# Distribution of the Invasive Ctenophore *Mnemiopsis leidyi* (Agassiz, 1865) in the North-eastern Aegean Sea in August 1998

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**Abstract**

The native habitats of *Mnemiopsis leidyi* are temperate to subtropical estuaries along the Atlantic coast of the North and South America, where it is found in an extremely wide range of environmental conditions (temperatures of 2-32ºC , salinities of <2-38‰). In the early1980s, it was accidentally introduced to the Black Sea, where it flourished and expanded into the Azov, Marmara and Mediterranean Sea. The presence of *Mnemiopsis leidyi* (Ctenophora) in the coastal waters of Gökçeada Island (the north-eastern Aegean Sea) was investigated by means of horizontal net tows during a survey between 24-25 August 1998. *M. leidyi* was sampled from the 9 stations where the abundance varied between 0 and 8.3 ind./100m$^3$ and the biomass between 0 and 28.2 g/100m$^3$

*Key Words*: *Mnemiopsis leidyi*, Ctenophore, Gökçeada Island, north-eastern Aegean Sea.

## Introduction

*Mnemiopsis leidyi* is an endemic ctenophore species of the Atlantic coast and of the bays of the USA, especially in northern areas of South Carolina (Mayer, 1912). During the summer this species can attain densities up to 50 ind./m$^3$ in these areas (Baker and Reeve, 1974; Kremer and Nixon, 1976). Probably it was transported by ships' ballast waters from the American ports to the Black Sea (Vinogradov *et al*., 1989; Harbison and Volovik, 1993; Mutlu *et al*., 1994). As *M. leidyi* is able to reproduce rapidly, it has spread throughout the Black Sea its biomass, reaching 1.5-2 kg/m$^2$ in the summer of 1988 (Vinogradov *et al*., 1989). *M. leidyi* feeds both on pelagic fish eggs and on zooplankton (Burrell and Van Engel, 1976; Mountford, 1980; Niermann *et al*., 1994). It caused the decline in the amount of pelagic fish such as anchovy and of zooplankton in the areas of the Black Sea where it occurred intensively (Vinogradov *et al*., 1989; Kideys, 1994). Spreading out of the Black Sea via the Strait of Istanbul, the biomass of this ctenophore was calculated 4.3 kg/m$^2$ in the Sea of Marmara in 1991 (Shiganova *et al*., 1995). Depending on the environmental conditions, this species caused serious problems in certain areas of the Black Sea and Sea of Azov (Studenika *et al*., 1991; Volovik *et al*., 1993; Gücü, 1994; Mutlu *et al*., 1994; Volovik *et al*., 1995) and may become a problem in higly productive estuarine regions of Aegean Sea (Harbison and Volovik, 1993). According to the results of recent investigations, the species was found in some areas of the Mediterranean Sea as well (along Mersin Bay the southern Turkish coast) (Kideys and Niermann, 1993; Uysal and Mutlu, 1993; Kideys and Niermann, 1994).

The Gökçeada Island was chosen as a base for observations on the distribution of *M. leidyi* in the Aegean Sea, because it is within an important water way geographically. Due to nutrient rich waters coming from the Black Sea via the Dardanelles Strait and from the Meriç River and suitable conditions of Saroz Bay for fish reproduction, the water surrounding the island which is on the migration routes of pelagic fishes is very rich in fish populations (Ulutürk, 1987).

## Materials and Methods

The Gökçeada Island with a coastline of 92 km and surface area of 279 km$^2$ is located in the Aegean Sea between 25°40'06" - 26°02'05" of eastern longitudes and 40°05'12" - 40°14'18" of northern latitudes. It is about 20 km off the Gelibolu Peninsula. On the northern coast of the island, the continental slope is steep and the Saroz Pit, a tectonic pit, is located immediately off the coast. The southern coast has wide sandy beaches. Especially in summer it is dominated by north-easterly and south-westerly winds (Kocataş and Bilecik, 1992). Due to the islands, the water movements in the northern Aegean Sea vary greatly. The Black Sea waters from the Dardanelles Strait have an orientation towards north in winter and south in summer (Kocataş and Bilecik, 1992). The area is enriched by nutrients of the Meriç River and has a variety of pelagic fish feeding on the abundant phytoplankton (Ulutürk, 1987). The water mass surrounding the island is affected by cooler and less salty water coming from the Sea of Marmara (Kocataş and Bilecik, 1992).

