



Temporal variation of Gastropoda and Scaphopoda (Mollusca) species along the Sugözü coast (İskenderun Bay, Levantine Sea)

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Abstract

The aim of the study is to investigate the temporal variations of the soft-bottom molluscan species distributed along the Sugözü coast in İskenderun Bay. The benthic material was collected in 12 sampling sites at depths between 2 and 19 m by using a van Veen grab sampler in the period between February and October in the year 2009. A total of 74 species were identified belonging to 27 families of the classes Gastropoda and Scaphopoda. The most dominant species in the area were *Finella pupoides* Adams A., 1860 (43% in spring) and *Bittium reticulatum* (Da Costa, 1778) (43% in fall, 48% in winter, 28% in summer). Besides, *F. pupoides* was with the highest frequency index values in the seasons. Of the identified taxa, 12 species were found to be with alien origin.

Keywords: Gastropoda, Scaphopoda, Mollusca, Sugözü, İskenderun Bay, Temporal variation

Introduction

Sugözü coast is located in the north-western region of İskenderun Bay which has been exposed to alien species invasion due to its proximity to the Suez Canal and intense maritime shipping traffic. In the area is also located one of the largest imported coal power plant of Turkey. Therefore, the intense coal transportation by ships probably also facilitates the invasion of alien species to the area through the ballast waters.

The preliminary data on alien gastropod species of İskenderun Bay can be encountered in the study by Barash & Danin (1977). Afterwards, many studies have been carried out on the alien species of İskenderun Bay (Kinzelbach, 1985; Enzenross & Enzenross, 1987; Çevik & Öztürk, 2001; Bitlis-Bakır et al., 2012; 2016; Öztürk et al., 2015) along with some other studies including the native molluscs of the area (Houart, 2000; Çevik & Ergüden, 2004).

The study by Bitlis-Bakır et al. (2012) attempt attention as the most comprehensive work on the molluscs of İskenderun Bay in which was listed 424 mollusc species. Besides, Bitlis-Bakır et al. (2016) analyzed the temporal variations during the years 2012, 2013 2014 of mollusks in the northwestern part of İskenderun Bay.

The aims of the present study is to determine the composition of the gastropod and scaphopod species on the soft bottoms in Sugözü coast and analyze the temporal variations.

Material and Methods

Benthic samples were collected at 12 sampling sites in depths from 2 to 19 m during the months February, May, July and October in 2009 by using a van Veen grab (0.1 m²) (Figure 1). The taken material was sieved with a 0.5 mm mesh and fixed in 4% seawater-formalin solution in the field and, in the laboratory, it was sorted to the taxonomic groups under a stereomicroscope and preserved in 70% ethanol. Later on, the mollusc specimens were identified and counted. Some of the ecological features of the sampling sites are given in Table 1.

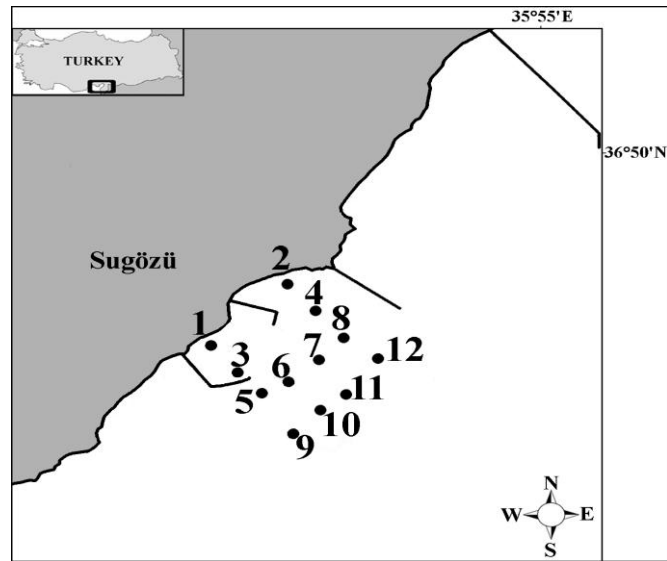


Figure 1. Map of the study area with location of sampling sites.

