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Macrozoobenthic community structure of İğneada region in Turkey (the southwestern Black Sea)

by

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Abstract

The present study deals with macrozoobenthic species on soft substrates in İğneada (Turkish coast of the Black Sea). Benthic samples were collected seasonally at three stations between 2012 and 2013. A total of 155 species belonging to seven taxa (Turbellaria, Nemertea, Nematoda, Oligochaeta, Polychaeta, Crustacea, Phoronida, Mollusca, Hemichordata) were identified. Of these, four species are new records for the Black Sea fauna, 15 species are new to the Turkish coast of the Black Sea; and two species are new to the Turkish Seas. Polychaeta was the most representative taxon in the study area – it was represented by 58 species (39% of the total number of species). In terms of the number of individuals, Mollusca were the dominant taxon in all seasons (82% of the total number of individuals). The most dominant species were *Bittium reticulatum* and *Caecum trachea* and the most frequent species were *Micronephtys stammeri*, *B. reticulatum* and *Chamelea gallina*.

Key words: Macrozoobenthos, distribution, new records, ecology, diversity, İğneada, Black Sea

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Introduction

İğneada is a small town located in the northwestern part of Turkey, in the district of Demirkoy, the Kirklareli Province, Turkey. The İğneada region is located on a coastal plain of the European and Turkish zones of the Black Sea, approximately 5 km south of the Rezovo River, which forms the border with Bulgaria. The area is of ultimate importance to the biological diversity by providing habitats for many floristic and faunistic species. The urban population is small in this region compared to other parts of Turkey (as well as compared to Bulgaria), therefore the anthropogenic impact on this coastal ecosystem is very limited. Ozturk et al. (2013) suggested this region as the most appropriate location for a transboundary protected area. The proposed potential area comprises the İğneada coastal inshore marine area and a terrestrial component, Strandja, located between Bulgaria and Turkey. The terrestrial part of İğneada is already protected due to its unique floodplain forests, wetlands on alluvial soils and coastal sands (Ozturk et al. 2013).

The Turkish coast of the Black Sea was poorly investigated in terms of dynamics and structure of zoobenthic communities compared to the Turkish Aegean and Mediterranean coasts. The studies performed along the Turkish coast of the Black Sea were generally focused on the specific taxonomic groups such as Polychaeta (Marinov 1959; Dimitrescu 1960; 1962; Rullier 1963; Gillet & Ünsal 2000; Çinar & Gonlugur-Demirci 2005; Agirbas et al. 2008; Gozler et al. 2009; Kurt Sahin & Çinar 2012; Kus & Kurt-Sahin 2015; Kurt Sahin et al. 2017), Crustacea (Kocatas & Katagan 1980; Mutlu et al. 1992; Sezgin et al. 2001; Kirkim et al. 2006; Sezgin & Katagan 2007; Bilgin et al. 2007), Mollusca (Mutlu et al. 1993; Gonlugur-Demirci 2005; Ozturk et al. 2004) and meiobenthic taxa such as Nematoda, Harpacticoida and Kinorhyncha (Ürkmez et al. 2015; Ürkmez et al. 2016b; Ürkmez et al. 2016c). The studies on the zoobenthic dynamics of the Turkish Black Sea coast are scarce (Jakubova 1948; Caspers 1968; Uysal et al. 2002; Sezgin et al. 2010; Ürkmez et al. 2016a). In addition, there is no comprehensive study on the zoobenthic diversity and structure from the İğneada region. The work carried out by Ongan et al. (2009) dealt with zoobenthos of the study area, but it focused on the Holocene sediments of the southwestern Black Sea and presented a species list of Mollusca and Ostracoda. On the other hand, Ürkmez et al. (2016c) investigated meiobenthic assemblages in the area within the scope of the same project (MISIS) as the present work. The authors listed species of free-living nematodes and harpacticoid copepods occurring on İğneada coasts, with several new records for the Turkish Seas.

The objective of the present work was to obtain data on the biodiversity of the macrozoobenthic community in the region and to determine possible seasonal changes in the communities of the area. The present study is important because it provides the first data on the macrozoobenthic biodiversity of the area. The results of this study will provide a basis for future research.

Materials and methods

Benthic sampling for the present study was carried out during the project "MSFD (Marine Strategy Framework Directive) Guiding Improvements in the Black Sea Integrated Monitoring System-MISIS" supported by the European Union. Benthic samples were collected seasonally at nine stations located at three different depths (5, 10, 20 m) of three transects using the Van Veen grab sampler between November 2012 and October 2013 (Table 1, Figure 1). Soft-bottom samples were sieved on board through 0.5 mm mesh and the retained material was transferred to separate jars containing 4% seawater formaldehyde solution. In the laboratory, samples were rinsed in freshwater, sorted into taxonomic groups under

Table 1

Coordinates, depth and biotope of the sampling stations

Station ID	Lat. (°N)	Lon. (°E)	Depth (m)	Biotope
I-1-1	41°52'10"	27°59'10"	5	Fine sand
I-1-2	41°52'05"	27°59'24"	10	Sand+Shell fragment
I-1-3	41°52'13"	28°00'15"	20	Sand
I-2-1	41°53'25"	28°00'25"	5	Fine sand+silt
I-2-2	41°53'04"	28°00'45"	10	Fine sand+Shell fragment
I-2-3	41°52'24"	28°01'13"	20	Sand
I-3-1	41°52'50"	28°02'43"	5	Silt
I-3-2	41°52'39"	28°02'40"	10	Sand+Shell fragment
I-3-3	41°52'14"	28°02'44"	20	Sand

