Turkish J. Mar. Sci. I:3-12 (1995)

DISTRIBUTION OF THE ICHTHYO-JELLYPLANKTON *Mnemiopsis leidyi (Agassiz, 1865)* IN THE MARMARA SEA (October 1992)

İHTİYO JELLİ-PLANKTON *Mnemiopsis leidyi* (Agassiz, 1865)'nin MARMARA DENİZİNDEKİ DAĞILIMI (Ekim 1992)

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Key words : Mnemiopsis leidyi; Bosphorus; Marmara Sea; Dardanelles.

Abstract

In this study, the distribution and the abundance of the abundance of Ctenophora *Mnemiopsis leidyi* in the Sea of Marmara are investigated. Samples were taken vertically and from surface from 16 stations with special plankton nets. They were determined taxonomically and separated into three different size groups.

According to vertical sampling the abundance of *M. leidyi* was found to be approximately 4.3 kg/m^2 near the Bosphorus and 9.7 kg/m^2 near the Dardanelles. According to the surface samples, the abundance was 0.5-0.7 kg/catch in near Bosphorus and 11-13 kg/catch in Dardanelles. It was determined that the population of *M. leidyi* was distributed between 10 and 30 m. water depth and there were no fish eggs or larvae in the area.

Introduction

Geographically the sea of Marmara, the Black Sea and the Sea of Azov are considered by the General Fisheries Council for the Mediterranean (GFCM) as subregions of unit region. This has biological foundations because commercial ichtyofauna of the Azov, Black and Marmara sea consists of the species that spend different periods of their life cycles in the Black and Marmara Seas and some of them in the Sea of Azov.

Many dramatic changes took place in the recent years of these seas, connected with anthropogenic stress. This includes unregulated diversion of fresh water for irrigation and power generation, industrial and agricultural wastes into the rivers that drain into the seas, increase in the level of marine pollution, change in the level of the Bosphorus and Kerch straits and heavy exploitation of the fish stocks in the last two decades (Caddy and Griffiths, 1990; Rass, 1992; Oven *et al.,* 1991).

Particularly considerable changes in the structure of the Black Sea communities have occured since 1987 due to the transfer of Ctenophore from the Atlantic coast of North America (Vinogradov et.al., 1989). It appeared also in the sea of Azov in 1988 (Studenikina et.al., 1991). By 1989 it was observed practically everywhere in the Black and Azov Seas (Vinogradov and Shushkina, 1991'. The mass development of *Mnemiopsis leidyi* has resulted in decrease of the medusa *Aurelia aurita* zooplankton biomass and the resultant reduction in quantity of the pelagic fish eggs and larvae (Vinogradov and Shuskhina, 1992).

Materials and Methods

The studies were conducted under the plan of the Turkish scientists in October 1992. For plankton sampling a BR closed net was used (500 μm mesh the upper ring diameter of 113 mm to the low 140 mm). The samples were taken from 100 m to 0 m depth or from the bottom to 0 m depth, if depth was less than 100 m (3-4 catches per 1 station) from 100 m thermocline (1 catch). The surface unclosed net PS (140x60 cm, 500 μm mesh size) was used for surface sampling. The tows were made during 10 min. in the 0-50 cm layer (1-2 catches per station). During the expedition 76 samples from 16 stations were collected. The ichtyoplankton was identified, preserved and stored in a buttered 4 % formaldehyde-water solution.

Zooplankton was preserved, identified and counted, Jellplankton was identified, measured, counted by size into three groups : 1 < 10 mm, 1=10-45 mm, 1>45 mm Vinogradov and Shuskina method (1982, 1989) was used for calculation of the abundance and biomass.

Environmental Conditions

The Sea of Marmara, together with straits of Bosphorus and Dardanelles, forms a transition region between the Black Sea and the Mediterranean Sea. The waters of the Black Sea and the Mediterranean are exchanged through the sea of Marmara. This exchange is achieved by a surface current towards Marmara through the Bosphorus from the Black Sea and a deep current form the Mediterranean towards the Black Sea.

The depth of the surface layer changes form 25m to 75 m depending on the season. This layer contains the waters of the Black Sea. Its temperature lies between 8 °C and 26°C. During our examination the depth of this layer was 20-25 m and the temperature was 17-19 °C. The average salinity of this layer was 22 ‰, while the actual values varies from 18 ‰ to 29 ‰ depending on the season and location.

