SOME REMARKS ON THE ECOLOGICAL STATE OF BENTHIC POPULATIONS RECORDED DURING THE IAEA '98 BLACK SEA CRUISE OF "PROF. VODYANITSKIY" R/V

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Abstract. This paper presents the quantitative and qualitative distribution of benthic populations in the north-western continental shelf of the Black Sea, in the summer of 1998. The studies are based on the 11 quantitative samples collected during IAEA '98 Redeux Project Cruise. Overall, 70 species belonging to 14 major taxa have been identified. The diversity of species and the abundance of populations were generally low. The most abundant organisms were the worm populations, with Nematoda group reaching the highest density. In comparison with the previous assessment the ecological state of the benthic populations is still precarious and there are some uncertainties, which make it difficult to draw a final conclusion. Certainly, the number of samples is small, but there are some difficulties in establishing the tendency of the populations, benthic organisms being heterogeneously distributed on the seabed.

Key words: Black Sea, ecosystems, benthos, biodiversity

INTRODUCTION

The Black Sea represents today for oceanographers the number one negative example of ecological decline among the marine ecosystems. The decline began in the middle of '70s and continues even today. During the totalitarian era, in most of the Black Sea riparian countries, many studies have been performed, which evidence major disturbances of the characteristic ecosystems, most of the disturbing causes being attributed to eutrophication (Gomoiu, 1992). Pollution, in particular its effects on the marine organisms, has been studied in less detail. Today, we signal the disappearance or scarcity of some species, and we still don't know exactly why; most of these organisms live on the sea bottom, formerly having a great biodiversity and high productivity in the shallow biotic areas (Gomoiu, 1999).

After 1990, the political changes in the Black Sea area led to the development of the international co-operation in the studying of this sea. The Black Sea became an extremely interesting "case" not only for the scientists from the riparian countries but also for many researchers from the European and North-American scientific community. The international programs from the last 5 years focused on the knowledge and structure of the water mass and paid less attention to benthos. However, in the framework of the EROS 2000 program, after 2 sampling cruises were carried out (Leg 2 and Leg 4), we succeeded to get an up-to-date general image of the benthic populations from the NW Black Sea (Gomoiu, 1997), but the number of stations and samples was nevertheless insufficient for a qualitative and quantitative assessment with a high degree of confidence.

The scarcity of the last decade of the NW Black Sea benthos studies, justified not only by the economical decline of the area, but also by the decreasing interest of the specialists for this field. However, thanks to the IAEA RADEUX program in the Black Sea and to Dr. Iolanda Osvath, who understood our desire to study the bottom organisms, in 1998 we performed an investigation on the benthic populations. The resulting data, although few are important, and all of them raise a series of problems, have contributed to a better knowledge of the Black Sea benthos.

WORKING METHODS

Quantitative samples of zoobenthos were taken from 11 stations (Figure 1), roughly distributed along two transects, which were more or less parallel with the NW coast of the Black Sea, covering the following sectors (depositional zones):

– shallow, nearshore bottoms: St. RA-6/23 m (influenced by the Dniestr River); St. RA-5/20 m. St. RA-4/14 m and St. RA-3/47 m (directly influenced by the Danube River);
– sediment starving bottoms on the offshore continental shelf: St. RA7/40 m, St. RA-8/50 m, St. RA-10/76 m and St. RA-11/65 m; in this group should also be included St. RA-12/107 m, situated near the shelf break, and
– bottoms situated in the area under Danube born sediment drift (Southern sector of the Romanian continental shelf): St. RA-2/48 m and St. RA-1/60 m.

In each station, quantitative (1/133 m^2) undisturbed sediment samples were taken with a multicorer Mark II-400, fitted with four perspex tubes. At least one core per station, planned for biological purposes, was carefully extruded from the tube in three fragments: 0-5 cm (with the overlaying water), 5-10 cm and 10-15 cm depth from the sediment-water interface; from some tubes the integral 0-15 cm layer of surface sediment and two smaller sediment subsamples for testacean microfauna were retained; all biological samples were stored in plastic bags, preserved in 4% formaldehyde and stained with Congo Red, to be subsequently sorted and studied in GeoEcoMar laboratory in Constantza.

The analyses of the benthos samples are performed according to the usual methodologies and data analysis used in marine benthology (Gomoiu, 1997).

RESULTS AND DISCUSSION

From the results of the biological data processing, the following conclusions can be drawn:

1. The organisms found in IAEA '98 Black Sea stations belong to 15 taxonomic groups; only in four cases the organisms were not identified to the species: the worms belonging to Turbellaria, Nematoda and Oligochaeta and the crustaceans from the Harpacticoida order. In the other 11 groups, 66 species were recorded (Table 1).

2. Diver groups include number of species: Polychaeta – 30 species, Foraminifera – 12 species, Ostracoda – 9 species and Amphipoda – 6 species (Figure 2).

3. Going from the taxonomical structure of organisms to taxonomic composition of the benthic populations (Figure 3), the most relevant aspects are:

– the most abundant group, both in average numerical density and biomass, are the worms – 66 - 69%; foraminifera represent numerically 17%, but they have a very low biomass; crustaceans are on the third place both in density and biomass – 16 – 12%; the mollusks which are very few by number, by their mass take the second place in the biomass of benthic populations;

– among the worms, the Nematoda are the most numerous (73%), but the Polychaeta (including Archiannelida) dictate the value of biomass – almost 100%;

– referring to the crustaceans, the importance of different groups varies: Tanaidacea – 11% in average density (D_{avg}) but 35% in average biomass (B_{avg}), Amphipoda – 6% in D_{avg} and 18% in B_{avg}, Harpacticoida – 36% in D_{avg} and only 1% in B_{avg}.

