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Preliminary study on hyperbenthos species composition in Varna Bay (the western Black Sea).

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ABSTRACT

Preliminary study of hyperbenthos composition in Varna Bay (the Western Black Sea) was carried out in June, August and October 2007, and in June and October 2008. A total of 37 hyperbenthos and zooplankton taxa were established. The hyperbenthos consisted mainly of decapod's larvae (6), fish eggs and larvae (10) and 4 crustacean's groups, belonging to merohyperbenthos and holohyperbenthos. The merohyperbenthos made up a significant share of the total species number in June - August 2007 (70 % -55 %), whereas the fish eggs were replaced by larval stages of anchovy, horse mackerel and red mullet in October 2007. In June 2008 the share of merohyperbenthos reached 61 %, whereas in October 2008 the hyperbenthos was dominated by holohyperbenthos (43 %).

Introduction

The hyperbenthos studies have been started at the beginning of the past century aiming to determine the importance of this group of organisms for the marine biodiversity, food web structure and function. For the first time Beyer (1958) used the term hyperbenthos for the animals that inhabited the lower layers of the water column. Then, Brunel et al. (1978) presented definition of this category of "small sized bottom-dependant animals, which have good swimming ability and perform, with varying amplitude, intensity and regularity, seasonal or daily vertical migrations above the seabed". The synonymy of terms and categories used in literature are discussed by Mees and Jones (1997) and the term hyperbenthos is accepted instead of: supra-, super- and nektobenthos, demersal zooplankton, benthopelagic plankton, benthic boundary layer fauna, implied by several authors. Typically, the upper fraction of the benthic community is composed of free-living crustaceans - Isopoda, Amphipoda, Cumacea, Mysida, larval stages of benthic animals, and fish eggs (Mees et al., 1993, Cattrijsse et al., 1993). The groups mentioned above are significant portion of demersal fish food ration, providing basis for complex predator-prey interactions.

The hyperbenthos is poorly studied along the Black Sea coast of Bulgaria. Several crustacean species are reported by Chichkoff (1912) from Sozopol, Bourgas, Aheloy, Nesebar and Varna Bays, and Băcesco (1948) - from Sozpol Bay. In the studies cited, the samples were collected by means of dredge or using a light during the night catch and several crustacean groups are reported, but the water layer at 20 cm above was poorly investigated. In this context, the present study aims to have a better knowledge on variability of hyperbenthos species composition in the Varna Bay (the western Black Sea).

The ecosystem of Varna Bay is known to function under the conditions of strong anthropogenic impact throughout several decades. It is connected to Varna Lake by means of channel, ensuing constant water exchange with one of the most contaminated lake systems along the Bulgarian coast. The cumulative effect of chemical pollution, eutrophication and alien species invasion on the Bay ecosystem has substantially increased during the 80s and 90s, but since the industrial collapse many signs of environmental status improvement have been recorded (Velikova et al., 2001; Uzunova, 2005; Gavrilova and Dolan. 2007; Langmead et al., 2009; Mihneva and Stefanova, 2011) .

This study makes a first step towards a broader perception of the bottom fauna biodiversity in coastal regions, and provides new scientific information about its contemporary state.

Material and methods

The samples were collected in Varna Bay (Figure 1, Table 1), from the water layer, situated at 20 cm over sand and sand-muddy substrata. The sampling gear was small sledge-type hyperbenthos sampler, with a net - 2 m long and mesh size of 0.5 mm. The trawling duration was 10 min - performed from the board of R/V “Prof. Valkanov”.

The sampling was carried out in June, August and October 2007, and in June and October-2008, during daytime at the depths between 9 and 16 m. The samples collected were fixed in 4% formalin and processed in laboratory according to methodology of Korshenko and Aleksandrov (2006) and identified according to Mordukhay-Boltovskoy (1968). The zooplankton species could be considered as by catch in the hyperbenthos samples.

