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RECENT CHANGES OF ZOOBENTHOS COMMUNITIES FROM THE REGION CAPE KALIAKRA – CAPE GALATA (THE BLACK SEA)

S. UZUNOVA
Institute of Fish Resources, BG – 9000 Varna, Bulgaria

Abstract

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In 2006, 2011 and 2013 benthic macrofauna investigations were carried out in the region between Cape Kaliakra and Cape Galata, situated at 1 mile distance in front of the Bulgarian Black Sea coast and two stations in Varna Bay, so that to reveal the present situation with the benthic communities in the studied area in 2013, compared to 2006 and 2011. The results show strong increase in abundance of benthic macrofauna from 2006 to 2013 and reverse trend for the biomass values. Similar results were established for the period 1998–2002, which prove that situation within benthic community is still very unstable. Trend of decrease in mollusk's share in species composition and increase of polychete number was found in 2013. Shannon – Wiener index shows improvement of the state of benthic communities in the investigated area. Values of Marine Biotic Index (AMBI) and multivariate AMBI (M–AMBI) are in conformity with Shannon – Wiener index and confirm the relatively good state of the ecosystem in the investigated area.

Key words: Black Sea, coastal area, macrozoobenthos

Introduction

Coastal waters are strongly exposed to the antropogenic pressure by the inflow of pollutants from the continental river discharge and industry and their assesment is subject of several legislative documents (i.e.Water Framework Directive – Directive 2000/60/EC and the Marine Strategy Framework Directive – Directive 2008/56/EC) in term to ensure sustainable management of aquatic resources. Benthic comunities respond to the disturbances in the marine enviroment by changing their species number and composition of the assemblages, abundance and biomass (Pearson and Rosenberg, 1978; Diaz and Rosenberg, 1995), therefore they have been considered as good indicator for environmental health (Holme and McIntyre, 1971). First investigations of the zoobenthos from the Bulgarian Black Sea sector startet in the period 1954–1957 by Kaneva-Abadjieva and Marinov (1960) and it is considered as pristine and used as basic for the investigations of benthic communities. Later on Kuneva-Abadjieva and Marinov (1966) pay special attention to the zoobenthos from sandy habitat. Marinov and Stoykov (1990) continued the quantitative investigation of zoobenthos on seasonal base. During 80-es of the past century is established a strong reduction in the Black Sea biodiversity due to serious increase in the level of eutrophication (Zaitzev and Mamaev, 1997). The results of 1996–1997 investigations of Todorova and Konsulova (2000) showed changes in benthic comunities structure leading to dominance of *Polychaeta* over Mollusca and decrease of crustaceans role with comparison to the pristine period. Recently Todorova (2005) and BS (2008) reported situation prior to the collaps. Uzunova (2012) found improvement at particular stations for the region Cape Kaliakra – River Kamchia area, but in general the situation with benthic communities remain unstable.The most contemporary information considers the region between Cape Kaliakra and Cape Galata as one of the most influenced by human activiy (IA, 2013).

The aim of the present paper is to reveal the present situation with the benthic communities in the Kaliakra – Galata sector of the Bulgarian Black Sea coastal area in 2013, compared to 2006 and 2011.

Materials and Methods

In summer of 2006, 2011 and 2013 zoobenthos samples were collected from stations, situated at 1 mile distance in front of Cape Kaliakra, Albena Resort, Balchik, Cape Galata and two stations in Varna Bay (Varna North and Varna South), (Figure 1) at a depth between 16 and 23 m. Samples were taken by van Veen grab (opening 0.1 m^2), sieved on vessel board and presereved in 4% buffered formaldehyde solution according to Todorova and Konsulova (2005) Sorting and taxonomic identification at a lowest possible level were performed in a laboratory conditions (except for the groups *Turbellaria, Nemertea, Oligochaeta, Nematoda*). Three main groups of organism were recorded, namely *Polychaeta*, *Mollusca*, *Crustacea*. In the forth group – "Varia" are included the rest of organisms found in the samples. Quantitative parameters (abundance (N) – ind.m^{-2} and biomass (B) – g.m^{-2} are recalculated to a meter square. Statistical analyses was performed by PRIMER 5 (Primer–E Ltd.), (Clarke and Warwick, 1994), software package programs of Plymouth Marine Laboratory. Marine Biotic index AMBI (Borja et al., 2000, 2003; Muxica et al., (2005) and multivariate AMBI (M-AMBI) were applied to identify the ecological quality status. Map of sampling area is produced uzing ODV programme (Shlitzer, 2014).