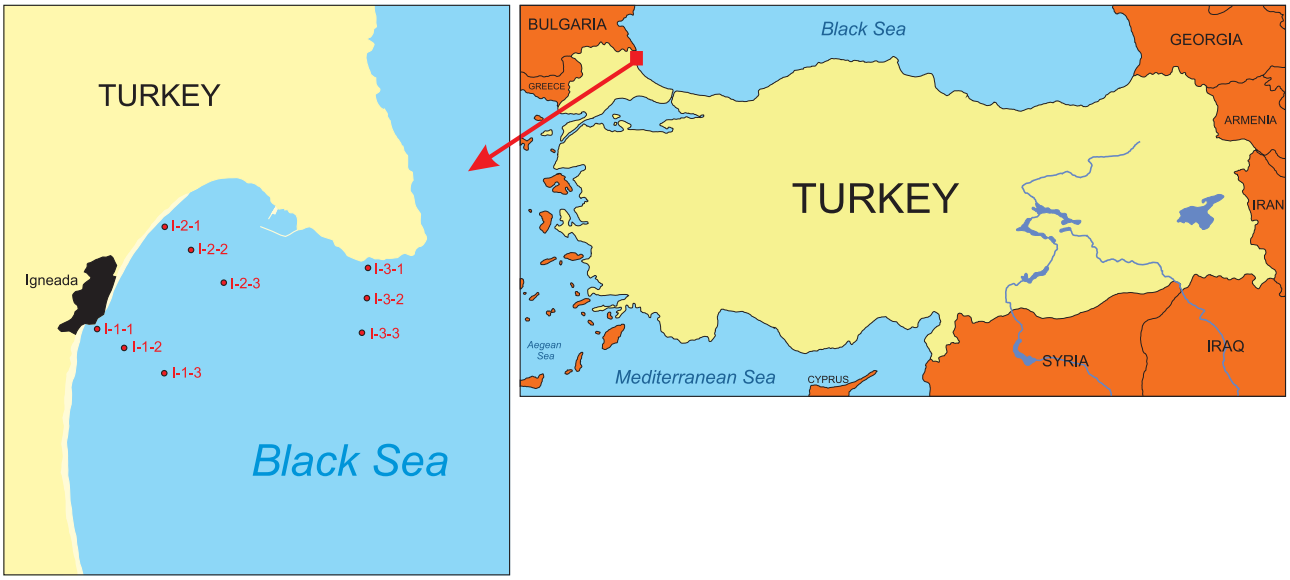

Figure 1

Study area with the location of the sampling stations

a stereomicroscope, and preserved in 70% ethanol. Next, macrozoobenthic species were identified and counted under stereo- and compound microscopes. In order to determine the water quality in the area, temperature, salinity, pH and dissolved oxygen concentration (DO) were recorded at each station in situ using the YSI 6600 V2 Water Quality Probe.

Soyer's Frequency Index (F) was applied to the abundance data to identify the characteristic species of the area. In order to interpret the quantitative data, Shannon-Weaver's diversity index (H') and Pielou's evenness index (J') were applied to the species abundance data. The pooled species abundance data, obtained per sampling station in each season, were analyzed using cluster techniques based on the Bray-Curtis similarity from the PRIMER 5 package (see Clarke and Warwick 2001).

Results

Physicochemical variables

The obtained values of these variables are presented in Table 2. The lowest and highest temperature values during the study period were 9.69°C and 24.72°C, respectively, and the highest mean temperature values were recorded in May 2013 (Figure 2). Salinity values were particularly low in summer (May 2013: 16.17 PSU, July 2013: 15.76 PSU) and high in autumn. The highest salinity value (18.28 PSU) was determined in October 2013 (Figure 2). The pH values measured at the stations ranged from 6.81 to 8.61. The pH values measured during the first half of the sampling period were high and they were low in the second half of the sampling period (Figure 2). The highest mean dissolved oxygen value recorded in the sampling period was 10.51 mg l^{-1} (May 2013) and the lowest oxygen value was 7.86 mg l^{-1} (October 2013) (Figure 2).

Fauna

The analyses of the material collected on the soft substrate in İğneada revealed a total of 45 959 individuals belonging to 154 species of seven taxa (Turbellaria, Nemertea, Nematoda, Oligochaeta, Polychaeta, Crustacea, Phoronida, Mollusca, Hemichordata). Table 3 shows that the maximum

Table 2

Physicochemical variables of the İğneada region

		Temp (°C)	Salinity (PSU)	pH	DO (mg l^{-1})
Nov-2012	Min.	14.81	17.82	8.25	8.24
	Max	15.25	18.04	8.31	9.43
	Mean	15.05	17.95	8.29	8.47
May-2013	Min.	9.69	15.42	8.39	9.21
	Max	18.04	17.95	8.61	10.51
	Mean	15.72	16.17	8.53	10.01
July-2013	Min.	22.97	14.92	6.87	7.39
	Max	24.72	16.17	6.98	8.66
	Mean	23.71	15.76	6.92	8.05
Oct-2013	Min.	18.35	18.24	6.85	7.86
	Max	18.65	18.28	6.89	8.2
	Mean	18.54	18.26	6.87	7.96

