PRESENT STATE OF THE SANDY INVERTEBRATE POPULATIONS IN THE MAMAIA AND MANGALIA SECTOR OF THE ROMANIAN BLACK SEA COAST

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Abstract. This paper presents the quantitative and qualitative distribution of sandy invertebrate populations of coastal littoral cells bordered by protective dams in Mamaia and Mangalia, in the summer and autumn of 2003. Overall, 60 taxa were found belonging to the 15 major taxa, with an average density of 722,012 indvs.m^{-2}, and a biomass of 192.25 g.m^{-2}. The comparative analysis of sandy invertebrate populations in the tow areas under observation have generally revealed differences of quantitative nature, both the macrobenthal and meiobenthal organisms in the Mamaia cell being approximately 2 times more numerous than in the Mangalia cell, because of the spatial limitations of the mobile sediments in the Mangalia cell, a situation that does not allow for the evolution of the typical psammic associations. The most abundant organisms were the meiobenthal populations, with Nematoda and Copepoda group reaching the highest density in the summer 2003 in comparison with the 1970s.

Key words: Black Sea, littoral cell, sandy invertebrate populations, qualitative, quantitative

INTRODUCTION

The systematic concern for the research of the littoral ecosystems in the shallow waters of the Romanian coastal areas has a history of over a century. Now, there are several observations and data concerning the situation of sandy invertebrate populations along Romanian littoral, many of which having been published in the series: "Marine Ecology" printed in the Romanian Academy Editions (Editura Academiei Române), in the periodicals "Marine Research" ("Cercetări marine – Recherches marines"), etc. Nevertheless, there still is a lack of information concerning detailed research on certain sectors. On the other hand, some of these studies, although of a real value, were conducted over 30 years before, when major changes of the marine environment had occurred due to the increasing pollution and eutrophy, changes that have had a profound impact on all biotic and abiotic components of the marine ecosystem.

This study presents the changes observed in the quantitative and qualitative structure of the sandy invertebrate populations of the littoral areas of Mangalia and Mamaia, as well as the current status of the sandy invertebrate populations in the "littoral cells" – coastal marine sectors bordered by permeable or impermeable protection dams, usually built perpendicularly to the shore, having variable terminal forms of T, Y, L etc. In those sectors, water communicates with the open sea only on one side (the exposed area), and this results in the creation of a sheltered area, that protects beaches against erosion and where the kinetic energy of the waves is lost or reduced to a minimum. The coastal littoral cells have a special character of "still waters", inside them occurring ecologic conditions that are different from those outside them, due to the relative isolation provided by the protection dams.

At the moment, little is known about the differences between the biotic composition in the cell interior and that in the open sea sectors. Certainly, these semi-enclosed sectors become, during summer, areas of ecologic risk, as a consequence of an explosive development of algae, bacteria or fungi populations that may be followed, in some cases, by mass mortality of benthal and nektonic organisms.

The areas undergoing research belong to the superior infra-littoral layer, represented by the fine sand biocenosis *Corbula mediterranea* – the only biocenosis that is typically psammobiontic, and that has an important presence along the Black Sea and Azov seacoasts. Also, according to Bacescu *et al.* (1971) this biocenosis is one of the most important biocenoses of the Black Sea, since it is the feeding area of several fish species of economic value, as well as of their offspring.

MATERIAL AND METHODS

The study is based on the analysis of 21 quantitative and 10 qualitative samples, collected in summer and autumn 2003, at 7 stations on the Romanian Black Sea coast (5 stations in Mamaia cell and 2 in Mangalia cell).

Quantitative sampling was done by Van Veen grab covering an area of 200 cm^2, and the qualitative sampling by a dredge ("Băcescu dredge" – having the net mesh size Φ 1 mm).

The samples have been conserved with buffered formaldehyde 5 % and stained by Congo Red Laboratory processing:

- Washing samples through 3 sieves of 1 mm, 0.25 mm and 0.125 mm to separate macro- and meiofauna;
- Identification of the species by binocular microscope;
- Counting all species / individuals;
- Larger size forms were weighed (wet weight, including shells, intervalvar water etc.);
- Meiobenthos biomasses were estimated using standard weight tables;
- Computer processing of the data for ecological parameters were performed.

In order to statistically process the results obtained following separation, the analytical ecologic indicators and diversity indicators were used.

RESULTS AND DISCUSSIONS

The results of researches carried out in summer and autumn 2003 at Mamaia and Mangalia shallow water zones proved the presence in the biocenosis of the mobile sediments of 60 taxa, of which 50 have been identified according to their species. Of the total taxa identified, foraminifers represent 12 % of species, worms – 45 %, mollusks – 7 %, crustaceans– 33 % and the other groups– 3 %. The average density recorded in the sandy invertebrate populations in the researched areas has been of 722,011.90 indvs.m^{-2}, and the biomass of 192.25 g.m^{-2}.

The most important role in obtaining the density and frequency of occurrence dominants is that of meiobenthal forms: nematodes, copepods, polychaetes *Nerine cirratulus* and *Polydora antennata*, turbellariates and the foraminifer *Amonia beccari*. Of these, the nematodes and the copepods represent 94 % of the total average density.

In the case of the biomasses, the macrobenthal populations account for 90 % of the total, represented by the bivalve mollusks *Mya arenaria, Corbula mediterranea, Cardium edule,* by the amphipod *Ampelisca diadema* etc.

After having conducted a comparative study of the sandy invertebrate populations of both the Northern Romanian shore (Mamaia) and the Southern area thereof (Mangalia) it was noted that the diversity of macrobental populations, although richer in Mamaia (34 taxa) is not different from that in Mangalia (30 taxa), where the fauna in the sandy areas is more like that of the submerged beaches to the North of Constanta than the fauna of the neighboring areas. Of the total taxa (40) identified in both areas - 24 (60 %) are common, 10 taxons (25 %) were present only in Mamaia and 6 taxa (15 %) only in Mangalia (APPENDIX I, Fig. 1). The differences concerning absence or presence of taxa in an area were noted in cases of polychaetes and crustaceans.

Yet the diversity of the meiobenthal populations is higher in Mangalia (18 taxa) than in Mamaia area (11 taxa), where poorer ecological conditions favour the development of some species with low ecologic plasticity (ostracods, some polychaetes) (APPENDIX II). Of the total identified taxa (20) only 8 taxa (42 %) are common to both areas, 9 taxa (47 %) were present only in Mangalia and 2 (11 %) only in Mamaia (Fig. 1).

