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HIGHER CRUSTACEANS IN THE UPPER SUBLITTORAL ZONE ALONG THE BULGARIAN BLACK SEA COASTAL AREA

Sonya Uzunova

ВИСШИТЕ РАКООБРАЗНИ В ГОРНИЯ СУБЛИТОРАЛ ПРЕД БЪЛГАРСКИЯ БРЯГ НА ЧЕРНО МОРЕ

Соня Узунова

Резюме: *Общо 50 вида от Malacostraca бяха установени за горния сублиторал пред българския бряг на Черно море. Най-богата на видове е биоценозата на Zostera spp. - 34, следвана от биоценозата на Mytilus galloprovincialis – 25, Cystoseira barbata – 21 вида и биоценозата на пясъчното дъно се оказа най-бедна (само18 вида).*

Ключови думи: *Malacostraca, Crustacea, Zostera spp., Mytilus galloprovincialis, Cystoseira barbata*.

INTRODUCTION:

Higher crustaceans (Malacostraca) are one of the most numerous groups of zoobenthos presented in the Black Sea. They are better expressed in the mussels and algal habitats of the upper sublittoral zone, due to the more favorable feeding conditions and high oxygen level.

First data about Malacostraca are reported by Chichkoff (1912), where 48 species, collected till 50 m depth along the Bulgarian Black Sea costal area, are reported. The publications of Pesta (1926), Paspaleff (1933), Motas & Bacesco (1938), Bulgurkov (1938, 1939, 1963, 1968, 1973) Bacesco (1948) and Caspers (1951), contribute to the faunistic information for higher crustaceans.

Kuneva-Abadjieva (1960a, b, 1965, 1968, 1970, 1974) investigated the species composition, biocoenologic distribution and dynamics of Malacostraca in biocoenosis of *Cystoseira barbata* and *Mytilus galloprovincialis* in the upper sublittoral zone of the Bulgarian Black Sea sector. Additional information about the crustaceans, as a part of the zoobenthos in the upper sublittoral zone is found in Kuneva-Abadjieva, Marinov (1977) and Marinov, Kuneva-Abadjieva (1982).

Konsulova et al. (1991) reported a significant decrease in the populations of some Decapoda (i.e. *Upogebia pusilla*) during the summer season of 1989, related to the increased eutrophication in this period.

Uzunova (1996) gives evidence on the dynamics of the quantitative parameters of the amphipods from the *Mytilus galloprovincialis* biocoenosis in Varna Bay. Later on during study of zoobenthos in *Zostera* spp. beds was established that Crustacea predominate in the species composition (Uzunova, 2010)

Nevertheless of the relatively high quantity of publications the historical information about the zoobenthos in the biocoenosis from the upper sublittoral along the Bulgarian Black Sea coast remain incomplete. For this reason the main purpose of the present paper is to present contemporary information about the distribution and composition of the investigated group.

MATERIAL AND METHODS:

The materials from the upper sublittoral zone were collected at a depth between 1 m and 5 m (fig.1). The total number of samples is 43, 12 of them being from the mussel's overgrowths, 9 – from the seagrass beds, 12 - from *Cystoseira* overgrowths and 10 - from sandy bottom. Sampling stations are situated along the Bulgarian coast line of Black Sea, namely: Krapetz, Cape Kaliakra, Kavarna, Baltchik, Varna, Emona and Sozopol.

Sampling was carried out in summer season of 1999 and 2000 by free diving. The materials from black mussel overgrowths were scraped off by a triangular instrument, furnished with teeth on scraping surface and with attached bag, mesh size 0,5 cm. Samples from *Cystoseira* overgrowths were collected by a bag, mesh size 0,5 cm, which covered the talus and the plant was detached near the crampon. The eelgrass were obtained the same way but the *Zostera spp.* was uprooted. Hand grab, mouth opening 0.01 m^2 was used for sandy sediments.

All materials were preserved in 4% formalin. In laboratory the species were identified and their density was recalculated per kilogram wet mussels or vegetation, according Marinov (1959).

