

# Decapod Crustaceans in the Marmara Island (Marmara Sea) and Ecological Characteristics of Their Habitats

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**Please cite this article as:** Ayfer B, Balkis H, Mulayim A. Decapod Crustaceans in the Marmara Island (Marmara Sea) and Ecological Characteristics of Their Habitats. Eur J Biol 2017; 76(1): 20-5.

## ABSTRACT

We have performed series of analyses to identify decapod crustaceans inhabiting the littoral zone of the Marmara Island and to study specific ecological characteristics of the habitat. Samples of decapod crustaceans species were collected from 12 stations (6 onshore, 6 offshore) on May 12-17, 2008 and November 17-22, 2008. A total of 17 species and 1199 specimens of decapod crustaceans were recorded. Eight species (*A. lacazei*, *N. norvegicus*, *P. bluteli*, *P. longimana*, *P. platycheles*, *D. pugilator*, *D. personata* and *L. vernalis*) have been reported in the littoral zone of Marmara Island for the first time in this study. Also our study also sheds light on some ecological properties (temperature, salinity, dissolved oxygen) of the habitats of the species from the littoral zone of the Marmara Island.

**Keywords:** Ecology, decapoda, crustacea, Marmara Island, The Sea of Marmara

## INTRODUCTION

The Archipelago in the Sea of Marmara consisting of small and large islands located southwest of the Sea of Marmara and the northwest of the Kapıdağ Peninsula are referred to as the Islands of Marmara. With an area of 120 km<sup>2</sup>, the Marmara Island is the largest of these islands in the Sea of Marmara. The Marmara Island extends to 18 km in the east-west direction and has coastline of 10 km in the north-south. Deep-water pink shrimp and rock lobster are target species for commercial fishing activities in the area (1).

The Marmara Island has similar water characteristics to the Sea of Marmara; the upper water layer is the Black Sea and the lower water layer is the Mediterranean Sea. The Black Sea water (low salinity: 18) and the Mediterranean water (high salinity: 38) do not mix with each other due to different densities of salinity, but form a salinity intermediate water (halocline) at 25 m depth of the Sea of Marmara (2).

There is a rich body of literature on the biodiversity of the Sea of Marmara. However, the number of studies conducted on the Marmara Island is relatively small.

The first study at the island was carried out by Ostroumoff (3,4) followed by studies by Okuş (5), Yüksek (6) and Balkis (7).

## MATERIALS AND METHODS

### Sample Collection

Samplings were performed at the coastal waters of the Marmara Island in May and November months of 2008 year. Specimens of decapod crustaceans were captured from 12 sites at the depths between 0 and 60 m. The sampling stations are shown in Figure 1. Samples were hand-picked or collected using a hand-held scoop while the offshore samples were collected using a beam trawl with a mesh size of 18 mm. The samples were preserved in 5% formalin and species were stored in 70% ethanol.

### Sample Identification

Specimens of decapoda were identified using the criteria as previously described by Bouvier (8), Zariquiey Alvarez (9,10), Demir (11), Holthuis (12-15), Geldiay and Kocatas (16,17), Ingle (18,19) and Balkis (20). The names of the species were updated according to WORMS (21).



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Received: 05.05.2017

Accepted: 28.05.2017

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### Measurements and Analysis

During the study, sea water variables such as temperature, were measured in situ. The temperature was measured using the thermometer on the sampling flask. The salinity was measured using silver nitrate titration using the Mohr-Knudsen method (22). The amount of dissolved oxygen was measured using a sodium thiosulfate titration according to the Winkler method (23).

Soyer's (24) Frequency index (Fs) was used to determine the frequency of the decapod species in the coastal zones of the study field. The results were analysed in three groups according to calculated Fs values as 'constant' ( $F_s \geq 50\%$ ), 'common' ( $50\% > F_s \geq 25\%$ ) and 'rare' ( $F_s < 25\%$ ). The Dominance Index Formula was used to determine the dominance of the decapod species in the coastal zones of the study field (25).

