Oceanological and Hydrobiological Studies

International Journal of Oceanography and Hydrobiology

Volume 48, Issue 2, June 2019
pages (174-183)

ISSN 1730-413X
eISSN 1897-3191

Mollusk fauna associated with *Cystoseira barbata* (Stockhouse) C. Agardh, 1820 in the Sea of Marmara (Turkey)

by

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DOI: **10.1515/ohs-2019-0016**
Category: **Original research paper**
Received: **July 02, 2018**
Accepted: **November 06, 2018**

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Abstract

Mollusk species associated with *Cystoseira barbata* were examined in the Sea of Marmara in 2012 at 14 sampling sites with a depth ranging from 0.2 to 0.5 m. A total of 18 468 specimens belonging to three classes (Polyplacophora, Gastropoda and Bivalvia) and 30 species were identified. *Alvania mamillata* Risso, 1826 is a new record for the marine mollusk fauna of the Sea of Marmara. The number of species at the sampling sites varied from 2 to 11 (400 cm^{-2}), the density ranged between 758 and 63 083 ind. m^{-2}, and wet weight between 0.4 and 34.3 g m^{-2}. Gastropoda were the richest class, represented by 22 species and 7611 individuals. The families Rissoidae, Mytilidae and Pyramidellidae were represented by the largest number of species. The most dominant mollusk species in *C. barbata* facies were *Mytilaster minimus* (Poli, 1795) (37.77%), *Rissoa splendida* Eichwald, 1830 (27.20%), *Mytilaster lineatus* (Gmelin, 1791) (18.69%) and *Bittium reticulatum* (da Costa, 1778) (6.89%). However, the mollusks *R. splendida* (86%), *M. lineatus* (71%), *M. minimus* (69%) and *Steromphala adansonii* (Payraudeau, 1826) (67%) were characterized by the highest values of the frequency index. Canonical correspondence analysis showed that the main factors affecting the assemblages of mollusks were the content of total nitrogen, the maximum thallus height, algal wet weight and temperature.

Key words: Mollusca, *Cystoseira barbata*, Sea of Marmara, distribution

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Introduction

The Sea of Marmara is an inland sea, located entirely within the borders of Turkey, which connects the Black Sea with the Aegean Sea through the Turkish strait system. The İstanbul and Çanakkale Straits provide a balance between the water supply and evaporation in the Sea of Marmara (Özsoy et al. 1995). The widest part (80 km) of the sea is located in the north-south direction and the longest one (280 km) in the east-west direction (Beşiktepe et al. 1994).

The Sea of Marmara has been the subject of various studies since the 18th century. The first study on benthic invertebrates inhabiting the Sea of Marmara was carried out by Forsskâl (1775), who reported *Tritia reticulata* (Linnaeus, 1758) and *Pinna nobilis* Linnaeus, 1758 from the area. Colombo (1885) reported 70 benthic species (including 37 mollusks) from the vicinity of the Çanakkale Strait in the Sea of Marmara. Sturany (1895), who investigated the mollusk fauna in the Sea of Marmara up to a depth of 1000 m, reported 50 species from the area. At the end of the 19th century, two important studies concerning the biodiversity of the region were conducted by Ostroumoff (1896) and Marion (1898). According to the checklist compiled by Öztürk et al. (2014), out of 1065 mollusk species known to occur along the Turkish coasts, 537 species (50.4%) were reported from the Sea of Marmara. Although most of the studies investigating the Sea of Marmara addressed macrozoobenthic organisms in a general aspect, more specific studies were also published (Pallary 1917; Albayrak & Balkıs 1996a,b; Aslan-Cihangir & Ovalis 2013; Doğan et al. 2016; Artüz et al. 2018), focusing on mollusk species inhabiting different habitats.

Cystoseira species are common in the infralittoral zone of the Mediterranean Sea and they provide habitat for invertebrate organisms, epiphyte algae and serve as a reproductive area for fish (Pitacco et al. 2014). *Cystoseira barbata*, which is the subject of this study, is a perennial alga and is widespread in the Sea of Marmara. It has been observed in the region together with other *Cystoseira* species, green algae and mussels. Mollusca assemblages inhabiting the algal facies have been the subject of just a few studies in the area (Oberling 1969–1971; Demir 2003; Albayrak et al. 2004). Oberling (1969–1971) briefly mentioned some specimens of the genera *Brachidontes*, *Bittium* and *Rissoa* associated with algae on the coasts of Sultanköy in the Sea of Marmara, but without identifying them to the species level. Demir (2003) reported brown weeds, however, no information was provided on the habitats of mollusks. Albayrak et al. (2004) studied mollusks associated with the biotope of algae in the Sea of Marmara and reported *Anomia ephippium* Linnaeus, 1758 from the coast of the İstanbul Strait and the Princes Islands. As mentioned above, the mollusks distributed in the biotopes of algae were not studied in detail in the Sea of Marmara.

