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Demersal cephalopods from the Sea of Marmara with remarks on some ecological characteristics

İsmail ÜNSAL[1], Nuran ÜNSAL[2], M. Hakan ERK and Hakan KABASAKAL[2,*]

[1]University of Istanbul, Faculty of Science, Dept. of Hydrobiology, Vezneciler 34 459 Istanbul, Turkey [1]

[2] University of Istanbul, Faculty of Fisheries, Dept. of Marine Biology, Ordu caddesi, No: 200, Laleli 34 470 Istanbul, Turkey

**Author for correspondence*

Eight species of demersal cephalopods were collected by means of otter-trawl, beam-trawl and dredge from the Sea of Marmara between 1990 and 1996. These included Sepia elegans, Sepia orbignyana, Rondeletiola minor, Sepietta oweniana, Alloteuthis media, Loligo vulgaris, Eledone cirrhosa *and* Eledone cf. moschata. *While* Sepietta oweniana *and* Loligo vulgaris *were recorded in the waters where the salinity is always over* $25x10^{-3}$, *the remaining species were also found in brackish water.*

Key words: Cephalopods, Sea of Marmara

INTRODUCTION

The Sea of Marmara is a unique intercontinental sea. It is affected by the hydrographic and biological characteristics of both the Black Sea and the Aegean Sea. Due to the inflows from these seas, two water masses occur in the Sea of Marmara. The salinity of the surface layer is closely related to the Black Sea inflow, and ranges from $17.8x10^{-3}$ in the northern part of the Bosphorus to $29.6x10^{-3}$ in the southern part of the Dardanelles (SAYDAM, 1989; ÜNSAL & ÜNSAL, 1994). The salinity of the water masses deeper than 50 m is $38.38\pm 0.17x10^{-3}$ and related is due to the Mediterranean inflow (ÜNSAL & ÜNSAL, 1994). The surface water layer of the Sea of Marmara is thus characterized by a brackish water mass.

Due to it's geographical location, the Sea of Marmara is strongly affected by heavy marine pollution. The dissolved oxygen content of the surface layer ranges from 6.2 to 8.0 mg l^{-1}. At a depth of 15 m, the dissolved oxygen content decreased to 5 mg l^{-1} which is the limiting

value for ecological stability. The dissolved oxygen content of the water is about 2 mg l^{-1} below the depth of 15 m (ARTÜZ & BAYKUT, 1986). It is evident that the dissolved oxygen of seawater is an important limiting factor for marine life in the depths of the Sea of Marmara.

The temparature of the surface water layer ranges from 6 °C (in winter) to 24 °C (in summer). The depth of the thermocline in the Sea of Marmara is controlled by winter conditions. The thermocline never exceeds a depth of 75 m, and the temperature of the water mass below the thermocline ranges from 14.5 to 15.0 °C, i. e. it is fairly constant throughout the year.

In summary, the ecological characteristics of the Sea of Marmara are unique, therefore, systematic and ecological surveys on the fauna of this sea are from the great importance.

Very few studies have been carried out on the cephalopod fauna of the Sea of Marmara (OSTROUMOFF, 1896; DEGNER, 1925; DIGBY, 1949; DEMIR, 1952; KATAGAN *et al.*, 1993). Cephalopods are typically marine animals. Cephalopods found in the Turkish territorial waters of the Aegean Sea have been previously investigated by KATAGAN & KOCATAŞ (1990) and by SALMAN (1995).

The aim of this study is to determine the species composition, ecological characteristics and biogeographical distribution of the cephalopods under the extreme conditions of the Sea of Marmara.

MATERIAL AND METHODS

Samples were collected on the sea bottom at depths between 10 and 350 m by means of otter-trawl, beam-trawl and dredge between 1990 and 1996. A total of 251 hauls were taken of which 22 contained cephalopods. The samples were fixed and preserved in 5 % formaldehyde in seawater. Environmental data, such as temperature, salinity, type of the sea bottom and the depth of each station were also recorded. Mantle length (ML) and total length (TL) of the largest individual of each species were given. Taxonomic nomenclature follows MANGOLD & BOLETZKY (1987) and BELLO (1995).