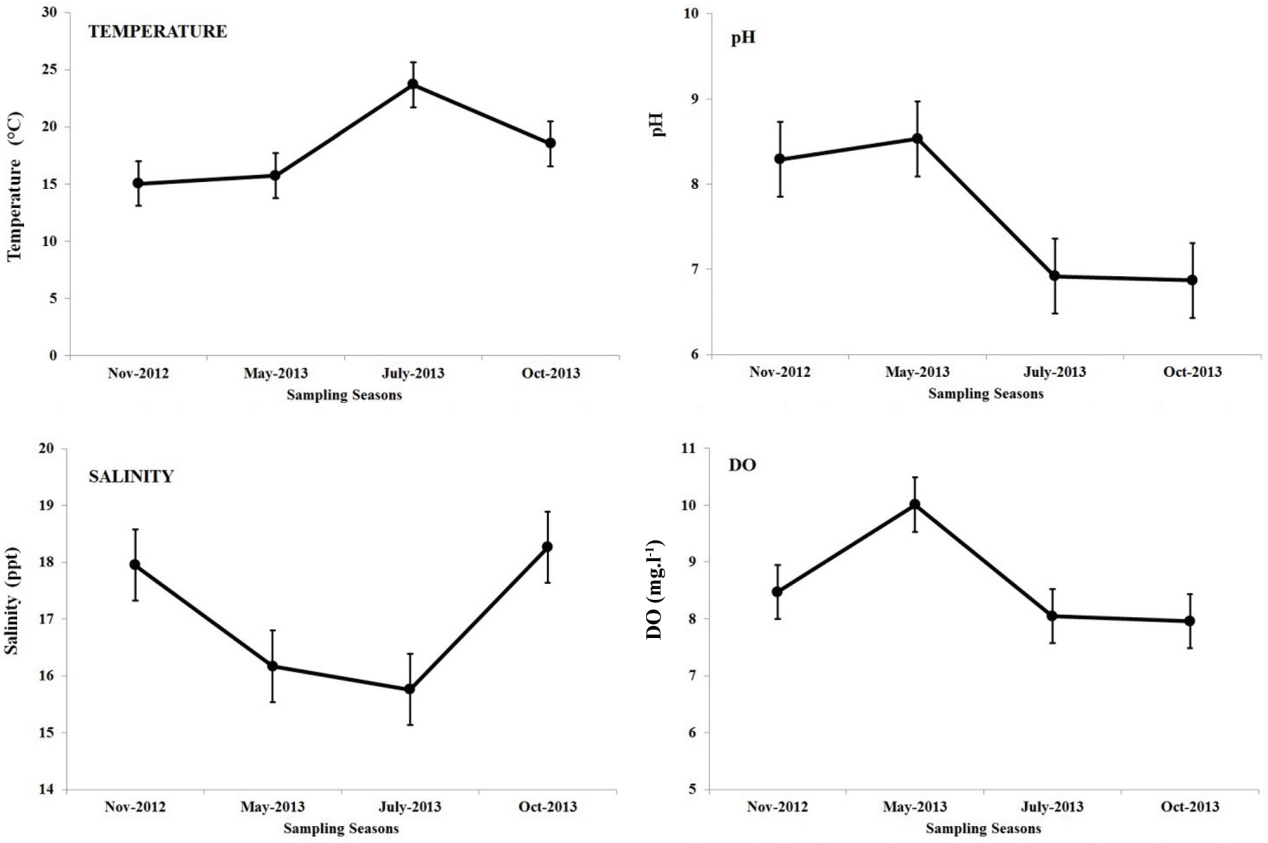

Figure 2

Physicochemical variables of the sampling seasons in the İğneada region

densities of species were found at the stations. Of the recorded species, four polychaete species were new to the Black Sea, and six polychaetes, five crustaceans, three mollusks and one hemichordate species were new to the Turkish Black Sea coast. The crustaceans *Eurydice racovitzai* Bacescu, 1949 and *Iphinoe trispinosa* (Goodsir, 1843) were also reported for the first time from Turkey (Table 3). Among the species identified in the area, *Anadara kagoshimensis* (Tokunaga, 1906) and *Rapana venosa* (Valenciennes, 1846) are alien mollusks.

Polychaeta was represented by the largest number of species (58 species, 39% of the total number of species), followed by Mollusca (48 species, 32%) (Figure 3a). When the number of individuals in the area is considered, the dominant taxon was Mollusca (37 409 individuals, 82% of the total number) throughout the seasons (Figure 3b). Mollusca was followed by Polychaeta (12%), Oligochaeta (5%) and Crustacea (1%). The other taxa were represented by 60 individuals in total. The dominant species in the area were *Bittium reticulatum* (da Costa, 1778) (47% of the total number of individuals) and *Caecum trachea* (Montagu, 1803) (14%) followed by Oligochaeta (sp.) (5%), *Lucinella divaricata* (Linnaeus, 1758) (4%) and *Chamelea gallina* (Linnaeus, 1758) (3%) based on the analysis of all samples (Figure 3c).