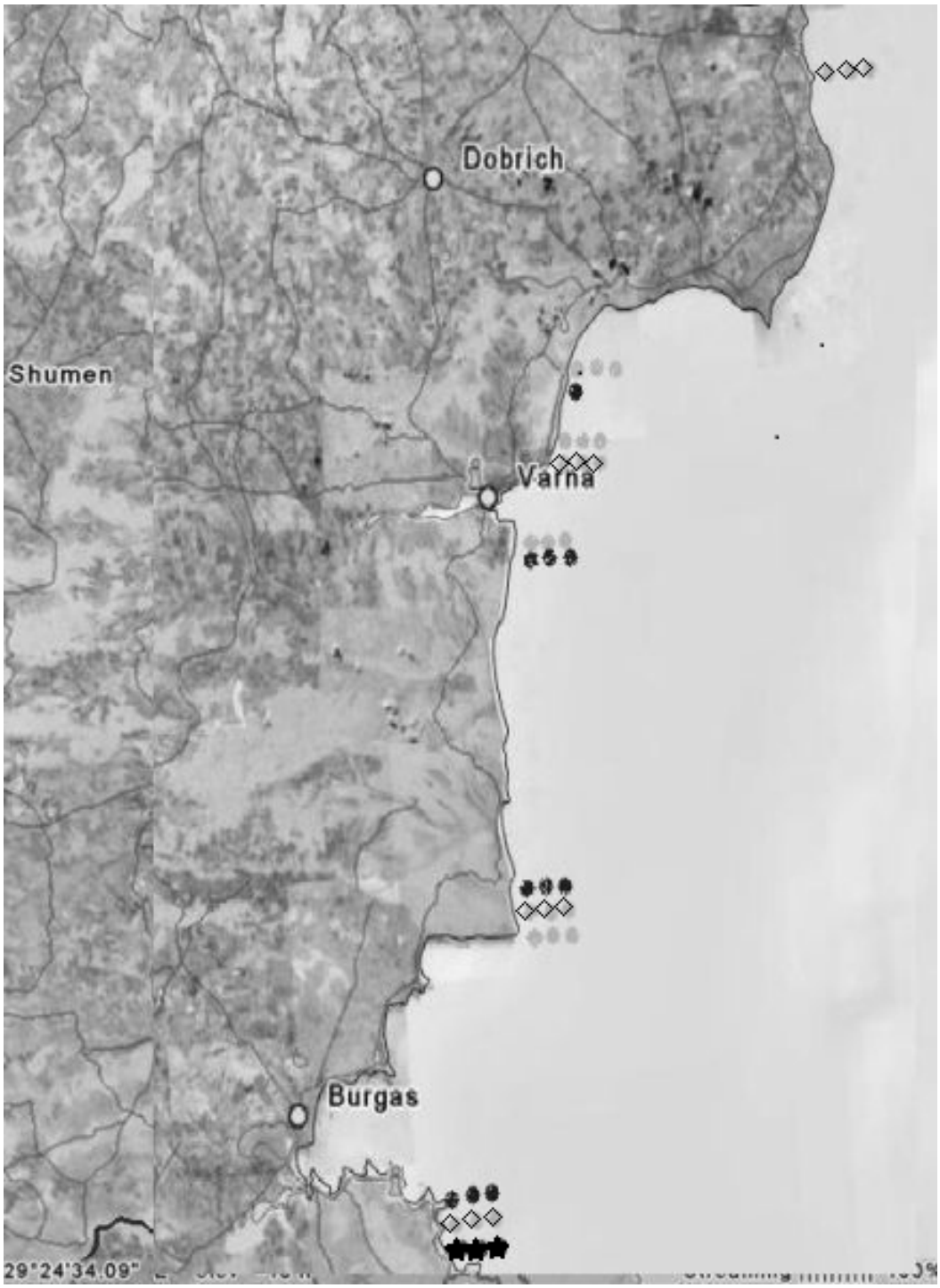

Fig. 1 Schedule of the sampling area (http://earth.google.com): rhombs – for *Cystoseira* overgrowths; grey dots – *Mytilus* overgrowths; black dots – sand; stars – *Zostera* medows.