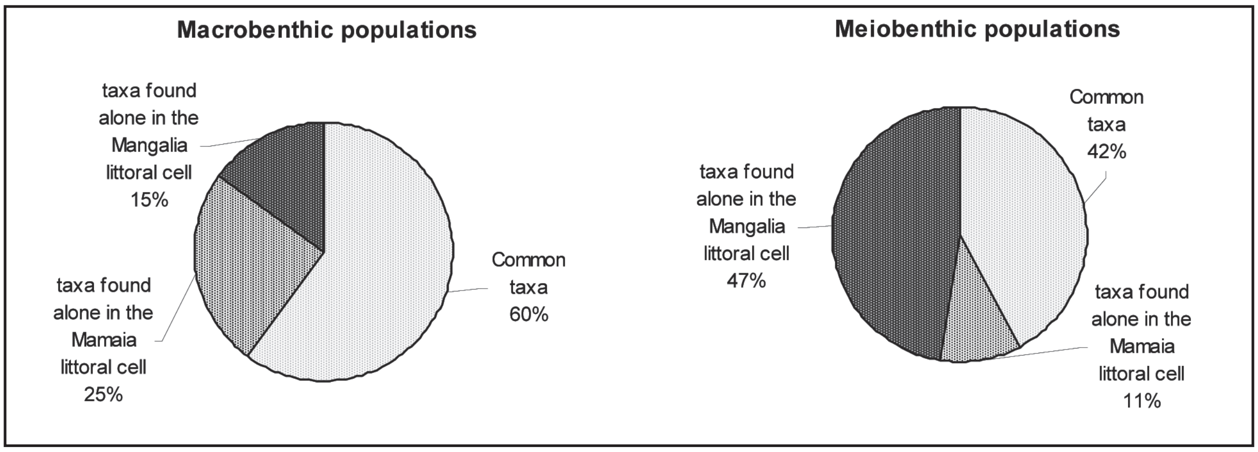

Fig. 1 The percentage of specific and common macrobenthal and meiobenthal taxa in the studied areas, i.e., Mamaia and Mangalia in 2003

By analyzing the values of average density and biomass of the macrobenthal populations that are cohabitating in the two sectors of Romanian sea coast, it was noted that fauna in the Mamaia cell (29,013 indvs.m^{-2}, that is 235.13 g.m^{-2}) has 1.4 times higher density and 3.2 greater biomass than in Mangalia (20,300 indvs.m^{-2} that is 73.37 g.m^{-2}) (Fig. 2). This has also been noticed in the case of meiobenthal populations, which, in the Mamaia area, have a density 1.8 times higher and an average biomass 1.9 times greater than in Mangalia area (Fig. 3).

The reduced contribution of the macro - and meiobenthal fauna segment in Mangalia sector to the formation of populations of average numeric and weight variables greater than those in the Mamaia sector is due to the spatial limitation of the mobile sediments, which does not allow the evolution of typical psammic associations.

The sediments that aggregate in sufficient quantities to allow for the support of sandy invertebrate populations are only achieved in the cell interior, sheltered by protection dams. Due to the bordering of the sedimentary bottoms by the natural one, the possibilities of fauna inflows from other regions are limited, and the quality was only improved where the species existed on the hard bottom (*e.g.*: polychaetes *Brania clavata, Eteone picta*, etc., amphipods *Amphithoe vaillanti, Hyale perieri, Hyale pontica*, cumaceans *Cumella limicola* etc). The reduction of the communities associated with the sandy bottom is achieved also through the important aggregation of algae that are wiped away from the hard bottom. This happens in the circumstances of the summer stillness, which favours the occurrence of the hypoxia in these areas through the consumption of O_2 in the shallow water column and subsequently by the decomposition of excess organic material, a process also related to high levels of O_2 consumption. Because of the reduced surface and stillness of the water mass in summer, the pseudo-faeces of the mollusks also contribute to a high extent to the overloading of sediments with organic material (and mineral, too). Generally, at the foundation of any coastal protection dam, especially on the inside, the fauna associated with mobile sediments is extremely poor in quality and in points of abundance, because of the pseudo-faeces rain favouring the decomposition processes using up the O_2 in the sediment column. Direct observations in free diving have shown that the sub-superficial layer of sediments was fully oxidized, and that it was producing a strong smell of sulphurous hydrogen. Thus, limitation of the hydrologic exchange in these semi-closed cells represents a decisive factor in electing some populations that are scarce in points of species count and abundance per surface unit, when compared to Mamaia cell, where extended exchange provides for a water mass circuit even in stillness periods, and the renewal of populations affected by mass mortality is more rapidly achieved.

The participation of macrobenthal populations, of the main organisms groups in the psammic biotopes in the areas analyzed is presented in figure 4, and the domination of Vermes group are obvious. Of these worms, in the Mamaia cell, a major weight in points of number and an almost constant presence is that of polychaetes that are exclusively psammic, *Nerine cirratulus* (9,460 indvs.m^{-2}) and *Polydora antennata* (6,217 indvs.m^{-2}) followed by oligochaetes, with 2,467 indvs.m^{-2}. In the Mangalia cell, apart from the species mentioned, a significant abundance has been recorded also in the polychaetes *Sphaerosyllis bulbosa* (1,267 indvs.m^{-2}) and *Spio filicornis* (1,100 indvs.m^{-2}). As compared to the years 1960 – 1970, the polychaete *Spio filicornis,* a species that is largely present in the infra-littoral with fine sands, has reduced its densities in the areas analyzed.

The mollusks are the most representative element in the sand area, defining the type of biocenosis. In the Mamaia cell, the mollusk populations are represented by *Corbula mediterranea, Mya arenaria* and *Cardium edule* that have recorded abundance and biomasses higher than those in the Mangalia cell. *Corbula*, the most common species in the fine sand area, has been thoroughly watched in its biocenosis by Băcescu *et al.* (1965, 1967) and Gomoiu (1965, 1966, 1968a, 1968b, 1969).

