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Coastal benthic diversity in the Black and Aegean Seas

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Abstract

Quantitative data pertaining to the composition of macrobenthic communities of soft bottoms along the coastal zones of the Black and Aegean Seas are reviewed. The study area includes one site in the Russian coastal zone, four sites in Ukraine (at depths 3-125 m), four sites in Bulgaria (at depths 12-83 m), and four sites in Greece (at depths 9-90 m). The species variety, population density and community diversity are compared between Seas, among regions and among stations. The fluctuation of these parameters in connection to anthropogenic impact (ranging from open undisturbed sites to those receiving heavy organic and chemical effluent) are discussed. The low species number of benthic fauna in the Black Sea, as opposed to the richness of the Aegean Sea (three times higher) a ratio well established for other marine groups, is not reflected in the overall abundance. Thus, the average population density of benthic organisms may reach 12352 ind per m^2 in the Black Sea (Cocketrice sandy bank) while in the Aegean it did not exceed 4,000 ind per m^2 (Saronikos Gulf). Community diversity was always lower in the Black Sea than similar sites in the Aegean Sea. Within the various regions examined, the protected areas exhibited the most complex community structure.

Keywords: Biodiversity, Benthos, Black Sea, Aegean Sea.

Introduction

Marine Coastal Zones have been widely recognised as the most vulnerable, suffering the impact of most anthropogenic activities. Inventory-making and classification of marine biodiversity in coastal ecosystems is fundamental in order to comply with the urgency of the present times which calls for a sustainable environment. Monitoring, conservation and restoration, if necessary, is possible, only when there is knowledge. And very little is known. World-wide, marine biodiversity research is suffering from an extremely fragmented approach and the eastern Mediterranean and Black Seas are among the areas least covered (CEC/EERO, 1996).

There is scanty published information on coastal benthic communities of soft substrata in the Aegean Sea (ZENETOS & BOGDANOS, 1987; ZENETOS & PAPATHANASSIOU, 1989;

SIMBOURA *et al.,* 1995) while a bulk of unpublished data exists in the grey literature. Similarly, in the Black Sea there is a lot of information concerning diversity and structure of benthic communities (ZAITSEV & MAMAEV, 1997; ZAITSEV & ALEXANDROV, 1998; KONSULOV, 1998), some of it in a data base of the IBSS (Dept. of Shelf Eco-systems) unpublished. The main difficulties with this information are:

a) the literature is in languages and journals difficult to access and understand that is

- in Russian for the Russian and Ukraine coasts (KISSELEVA., 1981; MILOVIDOVA & KIRYUKHINA, 1981; KISSELEVA & SERGEEVA, 1986; ZOLOTAREV & POVCHUN, 1986; POGREBOV *et al.,* 1992; SERGEEVA, 1992; PETROV & ALYOMOV, 1993).
- in Bulgarian for the Bulgarian coasts (MARINOV, 1990; TODOROVA & KONSULOVA, 1997)
- in Greek for the Aegean Sea (Technical Reports)

b) definitions of the benthic communities have been subjective.

Indeed, in most cases the benthic communities have been defined according to the subjective opinion of the researchers, because univariate and multivariate methods of statistical analyses were not developed or not available at the time of the investigations.

This study is a concerted effort to compile information regarding macrobenthic communities in the two areas and compare their diversity. The species richness (S), population abundance (N/m^2), Shannon-Wiener community diversity (H) and evenness of distribution (J) are compared between Seas, among regions (countries) and among sites. The fluctuation of theses parameters in connection to anthropogenic impact (ranging from open undisturbed sites to those receiving heavy organic and chemical effluent) is discussed.

Furthermore, the qualitative composition of the benthic communities at comparable biotopes of the two areas will provide a more comprehensive picture and will, thus, allow further conclusions on the similarities/dissimilarities between the two Seas.

Materials and Methods

The study sites

In order to assess the coastal benthic diversity, thirteen coastal sites, seen in Figure 1, with different degrees of environmental impact are examined in four countries: Russia, Ukraine and Bulgaria in the Black Sea and Greece in the Aegean Sea.

The Russian coastal zone examined (*The Caucasus site*) is mainly a resort area. Nevertheless, it is affected by municipal and industrial sewer as well as by drainage waters, coming from small rivers, which are polluted by oil, heavy metals, fertilisers and pesticides.