Data analysis is based on the total species number (S), density (N) of the higher crustaceans. Frequency is calculated according Vorobjov (1949):

$$p = (a/b)*100$$

a – number of samples, where the species was found

b – total number of samples.

The similarity between different habitats is presented by classificatory (cluster) analysis (Cormack, 1971; Clarke, Warwick, 1994). For calculation of the agglomerative hierarchical cluster the Bray-Curtis (1957) coefficient was used, on the presence/absence basis, due to different sampling

methods, applied for overgrowths and soft bottom materials. Statistical analysis was performed using program package Primer (Plymouth Marine Laboratory).

RESULTS AND DISCUSSION:

Total of 50 species were identified for the studied area. Richest in species were Amphipoda - 28, followed by Decapoda - 8, Isopoda – 6, and Tanaidacea and Cumacea presented by 3 species each, Mysidacea - 2. Highest is the species number of *Zostera spp.* biocoenosis – 34, followed by *Mytilus galloprovincialis* biocoensis – 25, *Cystoseira barbata* biocoenosis – 21 species and the sand biocoenosis is the poorest (only 18 species were recorded).

Table 1

Species composition of Malacostraca in the studied biocoenosis: *Cystoseira barbata* (CB), *Mytilus galloprovincialis* (MG), *Zostera spp*. (Z) and sand (S)

Species composition	CB	MG	Z	S
Mysidacea				
Mesopodopsis slabberi (Van Beneden, 1861)	+			
Siriella jaltensis Czerniavsky, 1868		+		
Amphipoda				
Ampelisca diadema (A. Costa 1853)			+	
Ampithoe helleri G. Karaman, 1975			+	
Ampithoe ramondi Audouin 1826	+	+	+	+
Microdeutopus algicola Della Valle, 1893			+	
Microdeutopus gryllotalpa Costa, 1853	+	+	+	
Monocorophium acherusicum (Costa,1851)	+		+	+
Monocorophium insidiosum (Crawford, 1937)	+	+	+	
Nototropis aff. guttatus (A.Costa, 1851)	+		+	+
Dexamine spinosa (Montagu, 1813)	+	+	+	+
Apherusa bispinosa (Bate, 1857)	+	+	+	
Gammarus insensibilis Stock, 1966			+	
Ericthonius difformis Milne-Edwards, 1830	+	+	+	+
Jassa ocia (Bate, 1862)	+		+	
Melita palmata (Montagu, 1804)	+	+	+	
Monoculodes gibbosus Chevreux, 1900			+	
Stenothoe monoculoides (Montagu, 1815)	+	+	+	+
Caprella ferox Leach, 1814	+		+	+
Perioculodes longimanus (Bate&Westwood, 1868)			+	
Microprotopus maculatus Chevreux 1886			+	
Microprotopus minutus (Sowinsky, 1893)			+	
Chaetogammarus olivii (Milne-Edwards, 1830)				+
Chaetogammarus foxi (Schellenberg, 1928)				+
Bathyporeia guilliamsoniana (Bate 1857)				+
Hyale pontica Rathke, 1837	+	+		
Hyale crassipes Chevreux et Fage, 1925	+	+		
Biancolina algicola Della Valle, 1893	+	+		
Gammarellus carinatus (Rathke, 1837)		+		
Caprella acatifera ferox Czenjavski, 1868	+			
Isopoda				
Idotea baltica Audouin, 1827	+	+	+	+
Synisoma capito (Rathke, 1837)	+	+	+	+
Sphaeroma serratum (Fabricius, 1787)		+		+
Sphaeroma pulhelum (Colosi, 1921)		+		
Naesa bidentata (Adams, 1800)	+	+		+
Euridice dolfusi Monod, 1930				+
Tanaidacea				