The objective of the study was to investigate the taxonomy and ecology of mollusk species inhabiting *Cystoseira barbata* (Stackhouse) C. Agardh, 1820 in the Sea of Marmara.

Materials and methods

The benthic material investigated in the present study was collected from the Sea of Marmara in 2012, at 14 sites at a depth ranging from 0.2 to 0.5 m (Fig. 1; Table 1). Samples were collected using a quadrate sampler 20 × 20 cm. At each site, three replicates were collected for community analysis and an additional water sample was collected for chemical analysis. The material was wet-sieved onboard using a 0.5 mm mesh and was stored in jars containing 4% seawater-formalin solution. In the laboratory, the material in jars was washed with water and the maximum height of the *C. barbata* thallus was measured, and epiphytes and total wet weight values were estimated using a scale with a sensitivity of 0.0001 and 0.01 g. Then, the material was sorted into taxonomic groups under a stereomicroscope and preserved in 70% ethanol. The mollusk species were identified and counted, and their total wet weight was estimated using a scale with 0.0001 g sensitivity. The World Register of Marine Species (WORMS Editorial Board, 2018) was followed for the classification of mollusk species identified in this study.

The salinity, temperature and dissolved oxygen concentration were measured in the field using a SCT meter (YSI 100) and an oxygen meter (YSI 55). Water samples were collected for chemical analysis and transferred immediately to the laboratory. Nutrients, chlorophyll *a* and pH were analyzed by a spectrophotometer and a pH meter (Orion brand), respectively (Parsons et al. 1984).

Bellan Santini's dominance index (D, Bellan Santini, 1969) and Soyer's frequency index (F, Soyer, 1970), wet weight (total biomass value; B), Shannon-Weaver diversity (H'; Shannon & Weaver, 1949) and Pielou's evenness (J'; Pielou, 1975) indices were calculated for each species and each site. These community parameters were processed on the map using the SURFER software. The correlation between community parameters (number of species and individuals, total wet weight, diversity and evenness indices) and environmental parameters were determined by

