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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

Mollusc fauna of Kemer Bay (Sea of Marmara)

Kemer Koyu Mollusca faunası (Marmara Denizi)

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Abstract: In the present study, mollusc species distributed in the Kemer Bay (Sea of Marmara) were determined seasonally (November, February, May, and August) in the years 2010 and 2011. The benthic samples were collected from different biotopes in 16 stations at depth ranging between 0.2 and 5 m by using a quadrate sampling gear. As a result of the evaluation of collected benthic materials, a total of 66 mollusc species belonging to 3 classes (Polyplacophora, Gastropoda, and Bivalvia) were identified. When the number of species and individuals are compared based on the seasons, maximum number of species (46 species) and individuals (168825 ind. m^{-2}) were counted in autumn and spring, respectively. *Mytilus galloprovincialis* (Lamarck, 1819) and *Mytilaster lineatus* (Gmelin, 1791) were the most abundant species in all the seasons. Whereas, *Bittium reticulatum* (da Costa, 1778), *Rissoa membranacea* (Montagu, 1803), and *Tricolia pullus pullus* (Linnaeus, 1758) were characterized as species having the highest frequency index values in all seasons.

Keywords: Mollusca, Kemer Bay, Sea of Marmara, distribution

Öz: Bu çalışmada Marmara Denizi, Kemer Koyu'nda dağılım gösteren mollusk türleri 2010 ve 2011 yıllarında mevsimsel olarak (Kasım, Şubat, Mayıs ve Ağustos) belirlenmiştir. Bentik numuneler kuadrat örnekleme aleti kullanılarak 16 istasyondan 0,2 ve 5 m derinlikler arasında farklı biyotoplardan örneklenmiştir. Alınan bentik materyalin değerlendirilmesi sonucunda 3 sınıfa ait (Polyplacophora, Gastropoda ve Bivalvia) toplam 66 mollusk türü tanımlanmıştır. Mevsimlere göre tür ve birey sayıları karşılaştırıldığında, maksimum tür sayısı (46 tür) ve birey sayısı (168825 birey m^{-2}) sırasıyla sonbahar ve ilkbahar mevsimlerinde sayılmıştır. *Mytilus galloprovincialis* (Lamarck, 1819) ve *Mytilaster lineatus* (Gmelin, 1791) tüm mevsimlerde en baskın türlerdir. Buna karşın, *Bittium reticulatum* (da Costa, 1778), *Rissoa membranacea* (Montagu, 1803) ve *Tricolia pullus pullus* (Linnaeus, 1758) tüm mevsimlerde en yüksek frekans indeks değeri ile karakterize edilen türler olmuştur.

Anahtar kelimeler: Molluska, Kemer Koyu, Marmara Denizi, dağılım

INTRODUCTION

The Kemer Bay is located in the Sea of Marmara near Dardanelles entrance and the preliminary data on the benthic fauna of the region can be encountered by Colombo (1885) who investigated the benthic invertebrate species of Çanakkale. In the following years, some remarkable studies on the subject have been carried out by Sturany (1895) and Ostroumoff (1896). Afterwards, many studies have been accomplished on the mollusc fauna of the region (Marion, 1898; Kaneva-Abadjieva, 1959; Albayrak and Balkıs, 1996a, b; Türkmen and Demirsoy, 2009; Doğan et al., 2016; Çulha and Şahin, 2018; Bitlis, 2019).

Since a new thermal power plant with a large port was constructed in Kemer Bay at the sampling time of the present study, it is aimed to be one of the fundamental studies in order to compare the results of the studies that will be carried out in the area during the coming years. Because, it is known fact that industrialization negatively affects the marine biodiversity by increasing the pollution (Bat et al., 2011; Şahin, 2016). It is inevitable that the settlement of many species of different taxonomic groups in the area as ship traffic in the region would be increased with the newly constructed port. The mean goal of the present study is to determine mollusc species distributed in the Kemer Bay and evaluate statistically the obtained values for their ecological and distributional characteristics.