Apseudopsis ostroumovi Băcescu et Cărăuşu, 1947			+	
Tanais dulongi (Audouin, 1824)		+	+	
Heterotanais gurneyi Norman, 1906		+	+	
Leptochelia savignyi (Krøyer, 1842)	+		+	
Cumacea				
Iphinoe maeotica (Sowinskyi. 1893)			+	
Culella limicola G.O.Sars, 1879			+	
Pseudocuma gracilloides Bacescu, 1950		+		+
Decapoda				
Hippolyte sapphica d'Udekem d'Acoz, 1993	+		+	
Hippolyte leptoceros (Heller, 1863)	+		+	
Xantho poressa (Olivi, 1792)			+	
Diogenes pugilator (Roux, 1829)			+	+
Pilumnus hirtellus (Linnaeus, 1761)		+	+	
Pisidia longimana (Risso, 1815)		+	+	
Athanas nitescens (Leach, 1814)		+		
Pachygrapsus marmoratus (Fabricius, 1787)		+		

MYTILUS GALLOPROVINCIALIS OVERGROWTHS

The Malacostraca from this biocoenosis are presented by 25 species distributed by groups as follows: Decapoda - 4, Mysida – 1, Tanaidacea – 2, Cumacea-1, Isopoda – 5, Amphipoda –12.

High values of the frequency show species: *M. palmata* и *N. bidentata* – 83%; *A. ramondi*, *M. gryllotalpa*, *P. hirtellus* – 67%; *Stenothoe monoculoides*, *Hyale perieri*, *Apherusa bispinosa*, *Pisidia longimana* – 50 %.

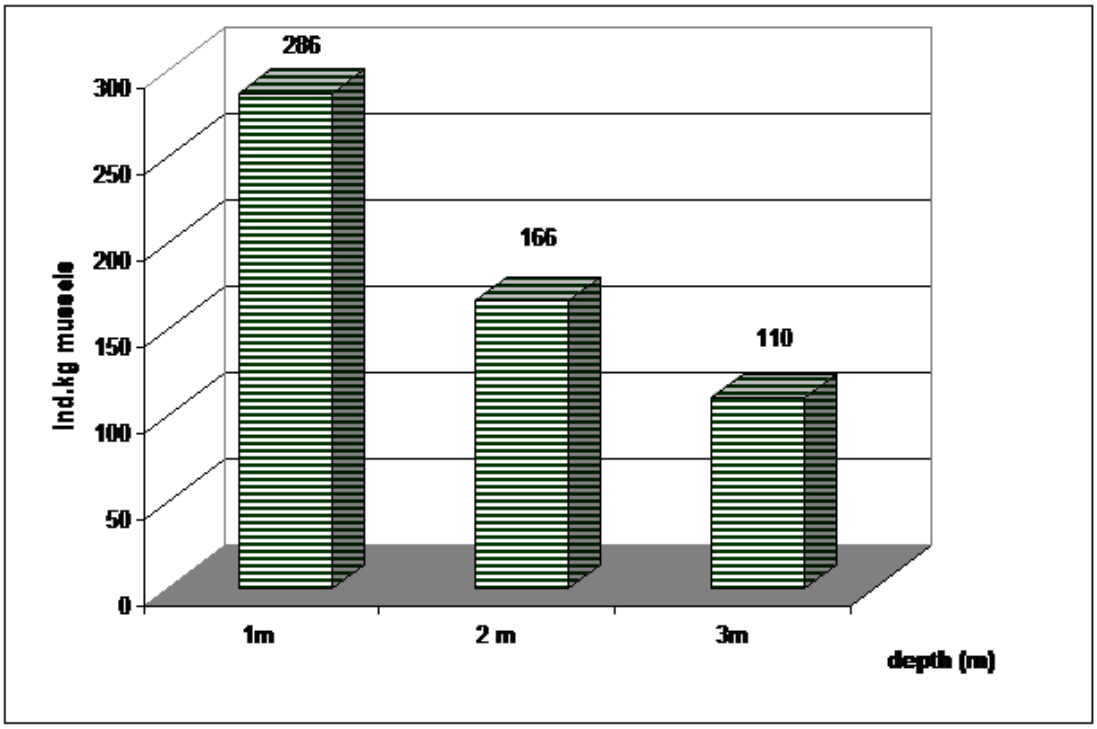

Fig. 2 Average abundance of Malacostraca in black mussel biocoenosis for the summer of 1999 and 2000

With comparison to historical information the species composition remain the same, but some opportunistic species increase their value for the investigated biocoenosis. For example the species *Stenothoe monoculoides, Melita palmata, Jassa ocia* were with lower frequency in Kuneva-Abadjieva (1960a). In the North coastal area more common nowadays is *H. crassipes*, than *H. perieri*. Decapoda keep the same species as in Kuneva-Abadjieva (1960b) – *P. hirtellus, P. longicornis, P. marmoratus u A. nitescens*, except *Hyppolyte spp., C. crangon* u *D. pugilator*. Representative of Cumacea is only one, but from the isopods *S. capito* u *S. Serratum* were present.