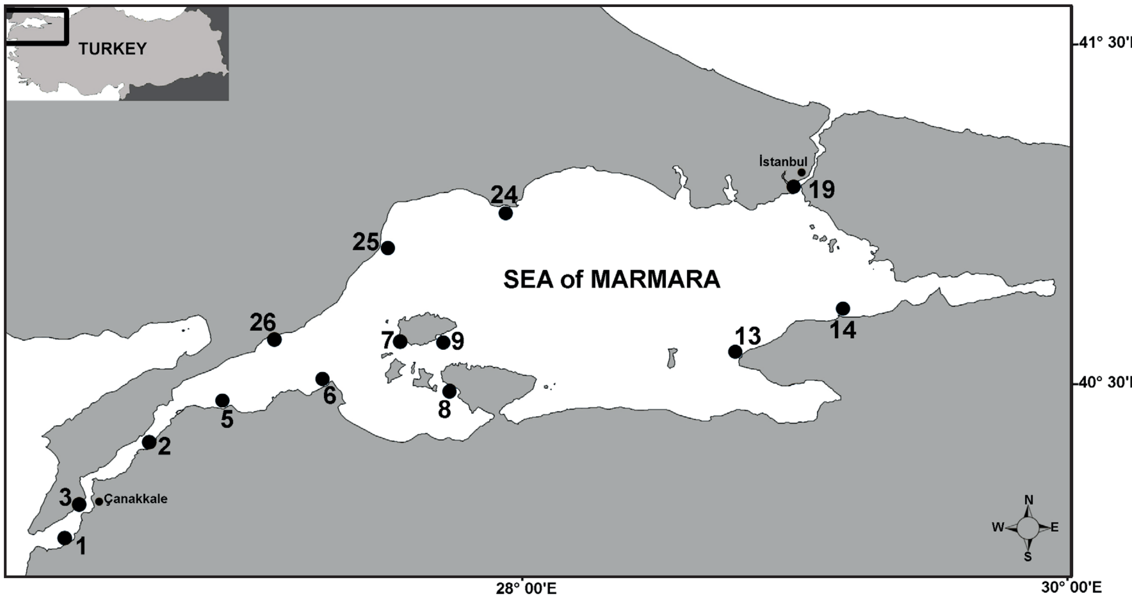

Figure 1

Map of the study area

Table 1

Coordinates, sampling dates, depth range and location of the sampling sites

Sites	Coordinates		Date	Depth (m)	Localities
	Latitude	Longitude			
1	40°01.650′N	26°19.950′E	25.09.2012	0.2	Çanakkale, Güzelyalı
2	40°17.483′N	26°36.933′E	26.09.2012	0.2	Çanakkale, Suluca
3	40°08.000′N	26°21.417′E	06.10.2012	0.2	Çanakkale, Havuzlar
5	40°23.900′N	26°52.633′E	26.09.2012	0.2	Çanakkale Şevketiye
6	40°28.083′N	27°16.250′E	26.09.2012	0.2	Karaburun
7	40°35.617′N	27°32.800′E	28.09.2012	0.5	Island of Marmara
8	40°28.050′N	27°42.583′E	27.09.2012	0.2	Erdek
9	40°36.317′N	27°40.067′E	28.09.2012	0.5	Island of Marmara
13	40°32.417′N	28°47.300′E	30.09.2012	0.5	Bozburun
14	40°39.567′N	29°09.200′E	01.10.2012	0.2	Koru
19	41°01.117′N	29°00.550′E	03.10.2012	0.5	Üsküdar
24	40°57.917′N	27°57.400′E	04.10.2012	0.5	Ereğli
25	40°51.983′N	27°27.633′E	05.10.2012	0.5	Kumbağ
26	40°36.500′N	27°05.817′E	05.10.2012	0.5	Şarköy

Pearson's correlation analysis with a significance level of $p < 0.05$. Cluster analysis based on the Bray-Curtis similarity index (group average technique) was used to group the sampling sites. SIMPER analysis was applied to determine the percentage contribution of species to the similarity and dissimilarity within each group formed as a result of the cluster analysis. Canonical correspondence analysis (CCA) was carried out to analyze the relationship between the assemblages of mollusks and the environmental factors. Prior to the cluster analysis, the raw data were transformed using the transformation of $yji = \log(xji + 1)$. Monte Carlo permutations were applied to determine the significance of the ordination axes. The statistical analyses were carried out using PRIMER 6, STATISTICA 7.0 and Canoco 4.5 software packages.

The specimens identified in this study were deposited in the Museum of Faculty of Fisheries, Ege University (ESFM), İzmir, Turkey.

Results

The analysis of the benthic material collected at 14 sites revealed a total of 30 mollusk species and 18 468 individuals belonging to three classes

(Polyplacophora, Gastropoda and Bivalvia) (Table 2). The class Gastropoda was represented by the largest number of species and individuals (22 species and 7611 individuals), followed by Bivalvia (7 species and 10 854 individuals) and Polyplacophora (1 species and 3 individuals). The identified mollusk species belonged to 13 different families, of which Rissoidae, Mytilidae and Pyramidellidae were represented by the largest number of species: 10, 5 and 3, respectively.

The dominant species in the area were *Mytilaster minimus* (37.77% of the total number of individuals), *Rissoa splendida* (27.20%), *Mytilaster lineatus* (18.69%) and *Bittium reticulatum* (6.89%). Among the most dominant species, *M. minimus* was found to form dense populations at sites K26 (48 200 ind. m^{-2}) and K8 (2108 ind. m^{-2}) (Table 2).

According to the frequency index value, four species were found to have continuous distribution in the area. The most frequent species were *R. splendida* (found in 86% of all samples), *M. lineatus* (71%), *M. minimus* (69%) and *Steromphala adansonii* (67%) (Table 2).

The mean number of species, the number of individuals, wet weight values and values of the diversity and evenness indices at the sampling sites are presented in Figures 2 and 3. Site K1 showed the highest mean number of species (11 species), followed by sites K8 (9 species) and K25 (7 species). Site K26 showed the highest mean mollusk density (63 083 ind. m^{-2}), while the lowest mean density (758 ind. m^{-2}) was found at site K19. The highest mean wet weight, i.e. biomass (34.3 g m^{-2}), was recorded at site K8, followed by sites K25 (21.8 g m^{-2}) and K9 (19.5 g m^{-2}) (Fig. 2).