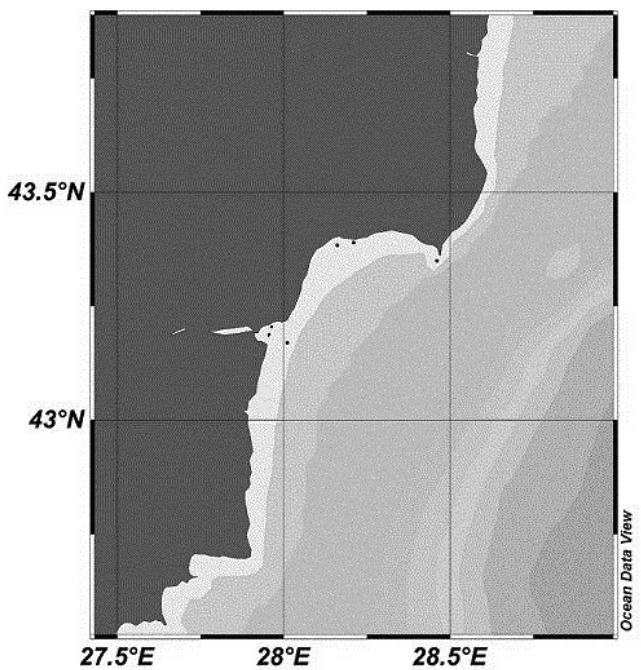

Fig. 1. Map of sampling area

Results and Discussion

Species composition

Total of 63 macrozoobenthos taxa were recorded in the samples for the area between Cape Kaliakra and Cape Galata during summer season of 2006, 2011 and 2013. Species number increased gradually from 35 in 2006 to 40 in 2013. Species composition was dominated by Mollusca in 2006 and 2011 and by Polychaeta in 2013 (Figure 2). Subdominants were polychaete worms during the first two years of the investigation and crustaceans in the last one.

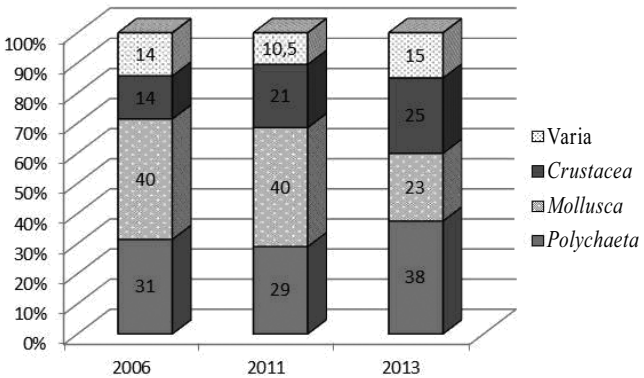

Fig. 2. Share (%) of the macrozoobenthos by groups in the formation of species composition

A trend of reduction in mollusk's share in the species structure was established, while the reverse is observed with polychaete and crustacean species – increase of their role in direction to 2013 (Figure 2).

Most frequent in the samples were *Nephtys hombergi* Savigny, 1818 (100%), *Melinna palmata* Grube, 1869 (75%), from *Polychaeta*, *Ampelisca diadema* A. Costa, 1853 (75%) from *Crustacea* and bivalve *Chamelea gallina* (L., 1758) (56%) and *Abra prismatica* (Montagu, 1808), (50%).

Quantitative parameters

During the compared years abundance was dominated by *Polychaeta*. The maximum value of this parameter for the investigated region was established in 2013 – 4085 ind.m^{-2}. Subdominants by abundance during the first two years were mollusks and in 2013 – crustaceans (Figure 3). At Figure 3 a trend of three-fold increase of polychaete's abundance in 2013 with comparison to 2006 is obvious. Same is the situation with "Varia" group, which gains values of 318 ind.m^{-2} in 2013, against 40 ind.m^{-2} in 2006, what is more than seven times higher. The main reason for this abrupt change was the high individual value of Oligochaeta (first order opportunists) at station Varna–South in 2013 (3420 ind.m^{-2}). This

Table 1

Community structure indices per station: S – species number, H′ – Shannon–Wiener index and AMBI and M-AMBI values per station