4. From the quantitative point of view, benthic populations from the NW Black Sea continental shelf, during Radeux '98 expedition have presented the following general features (Table 1):

– euconstant forms (having a presence of 75.1-100% in the studied area) are only Nematoda, present in all stations; constant species (50.1-75%) are some foraminifera (*Nonion depressulum, Ammonia beccarii, A. tepida*), some Polychaeta (*Harmothoe reticulata, Capitella capitata*) and Oligochaeta worms, species of crustaceans belonging to Ostracoda (*Cytheroma variabilis, Leptocythere multi-punctata, Loxoconcha granulata*) and Harpacticoida; then there are also 25 (35.7%) accessory species (25.1-50%) and the rest of 34 species (48.6%) are accidental forms (1-25%) being restricted ti limited areas of (1-2 stations);

– by numerical dominance the most important forms are: Nematoda (47,61%, Polychaeta worm *Capitella capitata* (8.47%), Harpacticoida crustaceans (5.81%), some foraminifera (*Nonion depressulum* – 3.53%, *Ammonia beccarii* – 3.69%, *A. tepida* – 2.71%, *Elphidium advenum ponticum* – 2.88% and *Cribroelphidium poeyanum* – 1.34%), some Ostracoda crustaceans (*Callistocythere diffusa, Cytheroma variabilis, Leptocythere multipunctata, Xestoleberis cornelii* – 1.06 – 1.79%) etc.; a total of 13 forms are ranked with a numerical dominance greater than 1%;

– regarding the index of dominance for the average biomass, the most important forms are the mussel *Mytilus galloprovincialis* (14.89%), the Polychaeta worm *Melinna palmata* (8.25%), *Terebellides stroemi* (4.90%), *Neanthes succinea* (3.87%) etc., the crustacean *Apseudes ostroumovi* (4.30%) and the little Ophiurida *Amphiura stepanovi* (2.03%); these 6 species form near 40% of the biomass;

– in accordance with the values of the index of ecological significance (synthetical expression of the relation between constancy and relative abundance of a population), the first five species in the studied area are:

Densities (=69.11%)

1. Nematoda var. (Worms)
2. *Capitella capitata* (Polychaeta worm)
3. Harpacticoida var (Crustacea-Copepoda)
4. *Ammonia beccarii* (Foraminifera)
5. *Nonion depressulum* (Foraminifera)

Biomasses (=36.21%)

1. *Melinna palmata* (Polychaeta worm)
2. Terebellides stroemi (Polychaeta worm)
3. *Mytilus galloprovincialis* (Mollusca–Bivalvia)
4. *Neanthes succinea* (Polychaeta worm)
5. *Apseudes ostroumovi* (Crustacea-Tanaidacea)

- average values of density and biomass in the area investigated by the Radeux '98 Black Sea expedition were 43,201 sps.m^{-2} and 35.72 g.m^{-2}.

5. The distribution of the benthic life considerably varies on the NW Black Sea bottoms, being influenced by many factors such as the influx of freshwater and pollutants, depth, depositional zones etc. Parallel analysis of densities and biomasses in connection with the depth gradient, along a hypothetical transect including all stations aligned according to the gradual increase of depth (Figure 4) reveals the following aspects:

– densities, with a single exception (St. RA-3 – 184.737 sps.m^{-2}), are generally low and uniform, oscillating between 10.000 and 60.000 sps. m^{-2};

– biomasses are also low, oscillating very much from one station to another in the range 2.555 – 102.083 g.m^{-2};

– the highest abundance of benthic populations by numerical density was recorded in St. RA-3, Southern sector of the Danube Delta front, and by biomass in St. RA-1, in the area under the Danube born sediment drift;

6. Large variations of densities and biomasses (Fig. 5) have been recorded within the taxonomic groups of organisms:

- Foraminifera are missing or are very few on the shallow bottoms; their highest abundance was recorded in St. RA-8/50 m depth (Figure 5);
- Worms are present everywhere, with densities oscillating in the range 3.000 – 173.000 sps.m^{-2} (Fig. 5);
- Mollusks were found only in few stations, covering two zones: one in the Northern sector of Danube Delta (Stations RA-4, RA-5 and RA-7) and another in the Southern part of the Sediment starving continental shelf (St. RA-11) (Figure 5);
- Crustaceans were recorded almost everywhere in the studied zone (except St. RA-4/14 m);
- Varia, representing only one species of Halacarida (Arachnoida) and one species of Ophiurida (Echinodermata) are present only in three stations (RA-1, RA-10 and RA-11) on deeper bottoms (Figure 5).

7. The worm populations, which are today the most abundant organisms on the NW Black Sea bottoms, actually play the most important role in benthic biocoenoses due to their high densities (Figure 6) and intense activity in sediments by processing – bioturbating them. Among the Worms, Nematoda reach the highest densities only in some stations, having lower, unimportant biomasses. Archiannelida are present in 5 stations with not so high densities and biomasses usually smaller than 1 g.m^{-2}. In four stations on the deeper bottoms, the Turbellaria and Nemertian (*Micrura fasciolata*) worms are present with small populations. The Polychaeta worms are well represented, having sometime an abundance higher than 20000 sps.m^{-2} and 35 g.m^{-2}; let's present some remarks on the Polychaeta populations:

- *Capitella capitata* (density rank 2) is the most common Polychaeta worm in the IAEA '98 Black Sea area; *Capitella* is a deposit feeder;
- *Melinna palmata* (biomass rank 1) is distributed continuously on the 40-60 m bottoms in the Southern sector of the Romanian continental shelf, being a tubicole sedimentophilous deposit feeder;
- *Harmothoe reticulata*, a eurybathic iliophilous organism, forms less abundant populations.

8. In some stations the samples were analyzed by three successive layers, 0-5 cm, 5-10 cm and 10-15 cm, in order to register the penetration of benthic organisms into the thickness of sediment. All the results reveal that most populations inhabit the surface layer; as the depth into the sediment increases, the organisms are less and less numerous (Figure 7).