Bray-Curtis similarity index and (MDS) analyses were performed in the Primer v6 program to determine the similarity between

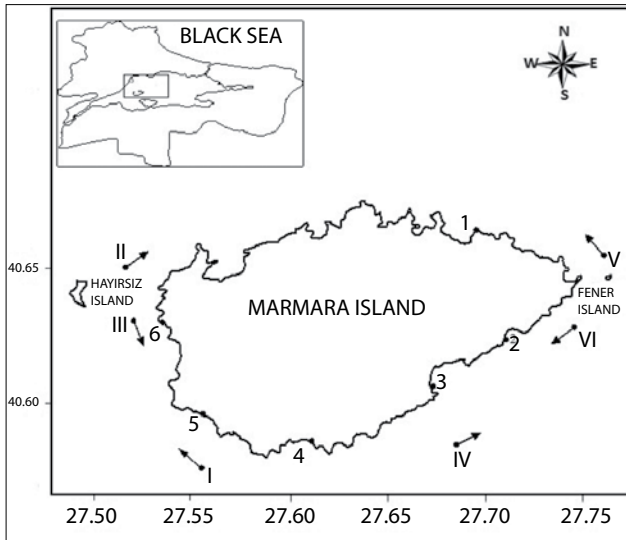


Figure 1. Map showing the sampling sites

the sampled stations (26). For these analyses, firstly,  $\log(x+1)$  conversion was applied on raw information. Using the composition of the number of species and the number of individuals at the sampling stations Shannon-Weaver Diversity Index ( $H'$ ) was performed.

### RESULTS

#### Environmental Variables

The ecological variable such as temperature ( $^{\circ}\text{C}$ ), salinity ( $\text{‰}$ ) and dissolved oxygen ( $\text{mg L}^{-1}$ ) at the sampling stations in the littoral zone of the Marmara Island were presented in Table 1.

The temperature varied between  $14.3^{\circ}\text{C}$  and  $18.0^{\circ}\text{C}$  in the two sampling periods. The temperature lowered with depth. The salinity values ranged from  $21.2\text{‰}$  to  $35.7\text{‰}$ . As a natural feature of the two-layered water system of the Sea of Marmara, the salinity increased with depth. The highest dissolved oxygen value ( $12.98 \text{ mg l}^{-1}$ ) was obtained in May from station 2 and the lowest value ( $5.65 \text{ mg l}^{-1}$ ) was obtained in May from station V at the depth of 50 m.

#### Faunistic Data

A total of 17 species of decapod crustaceans were reported (Table 2). Table 2 shows 10 species out of 17 species found from the onshore sampling while 7 from the offshore sampling studies. Pink shrimp *Parapenaeus longirostris*, Majid crab *Maja squinado* and Portunid crab *Liocarcinus depurator* observed from the offshore were found at the depths of 40, 50 and 60 m, respectively. Pandalid shrimp *Plesionika heterocarpus*, Crangonid shrimp *Aegaeon lacazei* and Norway lobster *Nephrops norvegicus* were reported only at the depth of 60 m, and brachyuran crab *Dromia personata* at the depth of 40 m. No common species was detected both from the shore and the deep water.

A total of 10 species were obtained during the onshore sampling (Table 3). While the highest number of species was observed with 6 species at site 5 in May, the lowest value (2 species) was recorded at site 4. In November, the highest number