Below the surface layer is an intermadiate region which the temperature and salinity have sharp gradients and high density. This transitional layer has a depth of 8 to 10 m. Beyond a depth of 75 m, there is the layer of Mediterranean water, its average salinity and temperature are 38.4 ‰ and 14.2 °C. This water mass does not mix with the surface water and consequently, keeps its temperature and salinity more or less unchanged.

Results

Ichtyoplankton

October is a month, when the fish reproducing in summer have already finished to spawn, and winter-spawning fish have not started to reproduce. But it is possible to meet larvae and even eggs of some of summer-spawning fish, which can continue to reproduce at this time. These are *Sardinella aurita, Engraulis engrasicholus ponticus, Belone belone euxini, Mugil cephalus. Liza saliens, Scomber scombrus,* some species of family *Blennidoe* and *Gobiidae*. Of the winter-spawning fishes it is possible to meet eggs and larvae *Merhuccius merluccius.* Only very scanty data are available on the sea of Marmara ichthyoplankton. No eggs or larvae were found in the surface layer.

Jellyplankton

For the first time a few adult specimens of ctenophore *Mnemiopsis leidyi* were noted by Artüz (1991) and Öztürk (1992) and Öztürk (1992) in Marmara Sea. In October 1992 it was already distributed practicaly over the whole of the Sea of Marmara and its average biomass was very high 4.3 kg/m^3 wet weight (Table 1). Population of *Mnemiopsis leidyi* occured exclusively in upper layer 15-30 m. small (1<10 mm) and

average (l=10 - 45 mm) size specimens prevailed at all stations. This fact showed that an the intensive reproduction of *Mnemiopsis leidyi* took place at that time. For example, according to the BR-net data average size specimens (l=10 - 45 mm, w_{av}=4.5 g) comprised 65.8 % of the total quantity, the second-small size (l<10 mm, w_{av}=0.18 g) 32.2 %, and the large ones (l<45 mm, w_{av}=34.5 g) constituted the remaining 2.0 %. According to the PS-net data, in the surface layer the small specimens predominated (92.6 % of the total quantity), the average ones made up 7.35 %, and large ones were only 0.05 % (Table 1,2). The average wet weight in the entire sea was 4.0 g according to the BR-net data, and 3.3 g according to the PS-net data. From these data it can be concluded : that the smallest specimens occured in the surface layer and the larger ones were found deeper.

Numerical abundance and biomass increased in direction from the Bosphorus to the Dardanelles (Fig 1). Near the Bosphorus according to the BR-net data, biomass was 1.7-2.5 kg/m^2, near the Dardanelles it reached 9.7 kg/m^2 (Biomass unit calculated as m^2, confide to Vinogradov method). According to the PS-net data near the Bosphorus biomass 0.5-0.7 kg/catch, near the Dardanelles 11-13 kg/catch. Average wet weight specimens also increase in biomass in the direction from the Bosphorus to the Dardanelles according to the BR-net data the ranges of wet weights near the Bosphorus and Dardanelles 2.76-4.0 g, and 5.89-7.94 g, respectively. (Table 1). According to PS-net data near the Bosphorus the average wet weight was 1.53 g. near the Dardanelles 3.8-6.3 g. Thus, as shown by data of the two nets *Mnemiopsis leidyi* reproduced during October and was distributed from the Bosphorus to the Dardanelles by the surface current to everywhere in the Sea of Marmara, reaching it peak in all parameters near the Dardanelles. In st. 10 according to the PS-net data the biomass was 225 ind./catch on the surface. This amount can explain as a result of drift ones by current between two islands. Most large specimens were caught at st. 12; its sizes being within the range of 8.4-10.3 mm.

Besides *Mnemiopsis leidyi* from Ctenophora in October *Beroe ovata* was found at six stations (Table 1,2), young specimens of *Pleurobranchia pileus* occured at station 13 Medusa *Aurellia aurita* was absent absolutely.

Analyzing the obtained data one can conclude that *Mnemiopsis leidyi* came from the Black Sea through the Bosphorus and became distributed everywhere in the Sea of Marmara with surface curretnt. There is intensive reproduction in October. The population of *Mnemiopsis leidyi* is rather young, the prevailing quantity of specimens were reproduction in September-October. Its abundance at inshore stations was a high as at the open sea stations. All populations inhabiting the surface water

Table 1. Abundance (N sp./m²), biomass (B g/m²), wet weight (W,g), Ctenophore *Mnemiopsis leidyi, Beroe ovata, Pleurobranchia pileus* (catchs BR-Net).