9. A general view over the benthic assemblages from IAEA '98 Black Sea Zone may be resumed by the following aspects:

➢ Specific similarity between benthic assemblages/stations, according to the index of Jaccard is generally low (Figure 8); the higher values (>50%) for a few groups of stations are as follows:

- Stations 5-4, in the near vicinity of the Danube Mouths, at 14-20 m depth, where assemblages are formed by a relatively low number of species, with fluctuant populations;
- Stations 7-8-2, at 40-50 m depth, with the associations formed by 20-29 species, whose populations have very variable density and biomass;

➢ In the NW Black Sea IAEA '98 area, the benthic diversity was low – 66 species (plus a few unknown species – not identified yet, from the higher taxa – Turbellaria, Nematoda, Oligochaeta and Harpacticoida). Benthic associations are formed by 6-36 taxa (in average 16-17 species), and among the populations constituting the communities, there are large quantitative differences (equitability being very low).

➢ The abundance of benthic populations is generally low and varies both within each assemblage/station as well as from one assemblage to another.

CONCLUSIONS

In conclusion, the actual state of Black Sea benthic ecosystems, at least those from the north-western continental shelf, may be briefly characterized as follows:

- drastic decrease of the specific diversity;
- simplifying of vegetal and animal benthic communities structures – biocoenotic homogenizing;
- decrease of the numeric abundance and biomass of benthic populations;
- diminution of the biofilter strength by reduction of the filter – feeder populations;
- qualitative and quantitative worsening of benthic biological resources, especially mollusks, forms playing an important ecological part and with great economic importance;
- thriving of opportunistic forms (especially worms populations causing sediment bioturbation – *Melinna palmate*) and, temporarily, some exotic species recently pervading Black Sea (*Mya, Scapharca, Rapana* etc.);
- great quantitative fluctuations of all benthic populations.

In comparison with the previous assessment of the ecological state of the benthic populations from the NW Black Sea (Gomoiu, 1997, 1999; Panin *et al*., 1996; Wijsman et al., 1999), the present situation worsened much more. For example, the ratios of the 1998 – IAEA Cruise (present data) vs. 1997 – EROS "Vodyanitzkyi" Cruise, Leg 2 (Gomoiu, 1999) of different parameters describing the general state of the benthic ecosystem are as follows: 0.60 for the number of recorded taxa, 0.23 for the average density of the populations, 0.22 for average biomass etc. It is worth mentioning that the structure of the first 12 species ranked according to the index of ecological importance in the NW Black Sea area is very similar in 1997 and 1998, although the abundance in 1998 is smaller than in 1997: 0.16

Nematoda (Rk 1), 0.50 *Capitella capitata* (Rk 2), 0.08 Harpacticoida (Rk 3), 0.40 *Ammonia beccarii* (Rk 4), 0.80 *Nonion depressulum* (Rk 5), 0.68 *Ammonia tepida* (Rk 6), 0.62 *Elphidium ponticum* (Rk 7), 0.92 *Cytheroma variabilis* (Rk 8), 0.78 Oligochaeta varia (Rk 9), 0.72 *Apseudes ostroumovii* (Rk. 10), 0.29 *Cribroelphidium poeyanum* (Rk 11), 0.03 *Leptocythere multipunctata* (Rk 12). This example indicates that it is obvious that beyond the natural variability and heterogeneity, the general tendency of main benthic organism abundance in 1998 is a decreasing one, in spite of the relative stability of the qualitative-biodiversity. Previous data (Gomoiu, 1982, 1997, 1999) pointed out the scarcity of the benthic diversity or of the abundance in the Black Sea recorded in the past 2–3 decades. Some questions remain.

Is there a continuous impoverishment of the benthic populations? At the moment, it is difficult to say. Benthic organisms are heterogeneously distributed on sedimentary beds, in "spots", so that new investigations can "rediscover" other species unseen for a short or a long period time. The former large extended benthic populations seem to be divided in few smaller meta-populations less abundant.

Are there are too few samples to make a realistic evaluation of the ecological state in such a large area as the NW Black Sea? Eleven samples are certainly not too many, but their distribution in the study area and the strictly quantitative collection method allows for a good assessment of the benthic populations. The quantitative method of "corer" sampling is adequate to assess the ecological state of all benthic populations, but it is less or not adequate at all for macrobenthos. This is why in the future, it is very important to use also quantitative sampling methods by controlling or dredging a larger bottom area of sampling. Also, the on board presence of a biologist is absolutely necessary for observations, measurements and collection of the biological samples.

There are other difficult ecological problems for the NW Black Sea benthos, ranging from the assessment of pollutant/toxic contamination to the eco-toxicological knowledge of their lethal or sub- lethal effects on biodiversity, and from the fate of contaminants in marine environment to the changes they induce to marine life – community structure, population behavior, genetic effects, ecosystem resilience, etc.

The solutions to these problems are urgent and some answers with a scientific support must be found in the near future, until it is not too late. IAEA can play a major role in this respect, as already proved.

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Table 1 General Features of the Black Sea Zoobenthos Populations in the Stations Performed during the IAEA Expedition

F % - frequency, D_D% and D_B% - numeric or biomass dominance, D_{avg} and B_{avg} - average numerical or biomass density, D_{eco} and B_{eco} - ecological numerical or biomass density, Rk_D and Rk_B - rank of species after numerical or biomass density