As a result of Soyer's frequency (F) categorizations, 13 species can be classified as constant ($F \geq 50$), 25 species as common ($25 \leq F \geq 49$) and 112 species as rare ($F < 25$) in İğneada. The most frequent species in the area were *Micronephthys stammeri* (Augener, 1932) (97.22%), *Bittium reticulatum* (94.44%), *Chamelea gallina* (91.67%), *Lucinella divaricata* (86.11%) and *Spio decoratus* Bobretzky, 1870 (80.56%).

Diversity and evenness index values at the stations were calculated based on the mean number of individuals obtained in all the seasons. The highest mean diversity index value was determined at station I-1-2 ($H' = 4.26$), and the lowest at station I-2-2 ($H' = 2.19$) (Figure 4). The mean evenness index (J') values ranged from 0.35 (sta I-2-2) to 0.71 (sta I-1-2) (Figure 4). The identified species were characterized by relatively even distribution at the sampling stations except station I-2-2.

The dendrogram of the stations obtained from the cluster analysis indicated the presence of six main groups (40% of similarity) (Figure 5). The main clustering factor was the season that divided the

Table 3

List of zoobenthos species collected during the study and their maximum densities (ind. m^{-2}) per station

Stations	I-1-1	I-1-2	I-1-3	I-2-1	I-2-2	I-2-3	I-3-1	I-3-2	I-3-3
Depth (m)	5	10	20	5	10	20	5	10	20
PLATHELMINTHES									
Turbellaria (spp.)				10/W			10/A		
NEMERTEA									
Nemertea (spp.)		50/S	100/Sp	10/S	50/Sp	50/S	90/Sp	80/S	40/A
OLIGOCHAETA									
Oligochaeta (spp.)					860/W		170/Sp		21250/Sp
POLYCHAETA									
Harmothoe imbricata (Linnaeus, 1767)						10/S			
Malmgreniella sp.		50/S	10/Sp			10/S	60/Sp		
Pholoe inornata Johnston, 1839	20/Sp	10/S	70/Sp						
Eumida sanguinea (Örsted, 1843)	10/S	10/S, A	10/Sp, S	30/S		10/S	10/A		
Mysta picta (Quatrefages, 1866)						10/S			
Nereiphylla rubiginosa (Saint-Joseph, 1888)	10/W	10/W					10/W		
Phyllodoce maculata (Linnaeus, 1767)						10/A	20/S		
Sigambra tentaculata (Treadwell, 1941)			20/Sp		10/Sp				
Exogone dispar (Webster, 1879)			520/Sp		320/Sp				
Exogone naidina Örsted, 1845		10/S	50/Sp		30/S	10/S		10/A	
**Odontosyllis gibba* Claparède, 1863							30/Sp		
Salvatoria clavata (Claparède, 1863)			80/Sp		60/Sp				
Sphaerosyllis hystrix Claparède, 1863			100/Sp		20/A			70/W	
Syllis garciai (Campoy, 1982)					10/Sp				
Syllis gracilis Grube, 1840			20/A						
Platynereis dumerilii (Audouin & Milne Edwards, 1834)	870/S	20/S, A	40/S			40/W	30/A		
Nereis zonata Malmgren, 1867	60/A			10/S		10/S			
Glycera alba (O.F. Müller, 1776)	80/S			170/S	150/S		170/S	10/A	
**Glycera fallax* Quatrefages, 1850		40/A	20/Sp	10/W	10/S, A			20/Sp	
**Glycera unicornis* Savigny in Lamarck, 1818		80/S		20/W		20/S		100/S	10/A
Micronephthys stammeri (Augener, 1932)	180/S	390/S	140/W	360/S	950/S	380/Sp	630/Sp	460/S	720/W
Nephthys hystricis McIntosh, 1900	50/W	10/W	10/A	10/W				40/W	
**Nephtys incisa* Malmgren, 1865			10/S			10/S			
Eunice vittata (Delle Chiaje, 1828)			10/W						
Protodorvillea kefersteini (McIntosh, 1869)		16/S	940/A	160/Sp	1690/Sp		260/Sp	740/W	850/S
Naineris laevigata (Grube, 1855)		10/A							
**Phylo foetida* (Claparède, 1869)	20/Sp			10/W,A	10/A	70/Sp	20/S	10/S	
***Aonides oxycephala* (Sars, 1862)			10/Sp	10/A	20/Sp				
Aonides paucibranchiata Southern, 1914			100/W						70/Sp
Polydora sp.			20/Sp		20/Sp		100/Sp		
Prionospio maciolekae Dagli & Çinar, 2011	40/A	270/S	2070/Sp	40/Sp	20/Sp	140/S	110/Sp	30/W	190/W
Pseudopolydora antennata (Claparède, 1870)							10/Sp		
Scolelepis tridentata (Southern, 1914)						10/W			
Spio decoratus Bobretzky, 1870	440/S	190/W	610/S	610/S	890/S	370/S	1910/S	1140/S	510/S
**Spiophanes afer* Meißner, 2005		10/Sp							
Aricidea (Acmira) catherinae Laubier, 1967		20/Sp	250/S		60/S	850/S	10/A	170/W	940/W
Aricidea (Strelzovia) claudiae Laubier, 1967		40/A	350/Sp	10/Sp		140/Sp	10/A		1650/A
Aricidea (Aricidea) pseudoarticulata Hobson, 1972			10/Sp	10/Sp		170/W			140/A
Cirrophorus branchiatus Ehlers, 1908			20/Sp		40/Sp	50/A	270/W		60/A
Paradoneis lyra (Southern, 1914)						10/A	30/S		
Magelona minuta Eliason, 1962	10/W	30/A		10/S	10/A		10/Sp	50/S	
***Magelona mirabilis* (Johnston, 1865)				20/Sp			30/S		
Cirriformia tentaculata (Montagu, 1808)			30/S						
Monticellina heterochaeta Laubier, 1961		10/S							
Capitella teleta Blake, Grassle, Eckelbarger, 2009	10/A				20/Sp	140/S	3520/Sp		10/A
Capitomastus minima (Langerhans, 1881)	140/S	80/S	80/S	140/S	90/S	1810/S	2990/Sp	80/A	260/W
Heteromastus filiformis (Claparède, 1864)	10/A	1000/S	160/S		210/A	2110/S		210/A	340/A
Notomastus latericeus M. Sars, 1851						40/S	10/S		
Leiochone leiopygos (Grube, 1860)					60/S	110/S	30/Sp	30/A	
Euclymene lumbricoides (Quatrefages, 1865)									10/S
***Petaloproctus terricola* Quatrefages, 1865			10/S						
Ophelia limacina (Rathke, 1843)			60/W		40/Sp	10/A	10/A		470/S