This research was carried out in the coastal waters of Gökçeada Island between 24-25 August 1998 with RV "Yunus". Nine stations in the coastal

waters of the island (Figure 1) were sampled using pleuston net. In every station; samples of *M. leidyi* was collected horizontally at the surface using a pleuston net with a frame of 70 cm high, 143cm wide, 350 cm long, mesh size of 500 µm. The pleuston net generally used in meroplankton sampling was towed horizontally at surface waters (0-70 cm) for 10 minutes (617 m) by the vehicle. The samples were identified, counted and subdivided by size into three groups (I<10 mm, I=10-45 mm, I>45 mm) at the ship. To convert from the body length to the live weight, empirical equations of Vinogradov *et al*. (1989) and Tsikhon-Lukanina and Reznichenko (1991) were used.

$$W_{live} = 2.36 \times L^{2.35}$$

Where L is the body length, mm and $W_{live}$ is the live weight, in mg.

Measurements of temperature and salinity were carried out using the reversible thermometer and Salinity Hand Refractometer W/A.T.C.

## Results

Temperature and salinity of the island coastal waters ranged between 26.5-25.2°C and 33.8-32.6‰ respectively. The sampling data are presented in Table 1. No other gelatinous organisms except *M. leidyi* were caught. The distribution of *M. leidyi* was patchy. In total, 97 *Mnemiopsis leidyi* individuals were counted at the nine stations in the coastal waters of Gökçeada Island. All nine stations sampled around the Gökçeada Island contained dominately medium size (I = 10-45 mm) specimens of *Mnemiopsis leidyi* (Figure 2). However the numbers varied greatly, from 2 to 50 individuals per tow around the Gökçeada Island. The maximum abundance and biomass of *M. leidyi* were 8.3 ind./100m$^3$ and 85 g/100m$^3$ in coastal waters of Kömür cape (Table 1). Abundance and biomass of *M. leidyi* were higher in the northern area than in the southern area of the Gökçeada Island. The size range of individuals collected in coastal waters of Gökçeada Island were 0.7-6 cm.

## Discussion

There are 17 species of ctenophores occurring in the Mediterranean Sea (Tregouboff and Rose, 1978). *M. leidyi* is a eurytermal 1.3-28.8ºC) and euryhaline 10-70‰) organism (Burrell and Van Engel, 1976). Therefore, it is not surprising that *Mnemiopsis leidyi* was able to survive well in the much warmer and more saline waters of the Aegean Sea in comparison to the Black Sea and the North Atlantic.

The maximum population density (8.3 ind./100m$^3$) found in our surveys is much lower than that found either in the native place of occurrence (i.e. the North Atlantic) or in the Black Sea because of different environmental conditions. Kremer and Nixon (1976) found more than 5000 ind./100m$^3$ of *Mnemiopsis leidyi* during summer peak densities in Narraganset Bay. During its first mass occurrence in the summer of 1988 in the Black Sea, the maximum

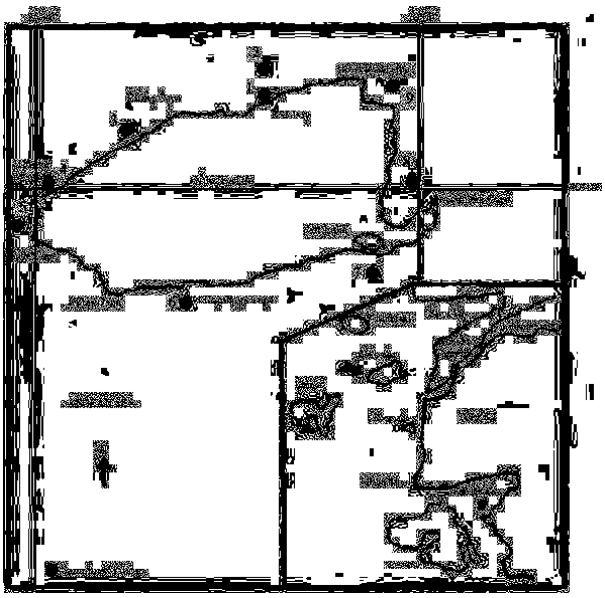

**Figure 1.** Location of nine stations around the Gökçeada Island (the northeastern Aegean Sea)

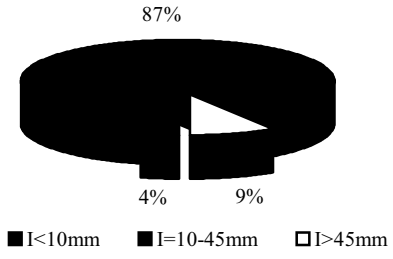


**Figure 2.** Relationship between the size groups of *Mnemiopsis leidyi* sampled around Gökçeada Island during 24-25 August 1998