Along the Ukrainian coasts, because of the high pollution level, it is difficult to isolate single sources of pollution. However, taking into account the prevalent pollution source, *Yalta* is considered as the most representative site suffering from organic pollution; *Karkinitsky* as mainly affected by chemical pollution while *Kalamitsky* Bay as intensively fished by bottom trawlers. Finally, *Karadag site,* situated in the eastern part of Crimea, far from industrial centres, is one of the cleanest areas. Since 1979, Karadag and the neighbouring coastal zone have been declared as a reserve zone.

Along the Bulgarian coasts four sites are examined: *Varna* Bay and *Bourgas* Bay, both suffering from a high level of complex industrial and urban pollution (organic, oil, etc.) and with a high level of eutrophication.; the third, *open coastal area* along the entire coast, is characterised by comparatively low anthropogenic impact. It is mostly affected by pelagic and bottom trawling fishing activities. Cocketrice sandy bank is examined as the most undisturbed one (nature reserve to be declared as a protect-

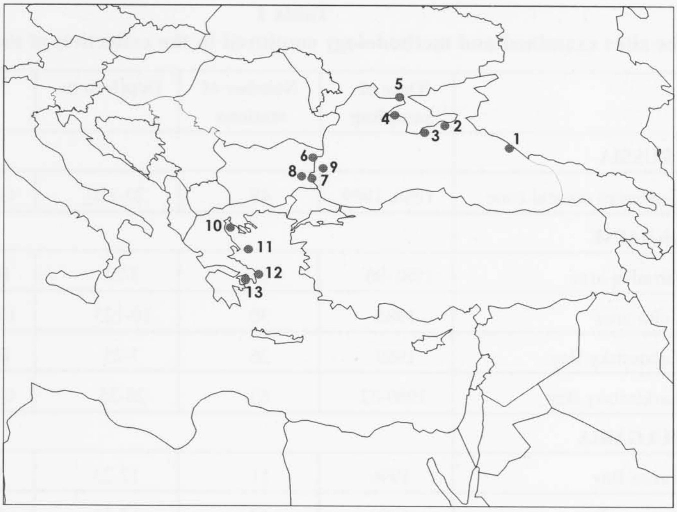

Fig. 1: Location of the study sites in the Black and Aegean Seas.

ed area: KONSULOVA & TOKMAKOV, 1995).

In the Aegean Sea, the four coastal sites examined are: *Saronikos* and *Thermaikos* bays with heavy anthropogenic impact, *Petalioi* Bay with moderate anthropogenic impact (mainly by fisheries), and Sporades, an extensive marine park as an example of a pristine environment.

The data

The areas were sampled for macrozoobenthos employing various effective sampling methods; albeit with varying sampling effort and at different time intervals. In the Aegean, sampling was seasonal (Saronikos and Thermaikos Gulfs) using Van Veen and Ponar grabs ($0.1 m^2$ and $0.05 m^2$ respectively); in Bulgaria Van Veen grabs were used ($0.1\ m^2$) and in Ukraine (box corer 0.05 and grab corer $0.25\ m^2$). The samples were sieved through a 1mm sieve. In the Black Sea samples were collected either annually or only once and with varying effort (11 stations at Varna bay, 83 stations at Karkinisky Bay). The different samplers and effort employed are shown in Table 1.

The data sets for each site, provided by the collaborating Institutes, cover a period from 1980-82 (Karkinitsky Bay) to 1998 (Cocketrice). Some, partly or totally, can be traced in Russian, Bulgarian and Greek publications, but unpublished data (part of Saronikos data: Elefsis, Varna Bay, Bourgas Bay, Cocketrice: 1996 to 98 data) are treated in this work too. The methodology followed enabled thorough description of the community diversity since the sieving was performed through a 1 mm sieve, identification was achieved to species level by experts and nomenclature was revised following recent Mediterranean and Black Sea systematics. In order to achieve uniform results the samples were extrapolated into m^2. However, the accuracy of the depiction of the diversity measures could have been greater if data from a station or similar stations had not been mingled and the population density had not been calculated as an average value per m^2 and the sampling effort had been identical in the four countries.

The "old" raw data were processed with recent software in order to assess standard diversity indices. The structure of the benthic community was analysed in terms of: population density (N/m^2), species richness (S), community diversity (H) calculated by the Shannon-Wiener diversity index to the

Table 1
The sites examined and methodology employed in the collection of the data sets.