	S p e c i e s	**F %**	**D_D %**	**D_{avg}**	**D_{eco}**	**Rk_D**	**D_B%**	**B_{avg}**	**B_{eco}**	**Rk_B**
1	*Nonion depressulum*	54.5	3.53	1523	2793	**5**	0.19	0.07	0.13	27
2	*Ammonia beccarii*	72.7	3.69	1596	2195	**4**	0.20	0.07	0.10	22
3	*Ammonia tepida*	63.6	2.71	1173	1843	**6**	0.15	0.05	0.08	29
4	*Cribroelphidium poeyanum*	45.5	1.34	580	1277	**11**	0.07	0.03	0.06	40
5	*Elphidium advenum ponticum*	45.5	2.88	1245	2740	**7**	0.16	0.06	0.12	34
6	*Elphidium haagensis*	27.3	0.35	151	554	28	0.02	0.01	0.02	57
7	*Elphidium pulvereum*	18.2	0.66	284	1563	27	0.04	0.01	0.07	54
8	*Esosyrinx jatzkoi*	9.1	0.34	145	1596	41	0.02	0.01	0.07	62
9	*Fissurina lucida*	36.4	0.48	206	565	21	0.03	0.01	0.03	50
10	*Laryngosigma williamsoni*	18.2	0.07	30	166	54	0.00	0.00	0.01	67
11	*Lagena vulgaris*	9.1	0.25	109	1197	46	0.01	0.00	0.05	63
12	*Protelphidium subgranosus*	36.4	0.39	169	466	25	0.02	0.01	0.02	52
13	Turbellaria varia	9.1	0.06	24	266	62	0.00	0.00	0.01	69
14	*Pycnophyes ponticus*	18.2	0.11	48	266	47	0.00	0.00	0.00	70
16	*Micrura aurantia*	27.3	0.07	30	111	50	0.30	0.11	0.39	32
17	Nematoda varia	100.0	47.61	20567	20567	**1**	0.10	0.04	0.04	28
18	*Protodrilus flavocapitatus*	45.5	1.04	447	984	14	1.11	0.40	0.88	**11**
19	*Nerilla antenata*	9.1	0.14	60	665	55	0.10	0.04	0.40	51
20	*Terebellides stroemi*	27.3	0.13	54	200	40	13.71	4.90	17.96	**2**
21	*Heteromastus filiformis*	27.3	0.31	133	488	29	0.30	0.11	0.39	31
22	*Clymene collaris*	36.4	0.76	326	898	18	0.18	0.07	0.18	35
23	*Hediste diversicolor*	9.1	0.11	48	532	56	1.35	0.48	5.32	24
24	*Nereis zonata*	27.3	0.20	85	310	33	2.37	0.85	3.10	**9**
25	*Nerine cirratulus*	9.1	0.06	24	266	63	0.01	0.00	0.05	64
26	*Brania clavata*	27.3	0.21	91	333	32	0.08	0.03	0.10	42
27	*Grubea limbata*	27.3	0.11	48	177	42	0.04	0.01	0.05	49
28	*Grubea tenuicirrata*	9.1	0.01	6	67	70	0.01	0.00	0.02	68
29	*Melinna palmata*	27.3	0.62	266	975	22	23.08	8.25	30.24	**1**
30	*Polydora ciliata*	18.2	0.24	103	565	37	0.49	0.17	0.96	30
31	*Aonides oxicephala*	18.2	0.08	36	200	53	0.71	0.25	1.40	23
32	*Aonides paucibranchiata*	9.1	0.06	24	266	64	0.47	0.17	1.86	39
33	*Harmothoe reticulata*	54.5	0.31	133	244	23	0.22	0.08	0.15	25
34	*Capitella capitata*	72.7	8.47	3658	5029	**2**	1.54	0.55	0.75	**6**
35	*Nerine tridentata*	9.1	0.81	351	3857	30	0.20	0.07	0.77	45
36	*Nerine* sp.	9.1	0.04	18	200	65	0.01	0.00	0.04	65
37	*Nephthis cirrosa*	36.4	0.11	48	133	39	1.22	0.44	1.20	15
38	*Nephthys hombergii*	36.4	0.13	54	150	35	1.37	0.49	1.35	**12**
39	*Neanthes succinea*	18.2	0.90	387	2128	24	10.83	3.87	21.28	**4**
40	*Magelona papilicornis*	9.1	0.48	206	2261	38	5.41	1.93	21.25	13
41	*Paraonis fulgens*	9.1	0.08	36	399	59	0.71	0.25	2.79	37
42	*Phyllodoce lineata*	27.3	0.07	30	111	51	0.05	0.02	0.07	47
43	*Polynoe scolopendrina*	9.1	0.22	97	1064	48	1.90	0.68	7.45	19
44	*Pygospio elegans*	9.1	0.08	36	399	60	0.01	0.00	0.04	66
45	*Sphaerosyllis bulbosa*	36.4	0.34	145	399	26	0.32	0.12	0.32	26
46	*Sphaerosyllis hystrix*	18.2	0.11	48	266	49	0.11	0.04	0.21	43
47	*Oridia armandi*	27.3	0.18	79	288	34	0.10	0.03	0.13	41
48	*Oligochaeta varia*	54.5	1.22	526	964	**9**	0.29	0.11	0.19	20
49	*Cardium edule*	9.1	0.03	12	133	66	0.20	0.07	0.80	44
50	*Modiolus phaseolinus*	9.1	0.31	133	1463	43	0.71	0.25	2.80	36
51	*Mytilus galloprovincialis*	18.2	0.98	423	2328	20	14.89	5.32	29.25	**3**
52	*Bythocythere turgida*	9.1	0.10	42	466	58	0.08	0.03	0.30	53
53	*Callistocythere diffusa*	18.2	1.78	768	4223	16	1.40	0.50	2.74	17
54	*Carinocythereis rubra*	45.5	0.43	187	412	19	0.34	0.12	0.27	21
55	*Cytheroma variabilis*	63.6	1.79	774	1216	**8**	1.41	0.50	0.79	**7**
56	*Leptocythere multipunctata*	54.5	1.06	459	842	**12**	0.84	0.30	0.55	14
57	*Loxoconcha granulata*	54.5	0.52	224	410	17	0.41	0.15	0.27	18
58	*Paradoxostoma simile*	9.1	0.20	85	931	52	0.15	0.06	0.61	46
59	*Sclerochilus gewemulleri*	9.1	0.03	12	133	67	0.02	0.01	0.09	61
60	*Xestoleberis cornelii*	36.4	1.37	592	1629	13	1.08	0.39	1.06	16
61	*Harpacticoida varia*	54.5	5.81	2509	4600	**3**	0.14	0.05	0.09	33
62	*Corophium robustum*	9.1	0.11	48	532	57	0.05	0.02	0.21	58