RESULTS

Observed species

Demersal cephalopods were found in the Sea of Marmara at the following locations and depths:

SEPIOIDEA

SEPIIDAE

1. *Sepia elegans* BLAINVILLE, 1827

Material obtained at:

40° 26' 45" N-27° 36' 42" E, depth: 41 m;
40° 20' 42" N-27° 36' 00" E, depth: 29 m;
40° 31' 02" N-28° 00' 44" E, depth: 46 m;
40° 35' 35" N-28° 53' 42" E, depth: 82 m;
40° 20' 42" N-27° 36' 00" E, depth: 29 m;
40° 21' 51" N-27° 26' 13" E, depth: 27 m.

Thirteen males and 8 females were obtained (ML=49 mm, TL=128 mm).

2. *Sepia orbignyana* FÉRUSSAC, 1826

Material obtained at:

40° 36' 10" N-27° 06' 32" E, depth: 31m;
40° 26' 33" N-27° 36' 40" E, depth: 42 m;
40° 39' 18" N- 27° 16' 54" E, depth: 58 m;
40° 26' 33" N-27° 36' 40" E, depth: 42 m:
40° 39' 48" N-29° 11' 22" E, depth: 20 m;
40° 21' 18" N-27° 36' 55" E, depth: 32 m.

Five females were obtained (ML=77 mm, TL=205 mm).

SEPIOLIOIDEA

SEPIOLIDAE

3. *Rondeletiola minor* (NAEF, 1912)

Material obtained at:

40° 43' 00" N-27° 22' 15" E, depth: 63 m;
41° 00' 48" N-28° 28' 15" E, depth: 17 m;
40° 36' 00" N-27° 44' 42" E, depth: 63 m.

Three females were obtained (ML=26 mm, TL=87 mm).

4. *Sepietta oweniana* (d'ORBIGNY, 1841)

Material obtained at:

40° 37' 12" N-27° 30' 18" E, depth: 62 m.

Two females were obtained (ML=31 mm, TL=85 mm).

TEUTHOIDEA
MYOPSIDA
LOLIGINIDAE

5. *Alloteuthis media* LINNAEUS, 1758

Material obtained at:

40° 26' 33" N-27° 36' 40" E, depth: 42 m;
40° 28' 24" N-27° 14' 12" E, depth: 55 m;
40° 33' 36" N-27° 41' 04" E, depth: 65 m;
40° 20' 48" N-27° 36' 45" E, depth: 33 m.

Seven males and 2 females were obtained (ML=92, TL=180).

6. *Loligo vulgaris* LAMARCK, 1798

Material obtained at:

40° 57' 00" N-28° 16' 15" E, depth: 350 m.

One male was obtained (ML=175 mm, TL=365 mm).

OCTOPODA
INCIRRATA
OCTOPODIDAE

7. *Eledone cirrhosa* (LAMARCK, 1798)

Material obtained at:

40° 20' 42" N-27° 36' 00" E, depth: 29 m;
40° 21' 51" N-27° 26' 13" E, depth: 27 m;
40° 36' 07" N-27° 45' 30" E, depth: 62 m.

Five males and 4 females were obtained (ML=70 mm, TL=334 mm).

8. Sp. *Eledone* cf. *moschata* (LAMARCK, 1799)

Material obtained at:

40° 21' 51" N-27° 26' 13" E, depth: 27 m;
40° 26' 33" N-27° 36' 39" E, depth: 42 m;
40° 21' 18" N-27° 36' 55" E, depth: 32 m.

One male was obtained (ML=78 mm, TL=320 mm).

Distribution of the cephalopods with salinity, type of the sea bottom and depth is given in Tables 1. and 2.

Table 1. Distribution of the cephalopods with salinity and type of bottom:
Sa: Sand; Gr: Gravel; Mu: Mud; Sg: Sea grass; Al+ Sh: Algae + shell detritus

SPECIES	SALINITY ($Sx10^{-3}$)		TYPE OF BOTTOM				
	18-25	25-38	Sa	Gr	Mu	Sg	Al+Sh
Sepia elegans BLAINVILLE, 1827	+	+	+		+		
Sepia orbignyana FERUSSAC, 1826	+	+			+		
Rondeletiola minor NAEF, 1912	+	+			+		+
Sepietta oweniana (PFEFFER, 1908)		+			+		
Alloteuthis media (LINNAEUS, 1758)	+	+			+		
Loligo vulgaris LAMARCK, 1798		+			+		
Eledone cirrhosa (LAMARCK, 1798)	+				+		+
Eledone cf. *moschata* (LAMARCK, 1799)	+	+	+		+		