**Table 1.** Sampling data, number of individuals (no/100 $m^3$), and biomass (g/100 $m^3$) of *Mnemiopsis leidyi* at each station between 24-25 August 1998.

| Station no. | Positions | Date | Salinity | T(ºC) | Per 100$m^3$ *Mnemiopsis leidyi* | |
|---|---|---|---|---|---|---|
| | | | | | no | g |
| 1 | 40° 13' 54" N - 25° 53' 28" E | 24.8.1998 | 32.6 | 26.5 | 0.0 | 0 |
| 2 | 40° 15' 15" N - 25° 53' 28" E | 24.8.1998 | 32.7 | 26.4 | 0.5 | 2.7 |
| 3 | 40° 12' 14" N - 25° 44' 12" E | 24.8.1998 | 33.6 | 26.0 | 2.5 | 28.2 |
| 4 | 40° 09' 40" N - 25° 40' 03" E | 25.8.1998 | 33.6 | 25.5 | 8.3 | 85 |
| 5 | 40° 08' 14" N - 25° 38' 02" E | 25.8.1998 | 33.7 | 26.0 | 0.5 | 2.7 |
| 6 | 40° 04' 16" N - 25° 48' 20" E | 25.8.1998 | 33.8 | 25.2 | 0.0 | 0 |
| 7 | 40° 06' 15" N - 25° 57' 35" E | 25.8.1998 | 33.8 | 25.5 | 0.0 | 0 |
| 8 | 40° 10' 45" N - 25° 59' 39" E | 25.8.1998 | 33.7 | 26.5 | 0.3 | 18 |
| 9 | 40° 14' 00" N - 25° 58' 26" E | 25.8.1998 | 33.7 | 25.8 | 4.2 | 24.1 |

abundance of *Mnemiopsis leidyi* was around 3100 ind./100$m^3$ (Vinogradov *et al*., 1989). A maximum value of 110 ind./100$m^3$, obtained in the late spring of 1992 in Mersin Bay (Kideys and Niermann, 1993) was also higher than that found in the present study. The average biomass of *M. leidyi* 152 g/$m^3$, calculated for the Sea of Marmara by Shiganova *et al*. (1995), was also higher than that found in the present study (17.85g/$m^3$). The reason could be that the Aegean Sea has lower productivity than the Sea of Marmara. Besides it is thought that decreasing the population of *Mnemiopsis leidyi* in the Black Sea in recent years (Kideys, 2002) will able to effect the abundance of *Mnemiopsis leidyi* in the Northern Aegean Sea.

*M. leidyi* was recorded in the North Aegean Sea for the first time during summer 1990 and it was found in large numbers in the Saranikos Gulf (Shiganova *et al*., 1999). In the following years, it was also observed during the warm period in several coastal areas of the Aegean Sea islands (Lesvos, Limnos, Alonissos, Skyros) (Shiganova *et al*., 1999).

Investigations in 1996/98 demonstrated that the main zooplankton bloom in coastal waters of Gökçeada Island occurred between April and May (Tarkan, 2000). Since there were no regular surveys in the coastal waters of the Gökçeada Island, we do not know the exact date for the first occurrence of *M. leidyi* and the effects of *M. leidyi* on zooplankton around the Gökçeada Island. But in Saranikos Gulf in 1990, when *Mnemiopsis leidyi* was most abundant, zooplankton biomass and abundance were somewhat lower (Shiganova *et al*., 1999).

It is suggested that there is a flow of low salinity Black Sea water to the northern (Özsoy *et al*., 1986) and South-eastern Aegean Sea (Zodiatis, 1993), which would transport *Mnemiopsis leidyi* to these area. The dominant size range of ctenophore individuals (4-5.5 cm with lobes) was approximately the same as in the Black Sea. These *Mnemiopsis leidyi* might have been carried to the northern Aegean Sea by the Black Sea currents and they spread freely out of the Black Sea current.

The Gökçeada Island has its own water current. The current increased by strong winds may affect the distribution of *M. leidyi* regionally. It is thought that as the movement of the water mass between Gökçeada and Semothraki Islands was very fast; population of *M. leidyi* was very abundant in the northern side of island.

Analysing the obtained data one could conclude that *M. leidyi* came from the Sea of Marmara via the Dardanelles Strait and distributed throughout North-eastern Aegean Sea and from there possibly to the Mediterranean Sea via a suitable surface current regime. The occurrence of *M. leidyi* around the Gökçeada Island was affected by the speed and the way of water current. In order to monitor the species distribution of this with respect to the current regime, a wider area comprising the entire Aegean Sea should be investigated in future.

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