MATERIAL AND METHODS

Benthic materials were collected seasonally (November, February, May, and August) in the years 2010 and 2011 of the Kemer Bay within the framework of a project supported by TUBITAK (Project Number: 2209). The materials were obtained in 16 sampling sites at depths between 0.2 and 5 m by scraping a quadrate sampling gear (20 x 20 cm) (Figure 1). The collected material was sifted with 0.5 mm mesh size and fixed in seawater-formalin solution (4%) at the field. In laboratory, the material was sorted into taxonomic groups

under a stereomicroscope and preserved in 70% ethanol. Later on, mollusc individuals were identified to species level and counted. Some of the ecological features of the sampling sites are presented in Table 1.

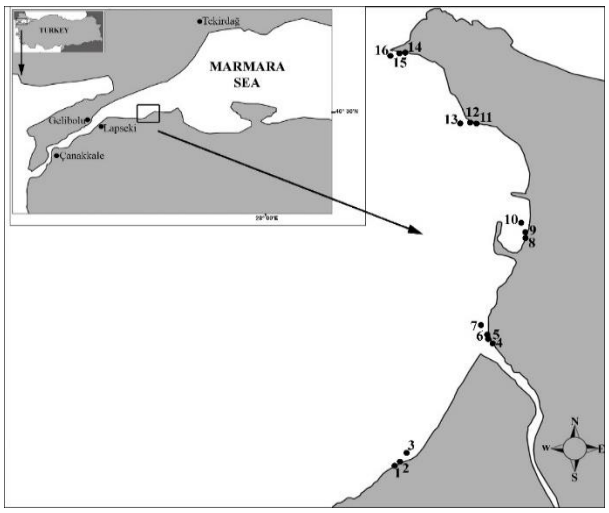

Figure 1. Map of the studied area with the location of sampling sites

Table 1. The coordinates, depth range, and biotopes of the sampling sites

	Coordinates		Depth (m)	Biotope
	Latitude	Longitude		
1	40° 24' 48.17"N	27° 03' 43.49"E	0.2	*M. galloprovincialis*
2	40° 24' 48.26"N	27° 03' 43.40"E	1	*Z. marina*+sand
3	40° 24' 48.50"N	27° 03' 43.33"E	5	*Z. marina*+sand
4	40° 25' 03.59"N	27° 03' 56.04"E	0.2	*M. galloprovincialis*
5	40° 25' 03.54"N	27° 03' 55.01"E	1	*M. galloprovincialis*
6	40° 25' 03.95"N	27° 03' 55.04"E	1	*Z. marina*+sand
7	40 °25' 05.73"N	27° 03' 53.08"E	5	*Z. marina*+grave
8	40° 25' 16.86"N	27° 03' 59.35"E	0.2	Muddy sand
9	40° 25' 17.09"N	27° 03' 58.54"E	1	*Z. marina*+sand
10	40° 25' 17.30"N	27° 03' 58.15"E	5	*Z. marina*+sand
11	40° 25' 29.48"N	27° 03' 54.46"E	0.2	*M. galloprovincialis*
12	40° 25' 29.33"N	27° 03' 54.27"E	1	*Z. marina*+shell
13	40° 25' 29.18"N	27° 03' 53.93"E	5	*Z. marina*+sand
14	40° 25' 39.20"N	27° 03' 36.58"E	0.2	*M. galloprovincialis*
15	40° 25' 39.06"N	27° 03' 36.05"E	1	*M. galloprovincialis*
16	40° 25' 38.82"N	27° 03' 35.80"E	5	*Z. marina*

In the field, the salinity (‰), temperature, (^{0}C), conductivity (µS/cm), and dissolved oxygen (mg/l) concentrations were measured using an oxygen meter (YSI 55) and multiple water analysis probe a SCT meter (YSI 650). pH was analyzed by a pH meter (Orion brand) in the laboratory (Parsons et al., 1984).