Station & Location	Depth (m)	Parameter	Ctenophora *Mnemiopsis leidyi*					
			l< 10 mm	l = 10-45 mm	l > 45 mm	Sum	Pleurobran - chia pileus	*Beroe ovata*
1. 40 54 N 29 05 E	25	N B W	114 23.9 0.21	428 1549 3.62	7 155 22.5	549 1728 3.14	1.56	
2. 40 55 N 28 41 E	74	N B W	72 15 0.21	620 2480 4.0	19 716.2 37.2	7113202 4.5	2.24	4.6 20.7 4.5
3. 40 54 N 28 35 E	180	N B W	12 21.6 0.1	655 3079.4 4.7	14 558.4 39.6	797 3659 4.5	2.56	2.3 9.1 4.2
4. 41 01 N 28 17 E	5	N B W	159 28.6 0.1	515 2368 4.6	8 285.6 33.3	682 2682 3.93	1.88	
5. 40 56 N 27 58 E		N B W	159 28.6 0.18	855 3761 4.4	30 34.6	922 4815 4.85	3.37	4.6 21.6 4.7
6. 40 55 N 27 39 E	200	N B W	185 37.1 0.2	523 2302 4.4	19.4 677.1 34.9	727 3016 4.15	2.11	
8. 40 38 N 27 16 E	61	N B W	402 56.3 0.14	1219 8481.5 6.96	32 1187.6 37.7	1652 9725 5.89	6.9	
9. 40 30 N 27 17 E	66	N B W	28 7 0.25	585 2897.7 4.95	62 2462.3 39.65	676 5367 7.94	3.65	
10. 40 34 N 27 29 E	67	N B W	128 29.4 0.23	823 4000.7 4.86	30 986.7 33.0	981 5016 5.11	3.56	
11. 40 30 N 27 29 E	29	N B W	1468 176.2 0.12	619 2710.3 4.38	28 984.8 35.68	2114 3871 1.83	2.67	
13. 40 35 N 27 47 E	59	N B W	475 90.3 0.19	912 3903.4 4.28	41 2197.8 54.0	1428 6192 4.37	4.09	
14. 40 42 N 27 44 E	330	N B W	176 128.9 0.18	1063 4356.7 4.1	16 531.3 33.0	1795 5017 2.8	3.71	
16. 40 28 N 28 12 E	49	N B W	510 102 0.2	780 2956 3.79	9 325.7 35.4	1299 3384 2.6	2.54	
17. 40 26 N 28 42 E	59	N B W	675 135.1 0.2	1272 5851 4.6	16.570 35.4	1964 6556.4 3.34	4.65	
18. 40 41 N 29 07 E	550	N B W	374 30 0.08	626 219.1 3.5	14 463.7 33.6	1014 2685 2.65	6 1.99 1.3	6.9 5.9
19. 40 46 N 29 12 E	600	N B W	444 40 0.09	475 2043 4.3	18 489 42.5	93 2575 2.76	1.8	2.3 60.5 26.3

Table 2. Abundance (N sp/catch), biomass (B g/catch), wet weight (W,g), Ctenophore *Mnemiopsis leidyi, Beroe ovata*, (catchs PS-Net).

Station & Location	Depth (m)	Parameter	Ctenophora *Mnemiopsis leidyi*				
			l < 10 mm	l = 10-45 mm	l > 45 mm	Sum	*Beroe ovata*
1.		N	93	148	1	241	2
40 54 N	25	B	9.3	683	47	718	2.4
29 05 E		W	0.1	4.6	23.5	3.0	1.1
2.		N	121	587	2	710	
40 55 N	74	B	10.9	2187	47	2245	-
28 41 E		W	0.09	3.7	23.5	3.2	
3.		N	300	648	24	972	
40 54 N	180	B	38.1	2722	631	3391	-
28 35 E		W	0.12	4.2	26.3	3.4	
4.		N	137	326	4	467	
41 01 N	5	B	17.4	1553	145	1716	-
28 17 E		W	0.12	4.7	36.2	3.6	
5.		N	104	384	10	498	
40 56 N		B	13	1904	323	2300	
27 58 E		W	0.1	4.2	32.3	4.57	
6.		N	142	2619	22	2783	
40 55 N	200	B	18.5	10749	840	11338	-
27 39 E		W	0.13	4.0	38.2	4.07	
8.		N	574	2280	6	2833	
40 38 N	61	B	60.2	10720	230	11011	-
27 16 E		W	0.11	4.7	38.4	3.8	
9.		N	444	1578	108	2130	
40 30 N	66	B	31.1	7890	6026	13974	-
27 17 E		W	0.07	5.0	34.5	6.3	
10.		N	2792	4380	54	7226	
40 34 N	67	B	251	17818	1566	19635	-
27 29 E		W	0.09	4.1	29.0	2.72	
11.		N	675000	38970	90	714060	
40 30 N	29	B	85658	135872	3330	224860	-
27 29 E		W	0.13	3.49	37.0	0.31	
13.		N	157	374	38	569	
40 35 N	59	B	23.6	2059	1380	3463	-
27 47 E		W	0.15	5.5	36.2	6.1	
14.		N	1	12	0	13	
40 42 N	330	B	0.26	48	0	48	-
27 44 E		W	0.26	4.0	0	3.7	
16.		N	335	479	3	835	
40 28 N	49	B	42.5	2176	109	2327	-
28 12 E		W	0.13	4.38	36.0	2.8	
17.		N	1518	726	2	2246	
40 26 N	59	B	180	2193	72.6	2446	-
28 42 E		W	0.11	3.0	36.3	1.1	
18.		N	808	579	5	1392	7
40 41 N	550	B	64.6	1853	146	2064	35.7
29 07 E		W	0.08	32	29.2	1.4	5.1
19.		N	222	104	4	330	
40 46 N	600	B	20	374	112	506	-
29 12 E		W	0.09	3.6	28.0	1.53	