**Table 1.** Coordinates of sampling stations on the Marmara Island and physicochemical data of seawater

Station	Depth (m)	SPRING			AUTUMN		
		Temperature ( $^{\circ}\text{C}$ )	Salinity ( $\text{‰}$ )	Dissolved Oxygen ( $\text{mg.l}^{-1}$ )	Temperature ( $^{\circ}\text{C}$ )	Salinity ( $\text{‰}$ )	Dissolved Oxygen ( $\text{mg.l}^{-1}$ )
1	0.5	18.0	21.3	11.54	15.0	24.2	10.43
2	0.5	17.5	21.7	12.98	15.0	23.9	9.26
3	0.5	17.5	21.2	10.63	14.9	23.7	9.44
4	0.5	17.0	21.8	11.73	15.0	23.7	9.13
5	0.5	17.0	21.3	11.89	15.1	24.4	9.97
6	0.5	17.0	21.9	10.11	14.9	23.4	8.92
I	50	14.5	35.3	6.97	16.9	35.7	10.18
II	60	14.5	35.1	6.22	16.0	34.8	9.27
III	40	14.5	35.6	6.28	16.2	35.1	8.25
IV	60	14.3	35.0	6.26	-	-	-
V	50	15.0	34.4	5.65	-	-	-
VI	40	14.8	33.8	6.75	-	-	-

**Table 2.** Species collected in the littoral zone of Marmara Island

	Depths (m)			
	0-1	40	50	60
<b>Order DECAPODA</b>				
<b>Suborder DENDROBRANCHIATA</b>				
<i>Parapenaeus longirostris</i> (Lucas, 1946)		+	+	+
<b>Suborder PLEOCYEMATA</b>				
<b>Infraorder CARIDEA</b>				
<i>Aegaeon lacazei</i> (Gourret, 1887)				+
<i>Palaemon elegans</i> Rathke, 1837		+		
<i>Plesionika heterocarpus</i> (A. Costa, 1871)				+
<b>Infraorder ASTACIDEA</b>				
<i>Nephrops norvegicus</i> (Linnaeus, 1758)				+
<b>Infraorder ANOMURA</b>				
<i>Clibanarius erythropus</i> (Latreille, 1818)		+		
<i>Diogenes pugilator</i> (Roux, 1829)		+		
<i>Pisidia bluteli</i> (Risso, 1816)		+		
<i>Pisidia longimana</i> (Risso, 1816)		+		
<i>Porcellana platycheles</i> (Pennant, 1777)		+		
<b>Infraorder BRACHYURA</b>				
<i>Carcinus aestuarii</i> Nardo, 1847		+		
<i>Dromia personata</i> (Linnaeus, 1758)			+	
<i>Liocarcinus depurator</i> (Linnaeus, 1758)		+	+	+
<i>Liocarcinus vernalis</i> (Risso, 1827)		+		
<i>Maja squinado</i> (Herbst, 1788)		+	+	+
<i>Pilumnus hirtellus</i> (Linnaeus, 1761)		+		
<i>Xantho poressa</i> (Olivi, 1792)		+		

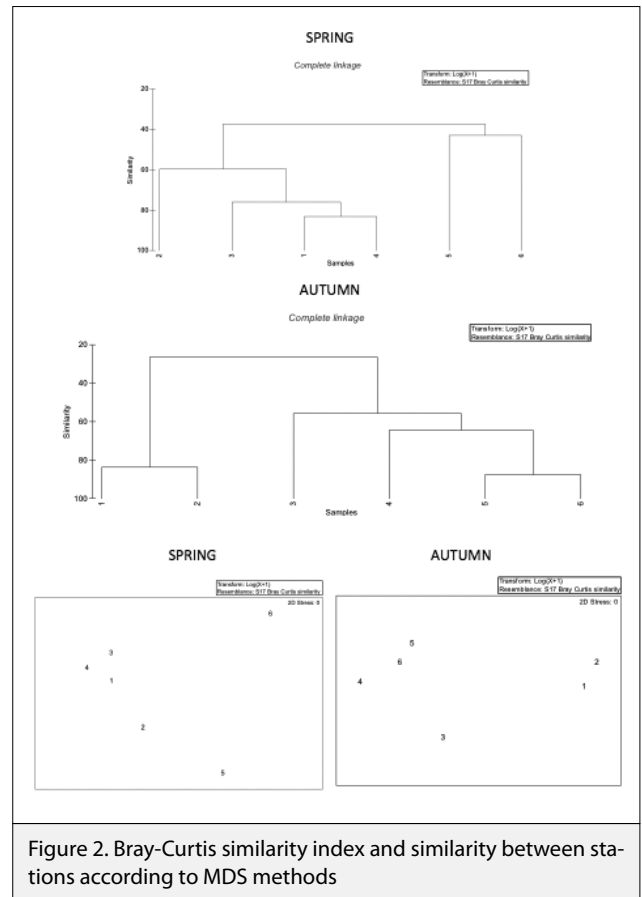


Figure 2. Bray-Curtis similarity index and similarity between stations according to MDS methods