Bellan Santini's dominance index (D) (Bellan-Santini, 1969), Soyer's frequency index (F) (Soyer, 1970), Pielou's evenness index (J') (Pielou, 1975), Shannon-Weaver's diversity index (log_2 base) (H') (Shannon and Weaver, 1949) were calculated for each sampling site for each season (winter, spring, summer, and autumn). Pearson's correlation analysis with a significance level of $p < 0.05$ was applied between the community parameters (number of species and individuals, evenness, and diversity indices) and environmental parameters. The Bray-Curtis similarity index based on cluster analysis was used to group the sampling sites. SIMPER analysis was implemented the species assemblages to identify the species most contributed to the similarity and dissimilarity of species assemblages. Statistical analyses were carried out by using the softwares PRIMER 6 and STATISTICA 7. The systematic classification is given according to WORMS (World Register of Marine Species, June 2022). The identified species were deposited at ESFM (Museum of Faculty of Fisheries, Ege University, İzmir, Turkey).

RESULTS

Of the studied benthic material collected of Kemer Bay, a total of 66 mollusc species belonging to 28 families and the 3 classes (Polyplacophora, Gastropoda, and Bivalvia) were determined (Table 2). The class Gastropoda includes the maximum number of species (36 species) followed by Bivalvia (28 species) and Polyplacophora (2 species). Among the families, Rissoidae (9 species) was the most dominant taxon in terms of the number of species, followed by the families Pyramidellidae (8 species) and Veneridae (8 species).

When the community parameters are compared based on the seasons, the maximum number of species (46 species) was determined in autumn and the maximum number of specimens (168825 ind. m^{-2}) was found in spring. The minimum number of species and specimens (25 species and 46225 ind. m^{-2}) were counted in summer. The most abundant species were *Mytilus galloprovincialis* (Lamarck, 1819) 75% and 54% in summer and spring, respectively and *Mytilaster lineatus* (Gmelin, 1791) in autumn (45%) and winter (44%) (Table 3).

According to the frequency index values, *Tricolia pullus pullus* (Linnaeus, 1758) had the highest frequency values in autumn (75%), *Bittium reticulatum* (da Costa, 1778) in winter (69%) and spring (60%), and *Rissoa membranacea* (Montagu, 1803) in summer (69%) (Table 3).

Table 2. List of the species identified within the present study and their total number of specimens belonging to every taxa according to the stations

