CTENOPHORES – INVADERS AND THEIR ROLE IN THE TROPHIC DYNAMICS OF THE PLANKTONIC COMMUNITY IN THE COASTAL REGIONS OFF THE CRIMEAN COASTS OF THE BLACK SEA (SEVASTOPOL BAY)

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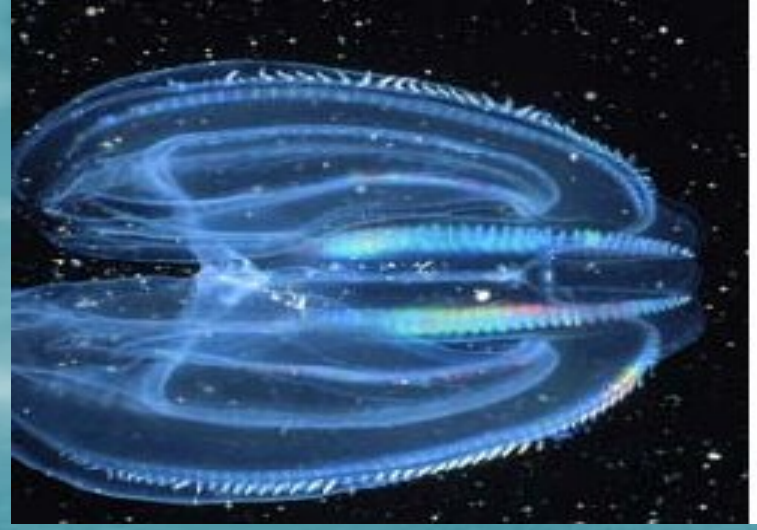
Mnemiopsis leidyi



The introduction of the ctenophore *M. leidyi* in the late 80's resulted in dramatic decrease not only the abundance of some species but also temporary poverty in biodiversity of zooplankton community. The ctenophore started to control the structure of the community and the functioning of pelagic ecosystem. *Mnemiopsis* consumed a considerable proportion of the zooplankton that had been the food for pelagic fish in the years before the *M. leidyi* arrival. *M. leidyi* competition with planktonic fish for zooplankton brought to remarkable decline in the fish stock registered those years and in economic damage as much as 240 millions of dollars per year for all the countries around the Black Sea. The lack of natural predators resulted in temperature and food conditions being the only factors controlling distribution and abundance of *M. leidyi* population.

Beroe ovata

- But by October 1997 a new invader ctenophore *Beroe ovata*, a known feeder on *Mnemiopsis* in native North Atlantic waters, had appeared in shallow waters near Bulgaria, and in September 1999 it was observed in abundance in different areas of the Black Sea**.** The appearance of *B. ovata* caused further changes in the planktonic community