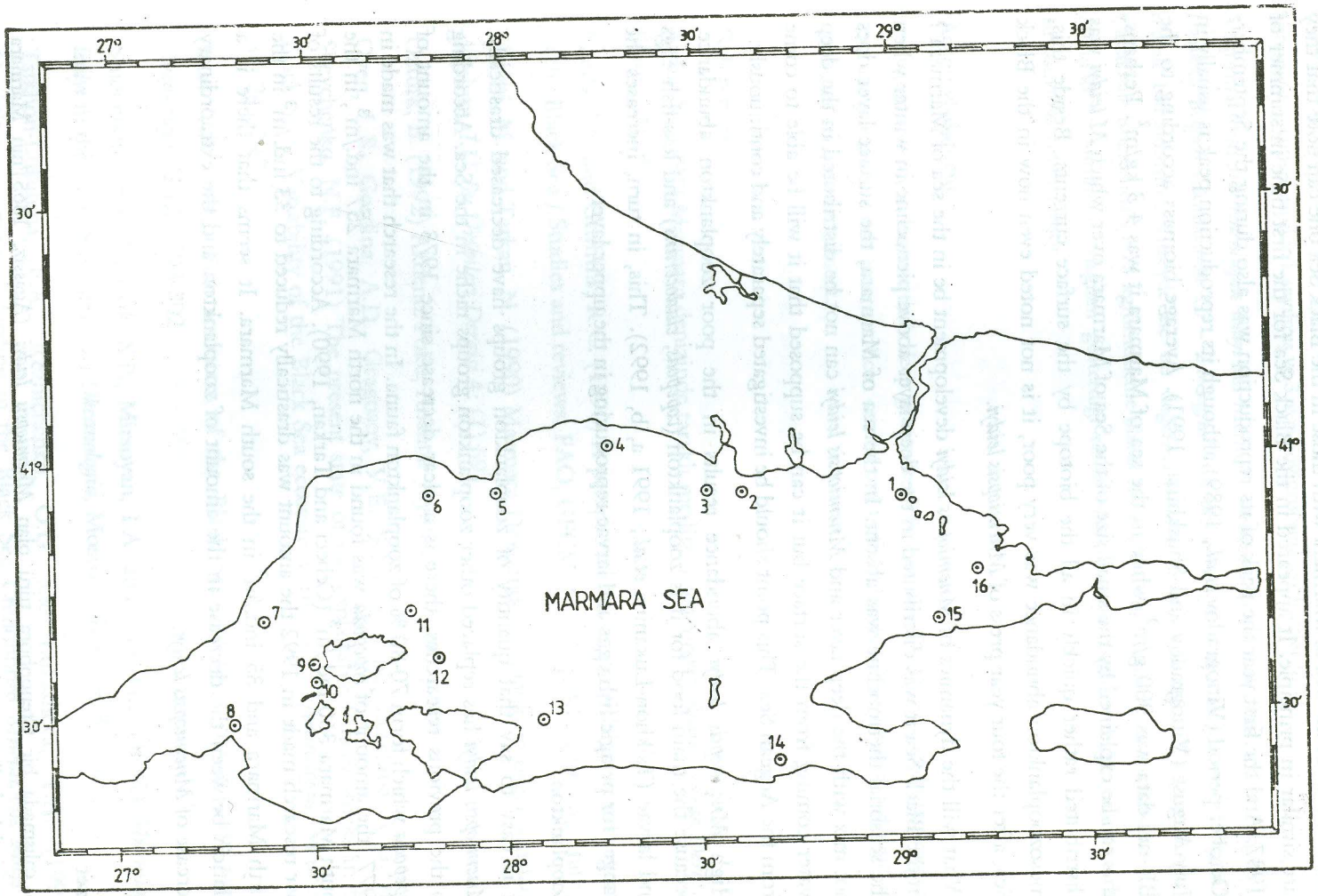

Figure 1 : Stations in the Marmara Sea

originating from the Black Sea, Comparing the *Mnemiopsis leidyi* transfer and distribution in the Sea of Marmara with those in the Black Sea one can note that they are similar in principle. It appeared in the Black Sea for the first time in summer of 1987. And the first year the peak of its reproduction was also during the September-October period (Vinogradov *et.al.,* 1989) although its reproduction peak is usually in July-August (Vinogradov and Shuskhina, 1991). Average biomass according to the BR-net data was 900 g/m^2, while in the sea of Marmara it was 4.3 kg/m^2. Perhaps, this can be explained by the small size of the Sea of Marmara over which *M.leidyi* was distributed rather quickly in all the biotope by the surface currents. Beside this, mesozooplankton abundance was very poor, it is not noted even now in the Black Sea, after the four year press of *Mnemiopsis leidyi.*

What will the dynamics of *Mnemiopsis leidyi* development be in the sea of Marmara ? In the Black Sea it was distributed in the deep layer above picnocline in winter when the seasonal thermocline was absent. In the sea of Marmara, the surface layer does not mix with the deep layer and *Mnemiopsis leidyi* can not be distributed in the deep water coming from the surface but it can be supposed that it will be able to come from the Aegean Sea. This point should be investigated separately and continuously.

High *Mnemiopsis leidyi* abundance results in the poor zooplankton abundance, because the main food for it is zooplankton (*copepods, cladocerans*) and less-fish eggs and larvae (Tsikhon-Lukanina *et.al.,* 1991 a, b, 1992). This, in turn, increases the danger for pelagic fish eggs and larvae reproducing in the upper layer.

Zooplankton