	Stations															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
POLYPLACOPHORA																
Lepidochitona cinerea (Linnaéus, 1767)	4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Acanthochitona fascicularis (Linnaéus, 1767)	1	-	-	-	-	-	-	2	1	-	-	1	2	-	-	-
GASTROPODA																
Patella caerulea Linnaéus, 1758	6	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-
Diodora gibberula (Lamarck, 1822)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Gibbula ardens (Salis Marschlins, 1793)	-	-	-	-	1	1	-	2	-	-	-	1	-	-	-	-
Phorcus mutabilis (Philippi, 1851)	-	-	-	-	-	-	-	21	-	-	-	-	-	-	-	-
Phorcus richardi (Payraudeau, 1826)	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Phorcus turbinatus (Born, 1778)	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Steromphala adansonii (Payraudeau, 1826)	1	-	-	-	1	2	-	4	7	5	2	2	2	2	13	9
Tricolia pullus pullus (Linnaéus, 1758)	15	9	21	-	20	3	4	5	13	16	1	42	15	-	6	3
Bittium reticulatum (Da Costa, 1778)	-	224	459	-	67	118	249	611	435	531	-	949	672	-	-	2
Cerithium vulgatum Bruguière, 1792	-	-	2	-	-	-	4	-	-	1	-	2	-	-	-	-
Epitonium turtonis (Turton, 1819)	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1
Alvania mamillata Risso, 1826	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2
Alvania lactea (Michaud, 1830)	-	-	-	-	-	-	-	-	-	1	-	6	-	-	-	-
Alvania discors (Brown, 1818)	-	-	-	-	-	-	-	-	-	-	-	4	1	-	-	-
Pusillina radiata (Philippi, 1836)	-	1	9	-	-	-	8	-	-	1	2	-	-	-	-	-
Pusillina philippi (Aradas & Maggiore, 1844)	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
Pusillina lineolata (Michaud, 1830)	-	3	2	-	1	-	-	-	-	-	3	-	-	-	-	-
Pusillina inconspicua (Alder, 1844)	-	-	-	-	2	2	-	-	-	-	-	1	-	-	-	-
Rissoa splendida Eichwald, 1830	-	37	64	-	1	9	15	43	27	13	5	178	130	-	4	71
Rissoa membranacea (Adams, 1800)	-	3	4	-	2	2	3	7	6	17	5	57	28	-	1	3
Ecrobia ventrosa (Montagu 1803)	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Ocenebra edwardsii (Payraudeau, 1826)	6	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-
Tritia reticulata (Linnaéus, 1758)	-	2	16	-	-	6	15	2	9	16	-	8	18	-	-	1
Tritia neritea (Linnaéus, 1758)	-	10	1	-	-	23	14	1	2	-	-	-	1	-	1	-
Mangelia costulata Risso, 1826	-	2	1	-	-	-	9	-	1	1	-	7	5	-	-	1
Mangelia brusinae van Aartsen & Fehr-de Wal, 1978	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Mangelia vauquelini (Payraudeau, 1826)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Parthenina terebellum (Philippi, 1844)	-	-	8	-	-	1	4	1	-	8	-	9	10	-	-	-
Parthenina interstincta (Adams J., 1797)	-	2	4	-	2	-	9	-	35	4	-	17	7	-	-	-
Brachystomia scalaris MacGillivray, 1843	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odostomia plicata (Montagu, 1803)	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Megastomia conoidea (Brocchi, 1814)	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-
Pyrgiscus rufus (Philippi, 1836)	-	-	3	-	-	-	4	-	3	-	-	-	1	-	10	-
Turbonilla pusilla (Philippi, 1844)	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Turbonilla acuta (Donovan, 1804)	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-
Ebala pointeli (de Folin, 1868)	-	-	1	-	-	-	-	-	-	1	-	1	1	-	-	-

Table 2. Continued

	Stations															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
BIVALVIA																
Modiolula phaseolina (Philippi, 1844)	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Modiolus barbatus (Linnaéus, 1758)	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Musculus subpictus (Cantraine, 1835)	-	-	5	-	25	-	-	-	-	-	-	-	-	1	-	-
Mytilus galloprovincialis Lamarck, 1819	336	-	-	169	155	-	-	-	110	-	1007	-	17	3534	432	-
Mytilaster lineatus (Gmelin, 1791)	2147	224	1092	350	1191	-	-	2	3	-	97	26	5	63	-	-
Pinna nobilis Linnaéus, 1758	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Flexopecten glaber (Linnaéus, 1758)	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-
Anomia ephippium Linnaéus, 1758	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-
Ostrea edulis Linnaéus, 1758	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Ctena decussata (Costa O.G., 1829)	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Lucinella divaricata (Linnaéus, 1758)	-	1	1	-	-	-	3	-	-	-	-	2	2	-	-	-
Loripinus fragilis (Philippi, 1836)	-	-	4	-	-	-	8	-	-	2	-	4	-	-	-	-
Cerastoderma glaucum (Bruguière, 1789)	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Parvicardium pinnulatum (Conrad, 1831)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Parvicardium exiguum (Gmelin, 1791)	-	-	-	-	-	-	5	-	5	1	-	1	9	-	-	-
Spisula subtruncata (da Costa, 1778)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4
Macomangulus tenuis (da Costa, 1778)	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	2
Moerella donacina (Linnaéus, 1758)	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-	-
Donax trunculus Linnaéus, 1758	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Abra alba (W. Wood, 1802)	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
Chamelea gallina (Linnaéus, 1758)	-	5	3	-	-	10	4	1	2	4	-	8	2	-	-	-
Gouldia minima (Montagu, 1803)	-	-	1	-	-	-	13	-	-	-	-	10	1	-	-	-
Pitar rudis (Poli, 1795)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Polititapes aureus (Gmelin, 1791)	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-
Polititapes rhomboides (Pennant, 1777)	-	3	-	-	-	-	-	-	-	-	-	3	2	-	-	-
Ruditapes decussatus (Linnaéus, 1758)	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Timoclea ovata (Pennant, 1777)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Thracia phaseolina (Lamarck, 1818)	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2