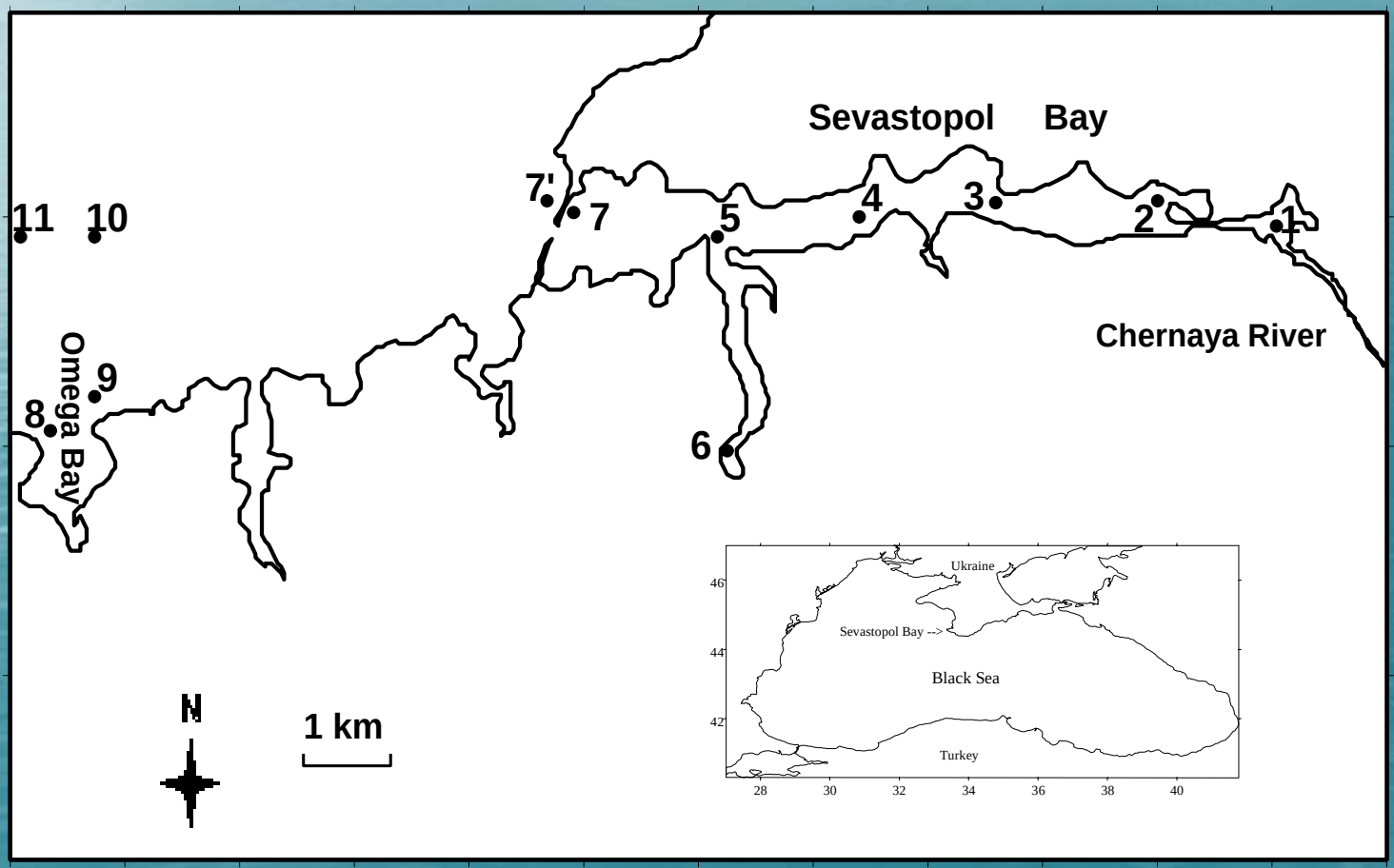
The aim and research tasks of this study are

- to study seasonal and inter-annual dynamics (1999–2005) of abundance, biomass and population structure of *M. leidyi* and *B. ovata* in Sevastopol Bay and adjacent water regions;

- to measure ingestion and growth rates of *B. ovata* and the effects of food conditions on these parameters

- to estimate impact of two new alien ctenophores
- *M. leidyi and B. ovata* on planktonic community in inshore waters of the Black Sea.

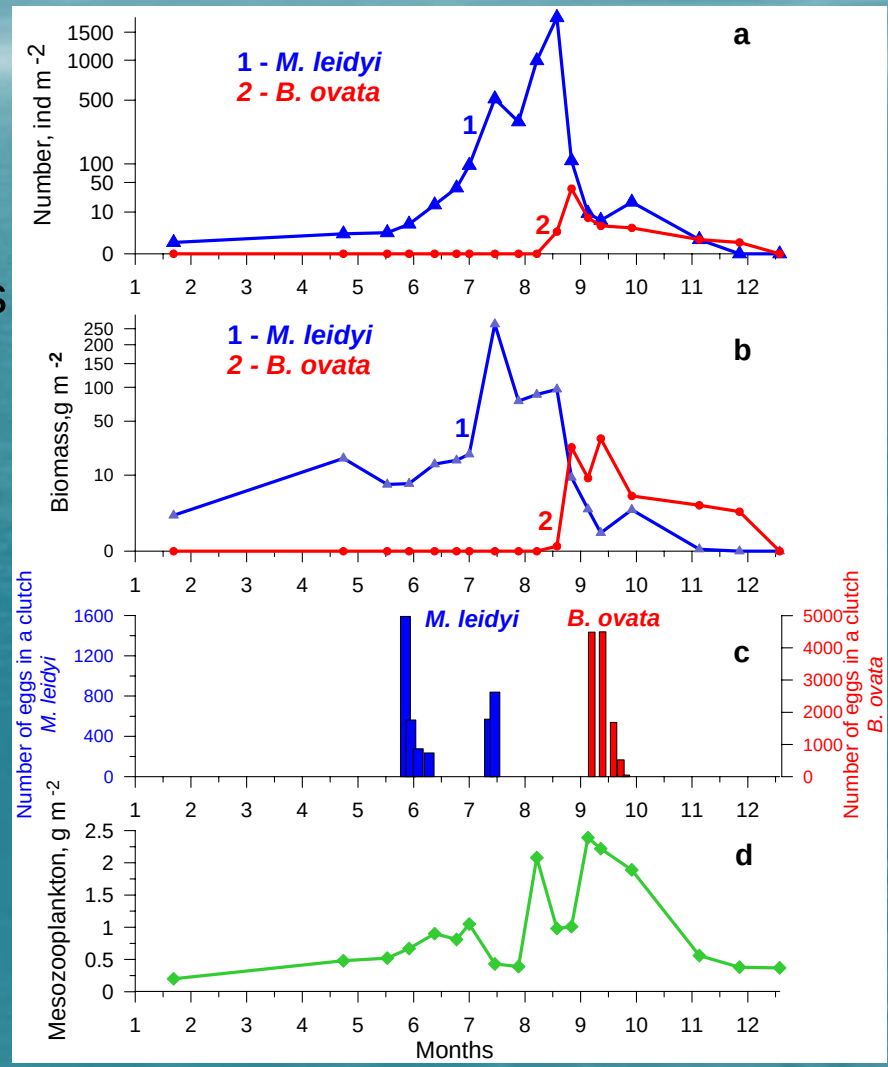
Sampling stations in Sevastopol Bay and adjacent regions.