	Species	F %	D_D %	D_{avg}	D_{eco}	Rk_D	D_B%	B_{avg}	B_{eco}	Rk_B
63	*Caprella acanthifera*	9.1	0.03	12	133	68	0.06	0.02	0.24	56
64	*Microdeutopus damnoniensis*	45.5	0.73	314	692	15	1.76	0.63	1.38	**8**
65	*Phthisica marina*	18.2	0.14	60	333	45	0.29	0.10	0.57	38
66	*Amphithoe vaillanti*	9.1	0.03	12	133	69	0.03	0.01	0.12	60
67	*Apseudes ostroumovii*	36.4	1.78	768	2111	**10**	4.30	1.54	4.22	**5**
68	*Iphinoe elisae*	18.2	0.04	18	100	61	0.02	0.01	0.05	59
69	*Eudorela truncatula*	36.4	0.13	54	150	36	0.04	0.01	0.03	48
70	*Halacarellus basterii aff.*	18.2	0.38	163	898	31	0.03	0.01	0.06	55
71	*Amphiura stepanovii*	27.3	0.10	42	155	44	2.13	0.76	2.79	**10**
	Taxa	**F %**	**DD %**	**Davg**	**Deco**		**DB %**	**Bavg**	**Beco**	
	Foraminifera	81.8	16.69	7212	8815		0.91	0.32	0.40	
	Vermes varia	36.4	0.24	103	283		0.30	0.11	0.29	
	Nematoda varia	100.0	47.61	20567	20567		0.10	0.04	0.04	
	Archiannelida	45.5	1.18	508	1117		1.22	0.43	0.96	
	Polychaeta	100.0	15.21	6571	6571		66.80	23.86	23.86	
	Oligochaeta varia	54.5	1.22	526	964		0.29	0.11	0.19	
	Mollusca	36.4	1.32	568	1563		15.80	5.65	15.53	
	Ostracoda	63.6	7.28	3144	4940		5.72	2.04	3.21	
	Harpacticoida varia	54.5	5.81	2509	4600		0.14	0.05	0.09	
	Amphipoda	54.5	1.04	447	820		2.19	0.78	1.44	
	Tanaidacea	36.4	1.78	768	2111		4.30	1.54	4.22	
	Cumacea	45.5	0.17	73	160		0.06	0.02	0.05	
	Halacarida	18.2	0.38	163	898		0.03	0.01	0.06	
	Echinodermata	27.3	0.10	42	155		2.13	0.76	2.79	
	Total		**100.00**	**43201**	**53563**		**100.00**	**35.72**	**53.13**	

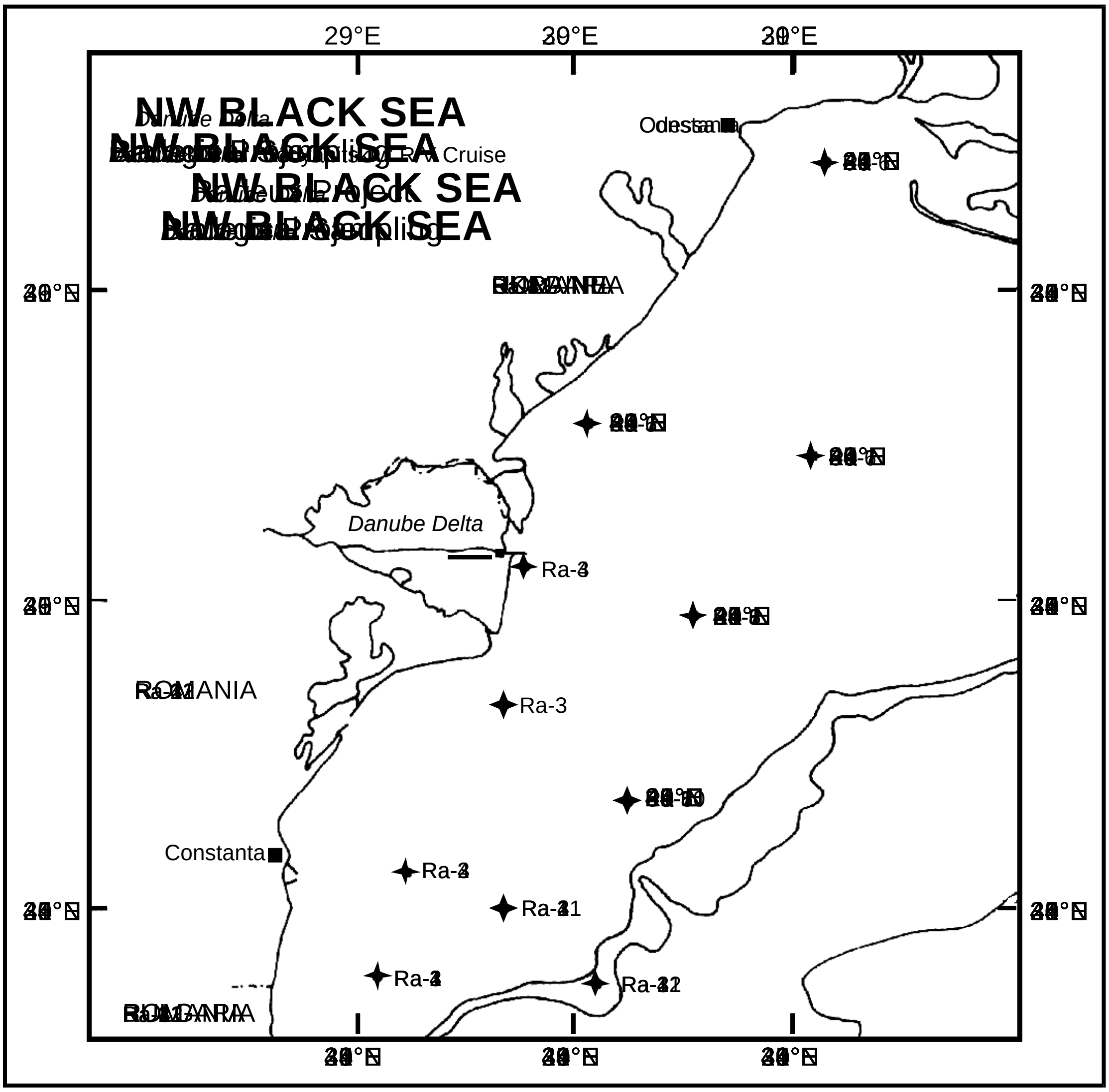


Figure 1 Map of the study area and sampling locations

Fig.2 - Proportion between the number of identified species in different groups of organisms