Table 3. The number of species (S), the number of individuals (N), frequency and dominance values based on seasons

Seasons	**S**	**N (ind/m^{-2})**	**Frequency index (%)**	**Dominance (%)**
Autumn	46	96625	*S. adansonii* (50%), *B. reticulatum* (56%), *R. splendida* (56%), *T. pullus pullus* (75%)	*M. lineatus* (45%)
Winter	37	110725	*T. pullus pullus* (50%), *T. reticulata* (50%), *B. reticulatum* (69%)	*M. lineatus* (44%)
Spring	34	168825	*B. reticulatum* (60%)	*M. galloprovincialis* (54%)
Summer	25	46225	*R. splendida* (62%), *R. membranacea* (69%)	*M. galloprovincialis* (75%)

Seasonal variations in the number of species and specimens, evenness, and diversity indices at all stations are showen in Table 4. The highest number of species was found at station 12 in spring (19 species) and in autumn (16 species). Station 3 showed the highest species number in winter and station 13 in summer. The largest number of individuals were recorded at station 14 (73575 ind. m^{-2}) in spring and at station 1 (30275 ind. m^{-2}) in autumn.

The maximum diversity index values were calculated at station 7 (3.0) in autumn and at station 10 (2.7) in summer, and similarly, the highest evenness index values were counted at sampling sites 4 (1.0) in spring, at station 10 and 5 (0.9) in summer, and at station 7 and 16 (0.8) in autumn (Table 4).

Table 4. Temporal variation in community parameters at the sampling sites according to the seasons

Stations	Number of species				Number of specimens (ind. m^{-2})			
	A	W	Sp	Su	A	W	Sp	Su
1	7	6	5	1	**30275**	20025	9500	3350
2	9	3	7	6	8575	450	3175	1000
3	12	**14**	7	6	3225	10875	26675	1875
4	4	3	2	1	6850	1675	3250	1325
5	1	9	2	6	1300	**29250**	5775	400
6	4	8	4	5	875	2225	1000	375
7	13	11	5	5	2525	5125	1425	400
8	13	6	7	5	5300	8000	4100	450
9	14	9	3	1	3625	7925	2300	2750
10	8	10	7	9	3025	9450	2675	525
11	8	1	4	1	3200	2625	10850	11400
12	**16**	11	**19**	9	10675	7475	13500	2150
13	13	11	8	**10**	8425	4125	8025	2775
14	4	2	2	1	2750	825	**73575**	**12875**
15	5	1	2	5	5600	250	3000	2850
16	6	7	0	4	400	425	0	1725

Stations	Diversity index				Evenness index			
	A	W	Sp	Su	A	W	Sp	Su
1	0.5	0.5	0.9	0.0	0.2	0.2	0.4	0.0
2	1.2	1.3	1.0	1.2	0.4	0.8	0.3	0.4
3	1.7	1.4	0.5	1.0	0.5	0.4	0.2	0.4
4	0.7	1.1	1.0	0.0	0.4	0.7	**1.0**	0.0
5	0.0	0.8	0.8	2.2	0.0	0.3	0.8	**0.9**
6	1.2	1.3	1.3	1.7	0.6	0.4	0.6	0.7
7	**3.0**	1.0	1.4	1.6	**0.8**	0.3	0.6	0.7
8	1.6	0.2	0.6	1.4	0.4	0.1	0.2	0.6
9	2.1	1.0	0.3	0.0	0.5	0.3	0.2	0.0
10	1.3	0.7	0.9	**2.7**	0.4	0.2	0.3	**0.9**
11	1.4	0.0	0.1	0.0	0.5	0.0	0.1	0.0
12	1.0	1.6	**1.6**	1.2	0.3	0.5	0.4	0.4
13	1.1	1.7	0.9	1.5	0.3	0.5	0.3	0.4
14	1.1	0.2	0.0	0.0	0.6	0.2	0.0	0.0
15	0.6	0.0	0.1	0.3	0.3	0.0	0.1	0.1
16	2.1	**2.3**	0.0	0.6	**0.8**	**0.8**	0.0	0.3

