03	2.20	127	32
Pseudomalacoceros tridentata	1.72	0.04	3.29	191	30
Aonides paucibranchiata	8.62	0.19	15.37	178	20
Spio filicornis	8.62	1.37	110.92	1 287	14
Pygospio elegans	1.72	0.24	15.37	573	20
Polydora limicola	25.86	14.26	1157.48	4 476	2
P. antennata	18.97	3.01	244.16	1 287	10
Prionospio cirrifera	37.93	8.88	720.77	1 900	3
Aricidea claudiae	24.14	36.95	2825.61	11 597	1
Notomastus profundus	3.45	0.16	13.18	382	22
Heteromastus filiformis	43.10	3.14	252.95	569	9
Capitella capitata	15.52	1.65	133.98	863	13
Leiochone clypeata	1.72	0.03	2.20	127	32
Terebellides stroemi	3.45	0.11	8.79	255	25
Terebellida larvae	10.34	1.94	157.41	1 522	12
Melinna palmata	29.31	4.14	334.21	1 084	5
Lagis neapolitana	5.17	0.08	6.59	127	28
Oriopsis armandi	20.69	3.29	267.22	1 292	8
Pomatoceros triqueter	1.72	0.03	2.20	127	32

Only six species have been encountered at a 100 m depth, three of which pertain are attributed to eumeiobenthos (*V.zaikai*, *S.longocirrata*, *E.gemmifera*) and three juvenile individuals (*P.cirrifera*, *H.filiformis*, *C.capitata*).

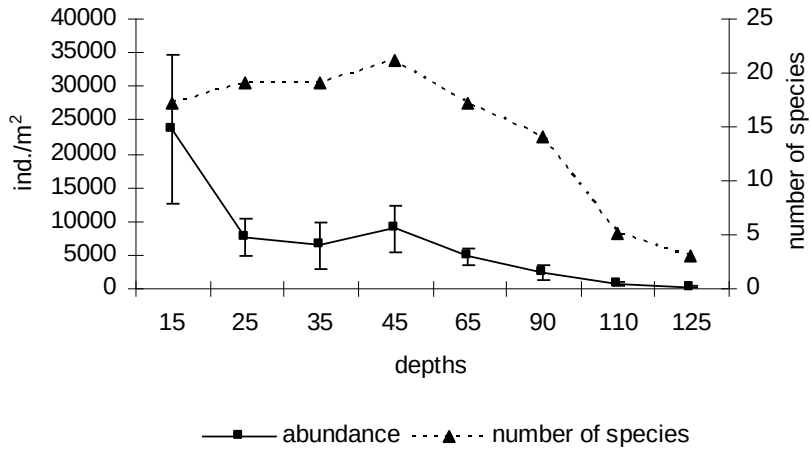

Figure 2. Distribution of abundance (ind./m^2) of meiobenthic polychaetes at different depths.

Eumeiobenthic polychaetes prevailed at 45-90 m depths. *V.zaikai* was present in samples taken at 110-125 m depths.

S.longocirrata; a species widely distributed and observed at 15-110 m depths. *S.bulbosa* may also be considered as an eurobathic species. According to literature data in spite of *E.gemmifera* being ascribed to these species in a 0-100 m depth range, in our samples they were recorded at 35-90 m depths. *O.armandi* has been noted at 35-60 m depths. At greater depths only sole specimens were encountered. *M.sczelkowii* in a small quantity (127 ind./m^2) was registered once on the Bulgarian shelf (45 m).

Most of the larval polychaetes settled at 15-45 m and with increasing depth their density decreased significantly. The highest density was observed for *P.cirrifera*, *A.claudiae*, *N.hombergii*, *H.filiformis* and *M.palmate* eurobiontic species. In the Black Sea *P.cirrifera* was

encountered up till 116-120 m depths and *A.claudiae* up to 160 m (Kiseleva 2004). They are tolerant to a lack of oxygen. The density of the first two species was maximal to a 40 m depth. *P.antennata* occurs on the Romanian shelf. *P.limicola* larvae were dispersed to a 35 m depth. Most of them occurred at a 15-25 m depth on the Ukrainian and Romanian shelves with *N.succinea* occurring there at 15-45 m depths. Maximum aggregations were observed on the Ukrainian (5 350 ind./m^2) and on the Romanian shelves (3 694 ind./m^2) at 15- 25 m. Adult forms of these species inhabit shallow water areas of the sea (Losovskaya 1988, Kiseleva 2004) and are considered as euryhaline species. They are tolerant both to significant freshening and high salinity (Marinov 1977, Kuhl, Oglesby 1979).

Polychaetes in the meiobenthos are represented by temporary (larvae and juveniles), and permanent components. At a 15-125 m depth six species belonging to eumeiobenthos have been revealed. Their average density on the Bulgarian shelf was 2 087 ind./m^2 (juvenile polychaetes- 11 213 ind./m^2). On the Romanian shelf the average density of eumeiobenthic polychaetes was 5 fold less (408 ind./m^2) with juveniles making up 2 243 ind./m^2.

On the Ukrainian shelf their average density was slightly higher (749 ind./m^2). However, juvenile average density (7 240 ind./m^2) was higher than on the Romanian and lower than on the Bulgarian shelf. Maximum aggregations of *E.gemmifera* 764 ind./m^2, *P.cirrifera* 1 656 ind./m^2, *A.claudiae* 22 293 ind./m^2, *M.palmate* 5 987 ind./m^2 and *O.armandi* 77 070 ind./m^2 occurred on the Bulgarian shelf. On the Romanian shelf it was maximum for *E.gemmifera* 1 805 ind./m^2, *N.succinea* 3 694 ind./m^2 and *P.antennata* 4 692 ind./m^2, and the Ukrainian shelf for *P.cirrifera* 11 465 ind./m^2, *N.succinea* 5 350 ind./m^2, *S.longocirrata* 7 516 ind./m^2 and *P.limicola* 54 904 ind./m^2.

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