of species (6) was found at station 4 and the lowest (2 species) at station 1. Among these species found during offshore samplings, only brachyuran crab *X. poressa* is constant species in both seasons. The common species in spring are Paguroid *D. pugilator*, Portunid crab *C. aestuarii*, Anomuran *P. bluteli*, and Paguroid *C. erythropus*. In autumn, *P. bluteli* and *Pisidia longimana* are constant species while *C. erythropus*, *C. aestuarii* and *P. hirtellus* are common species. Dominance index values show that, *D. pugilator* and *X. poressa* are dominant species in spring and in autumn, respectively.

A total of 7 decapod crustaceans were found at the offshore sampling stations (Table 4). In May and November, the highest number of species (4) was found at station II while the lowest (2) at station I. Out of these 7 species, *A. lacazei* was caught only in November while *N. norvegicus* and *D. personata* were found only in May. No samples could be collected at stations IV, V and VI in November. The general distribution of the species indicates that *P. longirostris* (429 individuals) and *L. depurator* (362 individuals) were collected from all the offshore sampling stations both in May and November.

(*H'*) values for grab samples collected from Marmara a Island are presented in Table 5. When (*H'*) values of the studied sites were analyzed, site 4 in autumn was found to have the highest *H'* value.

The similarities between the stations were evaluated according to the distributions of the species obtained from the onshore sampling stations.

The results of the Bray-Curtis similarity index and MDS methods applied at the onshore sampling stations in the spring and autumn are shown in Figure 2.

Figure 2 shows that there is a similarity between stations 1, 4 and 3 in the spring, while there is a similarity between stations 1 and 2, and between stations 5 and 6 in the autumn.

## DISCUSSION

The zoogeographical characteristics of the species were presented according to d'Udekem d'Acoz (27) and in compliance with Štević (28). Accordingly 12 species reported here (*P. longirostris*, *P. heterocarpus*, *N. norvegicus*, *P. longimana*, *P. platycheles*, *C. erythropus*, *D. personata*, *C. aestuarii*, *L. depurator*, *L. vernalis*, *X. poressa* and *P. hirtellus*) are Atlanto-Mediterranean originated, therefore, 3 species (*P. elegans*, *A. lacazei* and *D. pugilator*) are Cosmopolitan and the remaining two (*P. bluteli* and *M. squinado*) are Mediterranean Endemic.

Previous studies on the Turkish Strait System' decapods have examined the first records provided by Forskål (29) showing the presence of 2 crab species in Istanbul [*Nepinnotheres*

**Table 3.** Decapod crustacean species collected onshore, numbers of individuals, Frequency (f %) and dominance (Di)

Species	Shore Stations														f%	Di %
	Spring						Autumn									
	1	2	3	4	5	6	1	2	3	4	5	6				
<i>Palaemon elegans</i>								1							16.6	0.89
<i>Pisidia bluteli</i>					2	2	33.3	1.4		1	8	3	2	66.7	12.5	
<i>Pisidia longimana</i>							0	0	2	1	4		3	66.7	8.93	
<i>Porcellana platycheles</i>						1	16.6	0.3			8			16.6	7.14	
<i>Clibanarius erythropus</i>			2		35		33.3	13.1			3	5		33.3	7.14	
<i>Diogenes pugilator</i>	51	4	20	74	4		83.3	54.26						0	0	
<i>Carcinus aestuarii</i>	2	3			5		50	3.5	6	2				33.3	7.14	
<i>Liocarcinus vernalis</i>					1		16.6	0.3						0	0	
<i>Xantho poressa</i>	17	5	11	6	27	10	100	26.95	7	5	8	13	10	18	100	54.46
<i>Pilumnus hirtellus</i>								0			1	1		33.3	1.79	