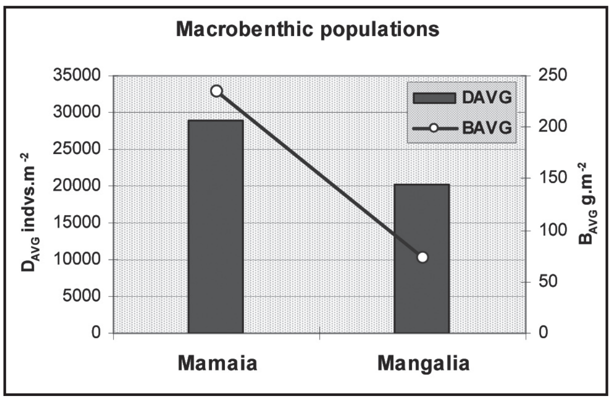

Fig. 2 The average density and biomass of the macrobenthal psammobiontic populations in Mamaia and Mangalia cells in 2003

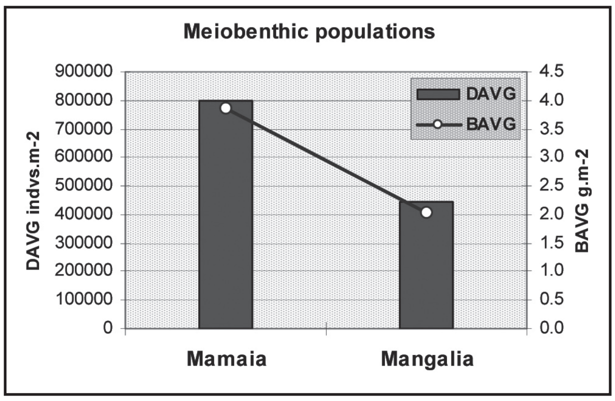

Fig. 3 The average density and biomass of the meiorobenthal psammobiontic populations in Mamaia and Mangalia cells in 2003

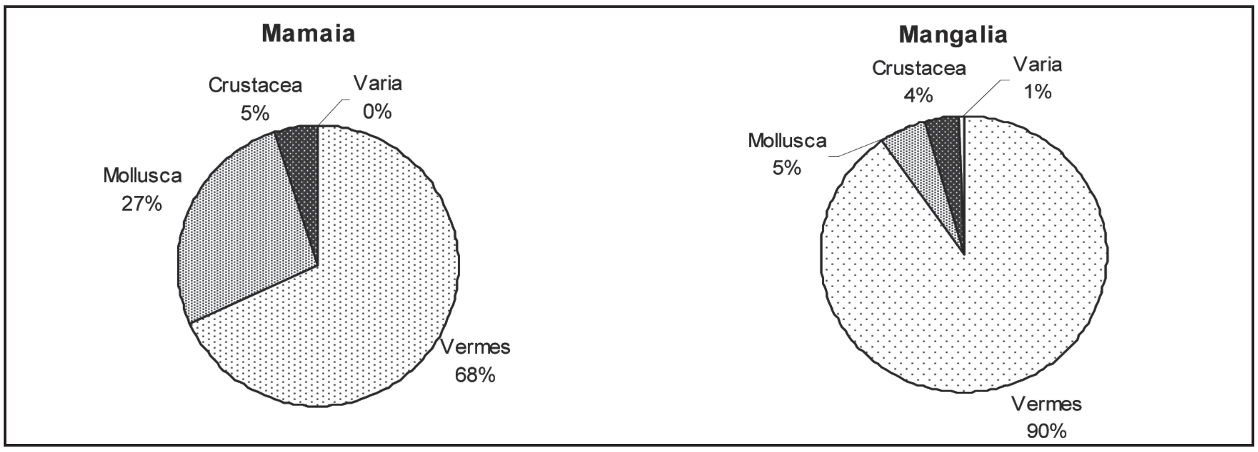

Fig. 4 Participation of the macrobenthal populations in the main groups of organisms to the psammic biotopes of Mamaia and Mangalia cells, 2003

Today, the populations of this species have undergone important changes in structure. Thus, the leading species, of the biocenosis, less tolerant to environmental changes has reduced populations from 246,000 indvs.m^{-2} in the 1960s (Bacescu *et al*. 1971) to 3,700 indvs.m^{-2} at the beginning of the 1990s (Petranu, 1997). At the moment, the densities of this species in the upper infra-littoral area of Mamaia, on the isobaths of 1.5 m, have increased to approximately 7,350 indvs. m^{-2}, the most abundant species in the macrobental populations. It is worth mentioning that in the Mangalia cell *Corbula mediterranea* has not been found in any of the samples analyzed, but its absence in the samples does not mean that it is missing in the sandy areas in the Southern littoral.

In the sands of the Romanian shore, but especially in Northern areas, *Mya arenaria* is an element quite frequent (it is found in over 50 % of the stations analyzed). Sometimes *Mya arenaria* remains the leading species in the biocenosis of fine sands, replacing *Corbula* (in the Mangalia cell).

Almost all systematic groups represent the crustaceans in the analyzed areas. Of the macrobenthal forms, the amphipods and cumaceans have recorded in the Mamaia cell densities almost twice as high as in the Mangalia cell. The amphipods populations are dominant in both areas by the species having a large ecological plasticity, *Ampelisca diadema,* but the important contribution of the populations of rocky – phitophagous species *Amphithoe vaillanti, Echinogammarus olivii, Hyale perieri, H. pontica* etc. should be noted.

Isopods, tanaids and decapods have a heterogeneous spreading in the areas analyzed. Significant abundance has been recorded in the populations of isopods represented by *Idotea baltica* and *Sphaeroma pulchelum* and the tanaids in the Mangalia cell, and the decapods analyzed from the quantitative samples in the Mamaia cell.

Among the meiobenthal forms, the worms represented by Nematodes were dominant, 90 % of the total density in both littoral cells. The meiobenthal crustaceans in the copepods group exhibited large densities in the Mamaia cell, 1.7 times higher than in the Mangalia cell, and the ostracods were only identified in Mangalia.

As in our quantitative samples the epifauna organisms have usually been missing, since they can only happen to be taken by our semi-quantitative dredgers, a series of semi-quantitative dredges were conducted, that revealed that the epifauna is made of Mysida, as a dominant group, and of Amphipoda, Cumacea and Decapoda.