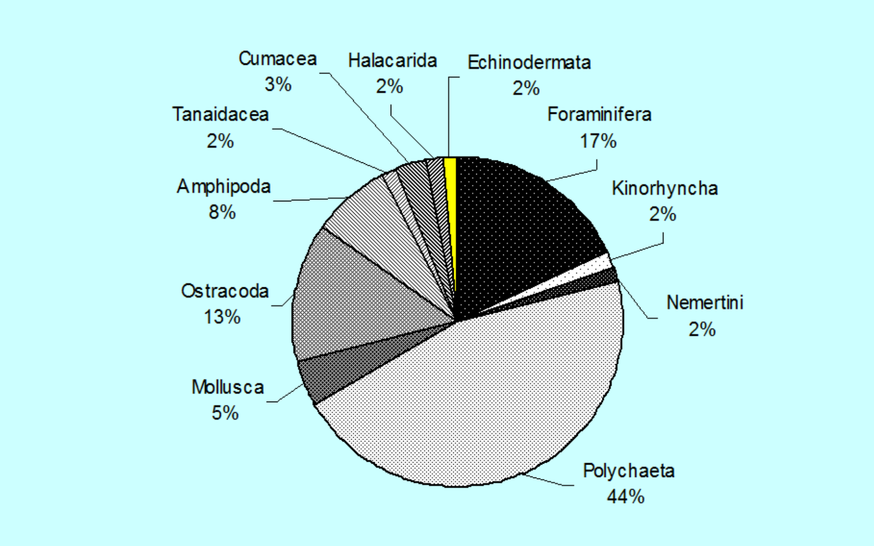


Fig. 3 - Taxonomical structure of benthic populations in IAEA '98 Black Sea zone

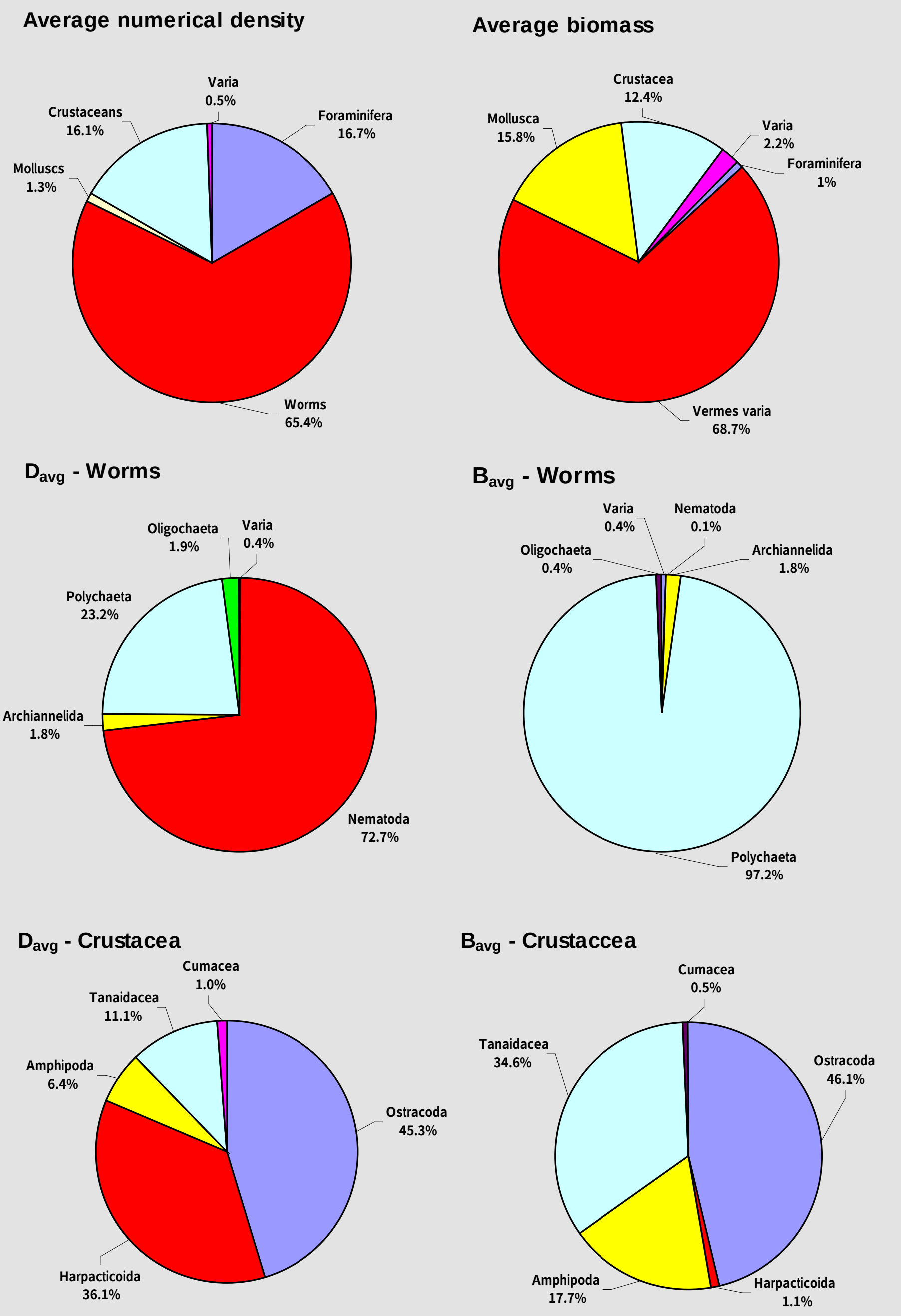


Fig.4 - Depth Transect of IAEA'98 Black Sea Stations and the Curves of Benthic Density (D:sps.m-^{2}) and Biomass (B:-g.n-^{2}) along this Hypothetical Transect