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

Stations	Coordinates		Biotope	Depth (m)
	Latitude	Longitude		
1	36°49'49.20"N	35°52'57.00"E	Sand	4.5
2	36°50'14.40"N	35°53'31.20"E	Fine sand	3.3
3	36°49'37.80"N	35°53'09.60"E	Mud	7.2
4	36°50'03.00"N	35°53'44.40"E	Muddy sand	6.6
5	36°49'29.40"N	35°53'21.00"E	Muddy sand	9.6
6	36°49'34.20"N	35°53'32.40"E	Muddy sand	10.2
7	36°49'42.60"N	35°53'46.20"E	Muddy sand	11.5
8	36°49'51.60"N	35°53'57.60"E	Muddy sand	11.7
9	36°49'13.20"N	35°53'35.40"E	Mud	18
10	36°49'22.20"N	35°53'47.40"E	Mud	19
11	36°49'28.20"N	35°53'59.40"E	Mud	18.5
12	36°49'43.20"N	35°54'13.20"E	Mud	18.5

In order to analyze the community structure, Bellan Santini's (1969) dominance index (D), Soyer's (1970) frequency index (F), Shannon-Weaver's (1949) diversity index (\log_2 base) (H'), Pielou's (1975) evenness index (J') were calculated for each sampling site in four seasons (winter, spring, summer, autumn). The systematic classification are given according to WoRMS (World Register of Marine Species, August, 2019).

The identified species have been deposited at ESFM (Museum of Faculty of Fisheries, Ege University, İzmir, Turkey).

Results

As a result of the faunistic analysis of sampled material, a total of 74 mollusc species belonging to 27 families and 2 classes (Gastropoda and Scaphopoda) were revealed. The class Gastropoda was represented by 71 species and Scaphopoda by 3 species. Among the identified taxa, 40 species were determined in the benthic samples taken in summer, 38 species in autumn, 29 species in spring and 22 species in winter (Table 2). In the present study, the most abundant species were *Finella pupoides* Adams A., 1860 (43%) in spring and *Bittium reticulatum* (Da Costa, 1778) in three seasons (43% in autumn, 48% in winter and 28% in summer).

According to the frequency index values, *F. pupoides* and *B. reticulatum* were found to have constant distribution in the region during autumn (58%, 75%), winter (50%, 58%) and summer (67%,



83%), although in spring season *F. pupoides* and *Cerithidium diplax* (Watson, 1886) were with the highest frequency values (67%) (Table 2).

Table 2. The number of species (S), the number of specimens (N), frequent and dominant species according to seasons.

Seasons	S	N (birey/m ²)	Frequency index values (%)	Dominance (%)
Autumn	3	12600	<i>C. scabridum</i> (50%), <i>S. brachystoma</i> (50%), <i>F. pupoides</i> (58%), <i>C. diplax</i> (58%), <i>B. reticulata</i> (75%), <i>T. pygmaea</i> (75%)	<i>B. reticulatum</i> (43%)
Winter	2	6820	<i>C. diplax</i> (42%), <i>F. pupoides</i> (50%), <i>T. pygmaea</i> (50%), <i>B. reticulatum</i> (58%)	<i>B. reticulatum</i> (47.8%)
Spring	2	5840	<i>F. pupoides</i> (67%), <i>C. diplax</i> (67%)	<i>F. pupoides</i> (42.6%)
Summer	4	5730	<i>F. pupoides</i> (67%), <i>B. reticulatum</i> (83%)	<i>B. reticulatum</i> (28.1%)

Seasonal variations in the number of species and specimens, diversity and evenness indices at all stations are presented in Table 3. The number of species was generally high at station 1 in spring (13 species), in autumn (16 species) and winter (10 species) except for summer season. The largest number of species was determined at station 6 (28 species) and station 7 (13 species) in summer, respectively. The highest number of specimens was encountered at station 1 (2540 spc.m⁻²) in spring, at station 7 (2300 spc.m⁻²) in summer, at station 4 (3810 spc.m⁻²) in autumn and at station 2 (3950 spc.m⁻²) in winter (Table 3).

Table 3. Temporal variation in community parameters at the sampling sites in seasons.