The dispersion of mysida populations is, in most cases, an aggregate one, and their density in the biocenoses analysed is generally low, not reaching the high values indicated in the specialized literature, namely thousands of items per m^2. This is supported also by the fact that mysida are species intolerant to pollution, and in the last two decades a series of changes in these aquatic ecosystems, following increase of the anthropogenic pressure, has certainly affected the mysida populations, taking into account their low number in the samples analysed.

Among the mysida populations of *Mesopodopsis slabberi* average densities were recorded of 36 indvs.m^{-2}, and *Paramysis kroyeri* of 118 indvs.m^{-2} in both areas analysed. The Mediterranean species slightly eurihalyne and psammic species *Gastrosaccus sanctus* together with *Siriella jaltensis jaltensis* – stenobiotic, rocky substratum, exceptionally phototropic and an excellent predator have been found only in the south of the Romanian Black Sea coast, (Mangalia cell) having average densities of 9 indvs.m^{-2}.

The decapods species found in the qualitative samples were the shrimp *Crangon crangon*, hermit crab *Diogenes pugilator* and the sand crab *Liocarcinus holsatus*.

The analysis of the quantitative and qualitative distribution of the macro - and meiobenthal fauna segment in the protected area of the Mamaia and Mangalia cells reveals mostly quantitative differences. Thus, in the case of macrobenthal populations in the Mamaia cell as well as in the Mangalia cell in their protected areas, protected by dams, densities twice as high as in the exposed areas were recorded. (Fig. 5, 6).

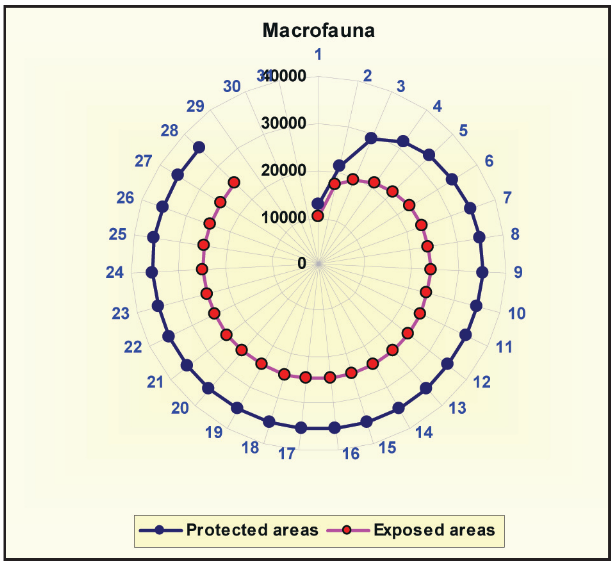

Fig. 5 Diagram representation of the macrobenthic populations in the protected and exposed areas of Mamaia cell, in 2003

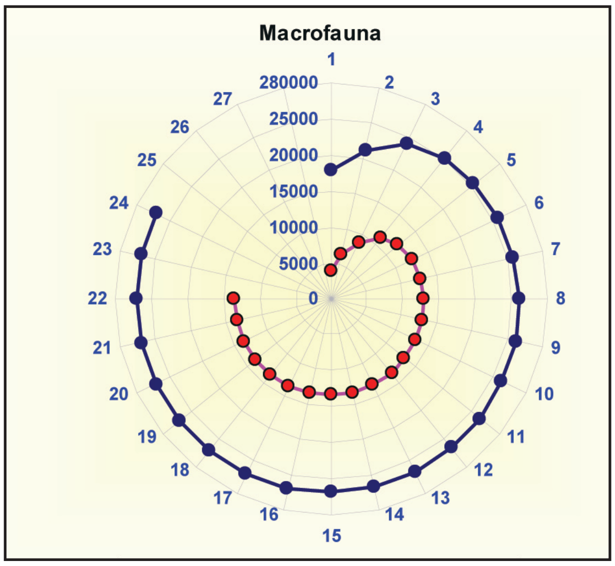

Fig. 6 Diagram representation of the macrobenthic populations in the protected and exposed areas of Mangalia cell, in 2003

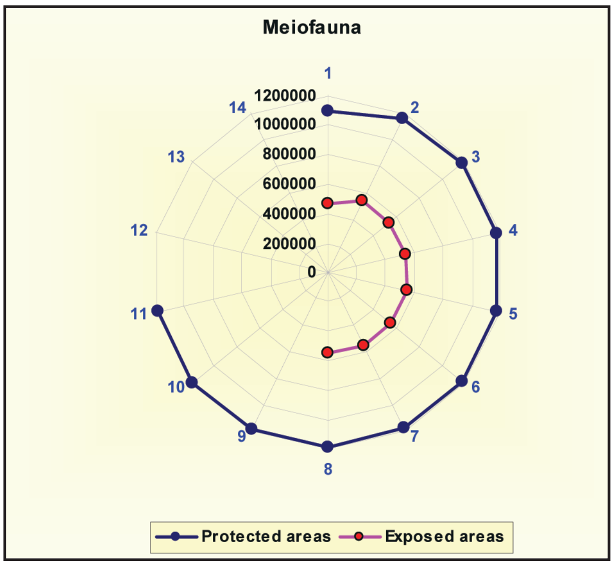

Fig. 7 Diagram representation of the meiobenthic populations in the protected and exposed areas of Mamaia cell, in 2003

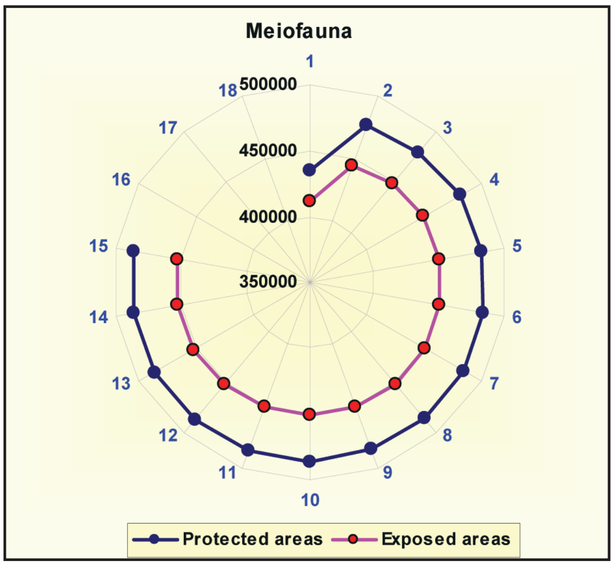

Fig. 8 Diagram representation of the meiobenthic populations in the protected and exposed areas of Mangalia cell, in 2003

The differences are accounted for by the polychaetes populations *Polydora antennata, Nerine cirratulus* as well as by the oligochaetes, preferring the protected areas of the littoral cells, where densities 7 times higher were recorded, as a consequence of the presence of a rich organic material found as detritus preventing the inter-specific competition and allowing for the quantitative count development thereof.

