Distibution and abundance of *Mnemiopsis leidyi* in the western Iranian coasts of the Caspian Sea

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Abstract- The alien ctenophore *Mnemiopsis leidyi* which was transported from the Black Sea into Caspian at the end of 1990s has been negatively affecting ecosystem in this new environment. In this study, spatial and temporal distribution of *M. leidyi* were studied from a total of 15 stations located along three transects (Lisar, Anzali and Sefidrood) in the western Iranian coasts of the Caspian Sea (Guilan province) during July 2001 to July 2002. *M. leidyi* achived maximum biomass (166.1 g m^{-2}) in July 2002. Minimum biomass (3.3 g m^{-2}) of the ctenophore were measured in December 2001. The highest biomass was at the station with 20 m bottom depth (97.0 g m^{-2}) in autumn and lowest biomass (1.6 g m^{-2}) was obtained at a station with a 50 m bottom depth in winter. The highest average biomass 67.3 g m^{-2} were measured in Sefidrood region, and the lowest biomass (34.1 g m^{-2}) observed in Anzali region. The young specimens (<5 mm) contributed about 94 % to the total abundance of the population. The maximum length was 51-55 mm, which was measured in August.

Keywords- Invasion, Caspian Sea, Iranian coasts, distribution, *Mnemiopsis leidyi*

Introduction

The invasive ctenophore *Mnemiopsis leidyi*, a native of western American coasts, after its great impact to the Black Sea in 1990s (Vinogradov 1989; Kideys 1994), has been damaging the Caspian ecosystem since its introduction (Ivanov et al.2000) to this new environment in 1997. This is no surprise as such possibility through the Volga Don Canal was warned as early as 1995 (Dumont 1995; GESAMP 1997). Since *Mnemiopsis* is a voracious predator on zooplankton, abundant small pelagic fishes feeding on zooplankton (i.e. the kilka species, *Clupeonella spp*) has already suffered as was clarified by catch data (Kideys & Mehdi 2003) and it is feared large predators feeding on these fishes such as white sturgeon (*Huso huso*) and endemic Caspian Seal (P*hoca caspica*) would be under significant threat in the Caspian Sea (Kideys et al. 2001). In this study temporal and spatial distribution of *Mnemiopsis leidyi* were studied in order to gather information on the levels and ecology of this ctenophore; for evaluation of its impact on the coastal pelagic communities along the southern Caspian Sea.

Methods

In this study, spatial and temporal distributions of *M. leidyi* were studied along three transects (Lisar, Anzali and Sefidrood) in the western Iranian coasts of the Caspian Sea (Guilan province) during a one year period starting in July 2001. Each transect had four stations located at 5, 10, 20 and 50 m bottom depth contours (Fig. 1). Because sampling of each transect is planned to be completed during the day, a speed boat was used for the sampling at sea. Temperature and salinity of the seawater at depth 5, 10, 20 and 50 m were measured by using an inverted thermometer *in situ* and by using a digital salinometer, respectively. At every station, the water clarity was also measured by using a Secchi Disk. *Mnemiopsis leidyi* was sampled using a 500 micron mesh sized METU net (having a diameter of 50 cm with large bucket suitable for *Mnemiopsis*). Samples were obtained via vertical towing from the bottom to the surface for all stations except the deepest station. At the deepest station, because of existence of the thermocline, it was better to sample two layers separately (from 50 m to 20 m and from 20 m to the surface). At the end of each tow, the net was washed from the exterior, and the cod end was passed into a container immediately to enumerate ctenophores by naked eye. The density (both as per m^2 and m^3) of *Mnemiopsis leidyi* was calculated from the diameter of the net and the tow depth. The ctenophores were sorted in length groups of 0-5 mm, 6-10 mm, 11-15 mm and so on, for size measurements. A total of 51,253 individuals were measured and grouped in this way. Individual weighing of these animals was not practical at sea. Weights of these animals were therefore calculated from size measurements (269 individuals) using a conversion formula which was obtained individual length (using a ruler for the lobed length) and weight measurements (using a digital balance with a sensitivity of 0.001 g) in July 2001. Length groups were thus converted to weight by using the equation obtained.