Table 2. Distribution of the cephalopods in accordance with depth

SPECIES	DEPTH	
	< 50 m	> 50 m
Sepia elegans BLAINVILLE, 1827	+	+
Sepia orbignyana FERUSSAC, 1826	+	+
Rondeletiola minor NAEF, 1912	+	+
Sepietta oweniana (PFEFFER, 1908)		+
Alloteuthis media (LINNAEUS, 1758)	+	+
Loligo vulgaris LAMARCK, 1798		+
Eledone cirrhosa (LAMARCK, 1798)	+	
Eledone cf. *moschata* (LAMARCK, 1799)	+	

DISCUSSION AND CONCLUSIONS

A total of eight species were identified. According to previous studies, There are twenty cephalopod species present in the Sea of Marmara (OSTROUMOFF, 1896; DEGNER, 1925; DIGBY, 1949; DEMIR, 1952; KATAGAN *et al.*, 1993). *Eledone cirrhosa* was recorded again from the Sea of Marmara 101 years after the previous recording of OSTROUMOFF (1896) (Table 3).

Although the cephalopods are typically marine animals, it was determined that *Sepia elegans, S. orbignyana, Rondeletiola minor, Alloteuthis media* and *Eledone cirrhosa* can also exist in a moderate brackish water environment. KATAGAN *et al.* (1993) report that no cephalopods were recorded east of the 28°E longitude in the northern Sea of Marmara. However, on October 20, 1996, a sample of *Loligo vulgaris* was caught by otter-trawl at a depth of 350 m off the coasts of Şarköy (40° 57' 00" N-28° 16' 15" E).

Table 3. Cephalopods recorded in the Sea of Marmara and the results of the present study: (DG) DEGNER (1925); (DE) DEMIR (1952); (DI) DIGBY (1949); (KA) KATAGAN *et al.* (1992); (OS) OSTROUMOFF (1896); (PR) *Results of the present study*

SPECIES	DG	DE	DI	KA	OS	PR
Sepia elegans BLAINVILLE, 1827				+	+	+
Sepia officinalis LINNAEUS, 1758		+				
Sepia orbignyana FERUSSAC, 1826				+		+
Rondeletiola minor NAEF, 1912				+		+
Sepietta neglecta NAEF, 1916			+	+		
Sepietta obscura NAEF, 1916				+	+	
Sepietta oweniana (d'ORBIGNY, 1841)				+	+	+
Sepiola rondeleti STEENSTRUP, 1856		+				
Chiroteuthis veranyi FERUSSAC, 1835	+					
Alloteuthis media (LINNAEUS, 1758)		+	+	+		+
Loligo vulgaris LAMARCK, 1798		+		+		+
Octopoteuthis sicula RÜPPEL, 1848			+			
Illex coindetii (VERANY, 1839)	+			+		
Todarodes sagittatus (LAMARCK, 1798)		+				
Todaropsis eblanae (BALL, 1841)				+		
Rhyncoteuthion sp.	+					
Eledone cirrhosa (LAMARCK, 1798)					+	+
Eledone cf. *moschata* (LAMARCK, 1799)		+	+	+		+
Octopus macropus RISSO, 1826		+				
Octopus vulgaris CUVIER, 1797	+	+				

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Pridneni glavonošci Mramornog mora s naglaskom na neke ekološke karakteristike

İsmal ÜNSAL[1], Nuran ÜNSAL[2], M. Hakan ERK[2] and Hakan KABASAKAL[2,*]

[1]*Sveučilište u Istanbulu, Fakultet znanosti, Odjel hidrobiologije, Vezneciler 34 459 Istanbul, Turska*

[2]*Sveučilište u Istanbulu, Fakultet ribarstva, Odjel biologije mora, Ordu caddesi, No:200, Laleli 34 470 Istanbul, Turska*

[*]*Autor za korespondenciju*

SAŽETAK

Osam je vrsta pridnenih glavonožaca sakupljeno pridnenom povlačnom mrežom i dredžom u Mramornom moru između 1990 i 1996. To su: *Sepia elegans, Sepia orbignyana, Rondeletiola minor, Sepietta oweniana, Alloteuthis media, Loligo vulgaris, Eledone cirrhosa* i *Eledone cf. moschata. Sepietta oweniana i Loligo vulgaris* ulovljeni su u vodama gdje je slanost mora uvijek bila preko 25 x 10^{-3}, dok su ostale vrste također ulovljene u boćatoj vodi.