		Time of sampling	Number of stations	Depth in m	Samplers
	RUSSIA				
1	Caucasian coastal zone	1986, 1989	48	20-110	Grab Corer 0.25 m^2
	UKRAINE				
2	Karadag area	1981-90	33	3-23	Box-Corer 0.05 m^2
3	Yalta area	1986	30	10-125	Grab Corer 0.25 m^2
4	Kalamitsky Bay	1989	26	7-25	Box-Corer 0.05 m^2
5	Karkinitsky Bay	1980-82	83	28-35	Grab Corer 0.25 m^2
	BULGARIA				
6	Varna Bay	1996	11	12-23	Van Veen 0.1 m^2
7	Bourgas Bay	1996	12	15-51	Van Veen 0.1 m^2
8	Cocketrice	1992-1998	4	17-22	Van Veen 0.1 m^2
9	Open coastal area	1997	15	20-83	Van Veen 0.1 m^2
	GREECE				
10	Thermaikos Gulf	1992-1996	37	11-45	Van Veen 0.1 m^2 Ponar 0.05 m^2
11	Sporades	1983	5	9-40	Van Veen 0.1 m^2
12	Petalioi Gulf	1996	3	35-69	Van Veen 0.1 m^2
13	Saronikos Gulf	1989-1993	12	10-90	Van Veen 0.1 m^2

base of 2 and J=Pielou evenness of distribution. Moreover, multivariate techniques were applied to the binary data. Clustering and Multidimensional Scaling (MDS) were performed with the Group Average technique using the PRIMER package.

Results

Comparison between the two Seas

A total of 235 species are recorded from the Black Sea while three time as much (646 species) are met in the Aegean Sea. However, average population density is higher in the Black Sea (3376 ind./m^2) than in the Aegean (2089 ind./m^2) Fig 2 (a-d).

The contribution of the dominant benthic taxa in terms of species numbers varies considerably between the two Seas. In the Aegean Sea, polychaetes are the dominant group (48%) and molluscs follow with 21% (Fig. 2b). In the Black Sea, molluscs share this first position with polychates (Fig. 2a). Their contribution varies between 29-35% (overall 30%) while that of polychaeta ranges from 25-33% (overall 29%). Crustaceans follow with a slight difference: 21% in the Aegean vs 27% in the Black Sea. The echinoderms are rarely met in the Black Sea (only one species in the coastal zone of Bulgaria, 4 in the entire Black Sea) as opposed to the Aegean Sea where their contribution may reach 4% (29 species in this study).

In sharp contrast to the above was the picture demonstrated by the quantitative analysis (Fig. 2c-d). In the Black Sea polychaetes share the first position with mollusca occupying an average of 41% while of

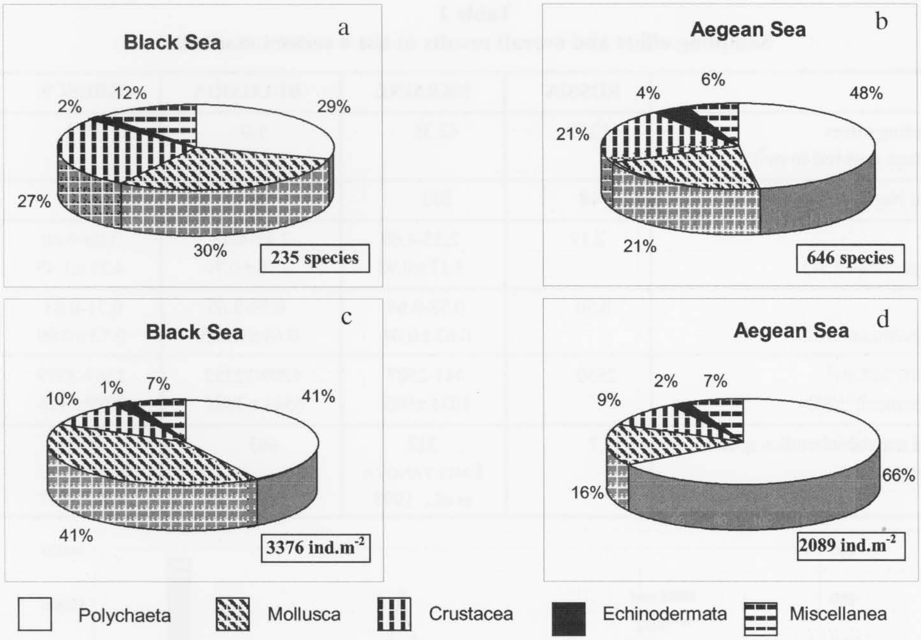

Fig. 2: a-b: (Qualitative contribution) and c-d (Numerical abundance) of the main benthic taxa in the two Seas.