Station	Number of species				Number of specimens (specimens/m ²)			
	Sp	Su	A	W	Sp	Su	A	W
1	13	4	16	10	2540	40	1920	1520
2	3	11	10	10	70	800	700	3950
3	6	0	1	3	520	0	10	50
4	2	9	21	6	40	480	3810	270
5	12	10	13	2	1980	410	3020	40
6	9	28	9	4	210	1430	1490	60
7	6	13	8	11	180	2300	930	770
8	5	4	9	4	90	70	640	70
9	1	2	3	1	10	20	40	20
10	1	1	1	1	30	10	10	50
11	6	1	1	0	100	10	30	0
12	2	4	0	2	70	160	0	20
Station	Evenness index				Diversity index			
	Sp	Su	A	W	Sp	Su	A	W
1	0,4	1,0	0,6	0,7	1,5	2,0	2,3	2,3
2	0,7	0,5	0,7	0,5	1,1	1,7	2,3	1,6
3	0,6	0,0	0,0	1,0	1,4	0,0	0,0	1,5
4	0,8	0,7	0,5	0,6	0,8	2,3	2,4	1,7
5	0,5	0,8	0,5	0,8	1,8	2,6	1,9	0,8
6	0,9	0,8	0,6	1,0	2,9	3,9	1,8	1,9
7	0,9	0,6	0,7	0,6	2,3	2,2	2,2	2,1
8	0,9	0,9	0,7	0,9	2,2	1,8	2,2	1,8
9	0,0	1,0	0,9	0,0	0,0	1,0	1,5	0,0
10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
11	0,9	0,0	0,0	0,0	2,4	0,0	0,0	0,0
12	1,0	0,7	0,0	1,0	1,0	1,4	0,0	1,0



As for the evenness index values at stations, the highest value ($J' = 1$) was found at station 12 in spring, at stations 1 and 9 in summer, at stations 6 and 12 in winter and at station 9 ($J' = 0.9$) in autumn. The highest diversity index values ($H' = 2.9$ and 3.9) were calculated at station 6 in spring and in summer, respectively. Whereas, the largest diversity values were determined in different stations in autumn (station 4, $H' = 2.4$) and in winter (station 1, $H' = 2.3$) (Table 3).

Of the identified species, 12 species were with alien origin and their number was changed between 7 and 9 according to seasons (9 species in winter and summer and 7 species in autumn).

Discussion

A total of 74 mollusc species belonging to 27 families were determined in the present study of which the class Gastropoda was represented by the majority of species and families (25 families and 71 species) followed by Scaphopoda with 2 families and 3 species only. The gastropods *Tritia pygmaea* (Lamarck, 1822) was with wide distribution along Sugözü coast in autumn and winter seasons. It is known as a species forming dense populations in the polluted areas (Çınar et al., 2006; 2012, Moreira et al., 2010).

The results of the present study can be compared with the studies carried out previously along the coasts of İskenderun Bay by Bitlis et al. (2016) and Mersin Bay by Çınar et al. (2012). Bitlis et al. (2016) encountered 94 species belonging to the class Gastropoda and 2 species belonging to Scaphopoda in the summer season of 2012, 2013 and 2014 near Botaş Oil Filling Facility in İskenderun bay. *B. reticulatum* and *F. pupoides* were similarly found as the abundant species in studies carried out by Bitlis et al. (2016) and Çınar et al. (2012). Furthermore, *B. reticulatum*, *F. pupoides* and *C. diplax* were widely distributed in the region (Bitlis et al. 2016).

The majority of the alien species determined in the present study (9 species) were lessepsian migrant entered the Mediterranean Sea through the Suez Canal and the other ones (*C. diplax*, *Cerithidium perparvulum* (Watson, 1886), *Conomurex persicus* (Swainson, 1821) are known to be introduced by shipping traffic (Çınar et al., 2011).

It is a known fact that *C. diplax* and *F. pupoides* are alien species which can affect the mollusc composition in the distribution area (Bitlis et al. 2016 and Çınar et al. 2012), and in the present study they were found to be widely distributed in İskenderun Bay.

The number of species was the highest in the summer season. It was decreased during autumn and was the lowest one through the winter season, although the number of specimens was high during autumn and winter. The fact may be due to the increase of abundance of *B. reticulatum*, *C. diplax* and *F. pupoides*. The temporal variations were similar to the findings noted by Çınar et al. (2012), where was stated that the abundance of alien species was high through autumn and winter seasons.

The present study showed that İskenderun Bay is exposed to intensive settlements of alien gastropods, and the benthic communities may have spatial and temporal variations, which should be investigated in further studies.

Acknowledgements

The authors thank to the colleagues of the Department of Marine Biology, Fisheries Faculty, Ege University for their help in collecting and sorting the benthic material. This study was supported by the “Marine ecology monitoring project of Sugözü power plant impact area”

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