Abundance (a), biomass (b), egg number in a clutch (c) of the Ctenophores and biomass of mesozooplankton (d)

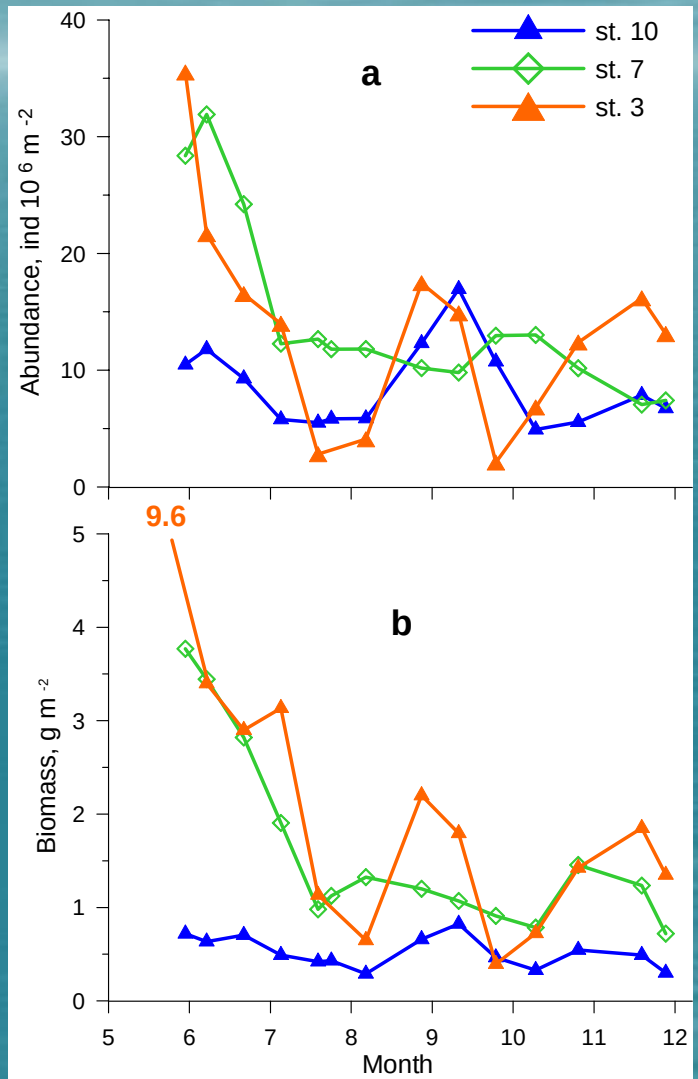
In winter – early spring (January – May), only small amounts of large *M. leidyi* were presented in the bay. In the middle of May they started reproduction and along with adult animals in plankton juveniles 0.25 –0.30 mm long and eggs were presented. Starting from this time population gradually increased its abundance.

The reproduction of *M leidyi*, which started in May, proceeded at different rates over the entire summer and the abundance increased sharply in early August. In the late August, the abundance dynamics changed roughly because of the appearance of another ctenophore – *Beroe ovata* in plankton.