Polyophthalmus pictus (Dujardin, 1839)							10/Sp		
Lagis koreni Malmgren, 1866						10/S			
Melinna palmata Grube, 1870		10/S				30/S			
Amphitritides gracilis (Grube, 1860)			30/A						10/S
Terebellides stroemii Sars, 1835									10/S
***Polygordius lacteus* Schneider, 1868			60/W		300/W	40/W	40/Sp		10/Sp
PHORONIDA									
Phoronida (sp.)							10/A	10/A	
CRUSTACEA									
Amphibalanus improvisus (Darwin, 1854)				130/Sp				10/Sp	
Siriella jaltensis jaltensis Czerniavsky, 1868			10/Sp			10/Sp			
Bodotria arenosa mediterranea (Steuer, 1938)			10/Sp		20/Sp		10/Sp		
***Bodotria scorpioides* (Montagu, 1804)	10/W				10/W				
Bodotria sp.			10/W						
***Cumopsis goodsir* (Van Beneden, 1861)	60/S	130/Sp	40/S	120/Sp	80/Sp	60/S	100/S	40/S	
Iphinoe maeotica Sowinskyi, 1893	10/S						30/S	20/S	10/S
***Iphinoe serrata* Norman, 1867			10/S					10/A	
Iphinoe tenella G.O. Sars, 1878					20/A				
****Iphinoe trispinosa* (Goodsir, 1843)						10/Sp, S			
Pseudocuma longicorne (Bate, 1858)			30/Sp			20/Sp			
Apseudopsis ostroumovi Bacescu and Carausu, 1947			70/A						
Leptochelia savignyi (Kroyer, 1842)			20/A						
Tanais dulongii (Audouin, 1826)						10/S			
***Dynamene bidentata* (Adams, 1800)	10/W								
Eurydice pulchra Leach, 1815		20/W	30/W	60/A	10/Sp	10/Sp			
****Eurydice racovitzai* Bacescu, 1949		40/Sp	20/W						10/S
Idotea balthica (Pallas, 1772)	20/A	10/Sp							
Ampelisca diadema (A. Costa, 1853)		20/A		10/Sp	60/S	10/A	20/A	10/Sp	
Ampelisca pseudospinimana Bellan-Santini and Kaim-Malka,1977	70/S	20/S	60/S	30/A	160/S	20/A	60/S	40/S	110/S
Ampelisca sp.						20/W			
Ampithoe ramondi Audouin, 1826	40/S	10/Sp		20/Sp		40/S	70/Sp		
Atylus massiliensis Bellan-Santini, 1975		20/W		20/Sp	60/Sp	10/Sp, S	130/Sp	10/Sp	20/S
Bathyporeia guilliamsoniana (Bate, 1857)	120/S	40/Sp	40/A	90/S	50/Sp	30/Sp	10/A	60/S	60/S
Dexamine spinosa (Montagu, 1813)	10/Sp				20/Sp			10/S	20/S
Ericthonius punctatus (Bate, 1857)		20/S							
Gammarus aequicauda (Martyinov, 1931)							30/Sp		
Megaluropus massilensis Ledoyer, 1976	40/S					20/W	30/S	110/S	10/S
Microdeutopus gryllotalpa A. Costa, 1853					10/Sp	10/Sp			
Microdeutopus versiculatus (Bate, 1856)			10/Sp			20/S			
Monocorophium acherusicum (A. Costa, 1853)		50/S	20/S		50/Sp	20/S	10/S		
Perioculodes longimanus (Bate and Westwood, 1868)	50/Sp	140/Sp	20/S	60/Sp	20/Sp	50/Sp	20/Sp, S	10/Sp	
Tritaeta gibbosa (Bate, 1862)							10/Sp		
Brachynotus sexdentatus (Risso, 1827)			10/Sp						
***Callianassa truncata* (Giard and Bonnier, 1890)							10/S	10/A	10/A
Crangon crangon (Linnaeus, 1758)	20/S								
Diogenes pugilator (Roux, 1829)	10/S	20/A		30/S		20/A	40/Sp, A	20/Sp, A	
Pisidia longimana (Risso, 1816)							10/Sp		
Upogebia pusilla (Petagna, 1792)			10/S		10/Sp				60/A
MOLLUSCA									
Gibbula albida (Gmelin, 1791)		10/S		10/S	130/S	10/S	10/A	10/A	
Gibbula divaricata (Linnaeus, 1758)			80/W			10/A	30/Sp		10/Sp, S
Tricolia pullus pullus (Linnaeus, 1758)	50/A	750/W	1350/W	110/S	160/S	200/S	3210/Sp	230/S	870/Sp
Bittium reticulatum (da Costa, 1778)	2310/S	1230/S	10360/Sp	6770/A	52240/S	2860/S	9750/Sp	13760/A	7100/Sp
Monophorus perversus (Linnaeus, 1758)		210/S	70/W		70/S			60/A	170/Sp
Epitonium clathrus (Linnaeus, 1758)					40/S				
***Epitonium turtonis* (Turton, 1819)		10/S	30/S	10/S	40/S	40/S	10/Sp, S		20/A
***Manzonia crassa* (Kanmacher, 1798)			10/Sp						
Rissoa membranacea (Adams, J., 1800)	110/A	30/S	10/W	1420/A	5310/S	250/S	730/A	1820/A	80/A
Rissoa splendida Eichwald, 1830	60/S	80/A	50/A	470/A	650/S	90/S	8640/Sp	290/A	90/A
Rissoa ventricosa Desmarest, 1814				20/W					
Rissoa sp.	20/W		150/Sp	40/W					
Pusillina lineolata (Michaud, 1830)			70/S		40/S	330/A		10/A	80/S
Pusillina radiata (Philippi, 1836)					1400/S				
Pusillina sp.		40/W, S	250/S	170/Sp	30/Sp	50/W	240/Sp		