crustaceans represent only 10%. These figures are mainly attributed a) to the high abundance of polychaetes along the Bulgarian coasts (average: 3658 ind./m^2) and b) to the disproportionate numerical contribution of molluscs along the Russian and Ukrainian coasts, reaching 84% at the Caucasus site. In the Aegean the polychaeta contribution ranged from 49 to 75% (Saronikos Gulf) with an average of 66% and that of molluscs from 4 to 26% (average 16%).

Overall species diversity in the studied sectors

Calculation of the total species number along the coastal zones of the countries (Table 2), revealed a minimum value of 61 species in Russia, followed by 141 species in Bulgaria, 203 in Ukraine and a maximum in the Aegean (646 species). However, as species richness is to an extent, size-dependent, the low number of species noticed in Russia and Bulgaria can be argued to be due to the relatively lower sampling effort. This might be true for Russia but not for Bulgaria. To enable comparisons the total number of macrozoobenthic species recorded so far in each country is cited along with the species variety documented before 1970. It is obvious that this work, indicative of some representative ecosystems only, deals with about 25% of the total macrobenthic fauna, a percentage which remained the same in the Greek and Bulgarian areas of study. In other words, the soft bottom macrozoobenthic communities at depths 3-125 m support about 25% of the benthic fauna encountered at each area.

Evenness of distribution followed closely the pattern shown for species variety and community diversity, that is minima at the Russian site (0.50), followed by 0.61 at the Bulgarian sites, a little higher at the Ukrainian sites (0.63) and >0.7 at the Aegean sites.

The total species number per studied site ranged from 53 to 390 (Fig. 3). Generally

Table 2
Sampling effort and overall results at the 4 sectors studied.

	RUSSIA	UKRAINE	BULGARIA	GREECE
sampling effort (surface covered in m^2)	12.75	42.38	5.0	19.2
Total No of stations	48	200	42	57
H Range/mean±SD	2.19	2,35-4.60 3.17±0.98	2.45-4.33 2.98±0.90	3.08-6.60 4.51±1.49
J Range/mean ±SD	0.50	0.58-0.68 0.63±0.04	0.59-0.65 0.61±0.025	0.71-0.83 0.73±0.09
density ind./m^2 range/mean ±SD	2550	441-2507 1034±985	4289-12352 6544±3882	1287-3399 2089±926
Total macrozoobenthos species all zones	?	312 EMELYANOVA *et al.*, 1998	463	2675 STERGIOU *et al.*, 1997

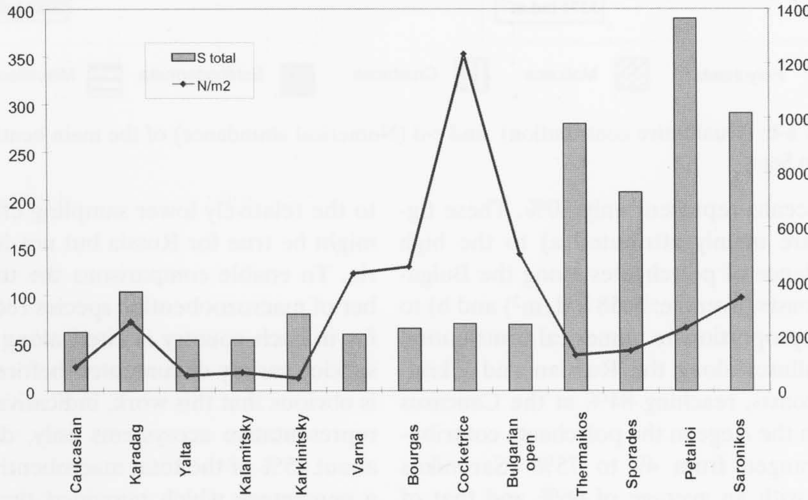

Fig. 3: Total species number (S) and mean densities ind./m^2 at each site.

species number was lower the more polluted the site was. Thus of the Ukrainian sites, Yalta and Kalamitsky, highly polluted and intensively trawled respectively, hold the fewest species (53 species). Of the Bulgarian coasts minimum (59 species) was noticed at the highly polluted Varna Bay. In the Aegean, the Saronikos and Thermaikos Gulfs, receiving the impact of industrial and urban effluent of the cities of Athens and Thessaloniki respectively, presented the lowest species numbers: 291 and 280 species respectively.