The highest mean value of the diversity index (H' = 2.7) was determined at site K1 and the lowest one (H' = 0.5) – at site K9. The highest mean values of the

Table 2

List of the species and total number of individuals at the study sites with their dominance (D%) and frequency values (F%)

	K1	K2	K3	K5	K6	K7	K8	K9	K13	K14	K19	K24	K25	K26	D%	F%
POLYPLACOPHORA																
Lepidochitona cinerea (Linnaéus, 1767)	–	–	–	–	–	–	1	–	–	–	2	–	–	–	0.02	4.76
GASTROPODA																
Steromphala adansonii (Payraudeau, 1826)	38	0	10	23	68	124	8	12	24	4	17	0	129	3	2.49	66.67
Jujubinus striatus (Linnaéus, 1758)	–	–	1	–	–	–	–	–	–	–	–	–	–	–	0.01	2.38
Tricolia pullus pullus (Linnaéus, 1758)	17	2	4	–	–	15	–	29	12	2	1	2	149	89	1.74	45.24
Homalopoma sanguineum (Linnaéus, 1758)	–	–	–	–	–	–	3	–	–	–	–	–	–	–	0.02	2.38
Bittium reticulatum (da Costa, 1778)	10	18	–	–	–	5	1224	1	–	–	–	–	7	7	6.89	35.71
Cerithidium submammillatum (De Rayneval & Ponzi, 1854)	–	–	–	–	–	–	245	–	–	–	–	–	–	–	1.33	2.38
Alvania cimex (Linnaéus, 1758)	3	–	–	–	–	–	–	–	–	–	–	–	–	–	0.02	2.38
Alvania discors (T. Allan, 1818)	41	–	43	–	–	–	–	–	–	–	–	–	–	–	0.45	11.90
**Alvania mamillata* Risso, 1826	–	–	1	–	–	–	–	–	–	–	–	–	–	–	0.01	2.38
Pusillina philippi (Aradas & Maggiore, 1844)	27	4	2	–	–	4	3	–	–	–	–	–	–	–	0.22	19.05
Pusillina radiata (Philippi, 1836)	–	–	–	–	–	–	41	–	–	–	–	–	–	–	0.22	2.38
Rissoa guerinii Récluz, 1843	54	–	7	–	–	–	–	–	–	–	–	–	–	–	0.33	9.52
Rissoa similis Scacchi, 1836	5	–	–	–	–	–	–	–	–	–	–	–	–	–	0.03	2.38
Rissoa splendida Eichwald, 1830	119	108	75	43	87	354	116	36	2648	22	14	–	835	566	27.20	85.71
Rissoa ventricosa Desmarest, 1814	2	–	–	–	–	–	–	–	–	–	–	–	–	–	0.01	2.38
Rissoa violacea Desmarest, 1814	1	–	–	–	–	–	–	–	–	–	–	–	–	–	0.01	2.38
Ocenebra edwardsii (Payraudeau, 1826)	1	–	2	–	3	1	–	11	–	–	–	–	1	–	0.10	16.67
Pisania striata (Gmelin, 1791)	–	–	–	1	9	–	–	–	–	–	–	–	–	–	0.10	7.14
Tritia neritea (Linnaéus, 1758)	–	–	–	–	–	–	–	1	–	–	–	–	–	–	0.01	2.38
Spiralinella incerta (Milaschewich, 1916)	–	–	–	–	–	–	1	–	–	–	–	–	–	–	0.01	2.38
Brachystomia eulimoides (Hanley, 1844)	–	–	–	–	–	–	–	–	–	–	–	–	6	–	0.03	4.76
Brachystomia scalaris (MacGillivray, 1843)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	0.01	2.38
BIVALVIA																
Modiolus barbatus (Linnaéus, 1758)	2	–	–	–	–	–	–	–	–	–	–	–	–	1	0.02	4.76
Mytilaster lineatus (Gmelin, 1791)	11	22	1	10	32	8	98	1815	108	38	9	42	144	1113	18.69	71.43
Mytilaster minimus (Poli, 1795)	182	95	–	12	5	80	253	–	146	30	47	99	242	5784	37.77	69.05
Mytilus galloprovincialis Lamarck, 1819	19	15	–	1	1	59	19	18	149	8	1	–	22	7	1.73	47.62
Musculus costulatus (Risso, 1826)	90	1	5	–	–	4	–	–	2	–	–	–	–	–	0.55	19.05
Flexopecten glaber (Linnaéus, 1758)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	0.01	2.38
Hiatella rugosa (Linnaeus, 1767)	–	–	–	–	–	–	3	–	–	–	–	–	–	–	0.02	4.76