The data for the average total abundance of Malacostraca in black mussel biocoenosis (fig.2) show maximum of Malacostraca at 1 m and regularly decrease with depth. The low values are determined by opportunistic species from amphipods *Monocorophium acherusicum* and *Ampithoe ramondi.*

CYSTOSEIRA BARBATA OVERGROWTHS

This biocoenosis offers very good conditions for crustaceans by the high level of oxygen and the rich feeding potential.

During the investigated period 21 species of higher crustaceans were recorded (table 1), 15 of them being from Amphipoda. Highest frequency demonstrate *S. capito* and *N. bidentata* (100%), followed by *Erichtonius difformis, Ampithoe ramondi, Stenothoe monoculoides, Dexamine spinosa, Apherusa bispinosa, Idotea baltica* - 80% and *Hyale crassipes* and *Caprella ferox* – 60%. For *Cystoseira* biocoenosis *Hippolyte* spp. are typical, despite their low frequency. They are distributed mainly along the South coastal region.

The results show the same species number as reported from Kuneva-Abadjieva (1977). Comparison between the recent data and historical information is presented in table 2. During 1999-2000 investigations only two species were not found – *P. gammaroides u G. crassicornis*, but new amphipod species was recorded for our coast - *Ampithoe helleri. Jassa ocia* was presented with low frequency. The species *Gammarellus carinatus* was not available in the samples, most probably due to the summer sampling, when this species withdraws in more deeper and cooler waters.

Table 2

Comparison of the species composition, established in 1999-2000 and their frequency (%) in the biocoenosis of *Cystoseira barbata*, with historical data by Kuneva-Abadjieva (1965, 1973, 1974)

Species composition	Kuneva-Abadjieva (1965)	Kuneva-Abadjieva (1973)	Kuneva-Abadjieva (1974)	1999-2000
H. pontica	+	-	-	14.3
A.ramondi (=A. vaillanti)	+	-	-	85.7
P. gammaroides	+	100	97,7	-
G. crassicornis	+	-	-	-
E. difformis	+	70	-	100
C. crassicorne	+	45	63,6	-
C. acherusicum	-	-	-	28.6
C. incidiosum	-	-	-	14.3
C. acanthifera	+	90	75	-
C. acanthifera ferox	-	-	-	49.9
B. cuniculus	+	90	90,9	42.9
S. monoculoides	+	95	93,2	100
J. ocia	+	-	-	28.6
N. guttatus	+	-	-	-
G. carinatus	+	-	-	-
G. locusta	+	5	-	-
Gammarus insensibilis	-	-	-	14.3
A. bispinosa	+	100	97,7	100
M. palmata	+	-	-	42.9
D. spinosa	+	40	-	57.1
M. damnoniensis	+	-	-	-
M. gryllotalpa	-	-	-	57.1
C. sundevalli	-	10	-	-
H. nilsoni	-	20	-	-
H. crassipes	-	-	-	0.6

The comparison with published data of Kuneva-Abadjieva, Marinov (1977) shows that Isopoda did not change their composition, Anisopdoda are presented by *Leptochelia savignyi*. From decapods *Hippolyte leptoceros* and *Hippolyte saphica* were found, but the shrimps *P. squilla* and *P. adspersus, D. pugilator, Clibanarius misantropus* and *Pilumnus hirtellus* were not available. Most

probably the reason is that these species belong to the mobile fauna and it is difficult be collected by the used devices.

The average total abundance of Malacostraca in *Cystoseira barbata* biocoenosis (fig.3) for the investigated period demonstrates maximum at 2 m of depth, dominated by amphipod species *M. acherusicum, A. ramondi, C. ferox* and the isopod *N. bidentata*.