The relationships between the community and environmental parameters of the mollusc fauna in each season were revealed with Pearson's correlation analysis. Two negative correlation values were counted to be significant between the number of individuals and salinity (r=-0.72) and conductivity (r=-0.54) in autumn. The number of species was

negatively correlated with pH values (r=-0.68) and negative correlation was found between the evenness index values and conductivity (r=-0.52) in winter. In spring, the evenness index values were correlated with pH (r= 0.77) and salinity (r=-0.58). The number of individuals was correlated with pH (r=0.62), and conductivity (r=-0.69) in summer, similar to autumn (Table 5).

Table 5. Relationships between the environmental and community parameters in each season. **S**: Number of species. **N**: Number of individuals. **H'**: Shannon-Weaver's diversity index values. **J'**: Pielou's evenness index values. Bold values are statistically significant ($p < 0.05$)

	Autumn					Winter			
	S	**N**	**J'**	**H'**		**S**	**N**	**J'**	**H'**
Salinity	0.20	**-0.72**	0.18	0.18	**Salinity**	0.40	0.12	-0.20	0.10
Temperature	0.07	0.28	-0.12	-0.01	**Temperature**	-0.05	0.36	-0.13	-0.23
O_2	0.21	0.28	-0.21	-0.36	**O_2**	-0.14	0.29	-0.32	-0.45
pHins	0.43	0.04	-0.11	0.03	**pHins**	**-0.68**	-0.33	-0.11	-0.30
Conductivity	0.32	**-0.54**	0.15	0.24	**Conductivity**	0.23	0.26	**-0.52**	-0.34
	Spring					**Summer**			
	S	**N**	**J'**	**H'**		**S**	**N**	**J'**	**H'**
Salinity	0.26	0.11	**-0.58**	-0.10	**Salinity**	-0.10	0.03	-0.01	-0.11
Temperature	-0.17	-0.21	0.29	-0.05	**Temperature**	-0.16	0.24	-0.39	-0.33
O_2	-0.42	0.43	0.33	-0.11	**O_2**	-0.35	-0.10	-0.17	-0.26
pHins	-0.19	-0.33	**0.77**	0.45	**pHins**	0.02	**0.62**	-0.41	-0.38
Conductivity	0.12	-0.25	-0.19	-0.11	**Conductivity**	0.28	**-0.69**	0.27	0.24

According to the Bray-Curtis similarity index values, the stations were clustered in four groups (A, B, C and D) with values higher than 40% (Figure 2). The group A is generally includes the sites with *M. galloprovincialis* biotopes. The most contributing species to the similarity within the group A were *Mytilus galloprovincialis* and *Mytilaster lineatus* (Table 6). The group B comprises the summer stations with average similarity of 53% and *R. splendida*, and *R. membranacea* were the most contributing species to the similarity in the group B. The stations consisting the group C included *Z. marina* biotopes. The similarity of the stations forming the group D showed an average similarity 47%. Within the group *T. pullus pullus*, and *B. reticulatum* were the most contributing mollusc species to the similarity. SIMPER analysis revealed the similarities/dissimilarities in the groups and the most contributing species.