Results

The changes in the average temperature of the study area during the course of one year are shown in Fig. 2. It oscillated between 29.3 °C in August to 8.8 °C in January. Within the same period, the salinity values ranged from 8.1 to 12.8 with an average value of 12.3 (of which standard deviation being 0.7) in the area. Vertically the water was well mixed in January and April 2002. The thermocline was observed in October and July 2001 in 30 m and 40 m depth respectively. The Secchi disk depth values fluctuated between 0.3 and 6.5 m with an average of 3.3 m during the study period in the southwestern Caspian Sea.

The length-weight equation of *Mnemiopsis leidyi* which is used in biomass calculation was found to be: Weight (g) = 0.0013 Length $(mm)^{2.33}$, $R^2 = 0.96$, n = 269. The minimum mean wet weight and mean length was recorded in December 2001 and January 2002. These figures increased after January 2001 and reached to its maximum in May 2002.

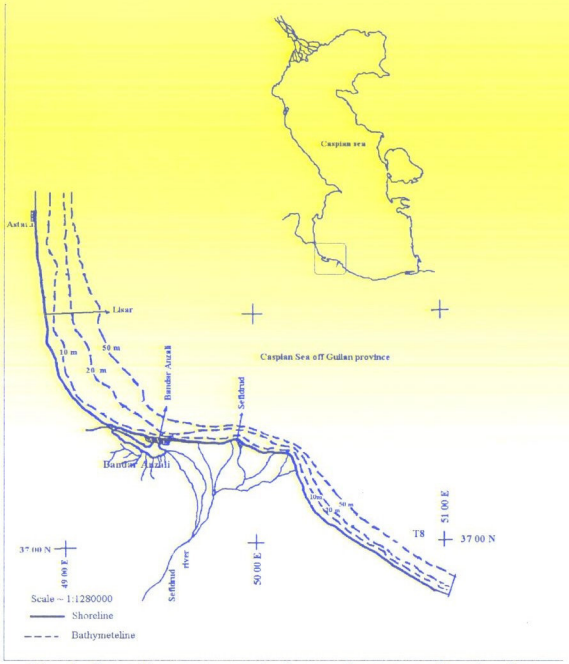

Fig. 1. Sampling transects in the southwestern Caspian Sea

The biomass of *M. leidyi* also fluactuated widely from 3.3 g m^{-2} in December 2001 up to 166 g m^{-2} in July 2002 in the southern part of the Caspian Sea (Fig. 2). Generally biomass values were low during cold months (i.e. November-March) and high in warmer months. Population increased quite suddenly between August and October 2001 when it reached to 128.3 g m^{-2} and sharply decreased by the November 2001. Comparing with the same months of 2001, the biomass values in 2002 were much higher. The highest biomass values were also observed in 2002.

With respect to spatial distribution (as per unit area), except in winter , the highest biomass of *M. leidyi* was occurred in 20 m depth. *M .leidyi* biomass sharply decreased below 20 m. The lowest mean biomass of this ctenephore was thus observed in 20-50 m depth in all seasons. As it is seen from this figure the mean biomass of *M. leidyi* was highest in autumn in comparison to other seasons, and in winter low biomass of ctenophore was encountered

Spatial biomass distribution of *M.leidyi* in 3 transect of Lisar, Anzali and Sephidrood is presented in Figure 3. The highest average biomass observed in Sephidrood with a value of 67.3 g m^{-2} and the lowest was measured Anzali with a value of 44.1 $g.m^{-2}$.

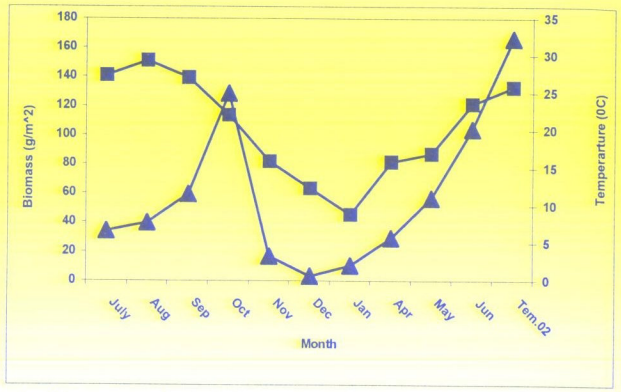

Fig. 2. Changes in *Mnemiopsis leidyi* biomass of Guilan during a year (squares temperature and triangles biomass values)