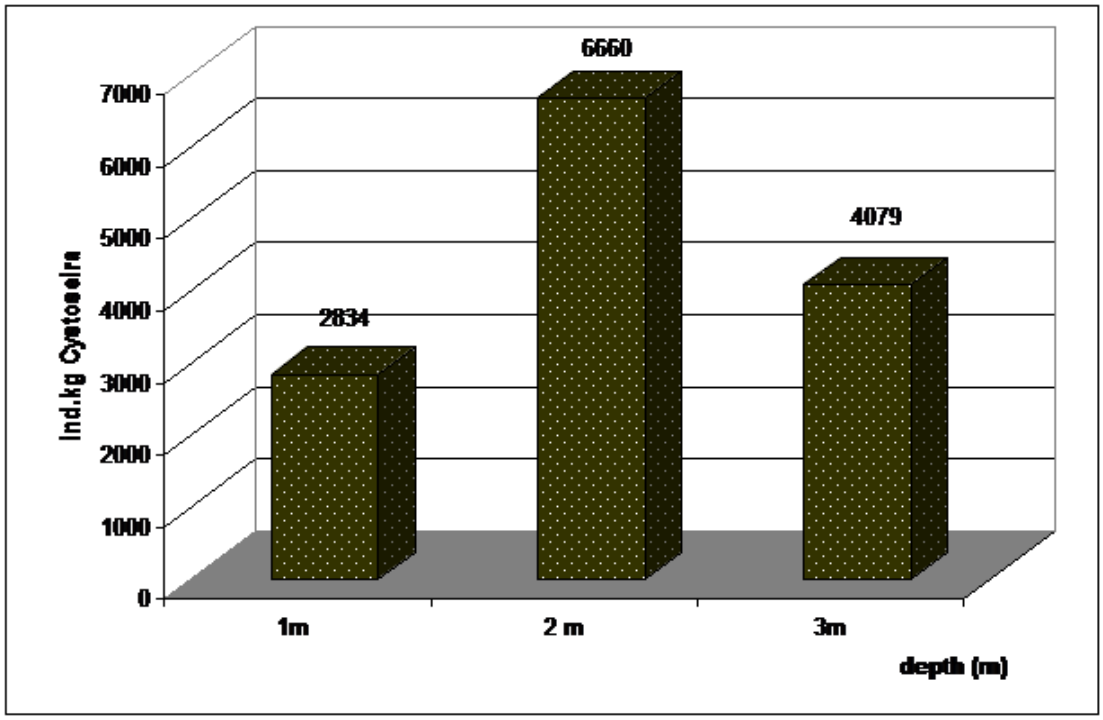

Fig. 3 Average abundance of Malacostraca in *Cystoseira barbata* biocoenosis for the summer of 1999 and 2000

ZOSTERA SPP. BEDS

Two eelgrass species were investigated for the Bulgarian Black Sea coastal area - *Zostera marina* Linnaeus, 1758 and *Zostera noltii* Hornemann, 1832. This biocoenosis is richest in Malacostraca, found during the investigated period. Total of 34 taxa were identified. With higher species number are presented Amphipoda – 20, followed by Decapoda - 6, Tanaidacea – 4, Cumacea – 2 and Isopoda –2. Few of them have frequency more than 50%, namely *Microdeutopus gryllotalpa, Monocorophium insidiosum* and *Dexamine spinosa, Ericthonius difformis, Synisoma capito. Z. noltii* biocoenosis is with higher number of species – 31 with comparison to *Z. marina* - 13. The main reason is the eutrophicated harbor sampling area of *Z. marina.*

The values for average total abundance for the investigated period are shown on fig. 4. It was established that highest values of crustacean abundance are at 1 m for *Zostera marina* and the minimum is at 2 m, followed by increase of species abundance at 3 m. for *Zostera noltii* the maximum was recorded at 3 m.