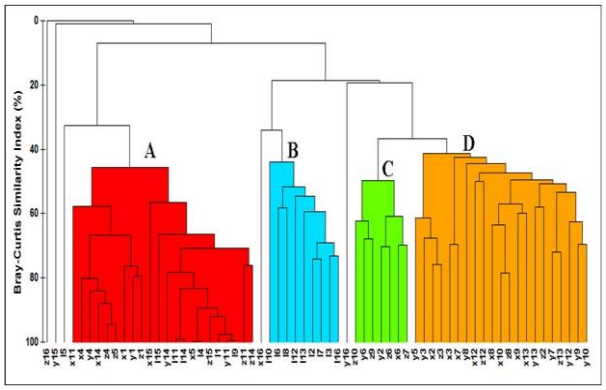

Figure 2. Bray-Curtis similarity analysis of the temporal samples (each association has a similarity higher than 40%). X: Autumn, Y: Winter, Z: Spring, I: Summer

Table 6. The most contributing species to the formation of assemblages in the stations among the seasons

	SIMILARITY				DISSIMILARITY					
Groups	**A**	**B**	**C**	**D**	**A-B**	**B-C**	**A-C**	**A-D**	**C-D**	**B-D**
Similarity/Dissimilarity (%)	**60**	**53**	**56**	**47**	**96**	**91**	**98**	91	**63**	**77**
M. galloprovincialis	87				30		30	18		
M. lineatus	11				11		11			
B. reticulatum			67	53		24	23	21		24
T. pullus pullus				12						
T. neritea			19						9	
R. splendida		56			20	21				10
R. membranacea		29				10				

DISCUSSION

In the present work, a total of 66 mollusc species belonging to three classes were identified in the benthic material sampled in Kemer Bay. The present study is the first exhaustive work on mollusc species in the region and may contribute to the monitoring of the ecological changes that may occur in the region in the following years.

The results of the study are comparable with the results of some studies on mollusc species performed in the Sea of Marmara. The findings in the study by Bitlis (2019) are compatible with those found herein. Bitlis (2019), which in a study on *Cystoseira barbata* facies in the Sea of Marmara, indicated that the class Gastropoda was the richest taxon regarding the species number, followed by the classes Bivalvia and Polyplacophora and among the families Rissoidae, and Pyramidellidae were the richest ones in terms of the number of species. In the same study was also reported that some species such as *R. splendida*, *M. lineatus*, *S. adansonii*, and *B. reticulatum* were the most dominant and frequent species taxa in the region.

In the study by Çınar et al. (2020), who investigated the macroinvertebrates associated with *M. galloprovincialis* in the Sea of Marmara, were obtained similar results presented herein. They found *B. reticulatum*, *M. lineatus, T. pullus pullus*, and *S. adansonii* were found to be the species with high dominance values. Moreover, *M. lineatus* was indicated as a species with constant distribution value of frequency index 77% in the area.

In the present study, an important positive correlation is found between the values of evenness index and pH in the summer season, which result compatible to those reported by Bitlis (2019) who found a negative correlation between the evenness index values and pH in October.

Regarding the SIMPER analysis performed in the present study, *Mytilus galloprovincialis*, *M. lineatus*, *B. reticulatum* and *R. splendida* are of interest as the species the most contributing to the groupings of the stations. A similar result was also indicated by Çınar et al. (2020). *M. lineatus* was mentioned among the species responsible for the groupings of the stations in the PCoA graph by Çınar et al. (2020).

As a result, the ancient city of Parion is also located behind the port of Kemer in the area and Kemer village was evaluated in the category of ancient cities in 2016. Therefore, the Kemer Bay should be protected against human and industrial impacts. In this context, the construction of the thermal power plant (İÇDAŞ) launched in 2011, will probably have some impact on the ecological properties of the area. After the power plant is put into operation, it would be beneficial for the area to be monitored the impact of the pressure of this increasing industrialization, global warming, and mucilage on marine benthic diversity including mollusc species every year or every two years.

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AUTHOR CONTRIBUTIONS

Banu Bitlis: Designing of the study, sorting into taxonomic groups, identification of mollusc species, data analysis, writing-original draft preparation, submission, writing-review and editing, software, visualization. Bilal Öztürk: Designing of the study, identification of mollusc species, checking-original draft preparation. Yusuf Şen: Designing of the study data collection, sorting into taxonomic groups, checking-original draft preparation.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest or competing interests.

ETHICS APPROVAL

No specific ethical approval was necessary for this study.

DATA AVAILABILITY

For questions regarding datasets, the corresponding author should be contacted.

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