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Setia pulcherrima (Jeffreys, 1848)			10/W						
Caecum trachea (Montagu, 1803)	860/S	960/S	7660/S	3100/S	23930/S	8740/S	560/S	3070/A	1530/S
Ecrobia ventrosa (Montagu, 1803)		80/S	720/S	120/S	520/S	1250/S	30/A	160/A	
Hydrobia acuta (Draparnaud, 1805)		40/A	20/Sp	100/A	180/Sp			10/Sp	
Calyptraea chinensis (Linnaeus, 1758)		20/S	160/A		920/A	230/S		40/A	60/S
#*Rapana venosa* (Valenciennes, 1846)	10/Sp	30/A			10/Sp		10/Sp		
Cyclope neritea (Linnaeus, 1758)	40/Sp	30/W	80/S	50/A	750/S	70/S	700/Sp	50/Sp, S	70/A
Nassarius reticulatus (Linnaeus, 1758)	20/S	30/S	50/S	110/A	1360/S	180/S	460/Sp	40/A	160/A
Bela nebula (Montagu, 1803)		20/S	20/S	30/S, A	280/S	20/S, A	140/Sp	180/A	
**Mangelia costata* (Pennant, 1777)	10/S	10/S	10/Sp						
Mangelia pontica Milaschewitsch, 1908					230/S		100/Sp		
Mangelia sp.		10/W	80/Sp	20/S					
Parthenina interstincta (Adams, J., 1797)		10/W	20/Sp	50/A				30/S	
Turbonilla acuta (Donovan, 1804)			70/Sp		40/A				
Turbonilla pusilla (Philippi, 1844)		140/S	130/S	50/S	170/S	240/S		210/S	10/S
Cylichnina robagliana (Fischer, P., 1869)					40/Sp			70/S	
Cylichnina umbilicata (Montagu, 1803)		10/W	140/Sp	130/A	140/A	150/S		120/A	10/A
Retusa truncatula (Bruguière, 1792)		110/S	170/S	120/S	3040/S	50/S	80/S	20/A	80/S
#*Anadara kagoshimensis* (Tokunaga, 1906)				10/W	10/Sp				
Mytilaster lineatus (Gmelin, 1791)			10/W, Sp	20/S	10/Sp		20/Sp	10/Sp	
Mytilus galloprovincialis Lamarck, 1819	100/Sp					10/Sp			30/S
Modiolus sp.			20/Sp	10/Sp				10/Sp	
Lucinella divaricata (Linnaeus, 1758)	100/A	590/W	830/S	160/S	9600/S	850/S	780/Sp	600/A	100/S
Parvicardium exiguum (Gmelin, 1791)			40/Sp	10/S	20/Sp			10/S	10/S
Spisula subtruncata (da Costa, 1778)	120/Sp	200/S	270/S	40/S	170/Sp	80/Sp	10/Sp	140/S	
Tellina tenuis Costa, 1778	40/A	40/A	20/S	60/A	50/Sp	30/Sp	30/Sp	20/S	
Donax trunculus Linnaeus, 1758	10/W								
Donax venustus Poli, 1795	10/Sp	10/A		40/S	30/Sp		30/Sp	20/Sp	
Chamelea gallina (Linnaeus, 1758)	960/A	590/A	400/S	980/Sp	2350/S	500/S	3430/Sp	1630/Sp	200/S
Gouldia minima (Montagu, 1803)			50/S	10/W	30/Sp				20/Sp
Pitar rudis (Poli, 1795)		160/S	80/S						
Polititapes aureus (Gmelin, 1791)					20/Sp, A	30/S			
Lentidium mediterraneum (Costa O.G., 1829)	30/Sp	20/Sp	40/W	220/W	50/W		450/Sp	10/A	
HEMICHORDATA									
**Branchiostoma lanceolatum* (Pallas, 1774)					20/W				10/Sp, S

* - New record for the Black Sea, ** - New record for the Turkish coast of the Black Sea, *** - New record for Turkey, # - Alien species;

A - Autumn, W - Winter, Sp - Spring, S - Summer

stations into six groups. The stations were clustered as winter-spring or autumn-summer, generally.