Specific abundance was recorded among the meiobenthal populations in the protected area of Mamaia cell, with densities exceeding 1,000,000 indvs.m^{-2}, as compared to Mangalia cell, where in both exterior and interior sides, the quantitative variables are similar (~ 450,000 indvs.m^{-2}) (Fig. 7, 8).

By comparing the structure of the sandy invertebrate populations in the two locations analysed with the data published by Băcescu *et al.* (1969) an increase is noted in the average density of the psammobiontic organisms in 2003, 5.8 times in Mamaia and 4 times in Mangalia. This increase is generated by the meiobenthal populations (worms of the groups Nematoda, Turbellaria and Polychaeta, crustaceans of the group Harpacticoida and Ostracoda) and affects the macrobental ones (Fig. 9).

But the average biomass of the benthal organisms in the Mamaia area was twice as high in 2003 (239.3 g.m^{-2}) as in 1968 (104.3 g.m^{-2}), and in the Mangalia area, it was 5 times lower in 2003 (74.8 g.m^{-2}) than in 1968 (367.4 g.m^{-2}) (Fig. 10). This increase and decrease of the average biomass is achieved based on the psammobiontic mollusk which, in the Mamaia area (2003) has witnessed a recovery in number, especially, populations of *Corbula mediterranea*. In the Mangalia area, the populations of mollusks were represented by juvenile stages of *Mya arenaria* and *Cardium edule* and this lead to the achievement of a lower average biomass, compared to 1960-1970, when the biocenosis of gross sands in the Southern littoral was dominated by *Corbula mediterranea*. Due to its high abundance, this small-scale species is the main element in points of weight in the structure of psammic shallow water populations of the Romanian shores.

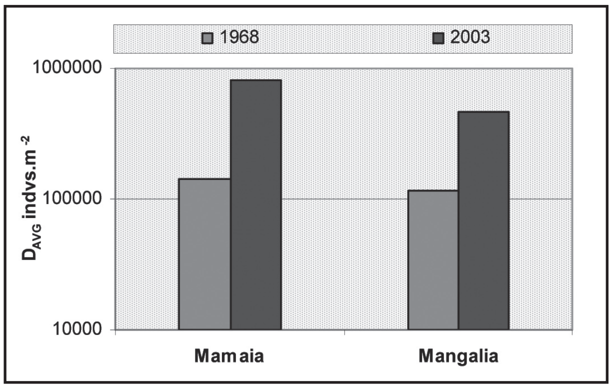

Fig. 9 Variation of average density of sandy invertebrate populations in Mamaia and Mangalia areas in the 1968 – 2003 interval

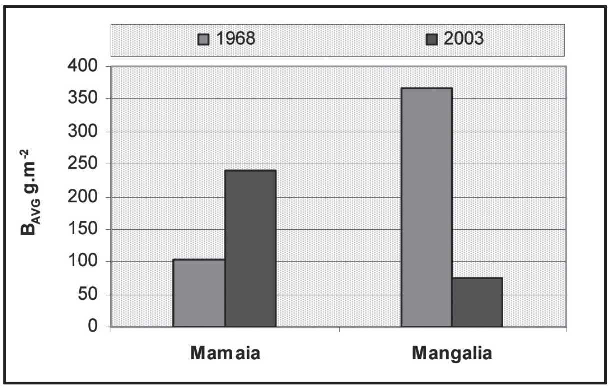

Fig. 10 Variation of average biomass of sandy invertebrate populations in the Mamaia and Mangalia areas in the 1968 – 2003 time interval

Table 1 The ratio of the average density and biomass of the macrobenthos and meiobenthos

		1968	2003
		Macrofauna : Meiofauna	Macrofauna : Meiofauna
Mamaia	D_{AVG}	1 : 13	1 : 27
	B_{AVG}	405 : 1	61 : 1
Mangalia	D_{AVG}	1 : 1	1 : 22
	B_{AVG}	371 : 1	36 : 1

A problem that is worth mentioning is the ratio between macrobenthos and meiobenthos, that has lately changed compared to the years of reference (1960 –1970) (Table 1). The value of the ratio macrobenthos – meiobenthos indicates the numeric abundance of the meiobenthal populations in the period analysed, more resistant to external perturbations – permanent instability and high fluctuations of the defining ecological factors, compared to the macrobenthal populations, that have better used the new biotopic conditions of the aquatorium.

After analyzing the current status of the major groups of macrobenthos and meiobenthos in the two areas under study, compared with the status existing in 1960 – 1970, it is evident that the populations of macrobenthal and meiobenthal psammobiotic organisms in the Mamaia area have recorded quantitative changes, that are usually characterized by increases in the benthos abundance, both in points of number and weight. The most important changes concerning the quantitative weight in the analysed areas were recorded in the groups of worms, crustaceans, and foraminifers, which reached significant abundances in 2003 (Fig. 11).

In the Mangalia area, apart from the reduction of the taxa count, there was a sharp decrease in the numeric abundance of mollusks' populations, from 40,120 indvs.m^{-2} between 1960-1970, to only 1,075 indvs.m^{-2} in 2003. But the macrobenthic crustaceans represented by amphipods, isopods, tanaids and decapods have doubled their densities (Fig. 12).

Together with the reduction of populations in species characteristic of the fine sands biocenosis with *Corbula mediterranea,* some opportunistic species have proliferated, benefiting from the increase of organic substance in the marine environment, and also the competition has decreased in the dominant species, the polychaetes *Polydora antennata, Nerine cirratulus*, the bivalves *Mya arenaria* and *Scapharca inaequivalvis* (Gomoiu, 1981, 1984a).