Conversely a peak in species numbers was noticed at the protected sites. In the Black Sea maxima in Karadag (Ukrainian protected site): 104 species and in Cocketrice (Bulgarian protected site): 70 species. In the Aegean, the maximum number of species (390) was recorded at Petalioi Gulf (the fished site, surface sampled $3m^2$). The Spo-rades site (marine park) presents a relatively low species number (208) which must be attributed to the low sampling effort (only five stations, surface coverage of 1 m^2). When the hard subsrata that dominate the coastal area

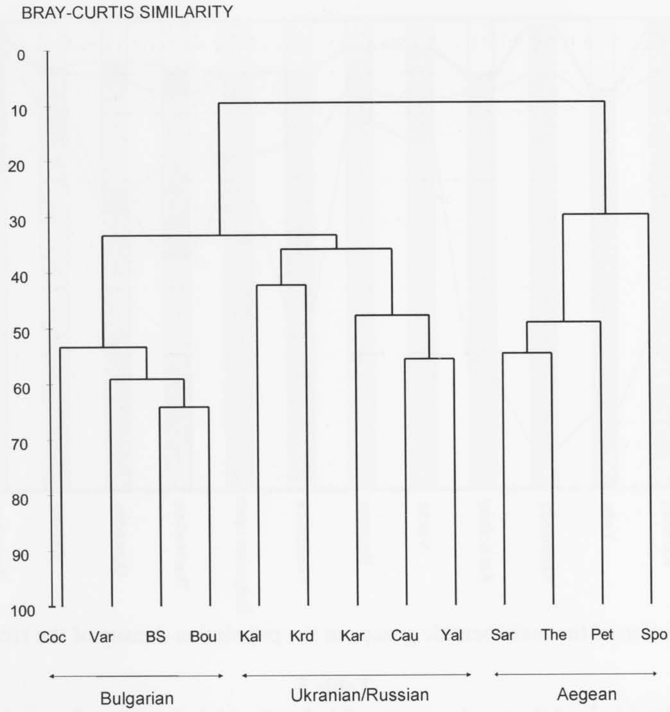

Fig. 4: Classification of the studied sites performed by the Group Average Clustering technique (presence/absence data).

are considered the true number of spe-cies exceeds the 400 taxa (SIMBOURA *et al.*, 1995).

As far as population density is concerned, the maximum values are exhibited along the Bulgarian coastal zones where densities as high as 18817 ind./m^2 per station were calculated (in Cocketrice site average 12352 ind./m^2). Moderate densities were noticed along the Aegean coasts, with minimum in the Sporades site (mean 1439 ind./m^2) and maximum in the Saronikos Gulf (3399 ind./m^2). However, extreme densities were noticed within the Saronikos Gulf ranging from 0, in temporarily azoic stations, to 4120 ind./m^2. Along the Bulgarian coasts, maxima of population density coincided with the maxima in species numbers (Fig. 3).

Community diversity varied between 2.19 and 2.94 bits/unit in the Black Sea with the exception of the Karadag and Cocketrice sites where it reached 4.60 and 4.33 bits/unit respectively. In the Aegean Sea, values of community diversity were about double those measured in the Black Sea. The maximum diversity (6.6 bits/unit), which is about the highest ever measured in the Aegean was estimated at the Petalioi Gulf site.