**Table 4.** List of decapod crustaceans collected using beam trawls

Species	Beam Trawl Stations											
	Spring						Autumn					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
<i>Parapenaeus longirostris</i>	21	74	49	71	28	54	33	61	37	-	-	-
<i>Plesionika heterocarpus</i>	1			1			2					
<i>Aegaeon lacazei</i>								1				
<i>Nephrops norvegicus</i>		1										
<i>Maja squinado</i>			2		1				1			
<i>Dromia personata</i>						1						
<i>Liocarcinus depurator</i>	19	3	16	47	3	101	57	65	51			

**Table 5.** Shannon-Weaver Diversity Index ( $H'$ ) values of the grab stations

Stations	$H'$ Values	
	Spring	Autumn
1	0.2318	0.9957
2	1.555	1.761
3	1.2111	1.278
4	0.3843	2.267
5	1.757	1.415
6	0.9913	0.9665

*pinnotheres* (Linnaeus 1758); *Eriphia verrucosa* (Forskål 1775)]. Then Bakır et al. (30) reported 144 and Balkis et al. (31) reported a total of 140 decapod crustaceans from the area.

Researchers who previously studied on the Marmara Island and the species they identified are shown in Table 6.

Ostroumoff (3,4) reported 14 species of decapod crustaceans in the littoral zone of the Marmara Island. Presence of the *Liocarcinus holsatus* is not very clear in this study so we accept the presence of 13 species as reported in the study. Okuş (5) reported the presence of 25 decapod Crustacea species in the littoral zone of the Marmara Island. However, 2 of these species were reported only at the level of genus and *Liocarcinus depurator* was specified twice in the study as *Macropipus depurator* and *Liocarcinus depurator*. Therefore, Okuş (5) reported 22 decapod

species. Yüksek (6) reported the presence of 20 decapod species from the southern coasts of the Marmara Island. However, having reported 7 species only at the level of genus, she reported 13 decapod Crustacea species. Balkis (7) carried out a study on the macrobenthos of the Marmara Island and reported 9 decapod species. Xantonid crab *Xantho incicus* and Caridean shrimp *Hippolyte longirostris* species reported by Balkis were not found in the Sea of Marmara in previous studies. Therefore, presence of these species is not validated. Current literature indicates there are a total of 36 decapod crustaceans present in the littoral of the Marmara Island to the date.

The similarity percentage of the stations are so different in the spring and autumn as indicated by their similarity percentages. Many environmental factors, such as temperature and food, control zoogeographical distribution of decapod crustaceans (33). Algal vegetation increases in the spring and *D.pugilator* and *X. poressa* species are abundant living in algae to protect and feed themselves. Specimens hidden under the stone are more common in the autumn with limited vegetation.

Because samples obtained from the offshore sampling stations were collected using two beam trawls, the dominance, frequency and similarity indices were not calculated. The species identified onshore and offshore are completely different from each other which is thought to be due to the significant effect of depth and sediment type on the distribution of decapods (33).