In order to maintain the essential ecological processes, of the life support system, and of the biodiversity in the marine and coastal areas, an integrated management thereof is required. This concept guarantees the sustainable development of marine and coastal areas, as well as reduction of their vulnerability to the natural pressures and especially to the anthropogenic ones.

CONCLUSIONS

The results of the ecological research on the sandy invertebrate populations in the upper infra-littoral in the Mamaia and Mangalia cells in 2003 have revealed the following conclusions:

- The coastal marine ecosystems are directly or indirectly targeted by the most powerful ecological pressures exerted by multiple human activities of the littoral areas, in the sea as well as in the hydrographical areas of the rivers flowing into the Black Sea, one of the two main coastal ecosystems

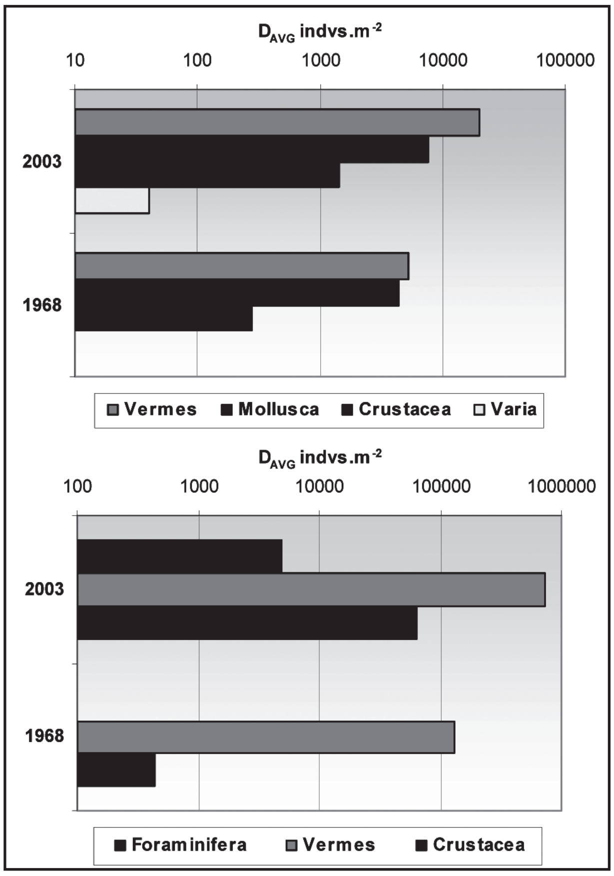

Fig. 11 Diagram of the quantitative and qualitative changes of the main groups of organisms in the macrobenthos and meiobenthos in Mamaia areas in the 1968 – 2003 time interval

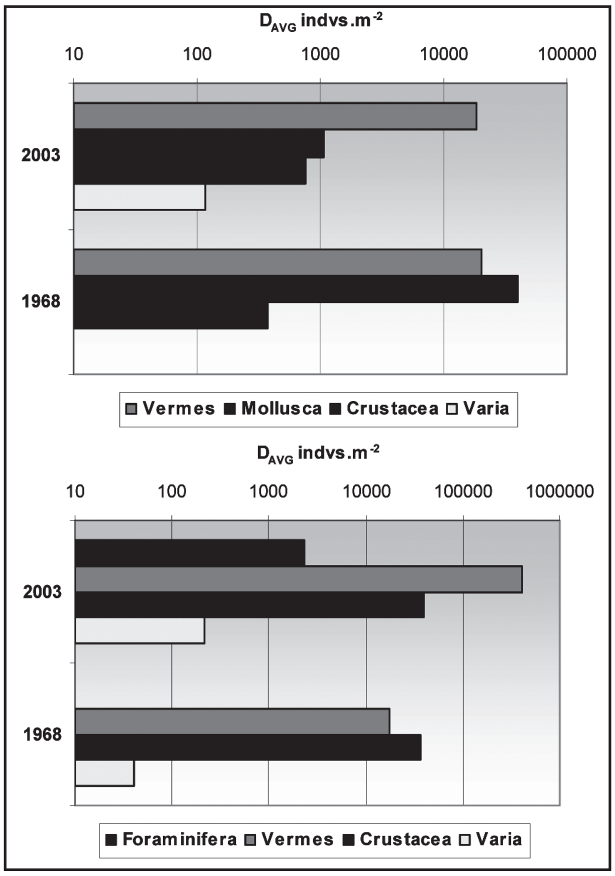

Fig. 12 Diagram of the quantitative and qualitative changes of the main groups of organisms in the macrobenthos and meiobenthos in Mangalia areas in the 1968 – 2003 time interval

– the one of the sandy grounds with *Corbula – Mya,* has recorded important ecological changes in the last decade, and sediment associations have occurred that make use of the organic material that is "captive" in the sediments;

- The comparative analysis of the sandy invertebrate populations in the two areas under observation have generally revealed differences of quantitative nature, both the macrobenthal and meiobenthal organisms in the Mamaia cell being approximately twice as many as in the Mangalia cell, because of the spatial limitations of the sandy bottoms in the Mangalia cell, a situation that does not allow for the evolution of the typical psammic associations;
- Following the comparative study between the protected and exposed areas of the Mamaia and Mangalia cells, it was noted that in the protected areas of the littoral cells, densities recorded are approximately twice as high as in the exposed ones, as a consequence of the presence of a rich organic material in the form of detritus, preventing inter-specific competition and allowing the numeric quantitative development thereof;
- By comparing the structure of the sandy invertebrate populations in the two localities analysed with the data published by Băcescu *et al*. (1969), an increase was noted in the average density of the psammobiontic organisms in 2003, 5.8 times in Mamaia and 4 times in Mangalia; the increase is marked in the meiobenthal populations (worms in the Nematoda, Turbellaria and Polychaeta groups, crustaceans in the Harpacticoida and Ostracoda groups) to the disadvantage of the macrobenthal ones;
- As for the average biomass, an increase approximately double was noted in the Mamaia area of the psammobiontic mollusk populations which, in 2003 record a numeric recovery, namely through the populations of *Corbula mediterranea*, and in Mangalia area the mollusk populations were represented by juvenile stages of *Mya arenaria* and *Cardium edule*, a fact that has lead to obtaining an average biomass lower than in the 1960-1970 interval, when the biocenosis of the gross sands in the southern littoral had been dominated by *Corbula mediterranea*;
- The value of the ratio macrobenthos – meiobenthos in the recent period has changed radically compared to the reference years (1960 –1970), which indicates the numeric abundance of the meiobenthal populations in the analysed period. These populations have proved a higher resistance to external disturbances – permanent instability and high fluctuations of the defining ecological factors, than the macrobenthal ones, and they make better use of the new biotope conditions of the aquatorium.