The clustering of the various sites based on faunal similarities (presence/absence data) produced the dendrogram of Figure 4 which shows clearly three levels of differentiation. The first major differentiation is between the two different Seas: The Black and the Aegean. The second level groups together similar geographic units (sectors) as the Bulgarian and Ukrainian coastal zones. The Russian site (Caucasus) joins the Ukrainian sites. Finally the third level represents the anthropogenic impact and groups together disturbed areas such as the Thermaikos and Saronikos Gulfs: heavy organic and industrial pollution, Yalta and Caucasus: sites with a complex of pollutants and fisheries. At this level the protected

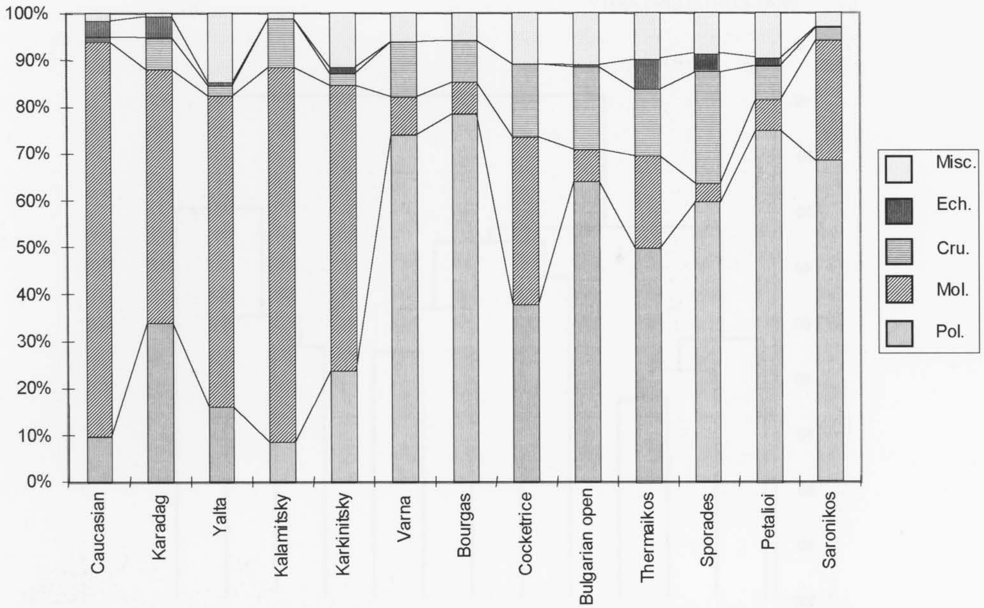

Fig. 5: Contribution of the main benthic groups in the population density of the studied sites.

Table 3

Abundance (ind./m^2) of the species responsible for the high densities observed at each site.

	Caucasus 29sts 50-110m mud	Karadag St.1 5-15m sand	Varna St11 18m silt	Bourgas St52 25m silt	Cocketrice St3 22m sand	Bulg.open St102 63m silty sand	Saronikos st2 83m sandy mud
Apseudopsis ostroumovi (Cru.)					1307	8130	
Coremapus versiculatus (Cru.)					1133		
Oligochaeta			640		3603		
Mytilus galloprovincialis (Mol.)		118	1200		2393		
Modiolula phaseolina (Mol.)	1235						
Aricidea claudiae (Pol.)			1250	5920			
Heteromastus filiformis (Pol.)			1860	1420			
Melinna palmata (Pol.)			330	2350		1040	
Neanthes succinea (Pol.)			710				
Spio filicornis (Pol.)				2097			
Pholoe synophthalmica (Pol.)		1055					
Protodorvillea kefersteini (Pol.)		445					
Prionospio cirrifera (Pol.)		233					
Chaetozone setosa (Pol.)							2920

zones (Sporades, Cocketrice, Karadag) are clearly separated from the rest in the region/country. The MDS plot (graph not shown here) differentiated even more the two Seas placing their sites at the extreme ends.

Indeed the benthic fauna of the two seas exhibits great dissimilarities not only concerning species variety and the ecological identity of the species but mainly in the structure of the ecosystem at the group level (both in terms of species and densities). As depicted in Figure 5, molluscs play the primary role along the Caucasian and Ukrainian coasts (up to 85%), while polychaetes dominate along the Bulgarian and Aegean Sea coasts contributing over 70%. Some of the species which are responsible for the high percentage and respective high densities observed at the above sites (see Fig. 3) are presented in Table 3. The observed analogy in groups contribution which differs in the Cocketrice site (protected area), among the Bulgarian sites, must be attributed to the mollusc *Mytilus galloprovincialis* which has been introduced in the area for mussel culture. The high percentage of polychaetes along the Bulgarian coasts and Saronikos Gulf and Petalioi sites (Aegean) is due to opportunistic species which benefit from the situation (disturbance). However, in the Sporades site (Aegean) this high percentage must be rather attributed to the elevated species variety than to some degree of disturbance.