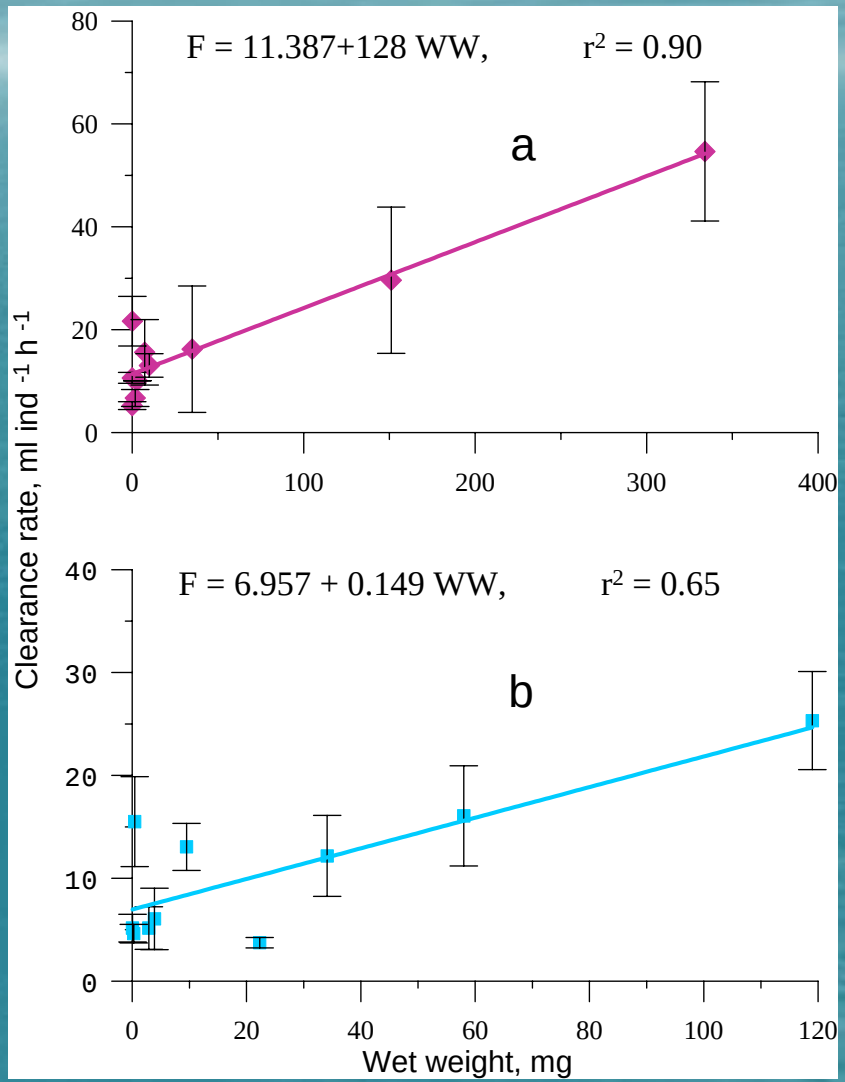
Microzooplankon abundance (a) and biomass (b) in Sevastopol Bay in 2003

The seasonal variations in the abundance and biomass of microzooplankton were characterized by 2 peaks (the early spring peak at the end of May – beginning of June and summer peak in August – September) at the stations in Sevastopol Bay. The bulk of microzooplankton biomass was provided by ciliates and rotifers.



Clearance rate of *M. leidyi* larvae feeding on infusoria(a) and metazoan microzooplankton (b)

Our experiments showed that high clearance rate of *M. leidyi* larvae can ensure a high predatory impact on microzooplankton in the sea.



Daily rations and predatory impact of *M.leidyi* population on meso - and microzooplankton (% of the biomass per day) in August 2003

Date	T °C	№ st.	*Mnemiopsis* biomass (g m $^{-3}$)	Daily ration		Predatory impact	
				meso	micro	meso	micro
5 August	25.1	10	0.55	13.1	0.7	0.6	0.8
		7	2.79	9.3	9.1	5.0	9.7
		3	3.27	3.3	18.7	7.7	25.6
19 August	25.0	10	0.41	0.7	5.8	0.7	1.2
		7	1.37	5.1	15.3	6.5	11.6