APPENDIX I

GENERAL CHARACTERISTICS OF THE MACROBENTHIC POPULATIONS RECORDED IN 2003 IN THE MAMAIA AND MANGALIA SECTOR

No.	Taxa	Mamaia cell									Mangalia cell								
		F%	D_{AVG}	D_D%	W_D	R_{kD}	B_{AVG}	D_B%	W_B	R_{kB}	F%	D_{AVG}	D_D%	W_D	R_{kD}	B_{AVG}	D_B%	W_B	R_{kB}
1	Brania clavata	20.00	43.33	0.15	1.73	14	0.01	0.01	0.33	22	33.33	33.33	0.16	2.34	19	0.01	0.01	0.67	22
2	*Capitomastus minimus*										16.67	8.33	0.04	0.83	25	0.00	0.00	0.14	30
3	*Eteone picta*	60.00	63.33	0.22	3.62	10	0.00	0.00	0.25	26	50.00	50.00	0.25	3.51	14	0.00	0.00	0.37	25
4	*Eulalia limbata*	6.67	3.33	0.01	0.28	30	0.00	0.00	0.02	34									
5	*Grubea tenuicirrata*	6.67	3.33	0.01	0.28	31	0.00	0.00	0.05	33	16.67	16.67	0.08	1.17	23	0.01	0.01	0.34	26
6	*Laonice cirrata*	6.67	3.33	0.01	0.28	32	0.00	0.00	0.08	32									
7	*Magelona papilicornis*	6.67	6.67	0.02	0.39	28	0.06	0.03	0.42	20									
8	*Neanthes succinea*	33.33	33.33	0.11	1.96	12	0.33	0.14	2.17	11	33.33	25.00	0.12	2.03	20	0.25	0.34	3.37	12
9	*Nereis rava*	13.33	10.00	0.03	0.68	25	0.10	0.04	0.75	16	16.67	8.33	0.04	0.83	26	0.08	0.11	1.38	16
10	*Nerine cirratulus*	100.00	9460.00	32.61	57.10	1	1.89	0.80	8.97	6	83.33	2891.67	14.24	34.45	3	0.58	0.79	8.10	7
11	*Nerilla antennata*										16.67	75.00	0.37	2.48	17	0.05	0.06	1.01	20
12	*Perinereis cultrifera*	6.67	3.33	0.01	0.28	33	0.03	0.01	0.31	25									
13	*Platynereis dumerilii*	6.67	30.00	0.10	0.83	23	0.02	0.01	0.23	27									
14	*Polydora antennata*	33.33	6216.67	21.43	26.73	4	6.21	2.64	9.39	5	50.00	9441.67	46.51	48.22	1	8.26	11.26	23.73	3
15	*Polydora ciliata*	33.33	70.00	0.24	2.84	11	0.03	0.01	0.60	17									
16	*Prionospio ciliata*	13.33	26.67	0.09	1.11	18	0.19	0.08	1.03	14	16.67	50.00	0.25	2.03	21	0.35	0.48	2.82	13
17	*Pygospio elegans*	20.00	270.00	0.93	4.31	9	0.03	0.01	0.48	19									
18	*Sphaerosyllis bulbosa*	20.00	43.33	0.15	1.73	15	0.03	0.01	0.54	18	66.67	1266.67	6.24	20.40	5	0.71	0.96	8.01	8
19	*Spio filicornis*	66.67	1073.33	3.70	15.70	5	0.32	0.14	3.02	10	100.00	1100.00	5.42	23.28	4	0.33	0.45	6.71	10
20	Oligochaeta	86.67	2466.67	8.50	27.14	3	0.49	0.21	4.26	8	83.33	3383.33	16.67	37.27	2	0.68	0.92	8.77	6
21	Midendorphia caprearum										16.67	16.67	0.08	1.17	24	0.05	0.07	1.08	19
22	*Cardium edule*	33.33	340.00	1.17	6.25	8	16.27	6.92	15.19	3	50.00	425.00	2.09	10.23	7	19.12	26.05	36.09	2
23	*Corbula mediterranea*	66.67	7350.00	25.33	41.10	2	36.35	15.46	32.10	2									