Discussion

The largest of the semi-enclosed European Seas, the Mediterranean Sea connects with the Sea of Marmara and thus with the Black Sea via the Dardanelles Strait. The Black Sea is today the inland Sea most isolated from the world ocean. Its present fauna, made up of Atlanto-Mediterranean originated species and a few relics of the Caspian complex, was mostly formed in the last millennia. As a result of past geological events, its morphology and specific water balance, nearly 87% of the Black Sea water volume is anoxic and contains high levels of hydrogen sulphide (ZAITSEV & MAMAEV, 1997).

Over, the last 30 years, the Black Sea has increasingly attracted the attention of scientists, governments and the public at large as a region suffering ecological deterioration. Until the early 1970s the species composition and quantitative distribution of the Black Sea macrozoobenthos could have been characterised as seasonally stable with comparatively small annual fluctuations in density and biomass. The ability of organisms to live on the bottom is limited by the presence of hydrogen sulphide. Moreover, the river induced nutrient enrichment and eutrophication caused significant changes in the species composition. Some species disappeared while others were introduced and became dominant. About 20 invertebrate species have entered by means of ballast waters, fouling or as species accompanying imported ones for commercial purposes. The unintentional introduction of new molluscs such *as Rapana thomasiana, Mya arenaria and Scapharca inaequivalvis* has become a significant reason for modern transformations of certain biocoenoses in the Black Sea (ZOLOTAREV, 1996). Conversely, the introduction of about 20-30 exotic species in the Aegean Sea, has not caused any significant changes in the marine ecosystem so far.

Abrupt changes were observed in the macrozoobenthos, particularly in the freshened areas of north-western Black Sea, in the early 1970s. The first mass mortality of benthic fauna was registered in the Dnestrovsky-Danube interfluve in September 1973 (SALSKY, 1977).

It has been established that the species diversity of free living multicellular organisms in the Black Sea is approximately 3.1 times lower compared with that of the Mediterranean - 1707 vs 5281 (MORDUKHAI-BOLTOVSKOI, 1972). This study which reviews the benthos at comparable coastal sites, representative of "clean" to "extremely polluted" ecosystems, records a total of 235 macrozoobenthic species in the Black Sea, in contrast to 646 in the Aegean. These numbers are only indicative of soft bottom fauna at depths 3-125 m. The results, which are derived from reviewing the situation after 1980, show that the proportion 3:1 has not changed significantly despite the dramatic changes which occurred in the early 1970's. The two Seas, sharing only 71 species in common (this study), have a faunal similarity of 0,087 (Jaccard coefficient, based on binary data).

Of the 235 species found in the Black Sea, besides the Caucasus area which was inadequately covered in this work, the Bulgarian coastal zone appears to be the poorest, with only 141 species in contrast to the Ukrainian coasts where 203 were found. Some "sentitive" benthic taxa, such as the Echinodermata, are rarely met in the Black Sea (only one species in the coastal area of Bulgaria, 4 in the entire Black Sea) as opposed to the eastern Mediterranean with 29 species in this study of the 107 species recorded in the Greek Seas (PANCUCCI-PAPADOPOULOU, 1996). Sipuncula, are also poorly represented in the Black Sea: 1 species vs 17 in the Aegean (PANCUCCI-PAPADOPOULOU *et al.*, 1999). The low spe-cies variety encountered in the Oligochaeta and Nemertea of the Aegean Sea must be attributed to lack of taxonomical expertise in these groups.

The contribution of the main benthic groups to the qualitative composition of the benthic macrofauna varies a little within the Black Sea areas but significantly between the Black and Aegean Seas. Thus, in the Aegean, polychaetes dominate (48%), as in the rest of the Mediterranean and in the world seas, reaching 70-90 % in disturbed ecosystems (STERGIOU et al, 1997) and molluscs follow with 15-25 % (21%, in the Aegean). In the Black Sea molluscs contribute equally with polychaetes in the species variety (29 & 30% respectively).