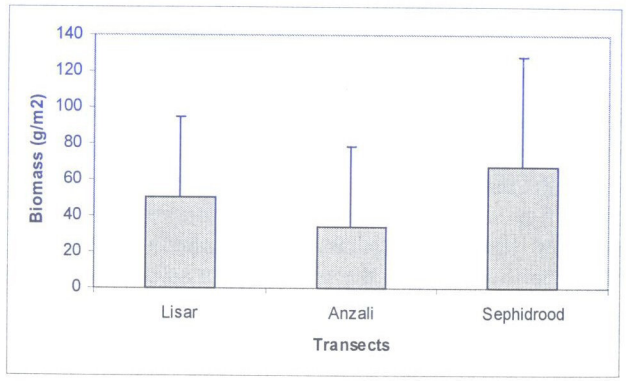

Fig. 3. Comparison of average biomass of *Mnemiopsis leidyi* among transects

Analysis of the monthly percentage of size frequency of *M. leidyi* off Guilan coastal waters showed that small ctenophores (<5 mm) were overall dominating the population: in 0-20 m and 20-50 m depths they comprised 95 and 93.7 % of total, respectively (Fig. 4).

Discussion

The variations of the biomass of *M. leidyi* in the Caspian Sea depend on temperature and possibly food conditions over the course of the year, as was reported for the Black Sea (Shiganova 1998). Reproduction of this species in the coastal water of the southern Caspian Sea starts during early July (as was observed in 2001 and 2002) and reach its maximum during August, reaching highest biomass levels in October due to fast growth of young generation.

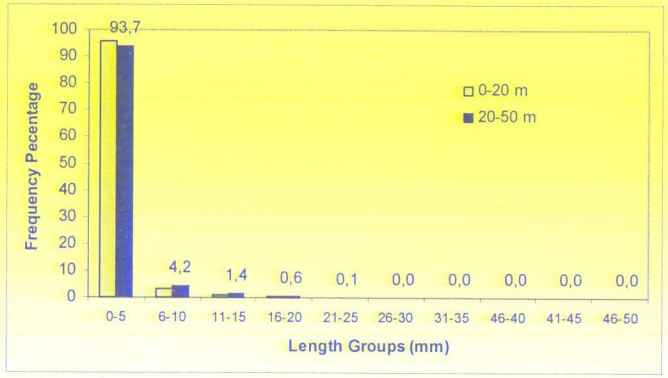

Fig. 4. Monthly percentage size frequencies of *Mnemiopsis leidyi* off Guilan.

The biomass of *M. leidyi* differed among the regions and as seen the Sephidrood transect had much more biomass compared with other transects. It seems that nutrient input (and consequently higher productivity) of the Sephidrood river was responsible for this situation. Kideys & Romanova (2001) observed that *M. leidyi* is distributed generally above the thermocline. Vinogradov *et al.* (1998) also observed similar vertical distibution in September 1987 and this pattern has observed repeatedly (Vinogradov 1990; Bogdanova and Konsoulov 1993) in the Black Sea. Our results from the deepest station confirm these results. Based on our results small *M. leidyi* (<5 mm) comprised more than 94% of the total population during the year, and mean length of individuals increased from January to May, but in summer the mean length of individuals decreased. Ctenophore body size in the Black Sea increase with an increase in temperature in spring (Purcell 2001). In the Black Sea young individuals (<10 mm) were abundant in summer due to reproduction, and food availability probably plays a very important role in the reproduction of *M. leidyi*.

Conclusions

There is a strong seasonality in *Mnemiopsis leidyi* biomass during the course of the year in the southwestern Caspian Sea. Maximum biomass value of 166 g m^{-2}, though lower than that peak values in the Black Sea in the late 1980s, has already very negatively affected the entire Caspian ecosystem. This is mainly caused by the enormous abundance made up by small individuals. The biomass values are getting higher in 2002 indicating that it did not reach peak levels in the Caspian Sea yet. This implies that fishery and overall ecosystem may suffer further losses.

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