No.	Taxa	Mamaia cell									Mangalia cell								
		F%	D_{AVG}	D_D%	W_D	R_{kD}	B_{AVG}	D_B%	W_B	R_{kB}	F%	D_{AVG}	D_D%	W_D	R_{kD}	B_{AVG}	D_B%	W_B	R_{kB}
24	*Mya arenaria*	40.00	13.33	0.05	1.36	17	161.67	68.76	52.44	1	66.67	633.33	3.12	14.42	6	34.50	47.02	55.99	1
25	*Ampelisca diadema*	80.00	806.67	2.78	14.91	6	3.94	1.68	11.58	4	50.00	133.33	0.66	5.73	10	0.76	1.03	7.19	9
26	*Amphithoe vaillanti*	6.67	3.33	0.01	0.28	34	0.00	0.00	0.09	29	33.33	25.00	0.12	2.03	22	0.02	0.03	1.01	21
27	*Echinogammarus olivii*	20.00	16.67	0.06	1.07	19	0.02	0.01	0.36	21									
28	*Hyale perieri*	6.67	6.67	0.02	0.39	29	0.00	0.00	0.08	31	50.00	41.67	0.21	3.20	15	0.03	0.05	1.51	15
29	*Hyale pontica*	13.33	6.67	0.02	0.55	26	0.02	0.01	0.31	24	16.67	8.33	0.04	0.83	27	0.00	0.00	0.26	28
30	*Melita palmata*	13.33	6.67	0.02	0.55	27	0.00	0.00	0.15	28	16.67	8.33	0.04	0.83	28	0.01	0.01	0.41	24
31	*Microdeutopus gryl-lotalpa*	26.67	40.00	0.14	1.92	13	0.01	0.00	0.32	23	66.67	83.33	0.41	5.23	12	0.02	0.03	1.32	17
32	*Nototropis guttatus*										50.00	25.00	0.12	2.48	18	0.07	0.09	2.10	14
33	*Stenothoe monocu-loides*	13.33	23.33	0.08	1.04	20	0.00	0.00	0.09	30	50.00	66.67	0.33	4.05	13	0.00	0.01	0.52	23
34	*Idotea baltica basteri*	20.00	40.00	0.14	1.66	16	1.20	0.51	3.19	9	83.33	133.33	0.66	7.40	8	4.00	5.45	21.31	4
35	*Sphaeroma pulchaelum*	20.00	13.33	0.05	0.96	21	0.12	0.05	1.01	15	33.33	50.00	0.25	2.87	16	0.45	0.61	4.52	11
36	*Tanais cavolini*										16.67	8.33	0.04	0.83	29	0.00	0.00	0.28	27
37	*Cumella limicola*										16.67	8.33	0.04	0.83	30	0.00	0.00	0.17	29
38	*Iphinoe maeotica*	93.33	466.67	1.61	12.25	7	0.07	0.03	1.67	13	50.00	166.67	0.82	6.41	9	0.03	0.03	1.31	18
39	*Diogenes pugilator*	13.33	13.33	0.05	0.78	24	4.67	1.98	5.14	7									
40	Chironomida	6.67	40.00	0.14	0.96	22	1.03	0.44	1.71	12	50.00	116.67	0.57	5.36	11	3.01	4.10	14.32	5
	Taxa	**Mamaia**									**Mangalia**								
			D_{AVG}	D_D%			B_{AVG}	D_B%				D_{AVG}	D%			B_{AVG}	D%		
	Vermes		19826.67	68.34			9.76	4.15				18350.0	90.39			11.30	15.40		
	Mollusca		7703.33	26.55			214.29	91.14				1075.00	5.30			53.67	73.14		
	Crustacea		1443.33	4.97			10.05	4.27				758.33	3.74			5.39	7.35		
	Varia		40.00	0.14			1.03	0.44				116.67	0.57			3.01	4.10		
	Total		**29013.33**	**100**			**235.13**	**100**				**20300.0**	**100**			**73.37**	**100**		

APPENDIX II

GENERAL CHARACTERISTICS OF THE MEIOBENTHIC POPULATIONS RECORDED IN 2003 IN THE MAMAIA AND MANGALIA SECTOR

No.	Taxa	Mamaia									Mangalia								
		F%	D_{AVG}	D_D%	W_D	R_{kD}	B_{AVG}	D_B%	W_B	R_{kB}	F%	D_{AVG}	D_D%	W_D	R_{kD}	B_{AVG}	D_B%	W_B	R_{kB}
1	*Ammonia beccarii*	93.33	4436.67	0.56	7.21	4	0.81	20.95	44.22	3	83.33	1816.67	0.41	5.84	4	0.24	12.08	31.73	3
2	*Ammonia tepida*	33.33	350.00	0.04	1.21	8	0.07	1.84	7.84	6	66.67	375.00	0.08	2.37	8	0.02	0.84	7.47	10
3	*Ammonia pelucida*	13.33	33.33	0.00	0.24	10	0.02	0.39	2.28	10									
4	*Elphidium incertum*	13.33	43.33	0.01	0.27	9	0.02	0.51	2.60	9	16.67	33.33	0.01	0.35	16	0.02	0.74	3.52	14
5	*Elphidium macellum*										33.33	25.00	0.01	0.43	15	0.00	0.06	1.36	17
6	*Cribroelphidium poeyanum*	13.33	33.33	0.00	0.24	11	0.02	0.39	2.28	11									
7	*Quinqueloculina aspera*										16.67	33.33	0.01	0.35	17	0.00	0.07	1.11	18
8	Turbellaria	100.00	5426.67	0.68	8.26	3	1.25	32.34	56.87	2	100.00	2425.00	0.55	7.39	3	0.69	34.32	58.59	2
9	Nematoda	100.00	717326.67	90.12	94.93	1	0.22	5.62	23.72	4	100.00	397925.00	89.59	94.65	1	0.10	4.81	21.93	4
10	Nerinidae larvae	40.00	2706.67	0.34	3.69	5	0.11	2.81	10.59	5	33.33	483.33	0.11	1.90	11	0.02	0.96	5.65	11
11	Polydora larv. Juv	26.67	1366.67	0.17	2.14	7	0.05	1.42	6.15	8	50.00	866.67	0.20	3.12	6	0.03	1.72	9.27	6
12	Spionidae larvae	53.33	813.33	0.10	2.33	6	0.03	0.84	6.71	7	50.00	616.67	0.14	2.63	7	0.02	1.22	7.82	9
13	Syllydae juv.										16.67	200.00	0.05	0.87	14	0.01	0.40	2.57	16
14	Polychaeta varia										16.67	16.67	0.00	0.25	18	0.01	0.50	2.87	15
15	Halacarida										83.33	216.67	0.05	2.02	10	0.02	0.75	7.92	8
16	Copepoda	100.00	63473.33	7.97	28.24	2	1.27	32.89	57.35	1	100.00	37933.33	8.54	29.22	2	0.76	37.61	61.33	1
17	Xestoleberis acutipenis										83.33	275.00	0.06	2.27	9	0.02	0.89	8.59	7
18	*Xestoleberis decipiens*										33.33	133.33	0.03	1.00	13	0.01	0.43	3.78	13
19	*Loxoconcha pontica*										66.67	100.00	0.02	1.23	12	0.01	0.32	4.63	12
20	*Paradoxostoma intermedium*										66.67	708.33	0.16	3.26	5	0.05	2.28	12.34	5
	Taxa		D_{AVG}	D_D%			B_{AVG}	D_B%				D_{AVG}	D_D%			B_{AVG}	D_B%		
	Foraminifera		4896.67	0.62			0.93	24.07				2283.33	0.51			0.28	13.79		
	Vermes		727640.00	91.41			1.66	43.03				402533.33	90.62			0.89	43.92		
	Crustacea		63473.33	7.97			1.27	32.89				39150.00	8.81			0.84	41.53		
	Varia											216.67	0.05			0.02	0.75		
	Total		**796010.00**	**100**			**3.86**	**100**				**444183.33**	**100**			**2.02**	**100**		

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