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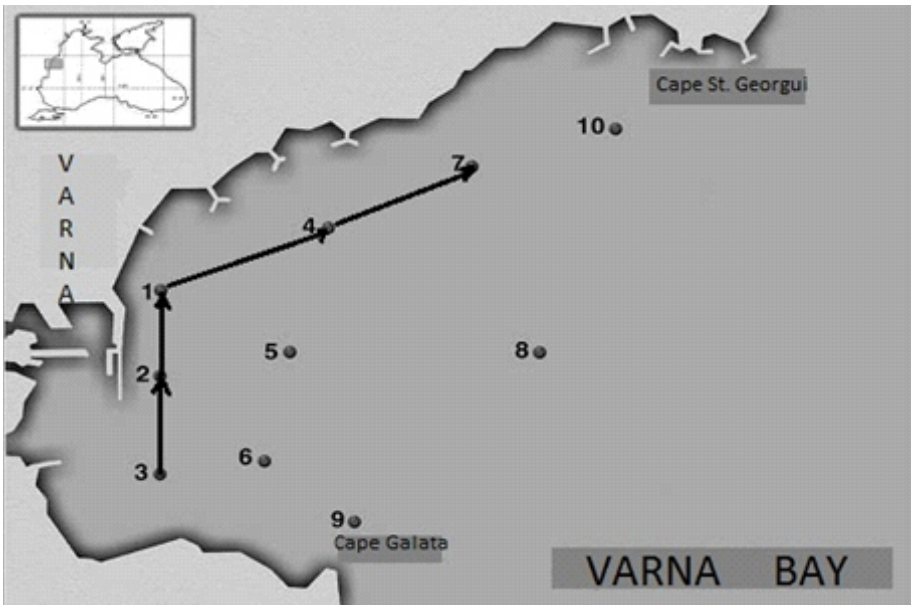

Figure 1. Map of sampling area in Varna Bay

Results and discussion

Monthly changes of species composition

A total of 37 hyperbenthos and zooplankton taxa were found in the samples throughout the study period (Table 2).

Twenty-three hyperbenthos and zooplankton taxa were established in 2007 (Table 2). In June the zooplankton was an important component of the species composition in the samples, but in October 2007 the dominant groups were larval stages of benthic organisms and fish eggs.

The maximum number of taxa (8 taxa) were found in June 2007 at two transects: B3→ B2 and B2→ B1, which were situated across the Varna Lake Channel, thus the enhanced species variety probably, reflected the inflow of nutrient - rich waters into the Bay. In August the species richness increased slightly and the highest number of taxa - (11 taxa) was recorded at transect B4→ B7, characterized by sand-muddy bottom sediment. The highest diversity in October was found for B1 → B4 transect with 5 taxa.

The fish eggs and larvae component belonged extremely to the plankton community. Exception was one demersal egg laid on a sandy bottom by Mediterranean sand eel (*Gymnammodytes cicerelus* Rafinesque, 1810) and recorded in October 2007.

In June 2007 the ichthyological sample at transect B3→ B2 included large number of anchovy eggs (*Engraulis encrasicolus ponticus* Alexandrov, 1927) - 473 and 5 eggs of horse mackerel (*Trachurus mediterraneus ponticus* Aleev, 1956). The high value of anchovy early stages in June 2007 is not surprising considering that this species is one of the most abundant species in the Black Sea, and the peak spawning season is in June-July. In August 2007 at transect B2 → B1 the sample comprised 8 anchovy eggs, whereas at transect B4→B7 - 237 larvae of anchovy, 2 mackerel larvae and 1 red mullet larvae were sampled . The sampling was carried out at the end of the month (29-30 August), so that the recorded eggs quantity of summer-spawning fish eggs was not so substantial: the anchovy eggs ranged from 8 to 170 ind/net, and the identified mackerel eggs l and red mullet were 2 and 11 ind/net respectively. These species were already at the end of spawning and the laying of sex cells in the upper 25 m warm layer gradually dropped down. In October, regarding the end of spawning in warm-water fish and since cold-water species were still in preparation for breeding and lay initially gametes in the offshore sea areas at deeper depths, the quantities of eggs and larvae were negligible.