* – new record for the fauna of Mollusca in the study area

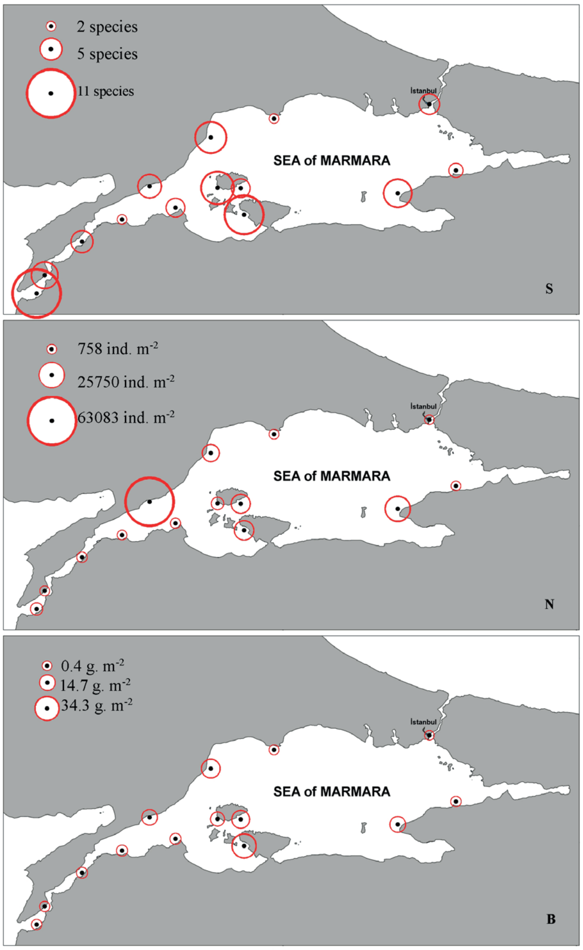

Figure 2

The mean number of mollusk species (S), the mean number of individuals per m^2 (N) and the mean biomass of mollusks g m^{-2} (B) at the sampling sites

evenness index were determined at sites K1 and K19 (J' = 0.8), whereas the lowest ones at sites K5, K13 and K 26 (J' = 0.3) (Fig. 3).

Pearson's correlation analysis revealed that the values of the evenness index were negatively correlated with temperature (p_r = −0.53) and pH (p_r = −0.59), but positively correlated with Chl*a* (p_r = 0.69; $p < 0.05$; Table 3). There was also a correlation between the values of the diversity index, pH (p_r = −0.55) and Chl*a* (p_r = 0.57; $p < 0.05$) (Table 3).

Based on the Bray-Curtis similarity index, two species assemblage groups (A and B) were clustered with values higher than 50% (Fig. 4). Group A included sites K1 and K3 with an average similarity of 58% and group B comprised sites K8, K5, K6, K14, K19, K9, K2, K26, K13, K7 and K25, showing an average similarity of 64%. *Rissoa splendida* and *Alvania discors* were the most contributing species to the similarity in groups A and B (Table 4). SIMPER analysis revealed that site K24 was dissimilar to group A (average dissimilarity of 76%) and group B (average dissimilarity of 54%), mainly due to the high abundance of *R. splendida* at the sampling sites in groups A and B.

CCA showed that the environmental factors affect the distribution of the mollusk species (Table 5; Fig. 5). The first two canonical axes showed high values of correlation between the species and environment (r = 0.999 and 0.994 for axes 1 and 2). CCA axes 1 and 2 explained 30.8% and 25.5% of the relationship between the species and environment respectively, amounting to 56.3% in total. The Monte Carlo test showed that all canonical axes were statistically significant (F = 4.652; $p = 0.002$). According to CCA, the mollusk community structure was strongly affected by total nitrogen, maximum thallus height, temperature and algal wet weight (Table 5). The content of total nitrogen, maximum thallus height, temperature and oxygen were strongly correlated with the first axis, whereas the content of total nitrogen, algal wet weight and phosphorus were correlated with the second axis (Table 5). The maximum thallus height and silicate were negatively correlated with algal wet weight and salinity (Fig. 5). Species contributing to the clustering of the sampling sites are presented in Figure 5. *Alvania mamillata*, *J. striatus*, *P. striata*, *C. submammillatum*, *A. discors*, *S. adansonii*, *M. galloprovincialis*, *R. splendida*,

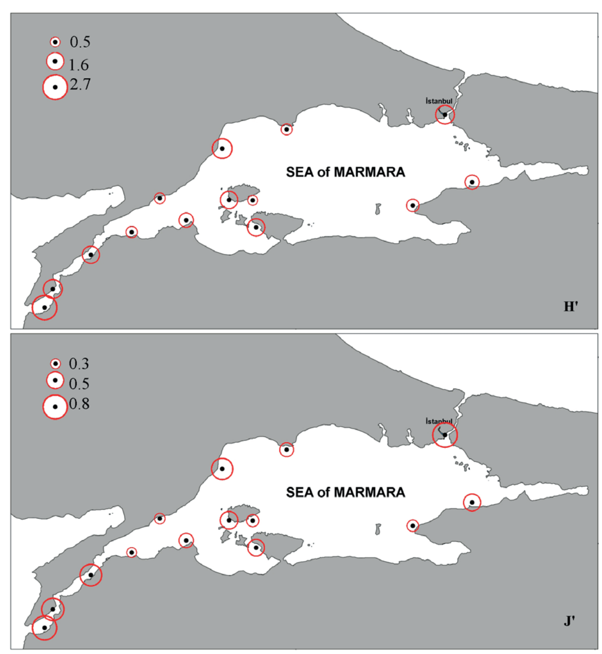

Figure 3

Mean values of the diversity index (H') and of the evenness index (J') at the sampling sites

Table 3

Pearson's correlation coefficients between the environmental variables and community parameters. Statistically significant values ($p < 0.05$) are marked in bold.