Sample/year	S	H′	Mean AMBI	M-AMBI
Kaliakra/2006	14	3.12	1.663	0.83
Albena/2006	16	2.48	0.72	0.84
VarnaBay/2006	15	2.37	0.632	0.81
Galata/2006	16	1.88	2.531	0.67
Kaliakra/2011	13	2.31	4.236	0.58
Balchik/2011	9	2.04	2.722	0.56
Albena/2011	19	2.59	2.581	0.8
VarnaBay (North)/2011	9	0.61	5.745	0.24
VarnaBay (South)/2011	15	2.58	4.084	0.65
Galata/2011	16	2.55	2.149	0.77
Kaliakra/2013	17	3.04	2.597	0.82
Balchik/2013	9	2.25	2.347	0.6
Albena/2013	14	2.9	2.713	0.74
VarnaBay (North)/2013	12	2.39	4.091	0.79
VarnaBay (South)/2013	21	2.91	2.419	0.67
Galata/2013	21	2.24	0.985	0.88

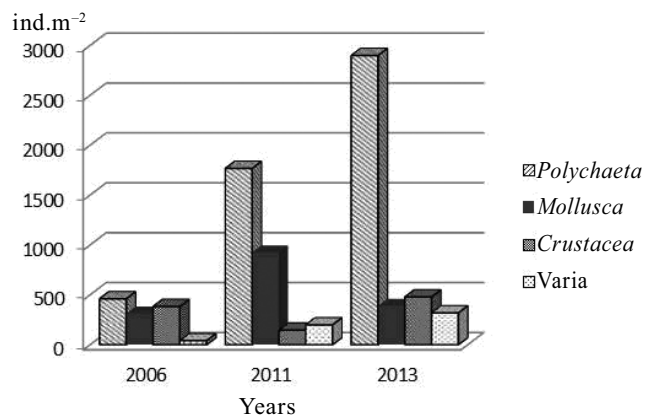

Fig. 3. Macrozoobenthos abundance (ind.m^{-2}) by groups in 2006, 2011 and 2013

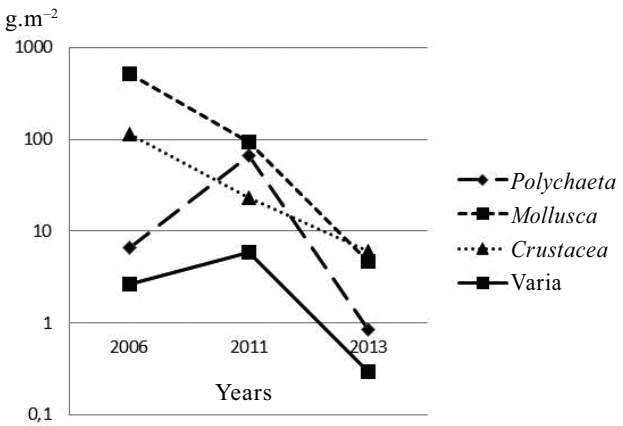

Fig. 4. Zoobenthos biomass (g.m^{-2}) by groups in 2006, 2011 and 2013

sampling point is situated in the Southern part of Varna Bay and is much influenced from the Varna lake inflow, very rich in nutrients in summer.

Biomass dominating for the investigated years were *Mollusca* and this parameter's total average value for the investigated region was found 637.083 g.m^{-2} in 2006, dominated by *Mollusca* (513.083 g.m^{-2}). Maximum value of mollusks is defined mainly by bivalve species *Chamelea gallina*, followed by the invasive species *Anadaraina equivalvis* (Bruguiere, 1789). In 2011 five-fold decrease in the mollusk's biomass is registered, due to reduction in population of blue mussel *Mytilus galloprovincialis* Lamarck, 1819 and *Chamelea gallina*. On Figure 4 a pronounced trend for decrease in biomass of conservative (*Mollusca*) and sensitive (crustacean) species since 2006 is observed. The opportunists *Polychaeta* and "Varia" group have a pick of biomass in 2011, but also drop down in 2013.