Table 3

Frequency of Malacostraca in *Zostera spp*. beds

Species composition	Frequency (%)	
	Zostera marina	*Zostera noltii*
Amphipoda		
A. diadema	0	20
A. helleri	0	20
A. ramondi	0	60
M. algicola	33	0
M. gryllotalpa	100	80
M.acherusicum	33	0

M. insidiosum	100	60
N. aff. guttatus	0	40
D. spinosa	100	40
A. bispinosa	0	20
G. insensibilis	33	60
E. difformis	67	60
J. ocia	33	0
M. palmata	0	40
M. gibbosus	33	0
S. monoculoides	33	80
C.a. ferox	0	60
C. danilevski	0	20
P. longimanus	0	20
Microprotopus maculatus	33	20
Microprotopus minutus	33	0
Isopoda		
I.baltica	33	20
S. capito	67	80
Tanaidacea		
T. dulongii	0	20
A. ostroumovi	0	40
H. gurneyi	0	20
L. savignyi	0	100
Cumacea		
I. maeotica	0	20
C. limicola	0	20
Decapoda		
H. saphica	0	20
H. leptoceros	0	20
X. poressa	0	40
D. pugilator	0	20
P. hirtellus	0	20
P. longimana	0	20

UPPER SUBLITTORAL SAND

Biocoenosis of upper sublittoral sand is distributed until 12 m depth. The species composition includes eurybiont species and typical fauna like *C. crangon, M. acherusicum, C. limicola, I. elisae, M. Gryllotalpa* and *P. longimanus*. In this biocoenosis at a depth less than 5 m 18 species were recorded, neither of them with frequency higher than 50% (table 4). The only species with frequency 42% is *D. spinosa* until the typical psammobiont *B. guilliamsoniana* is with 25%. Low levels of the frequency are due to the fact that most of species are free living or are migrating from neighbors' habitats.

Table 4

Frequency of species from the sandy biocoenosis (until 5 m depth)

Species composition	Frequency /%/
D.spinosa	42
E.difformis	8
C. foxi	17
C. olivii	17
C.acherusicum	17
A.ramondi	17
S. monoculoides	25
C. ferox	8

M. hargensis	8
N.aff.guttatus	8
S. serratum	8
N. bidentata	17
I.baltica	8
D. pugilator	18
B. guilliamsoniana	25
E. dolfusi	8
S. capito	8
P. graciloides	8

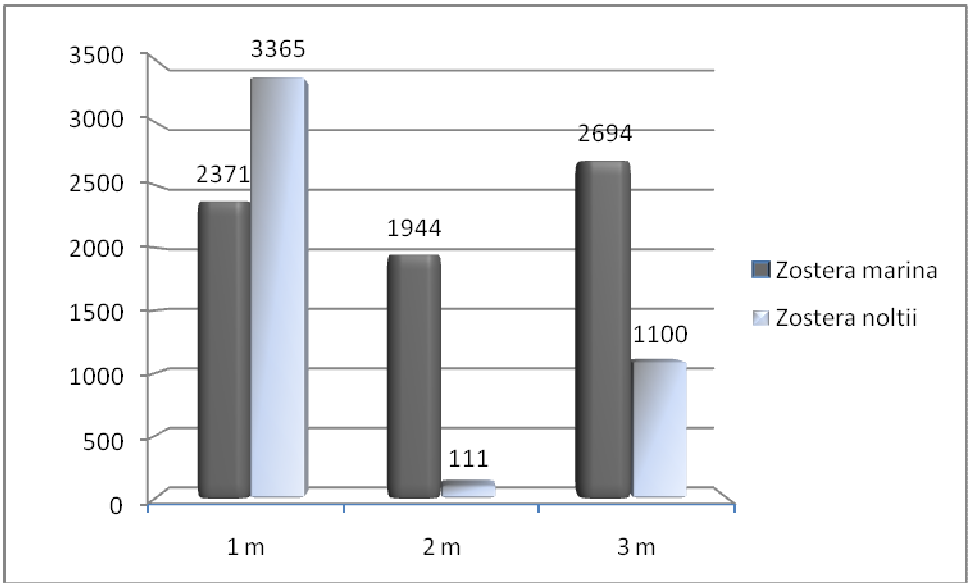

Fig. 4 Average abundance (ind.$^{m-2}$) per depth (m) of Malacostraca in *Zostera spp*. biocoenosis for the summer 2000