With regard to the numerical abundance the classical model of over-increase of densities at very disturbed areas is skewed due to the highest densities observed at the Bulgarian sites (>4000 ind./m^2). These values are due to a few opportunistic species, mainly polychaetes, who benefit from the situation. In the Ukrainian sites the maximum density was observed at Karadag site, the protected area, due to the abundance of mollusca and a few opportunistic polychaetes. Similarly, molluscs dominated along the other Ukrainian sites as opposed to polychaetes that made up to 75% of the population along the Bulgarian coasts. Exceptional is the case of Cocketrice site (Bulgaria) where densities as high as 12352 ind./m^2 (average) were measured attributed mostly to mussel culture and accompanying opportunistic species, but to some introduced species as well. The Aegean Sea communities presented a picture similar to that of their western Mediterranean counterparts, with maximum density and minimum variety in the Saronikos Gulf where a few opportunistic polychaetes account for about 70% of the population.

The pattern shown in species variety and abundance, was also exhibited in the community structure. Thus, community diversity and evenness of distribution were lowest at the Bulgarian sites, a little elevated in the Ukrainian coasts and 2-3 times higher in the Aegean than in the Black Sea. The maximum (6.6 bits per unit), calculated at the Petalioi Gulf, is one of the highest values ever measured in Greek waters (SIMBOURA *et al.,* 1998). However, it was measured in the fished site and not in the marine park. The Shannon community index with macrozoobenthos has been tested as a measure of the sanitary assessment of marine waters of the Black Sea where proved to be a reliable measure for silt and silt-sand bay ground but not for coarser sediments in the open sea (MILOVIDOVA & KITYUKHINA, 1979). As species diversity is very dependent on habitat type there is a need to be carefully standardised for broader comparative purposes (WARWICK, 1998).

Comparison of the ecological parameters among the sites examined revealed that within the various sectors, the protected areas exhibited the highest values in species diversity, community diversity, evenness of distribution and a better picture in the participation of the main groups. In contrast to this, the damage of fishing was not clear on the benthic ecosystem structure of intensively-fished zones, possibly because it was difficult to locate areas with a single disturbance factor in the Black Sea.

However, anthropogenic stress has not influenced equally all benthic ecosystems. Narrow steep shelf areas, characterised by intensive water exchange with the open sea, were affected insignificantly as demonstrated by comparative studies in the Anapa Bay, 30 years apart (NEJMAN & FILIPPOV, 1991). Besides, there are "oases" of biodiversity, where the composition of the fauna has remained to relative high levels. These oases are the protected areas which are clearly differentiated in this study by the multivariate analyses. One of these is the Karadag marine reserve. This study shows a relatively undisturbed ecosystem as evidenced by a) species diversity (104 species) in the coastal zone which is the richest among the Ukrainian sites and b) community diversity index (H=4.60). It must be pointed out that 296 species were recorded before 1952 (PROKUDINA, 1952). Similarly, among the Bulgarian site the Cocketrice sand bank (semi-protected area) is separated by the clustering technique and among the Aegean the Sporades marine park.

Within the Black Sea, as shown by the parameters examined, the most polluted section, among those studied - the Caucasus zone excluded, is the Bulgarian coastal area. This is in agreement with FASHCHUK & CHERALYPA (1997), who state that the southern and western coasts of Crimea appear to be in a rather safe situation due to peculiarities of general circulating system in the Black Sea. A survey of bottom communities on the Black Sea shelf of the Caucasus, Crimea and Bulgaria, carried out during 1989, largely confirmed literature data. Thus, biomass values over 5000 g/m^2 which were recorded in the north-western part of the sea are indicative of the high degree of disturbance in the area (ALEKSEEV & SINEGUB, 1992). Among the areas most affected is also the Romanian coastal zone where about 50-60% reduction of species the last 30 years has been demonstrated (TIGANUS, 1997). Along the Turkish coast, only 37 mollusca species were collected (MUTLU, 1995) in contrast to 174 species recorded in the Black Sea before 1970 (BASESCU *et al.,* 1971). In the near Bosphorus region (at the depth of 86 m), the benthic fauna is characterised by even lesser species diversity- 15 species in all (MIKHAJLOVA, 1992b).

In Conclusion,

• The macrobenthic fauna variety of the Black Sea is about three times lower than that of the Aegean.

• The level of disturbance is adequately reflected on the benthos composition and structure in both Seas.

• The western part of the Black Sea is the most affected as demonstrated by all community parameters.

• Within the various regions examined, the protected areas exhibit the most complex community structure.

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