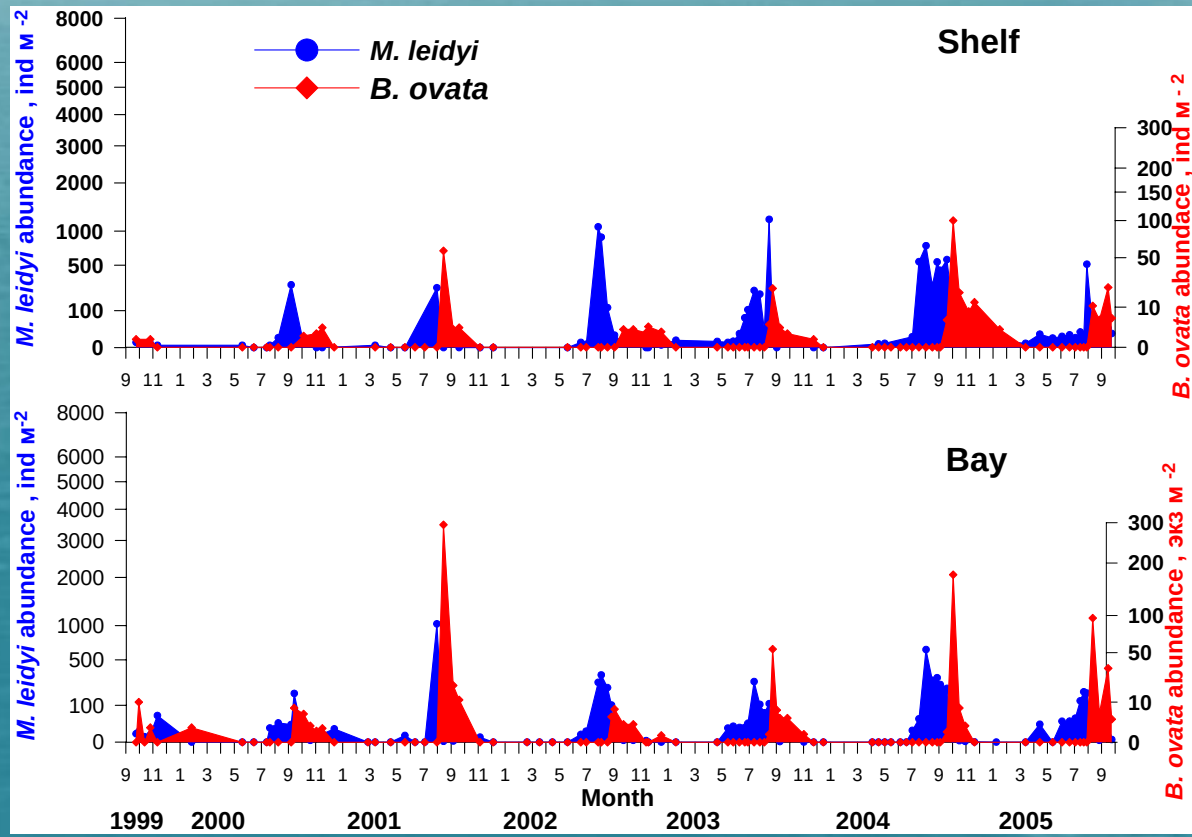
Daily rations of *M. leidyi* population on microzooplankton were close to these on mesozooplankton. Predatory impact of *M. larvae* on microzooplankton was even higher than on mesozooplankton.

Abundance of *M. leidyi* and *B. ovata* in different regions (shelf and Sevastopol Bay) in 1999-2005

The seasonal dynamics of Ctenophores was similar during 6 years (1999 – 2005) but differences in the timing of *M. leidyi* mass appearance can be as long as one month and it was affected by summer temperature.