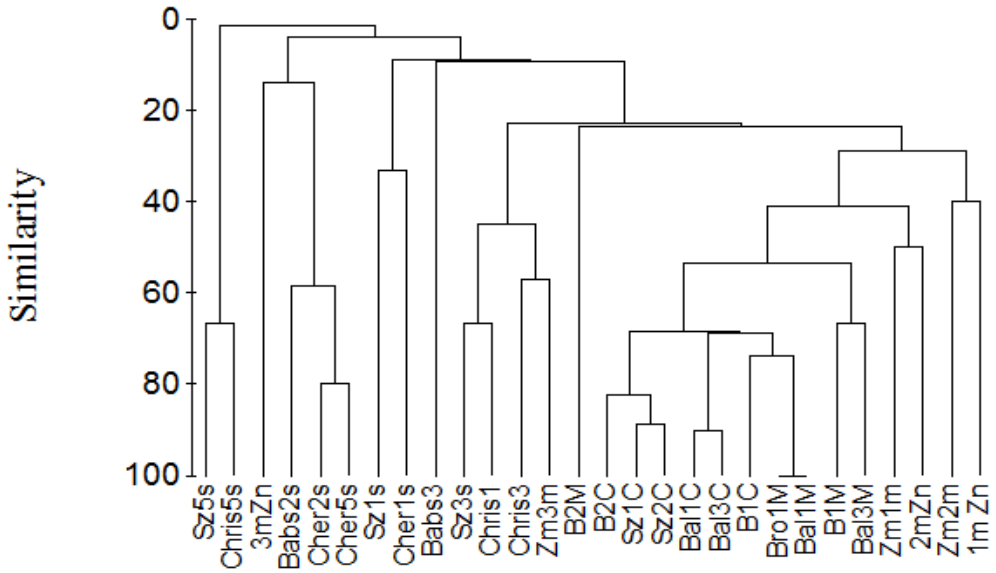

Fig. 5. Bray-Curtis similarity in the upper sublittoral biocoenosis.
Symbols ending in “s” are from sand biocoenosis, in “M” – from *Mytilus* biocoenosis, in “C” – from Cystoseira biocoenosis and in Zn, Zm – from *Z. nolti* and *Z. marina*.

Cluster analysis shows simillarity between samples from 1-2 m of depth between the *Mytilus* and *Cystoseira* overgrowths and *Zostera* beds, due to relatively identical species composition. These groups form a big cluster at 25% level of similarity. The samples from sand and from 3-5 m depth are relatively scattered and forms small clusters, which join the main group at very low similarity level (fig. 5).

CONCLUSIONS:

Species composition consists from 50 taxa. The highest species number was recorded for *Zostera spp.* biocoenosis – 34, followed by *Mytilus galloprovincialis* biocoensis – 25, *Cystoseira barbata* biocoenosis – 21 species and the sand biocoenosis - only 18 species. New amphipod species was recorded for the Bulgarian Black Sea coastal area - *Ampithoe helleri.*

Crustacean abundance is built on by the high level of small sized opportunistic species. Maximal level of abundance was found in Cystoseira overgrowths. Highest value of the abundance was at 1 m depth in *M. galloprovincialis* overgrowths. For *C. barbata* maximum of density was recorded at 2 m of depth and for *Zostera* were two different maximal values – at 3 m for *Z. marina* and at 1m for *Z. noltii*.

The species composition of higher crustaceans from the upper sublittoral zone shows highest similarity at 1-2 m depth between the *Mytilus* and *Cystoseira* overgrowtha and *Zostera* biocoenosis. This is due to the fact, that crustacean groups dwelling this region are stenobiont with specific requirement for high oxygene level, available in algal and eelgrass habitats.

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За контакти:
гл. ас. д-р Соня Узунова
ИРР – Варна, ССА, бул. „Приморски” 4,
гр. Варна, 9000, ПК 72,
тел.: 052 632066
e-mail: sonja_ouz@yahoo.com