Diversity indices calculated on the basis of abundance (Table 1) show relatively similar species richness in most of samples, except for Balchik and Varna Bay (North) in 2011 and in Balchik 2013. Most of Shannon–Wiener index (H') values are relatively high and respond to moderate and good status of the benthic communities, defined by Trayanova et al. (2007). The only station referred to "bad" status is Varna Bay (North) in 2011. Values of

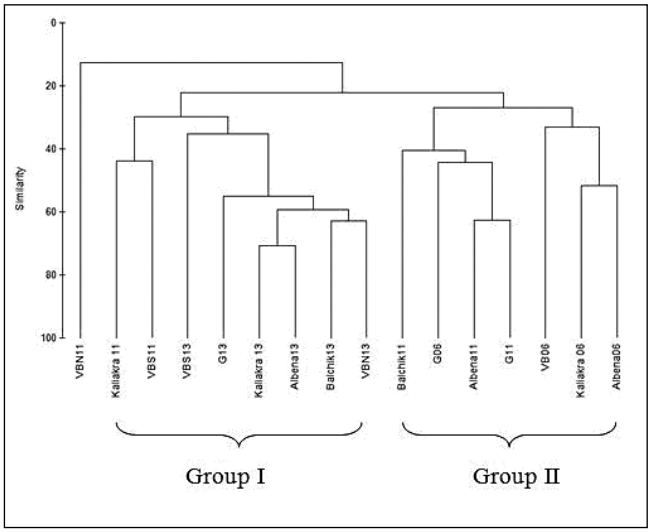

Fig. 5. Dendrogram of Bray-Curtis similarity among stations, based on √√ – transformed abundance of macrofauna

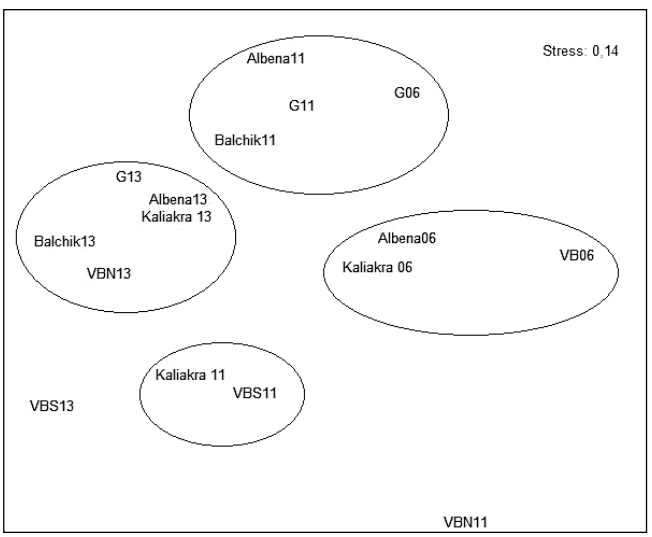

Fig. 6. MDS-plot of Bray-Curtis similarities from √√ - transformed abundance data at the stations from 2006, 2011 and 2013

AMBI and M-AMBI respond to good status for 2006, except for Galata station, where moderate disturbance was recorded. In 2011 only two stations fall under definition for good ecological status, namely Galata and Albena. The values of AMBI and M-AMBI for rest of samples respond to "moderate" and even "bad" ecological status, probably due to local source of eutrophication. In 2013 stations Balchik and Varna Bay (North) are still moderately disturbed and the rest recovered.

Multivariate analyses

Group I aggregates all stations from 2013 and two stations from 2011. They are described by relatively high species diversity, species number and indices values. Within Group II are included the rest of samples from 2006 and 2011, which differ from group I by relatively lower species number and abundance. The single sample from Varna Bay North 2011 differs significantly, due to its lower species diversity and abundance.

MDS-plot shows more detailed subdivision in Group I divided in two subgroups – one of stations from 2013 and a small group of Kaliakra and Varna Bay (South) 2011. Group II also includes two smaller groups – 3 stations from 2006 in the first and 3 stations from 2011 plus Galata 2006. Varna Bay South 2013 and Varna Bay North 2011 differ much from the rest station being the richest and poorest in species from the entire sample set.

Conclusions

The comparison of 2006, 2011 and 2013 shows strong increase in abundance of benthic macrofauna from the first to the last year of investigation and reverse trend for the biomass values. Similar situation was established for the period 1998–2002 (BSC, 2008), which proves that situation within benthic communities in the coastal area is still very unstable and recovery is temporary. Trend of decrease in mollusk's share in species composition and increase of polychete number was found in 2013. Shannon – Wiener index shows improvement of the state of benthic communities in the investigated area. Values of Marine Biotic Index (AMBI) and multivariate AMBI (M-AMBI) are in a good agreement with Shannon – Wiener index and confirm the relatively good state of the ecosystem in the investigated area.

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