Table 1. GPS Coordinates of the sampling stations in Varna Bay

Station number	Depth	Coordinates
1	11	43°11,738 N /027°56,140 E
2	9	43°11,350 N /027°55,650 E
3	12	43°11,020 N /027°55,932 E
4	16	43°12,200 N /027°57,430 E
7	14	43°12,150 N /027°57,200 E

In 2008 total abundance increased in comparison to the previous year and 28 taxa were estimated, with almost equal proportions - 16 taxa in June and 15 in October. The larval stages of decapods were predominant in June 2008, these were followed by zooplankton and ichthyoplankton. The dominant species in this period were Thalassinid, *Upogebia pusilla* I-II stage and the zooplankter *Pleopis polyphemoides* (Leuckart, 1859). Later in October, the larvae of *Upogebia pusilla* and of Caridean shrimp, *Palaemon elegans* were replaced by larval stages of *Crangon crangon* (Linne, 1758) and *Pisidia longimana* (Risso, 1815). During this month the holohyperbenthos representatives were also abundant especially mysid, Mesopodopsis slabberi (Van Beneden, 1861). The zooplankton assemblage was dominated by *Chaetognatha - Sagitta setosa* (Müller, 1847) and the ichthyoplankton group was presented only by sprat eggs, because the summer-spawning fish has already terminated their spawning season.

Structural group composition

During the whole study period it was found that two groups of hyperbenthos, as defined by Mees and Jones (1997), were presented in the samples: merohyperbenthos – that spend only part of their early life history in hyperbenthos, and holohyperbenthos – which could be found in variable periods of their adult life in hyperbenthos.

The present studies show that the role of the merohyperbenthos is significant in the hyperbenthos structure (Figure 2). In 2007 the hyperbenthos was dominated by merohyperbenthos (Figure 2). Especially merohyperbenthos group was abundant during the warm months, involving larval stages of decapods, particularly *Upogebia pusilla*, and ichthyoplankton. The abundance of veliger larvae belonging to *Lamellibranchia* and mysis of decapod has increased

Table 2. Species composition of hyperbenthos in Varna Bay.

Months	June 2007	June 2007	June 2007	August 2007	August 2007	October 2007	October 2007	June 2008	October 2008	October 2008
Species composition	B3→ B2	B2→ B1	B1→ B4	B2→ B1	B4→ B7	B2→ B1	B1 → B4	B1→B4	B2→B1	B1→B4
Oikopleura dioica Fol, 1872			+					+		+
Upogebia pusilla III stage		+++	+		+	+				
Palaemon elegans I-II stage								+		
Crangon crangon – V stage										+
Pisidia longimana - II stage										+
Upogebia pusilla I-II stage	+	+		+++	+++			+++		
Diogenes pugilator I-II stage	+			+				+		
Diogenes pugilator III stage	+	+			+					
Gasropoda veliger		+		+				+		
Cirripedia cypris		+					+		+	++
Cirripedia nauplii									+	
Acartia clausi Giesbrecht, 1889		+		+	+			++	+	+
Acartia nauplii									+	
Acartia copepodit III-IV stage								+		
Lamellibranchia veliger	+	+						+	+	+
Pleopis polyphemoides (Leuckart, 1859)		+		+				+++		
Copepoda nauplii	+									
Paracalanus parvus (Claus, 1863)								+		
Noctiluca scintillans Suriray, 1836	+									
Centropages ponticus Karavaev, 1895				+						
Sagitta setosa Müller, 1847					+				+	+++
Calanus euxinus Hulsemann, 1991										+
Ostracoda							+		+	+
Harpacticoida									+	
Idotea baltica (Pallas, 1772)								+		
Mesopodopsis slabberi (Van Beneden, 1861)									++	++
Hydromedusae										+
Anchovy eggs	+			+	++	+		++		
Horse mackarel eggs	+				+			+		
Red mullet eggs					+			+		
Mullets eggs										
Gobies eggs								+		
Anchovy larvae					+++			+		
Horse mackarel larvae					+					
Red mullet larvae					+					
Sprat eggs									+	+
Sand eel eggs						+				