	Number of species	Number of individuals	Wet weight	Evenness index	Diversity index
Salinity	0.45	−0.06	−0.14	0.18	0.37
Temperature	0.13	0.37	0.44	**−0.53**	−0.32
Oxygen	0.00	0.06	0.05	−0.33	−0.19
pHins	−0.18	0.40	0.35	**−0.59**	**−0.55**
Chl*a*	0.22	−0.20	−0.36	**0.69**	**0.57**
Total nitrogen	0.05	−0.18	0.23	−0.27	−0.03
Phosphorus	−0.01	0.48	0.06	−0.31	−0.26
Silicate	−0.07	−0.27	−0.20	0.44	0.16
Max. thallus height	0.15	0.20	0.44	0.32	0.20
Epiphyte wet weight	0.25	0.20	0.21	−0.07	−0.08
Algae wet weight	0.01	0.05	0.16	0.05	0.08

Table 4

Species contributing most to the species assemblages of *C. barbata* according to the SIMPER analysis. Bold values indicate the highest scores of species contribution in each assemblages.

	Similarity		Dissimilarity		
Associations	A	B	A–B	A–K24	B–K24
% similarity and dissimilarity	58%	64%	53%	76%	54%
Steromphala adansonii	13	14		9	16
Tricolia pullus pullus	10				
Alvania discors	16		**11**	11	
Pusillina philippi	8				
Rissoa guerinii	12		10	9	
Rissoa splendida	**18**	**23**		**12**	**23**
Mytilaster lineatus		20			
Mytilaster minimus		17	9	8	
Mytilus galloprovincialis		13			14
Musculus costulatus	11		8	9	

R. guerinii, *R. similis*, *R. violacea*, *R. ventricosa*, *A. cimex*, *M. costulatus*, *B. eulimoides*, *F. glabber* and *P. philippi* are positively correlated with algal wet weight and salinity. *Lepidochitona cinerea* is significantly correlated with silicate and the maximum thallus height.

One of the findings of the present study is the rissoid *A. mamillata*, recorded for the first time in the Sea of Marmara (Fig. 6).

***Alvania mamillata* Risso, 1826 (Fig. 6)**

Alvania mamillata Risso, 1826: vol. 4, p. 145 (original description)

Material examined: Site K3, 1 sp.

Remarks: *Alvania mamillata* is a species similar to *A. cimex*, but differs in the number of protoconch whorls. The protoconch of *A. mamillata* has about 1.3

Table 5

Results of canonical correspondence analysis. Statistically significant values ($p < 0.05$) are marked in bold.

Environmental variables	Axis 1	Axis 2
Temperature	**0.483**	−0.401
Oxygen	0.413	0.237
pH	−0.021	−0.053
Chlorophyll *a*	−0.301	0.115
Total nitrogen	**0.751**	0.555
Phosphorus	−0.501	0.208
Silicate	0.303	−0.084
Maximum thallus height	**0.651**	−0.203
Epiphyte wet weight	−0.047	0.039
Algal wet weight	−0.222	**0.483**
Eigenvalues	0.703	0.585
Species-environment correlations	0.999	0.994
Cumulative percentage variance of species data	29.6	54.2
Cumulative percentage variance of species-environment relation	30.8	56.3