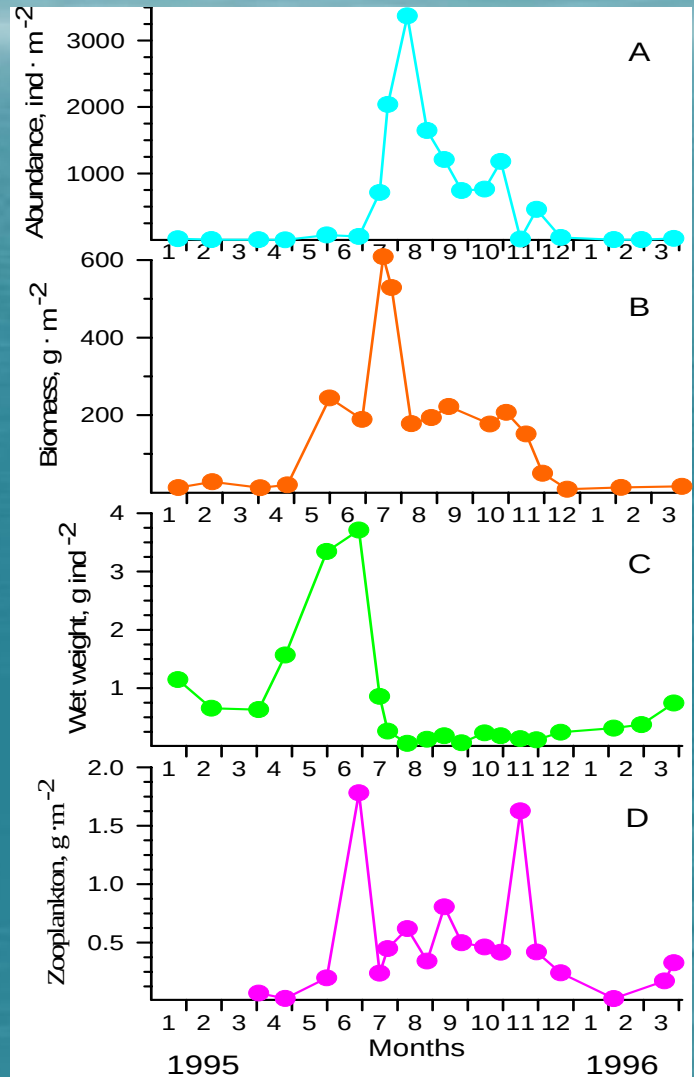
The *B. ovata* bloom after the peak of *M. leidyi* biomass resulted in the biomass sharply falling to extremely low values. *Beroe* was available in plankton only during 3 months (September – November). It appeared at the height of maximum

M. leidyi biomass.



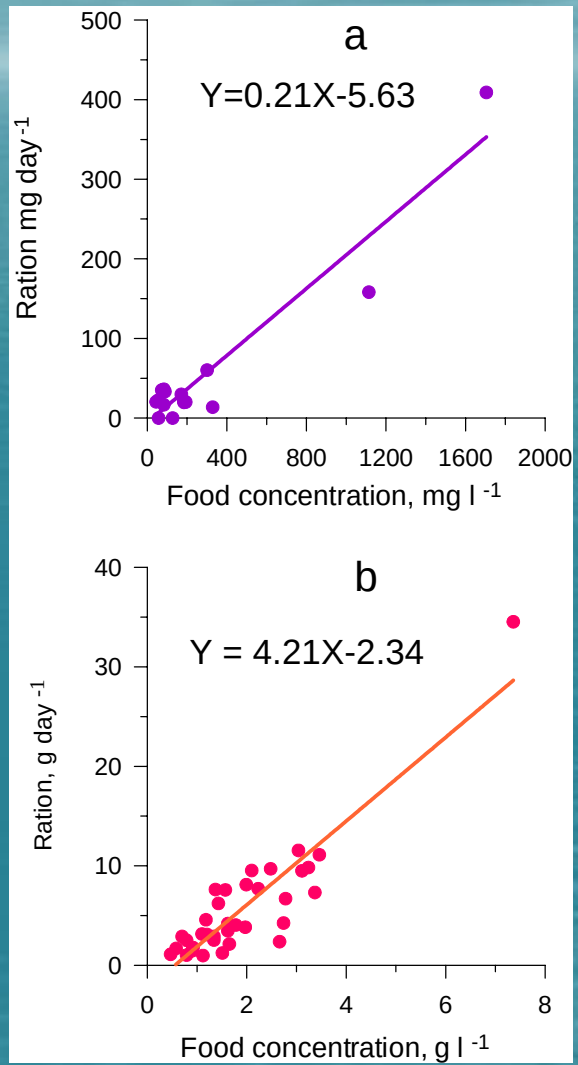
Abundance (A), biomass (B), mean wet weight (C) of *M. leidyi*, biomass of fodder zooplankton (D) in Sevastopol Bay in 1995-1996

The population succession of *M. leidyi* before and after intrusion of *B. ovata* is quite different. In 1995 *M. leidyi* was abundant in the Bay from the late June till the mid November. After appearance of *B. ovata* period of *M. leidyi* abundance decreased from 4-5 to only 1-2 months. These years *M. leidyi* abundance decreased more than 2 orders of values due to predatory impact of *Beroe* instead of three times in 1995-1996