Discussion

Macrozoobenthic community structure and changes in the benthic fauna of the İğneada region of the Black Sea are documented for the first time through the present study. The species composition of zoobenthos on the western Black Sea coast in Turkey was studied by Jakubova (1948), Caspers (1968), Uysal et al. (2002) and Ürkmez et al. (2016c) who studied the meiobenthic community structure in the area. In the central Turkish Black Sea (Sinop), the seasonal dynamics of the meiobenthic assemblages were studied (Ürkmez et al. 2016a). The eastern coast was considered only by Sezgin et al. (2010). So far, 768 macrozoobenthic species were identified from the Turkish coast of the Black Sea (Açik 2014; Bakir et al. 2014; Çinar 2014; Çinar et al. 2014a,b; Evcen et al. 2016; Koçak & Onen 2014; Oztoprak et al. 2014; Ozturk et al. 2014; Topaloglu & Evcen 2014; Kus & Kurt-Sahin 2015; Kurt Sahin et al. 2017). The number of macrozoobenthic species reported from the Turkish coast of the Black Sea increased to 789, including the new species reported in the present study. Since no detailed study on the macrozoobenthos in the İğneada region is available, the results of the present study could not be compared with any other studies. However, Uysal et al. (2002) studied the prebosphoric region of the Black Sea and reported 29 macrozoobenthic species. Stoykov and Uzunova (2001) analyzed macrozoobenthic organisms of the southern Bulgarian coast and identified 96 species. Uzunova (2010) examined the zoobenthos of the eelgrass (*Zostera* spp.) of Sozopol Bay, Bulgaria and reported 69 species. In the present study, we identified 154 species on the coast of İğneada, including *Anadara kagoshimensis* – an alien species transported to the Aegean and Black Seas from

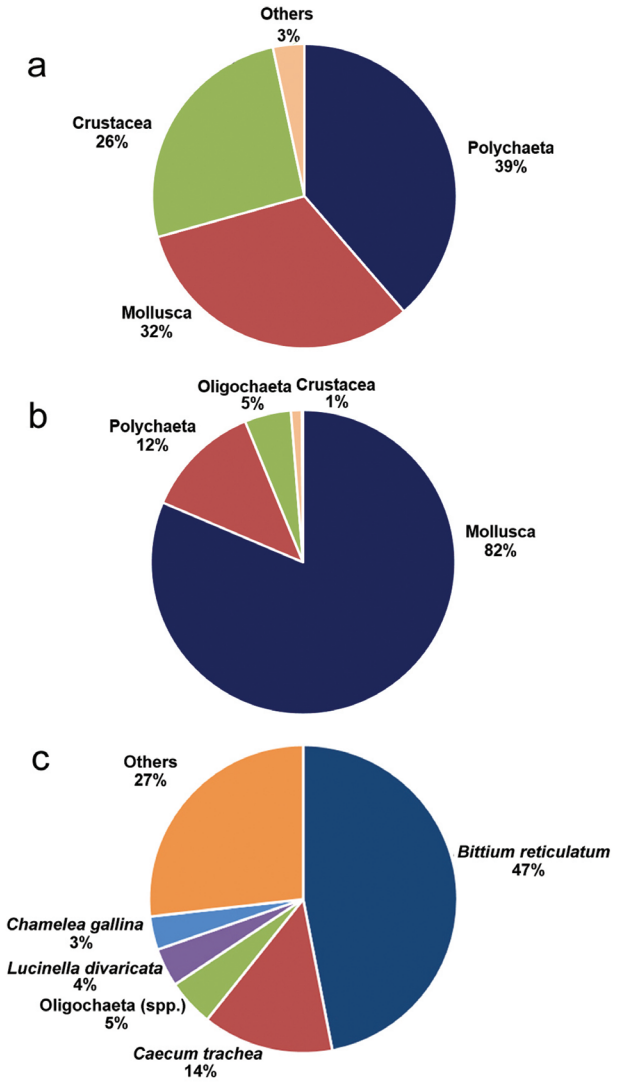

Figure 3

a) Relative dominance of zoobenthos by the number of species, b) Relative dominance of zoobenthos by the number of individuals, c) Relative dominance of zoobenthic species by the number of individuals

the Pacific Ocean via ship ballast waters. The species was first reported from the Turkish coast of the Black Sea by Albayrak (2003). *Rapana venosa* was the other alien mollusk species from the Pacific Ocean. It was introduced to the Black Sea in the 1940s and expanded its distribution toward the Azov Sea, the Caucasus, and the Crimea. The species was first reported from the Turkish Black Sea coast in 1960 by Fischer-Piette (1960).

Salinity levels in the study area were at 16 PSU in May and July; they were slightly higher (18 PSU) in October and November. Sea currents induced by winds increase the influence of freshwaters introduced into the sea near the study area. Salinity levels are lower in the area under these circumstances.