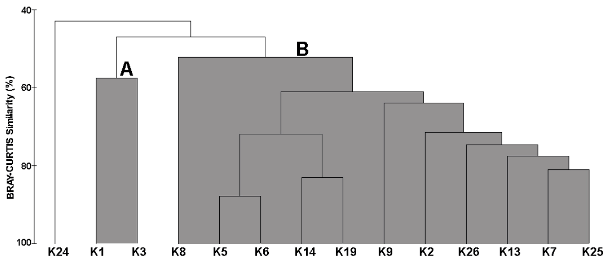

Figure 4

Dendrogram indicating similarities and dissimilarities of the sampling sites

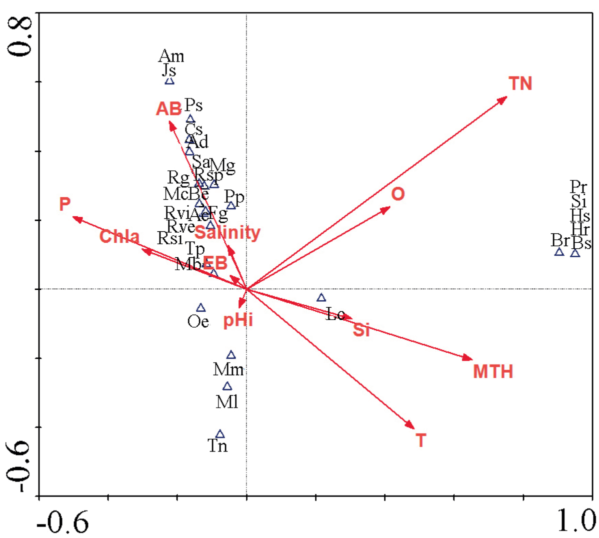

Figure 5

Biplot of CCA performed on the total abundance of all species in samples and environmental variables (arrows): T – temperature; O – oxygen; pHi – pH; Chl *a* – chlorophyll *a*; TN – total nitrogen; P – phosphorus; Si – silicate; MTH – maximum thallus height; EB – epiphyte wet weight; AB – algal wet weight; Lc – *Lepidochitona cinerea*, Sa – *Steromphala adansonii*, Js – *Jujubinus striatus*, Tp – *Tricolia pullus pullus*, Hs – *Homalopoma sanguineum*, Br – *Bittium reticulatum*, Cs – *Cerithidium submammillatum*, Ac – *Alvania cimex*, Ad – *Alvania discors*, Am – *Alvania mamillata*, Pp – *Pusillina philippi*, Pr – *Pusillina radiata*, Rg – *Rissoa guerinii*, Rsi – *Rissoa similis*, Rsp – *Rissoa splendida*, Rve – *Rissoa ventricosa*, Rvi – *Rissoa violacea*, Oe – *Ocenebra edwardsii*, Ps – *Pisania striata*, Tn – *Tritia neritea*, Si – *Spiralinella incerta*, Be – *Brachystomia eulimoides*, Bs – *Brachystomia scalaris*, Mb – *Modiolus barbatus*, Ml – *Mytilaster lineatus*, Mm – *Mytilaster minimus*, Mg – *Mytilus galloprovincialis*, Mc – *Musculus costulatus*, Fg – *Flexopecten glaber*, Hr – *Hiatella rugosa*

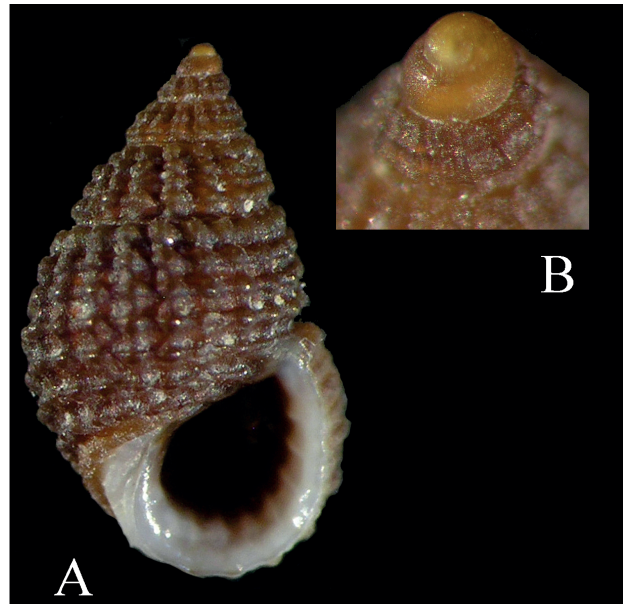

Figure 6

Alvania mamillata; A – frontal view of the specimen and its protoconch (B) (h = 4.8 mm)

whorls versus 2–2.3 whorls in *A. cimex*. The granules on the teleoconch of *A. mamillata* look quite coarser compared to those of *A. cimex*.

Distribution: *Alvania mamillata* occurs in the Mediterranean Sea and the northeast Atlantic Ocean (Zenetos & Aartsen 1995). It was previously reported from the Turkish Aegean (Aartsen & Kinzelbach 1990) and Levantine (Bitlis & Öztürk 2017) coasts.

Discussion

The present study is the first comprehensive work focusing on the mollusk species associated with *C. barbata* in the Sea of Marmara. *Alvania mamillata*, which is a new record for the mollusk fauna of the Sea of Marmara, encountered only at one site K3, was previously reported from the Aegean coast of Turkey (İztuzu beach) by Aartsen & Kinzelbach (1990) and from the Turkish Levantine coast by Bitlis & Öztürk (2017).