It is easy to say that quantity of zooplankton groups have decreased drastically. *Mnemiopsis leidyi* has replaced other zooplankton groups niche in the Sea. According to the previous researches, there is a clear decrease since 1973 in the amount of *copepoda* which form 70-80 % of zooplankton fauna. In the research that was made in 1977, the amount of *copepoda* was found in the north Marmara 257 ind./m^3, in the south Marmara 360 ind./m^3 (Cebeci and Tarkan, 1990). According to the results of ther research made in 1992 the amount was drastically reduced to 33 ind./m^3 in the north Marmara and 35 ind./m^3 in the south Marmara. It seems that there is a relation between the decrease in the amount of zooplankton and the extraordinary increase of *Mnemiopsis leidyi.*

Özet

Bu çalışmada bir Ctenophora türü olan *Mnemiopsis leidyi* (Agassiz, 1865)'nin Marmara Denizindeki bolluğu ve dağılımı araştırılmıştır. Araştırma materyali 16 istasyondan düşey ve

yüzeyden özel plankton ağları ile elde edilmiştir. Örnekler deniz suyu içerisinde incelenmiştir. Sistematik tayinleri yapılarak sayılmış ve 3 ayrı boy grubuna ayrılmışlardır.

Araştırma sonunda *Mnemiopsis leidyi*'nin Marmara Denizindeki ortalama bolluğu 4.2 kg/m^2, İstanbul Boğazı yakınlarında 1.7 - 2.5 kg/m^2, Çanakkale Boğazı yakınlarında ise 9.7 kg/m^2 olarak bulunmuştur. Yüzeyde ise bu değerler İstanbul Boğazında 0.5-0.7 kg/örnekleme, Çanakkale Boğazında 11-13 kg/örnekleme olarak hesaplanmıştır. Türün yüzeyden itibaren 10-30 m'lik su sütununda dağılım gösterdiği tesbit edilmiş ve bu bölgede balık yumurta ve larvasına rastlanılmamıştır.

Acknowledgment :

The authors wish to express their deep gratitude to Bayram ÖZTÜRK as expedition leather. The present study could have not been carried out both in the scope and extent without his assistance and encouragement.

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Accepted 10.2.95