**Table 6.** Crustacean species in Marmara Island

<b>Order DECAPODA</b>	
<b>Suborder DENDROBRANCHIATA</b>	
<i>Parapenaeus longirostris</i> (Lucas, 1846)	6, This study
<i>Penaeus kerathurus</i> (Forskål, 1775)	7
<b>Suborder PLEOCYEMATA</b>	
<b>Infraorder CARIDEA</b>	
<i>Aegaeon lacazei</i> (Gourret, 1887)	This study
<i>Alpheus glaber</i> (Olivier, 1792)	5
<i>Athanas nitescens</i> (Leach, 1813)	5, 7
<i>Crangon crangon</i> (Linnaeus, 1758)	5
<i>Hippolyte holthuisi</i> Zariquiey Álvarez, 1953	5
<i>Palaemon adspersus</i> Rathke, 1837	5
<i>Palaemon elegans</i> Rathke, 1837	32, 5, 6, This study
<i>Pandalina brevirostris</i> (Rathke, 1843)	5, 7
<i>Plesionika heterocarpus</i> (A. Costa, 1871)	32, This study
<i>Processa canaliculata</i> Leach, 1815	5, 6
<i>Processa edulis edulis</i> (Risso, 1816)	32
<i>Typton spongicola</i> O.G. Costa, 1844	32
<b>Infraorder ASTACIDEA</b>	
<i>Homarus gammarus</i> (Linnaeus, 1758)	7
<i>Nephrops norvegicus</i> (Linnaeus, 1758)	This study
<b>Infraorder ANOMURA</b>	
<i>Clibanarius erythropus</i> (Latreille, 1818)	5, This study
<i>Diogenes pugilator</i> (Roux, 1829)	This study
<i>Galathea nexa</i> Embleton, 1834	32
<i>Galathea squamifera</i> Leach, 1814	5
<i>Munida rugosa</i> (Fabricius, 1775)	32
<i>Pagurus cuanensis</i> Bell, 1846	32
<i>Pisidia bluteli</i> (Risso, 1816)	This study
<i>Pisidia longicornis</i> (Linnaeus, 1767)	5, 6
<i>Pisidia longimana</i> (Risso, 1816)	This study
<i>Porcellana platycheles</i> (Pennant, 1777)	This study
<b>Infraorder BRACHYURA</b>	
<i>Carcinus aestuarii</i> Nardo, 1847	5, 6, 7, This study
<i>Dromia personata</i> (Linnaeus, 1758)	This study
<i>Ebalia cranchii</i> Leach, 1817	32
<i>Eriphia verrucosa</i> (Forskål, 1775)	5
<i>Eurynome aspera</i> (Pennant, 1777)	32, 5
<i>Inachus leptochirus</i> Leach, 1817	32
<i>Inachus thoracicus</i> Roux, 1830	6
<i>Liocarcinus depurator</i> (Linnaeus, 1758)	32, 5, 6, 7, This study
<i>Liocarcinus navigator</i> (Herbst, 1794)	5, 6, 7
<i>Liocarcinus vernalis</i> (Risso, 1827)	This study
<i>Macropodia longirostris</i> (Fabricius, 1775)	5, 6
<i>Macropodia rostrata</i> (Linnaeus, 1761)	5, 6
<i>Maja crispata</i> Maja crispata Risso, 1827	5
<i>Maja squinado</i> (Herbst, 1788)	5, 6, This study
<i>Monodaeus couchii</i> (Couch, 1851)	32
<i>Pilumnus hirtellus</i> (Linnaeus, 1761)	5, 6, This study
<i>Pisa tetraodon</i> (Pennant, 1777)	32
<i>Xantho poressa</i> (Olivier, 1792)	5, 6 This study

Nine of the species (*P. longirostris*; *P. elegans*, *P. heterocarpus*, *C. erythropus*, *M. squinado*, *C. aestuarii*, *L. depurator*, *X. poressa* and *P. hirtellus*) in this study have been reported before while the remaining 8 species (*A. lacazei*, *N. norvegicus*, *P. bluteli*, *P. longimana*, *P. platycheles*, *D. pugilator*, *D. personata* and *L. vernalis*) have been reported in the littoral zone of Marmara Island for the first time in this study. Including these species, the number of decapod Crustacea species found in the littoral zone of Marmara Island has increased to 44.

This study was conducted in spring and autumn and hence 8 more species have been added to the decapod crustaceans reported to be living in the littoral zone of Marmara Island. In addition, some ecological factors of the habitats of these species have been revealed. This study will also contribute to the further systematic and ecological studies on decapod crustaceans in the region.

#### Acknowledgements

This study was supported by (the Research Fund of Istanbul University (project number: 1389).

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