Due to the lack of detailed studies on the assemblages of mollusks inhabiting *C. barbata* in the Sea of Marmara, the results of the present study were compared with similar research conducted in the Mediterranean Sea. In the western Mediterranean, Sánchez-Moyano et al. (2000) encountered 98 mollusk species, which were found among the alga *Halopteris scoparia* along the coast of southern Spain. A total of 57 mollusks species and 1914 individuals, sampled from six algae species, including *C. barbata* and *Cystoseira spinosa* on the coast of Lampedusa Island, were reported by Chemello & Milazzo (2002). In the Gulf of Trieste (northern Adriatic Sea), 69 mollusk species and 2649 specimens were recorded on *Cystoseira* spp. facies (Pitacco et al. 2014). In the recent study, Chiarore et al. (2017) identified 53 mollusk species on *Cystoseira* spp. in the Gulf of Naples (southern Tyrrhenian Sea). One of the few related studies carried out in the eastern Mediterranean Sea was that conducted by Russo (1997), who studied the epifauna on seaweeds along the Cypriot coast and reported 22 mollusk species associated with *C. barbata* and *Cystoseira* spp. On the Turkish coast of the Black Sea, the fauna inhabiting *C. barbata* was investigated seasonally by Çulha et al. (2010) and Gözler et al. (2010). Çulha et al. (2010) mentioned 14 mollusk species distributed around the Sinop Peninsula, and Gözler et al. (2010) reported seven mollusk species from the southeastern Black Sea. The mollusk fauna associated with *Cystoseira* species along the Turkish Aegean coast was addressed in only two studies, i.e. conducted by Kocataş (1978), who reported 44 species, and by Ergen & Çınar (1994), who reported 27 species.

Compared to other algae species (*Jania rubens*, *Padina pavonica*, *Laurencia obtusa*), the low diversity and abundance of mollusks inhabiting *C. barbata* may be attributed to the lower herbivore pressure on *C. barbata* (Russo 1997), and this could be further researched.

The findings of the present study are consistent with the results obtained by Russo (1997), Pitacco et al. (2014) and Chiarore et al. (2017), who found that the Gastropoda class was represented by the largest number of species and individuals, followed by Bivalvia and Polyplacophora. Similarly, Pitacco et al. (2014) indicated that Rissoidae and Mytilidae associated with *Cystoseira* spp. were the richest families in terms of the number of species, and they suggested that this could be attributed to the feeding types of these mollusk species, because the representatives of Rissoidae and Mytilidae are micrograzers and filter-feeder organisms (Pitacco et al. 2014).

In the present study, *M. minimus*, *M. lineatus*, *R. splendida*, *B. reticulatum* and *S. adansonii* were found to be the most dominant and frequent species, which was also consistent with the findings reported by Çulha et al. (2010), who listed *M. lineatus*, *R. splendida* and *S. adansonii* as the most dominant species in the *C. barbata* facies inhabiting the Black Sea. On the other hand, *Jujubinus exasperatus*, *Rissoa guerinii* and *B. reticulatum* were the most dominant species of algae facies in a few studies (Sánchez-Moyano et al. 2000; Pitacco et al. 2014) carried out in the Mediterranean Sea.

The present study showed a significant positive correlation between the values of the diversity and evenness indices and Chl *a*, which is consistent with the results reported by Tselepides et al. (2000), who observed a positive correlation between the community parameters and Chl *a* along the coast of the South Aegean Sea.

According to CCA, total nitrogen and temperature were important environmental variables contributing to the distribution of the mollusk species in the study area. These results are consistent with those reported by Kurt Şahin et al. (2017) and Açık (2017), who found positive correlations between soft-bottom polychaetes assemblages and sipunculans and temperature. According to Sánchez-Moyano et al. (2000), the assemblage of mollusks with macroalgae was correlated with organic matter. In addition, it is known that *Cystoseira* species decline with increasing nutrient concentrations (Orfanidis et al. 2001; Berov et al. 2012). Therefore, the fauna of mollusks inhabiting the *Cystoseira* facies can be indirectly affected by changes in nutrient loads.

In conclusion, *Cystoseira* species associations are important for mollusk assemblages. Thus, future research on *Cystoseira* spp. facies and other macrophytes at the seabed should be more comprehensive and cover longer periods.

Acknowledgements

I am much indebted to my colleagues at the Department of Hydrobiology, Ege University for their help in collecting and sorting the benthic material. I also thank Bilal Öztürk and Alper Doğan for helping with the identifications and Güley Kurt Şahin for the contribution to the statistical analysis. Derya Ürkmez is acknowledged for her recommendations on improving the English of the manuscript. The present study was financially supported by Scientific Research Projects of TUBITAK (Project number: 111Y268).

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