In general, Polychaeta is the dominant taxon in the Black Sea, both in terms of the number of individuals and the number of species. The present study indicates that Polychaeta is the most diverse taxon, but mollusks are dominant and account for 82% of the total number of individuals. The dominant taxon is the mollusk *Bittium reticulatum*. No detailed ecological information on this species is available for the Black Sea, even though it is known that it forms dense populations in vegetated habitats. In general, they live as epiphytic grazers on the *Zostera* leaves. As supporting evidence, patchy *Zostera* beds are found to be abundant on the soft bottoms of the study area.

The present study was supported by the MISIS project, the objective of which was e.g. to deal with issues related to the establishment of the Transboundary Protected Area Strandzha – İğneada located on the border between Bulgaria and Turkey. Strandzha had the status of Natura 2000 SCI under the Habitats Directive before the study area was designated as a protected area (BG0001007). The İğneada marine area had no status of protection, except that it indirectly benefited from its location in very close proximity to Longoz Forest National Park (designated in 2007). Therefore, the project focused on thorough investigation of its current biological and ecological status for future designation of the marine part of the İğneada region as a Marine Protected Area under the Habitats Directive. The present study contains the results of the research on marine diversity in the İğneada area in order to gain knowledge about the ecological value and the current status of its biological and ecological aspects. In accordance with these objectives, macrozoobenthic fauna and its ecological status were determined to support the

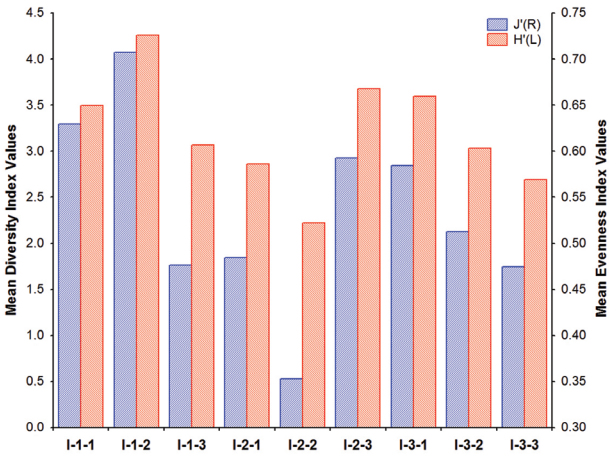

Figure 4

Diversity and evenness index values at the sampling stations

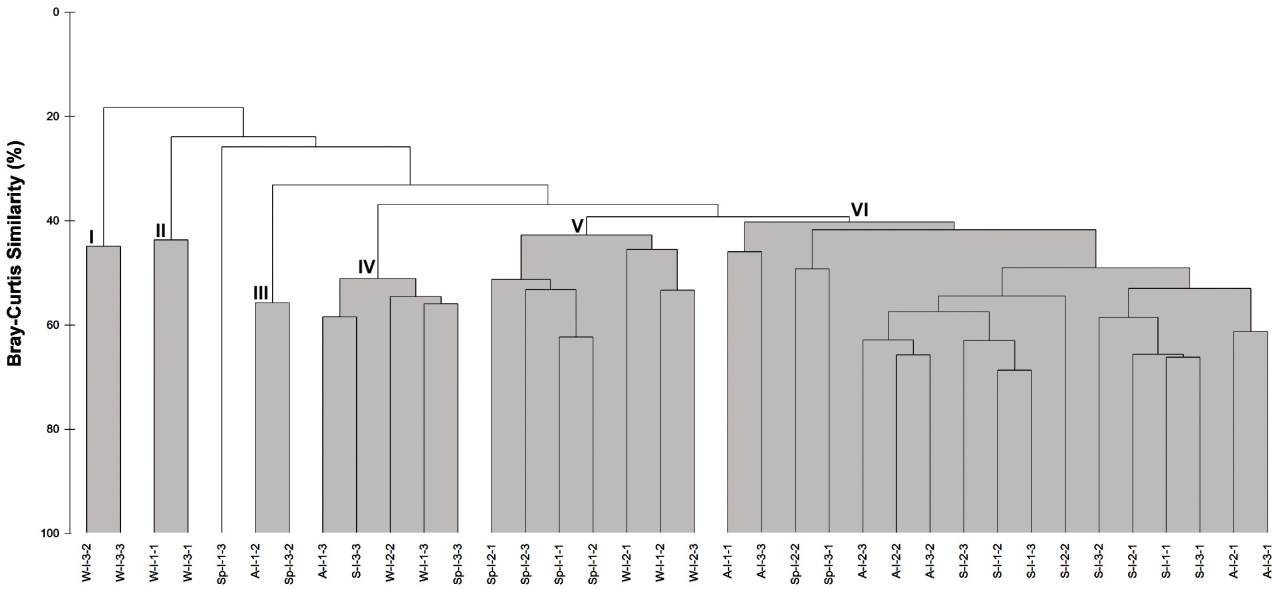

Figure 5

Dendrogram of the sampling stations (A: Autumn, W: Winter, Sp: Spring, S: Summer)

work carried out in the area aimed at creating a marine protected zone. In order to better understand the distributional and ecological features of the species occurring in the area, more samplings should be designed at various depths and representing different habitats.

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