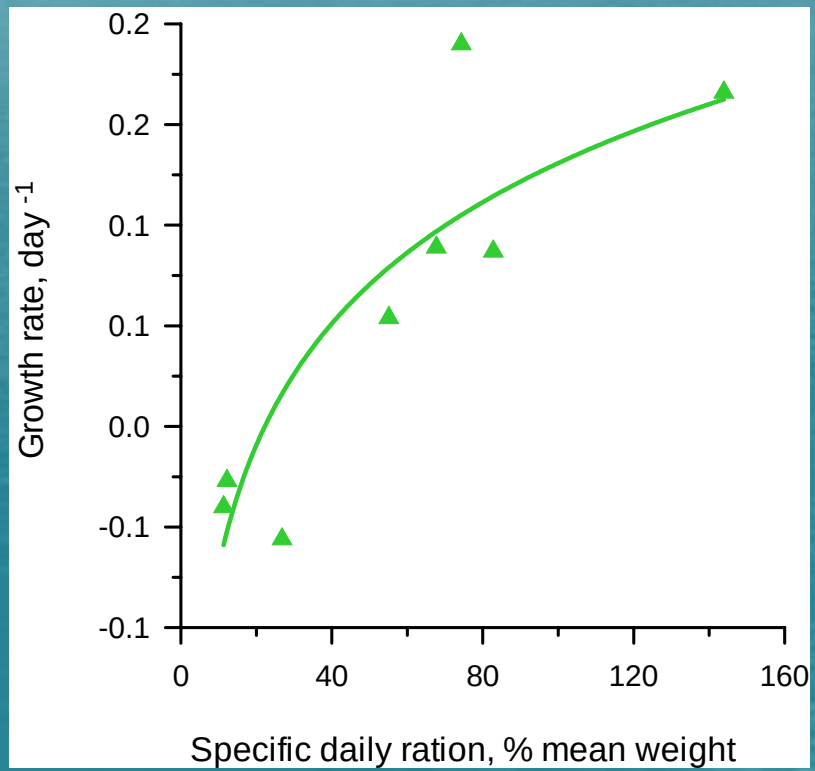
Effect of food concentration on daily ration in juvenile (a) and adult (b) *B. ovata*

- In laboratory experiments the ingestion rate of juvenile and adult *B. ovata* is proportional to food concentration over an extremely wide range of prey concentrations up to the highest experimental densities used where it could reach more than 400% of body wet weight per day. Such a high ingestion rate could produce a high growth rate of ctenophores.



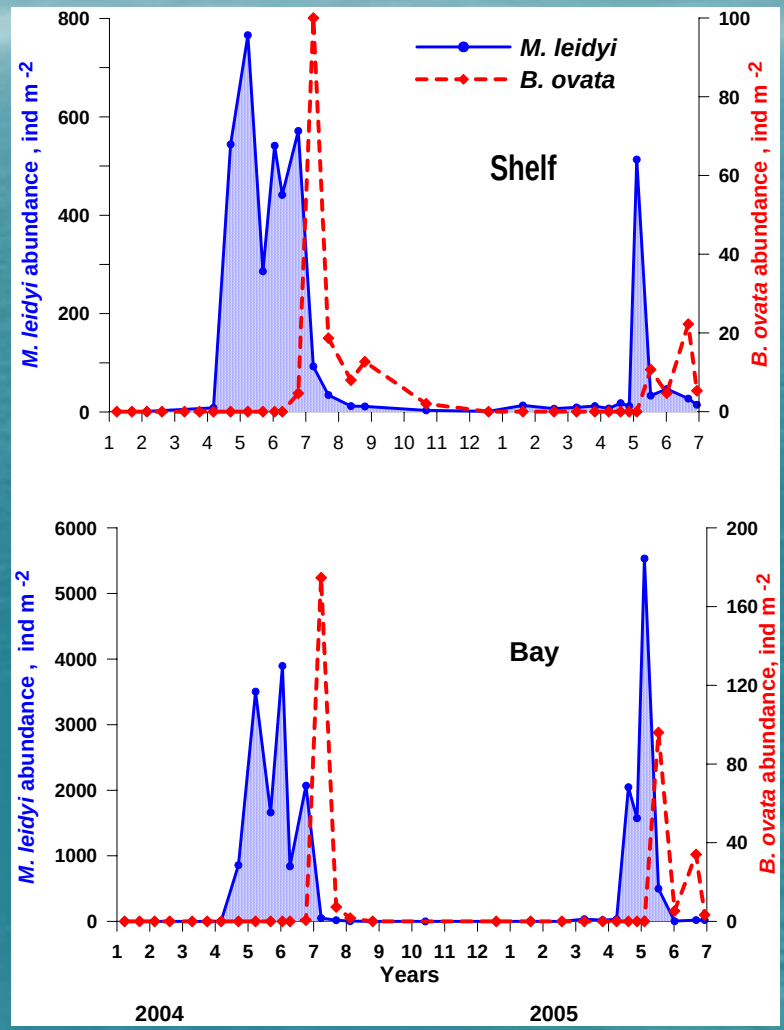
Effect of specific daily ration (% mean wet weight) on specific growth rate (day^{-1}) in adult *B. ovata*

- The specific growth rate increased from -0.05 to 0.20 while the ration increased from 27 to 150% of *B. ovata* wet weight So, *B. ovata* demands both high food rations and a high prey biomass for growth. Probably the low prey abundance in late autumn is a major reason for the disappearance of *B. ovata* from the plankton.