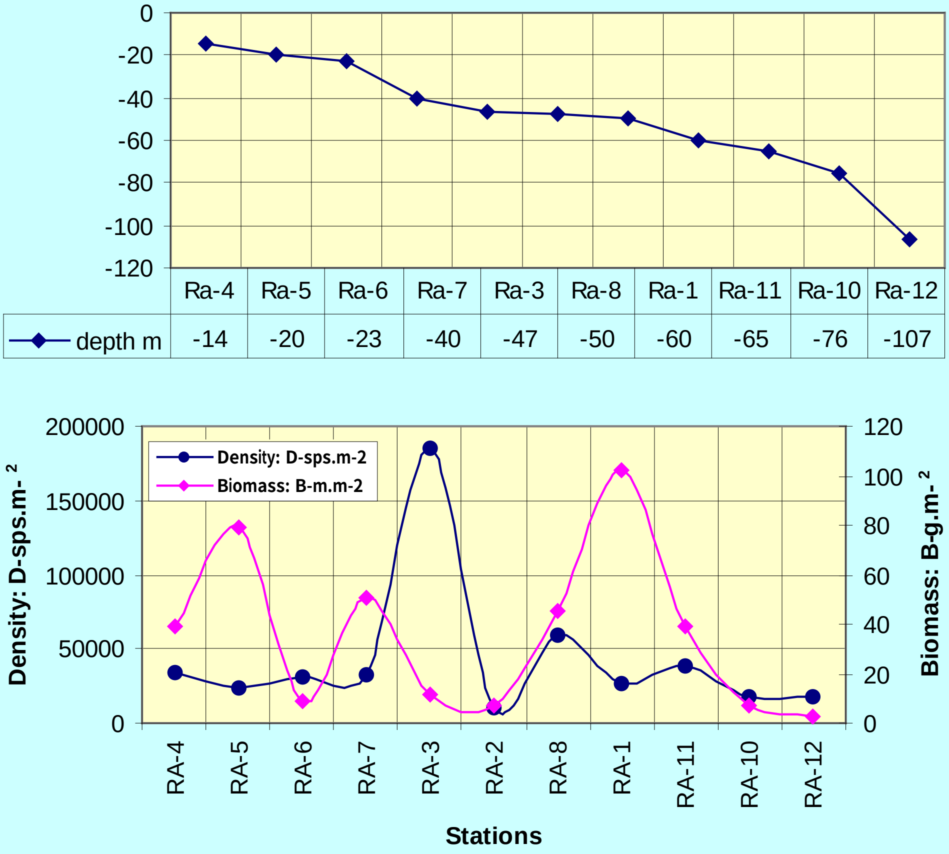


Fig. 5 - Abundance of benthic populations in the IAEA '98 Black Sea zone by major taxonomic groups

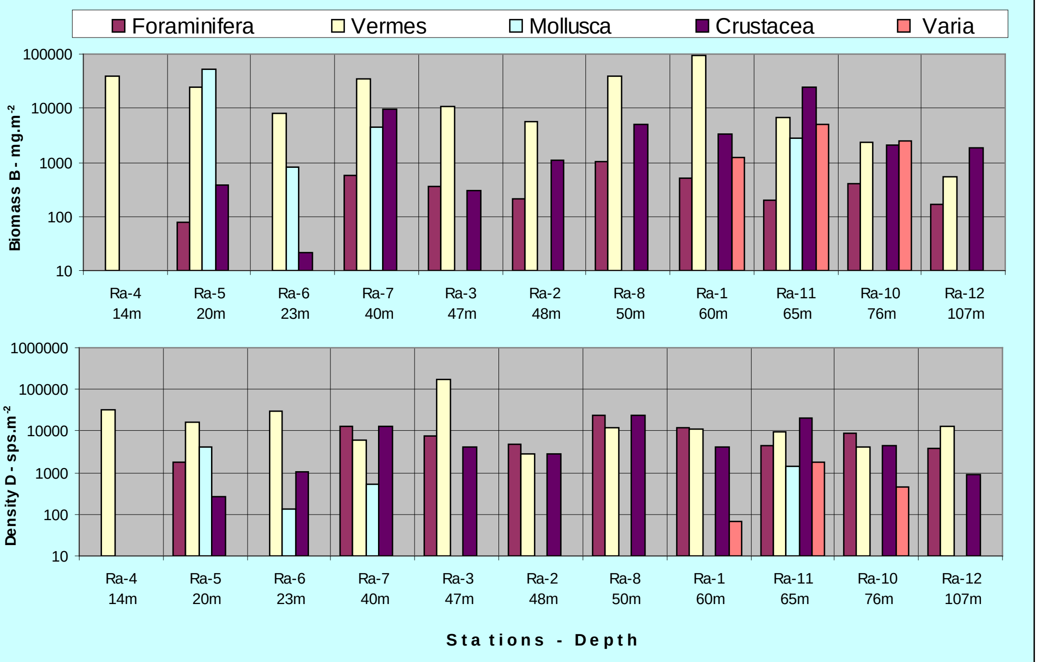
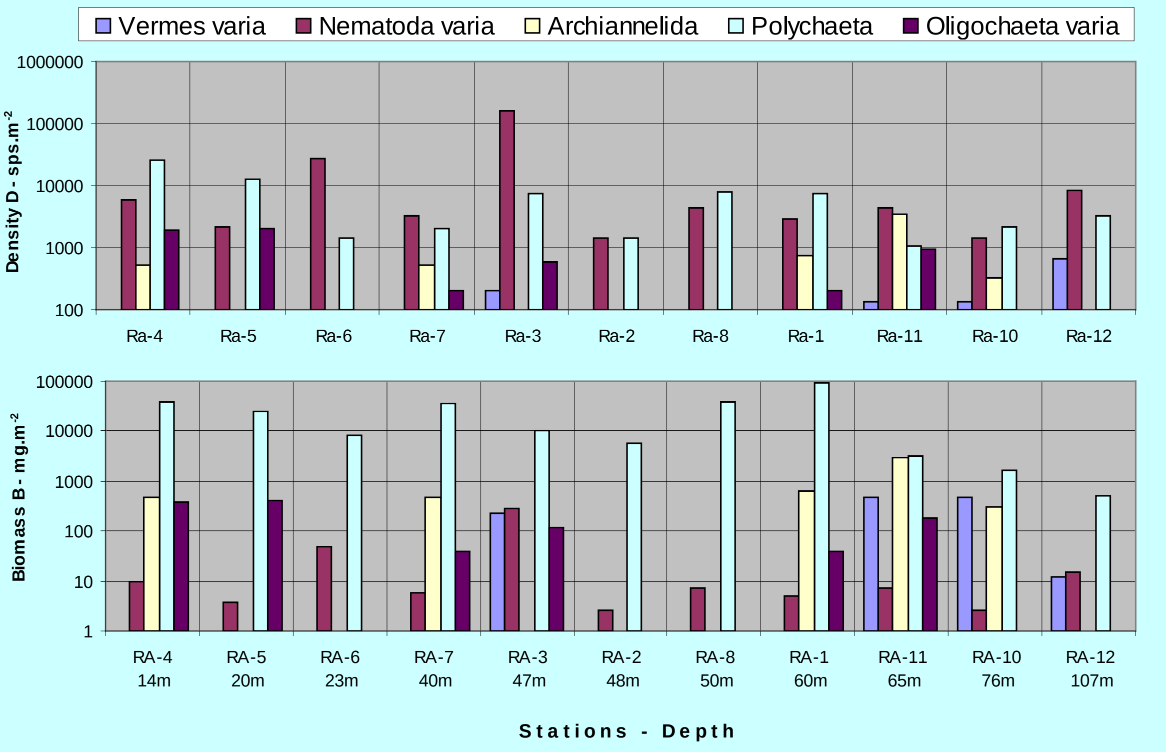