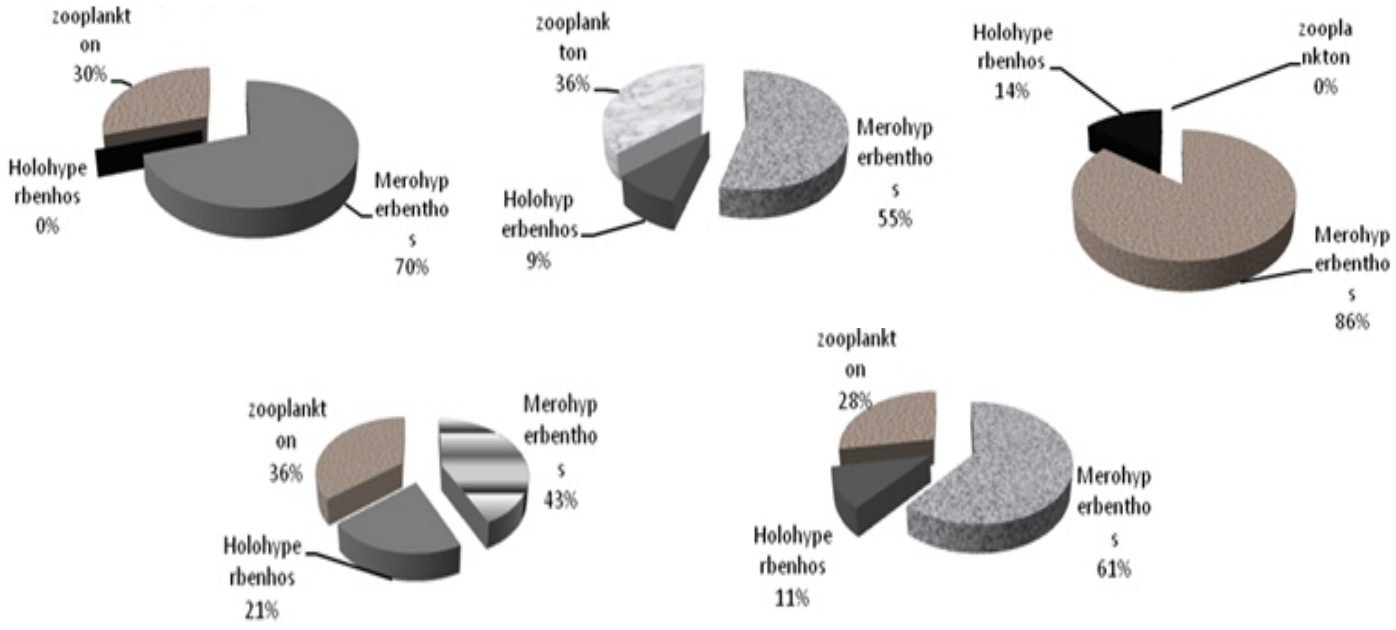

Figure 2. Seasonal changes of the main structural groups zooplankton, merohyperbenthos, holohyperbenthos in 2007-2008

The holohyperbenthos occurred in samples for summer and autumn 2007, and the share of this group has increased in 2008 (Figure 2), but the dominant position was taken by merohyperbenthos, having the highest frequency of occurrence.

Conclusions

·A total of 37 hyperbenthos and zooplankton taxa in Varna Bay were found. Among these, 23 were reported in 2007, and 28 taxa – in 2008. Further studies could show whether this tendency will stay stable or it is just a single phenomenon, dependant on environmental conditions.

·The hyperbenthos consisted mainly of decapod's larvae (6), fish eggs and larvae (10) and 4 crustacean's groups. *Mesopodopsis slabberi* (Mysida) which is typically holohyperbenhos form was recorded only once - in October 2008.

·The two large hyperbenthos groups - merohyperbenthos and holohyperbenthos were well presented in Varna Bay. The merohyperbenthos made up the most significant share of total species number in June (70 %) and August 2007 (55 %), and its frequency of occurrence has been high in October 2007, but the fish eggs were replaced by larval stages of anchovy, horse mackerel and red mullet at this time. In June 2008 the share of merohyperbenthos reached 61%, whereas in October 2008 the holohyperbenthos dominated (43 %).

·The dominant hyperbenthos taxa were different larval stages of decapoda and fish larvae during the investigated period.

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