Fig. 6 - Numerical Density (D - sps.m^{-2}) and Biomass (B - mg.m^{-2}) of Worm Populations in IAEA '98 Black Sea Zone



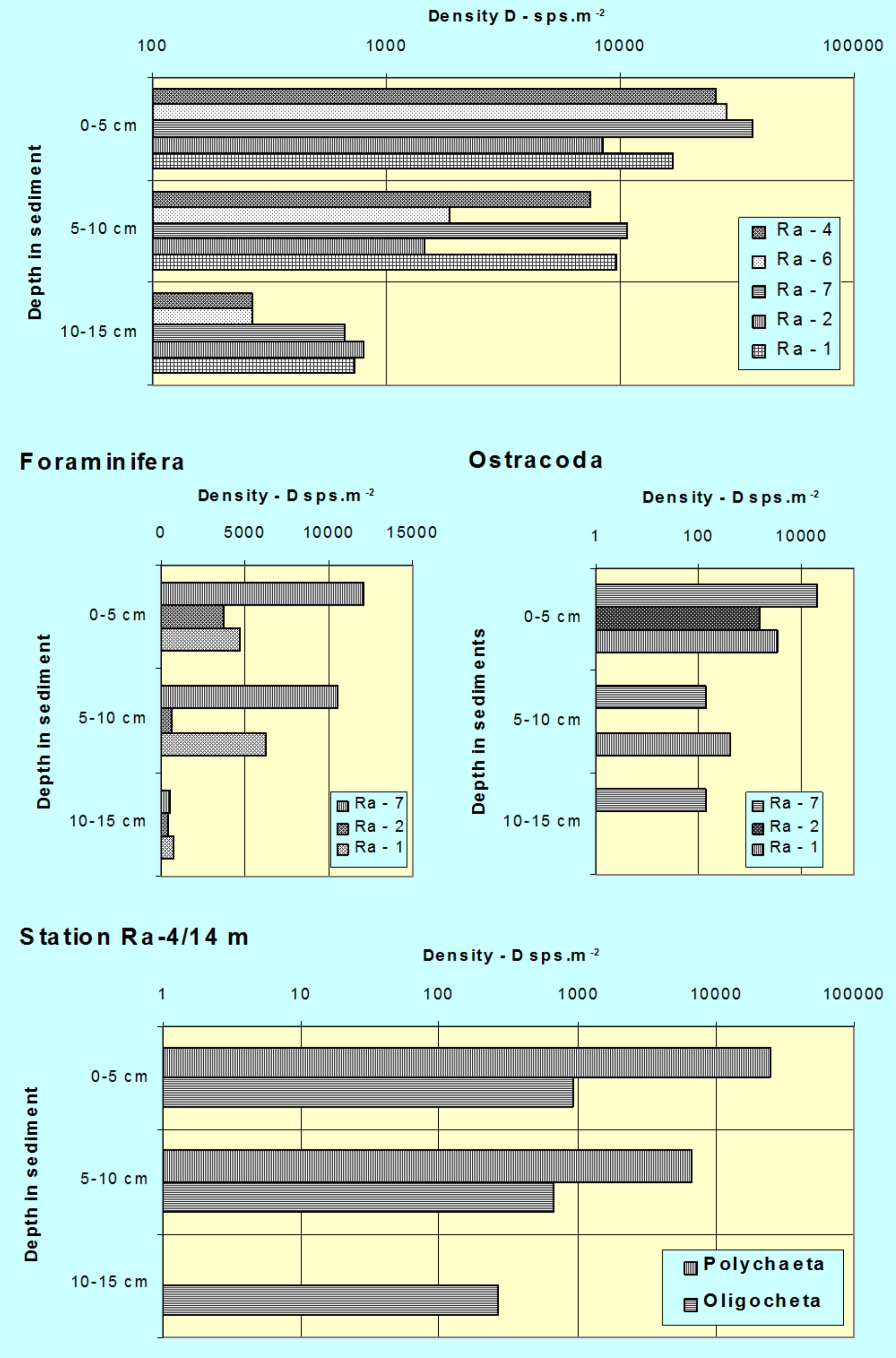


Fig. 7 - Vertical distribution of benthic organism in sediment in some stations

Fig. 8 - Similarity (%) between the zoobenthos structure in different stations performed during Radeux expedition in 1998