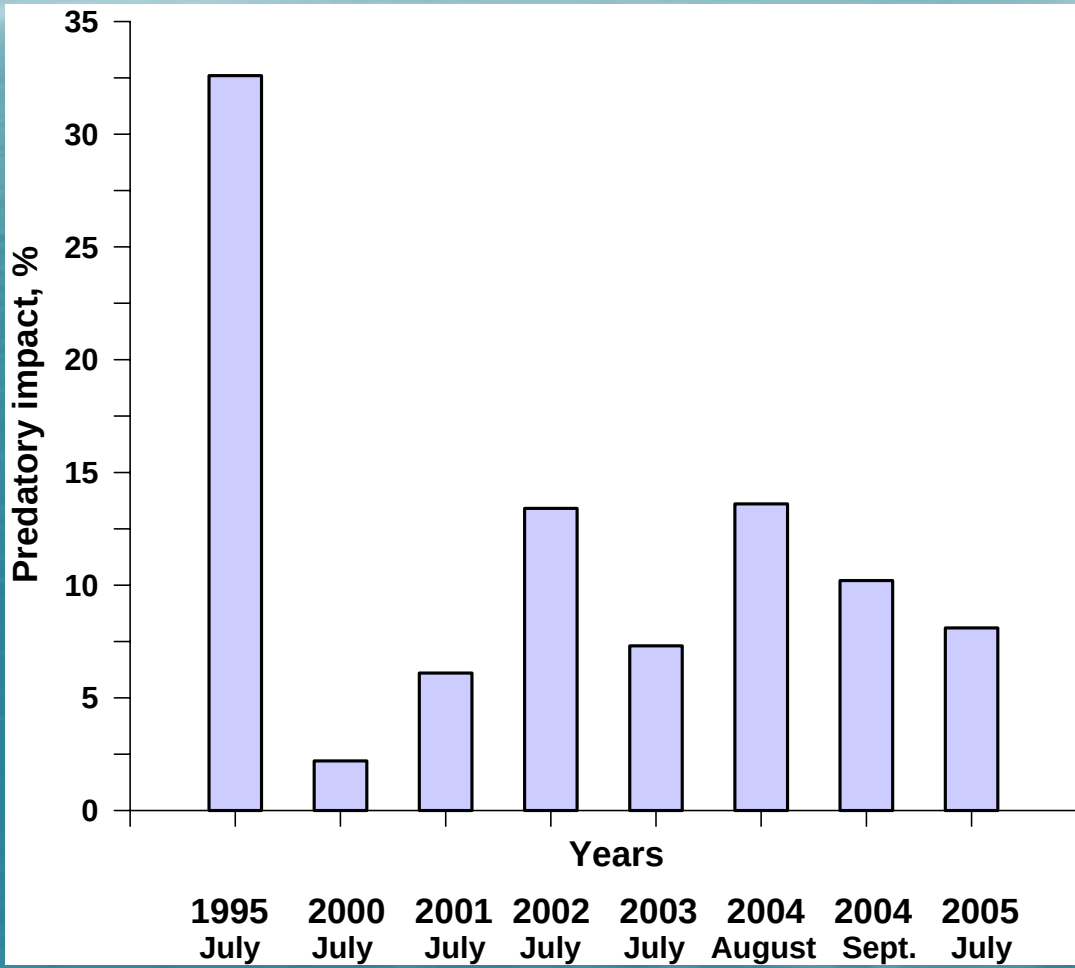
Abundance of *M. leidyi* and *B. ovata* in shelf region and Sevastopol Bay in 2004 –2005

2004 was different from the other years: *M. leidyi* appeared in plankton of shelf regions and Bay in large number one month later of previous years. There was high abundance during 2.5 months instead of 2-3 weeks. *Beroe* was observed in plankton only in October, that 2- 4 weeks later than in 2000-2003



M. leidyi predatory impact on mesozooplankton in 1995 - 2005

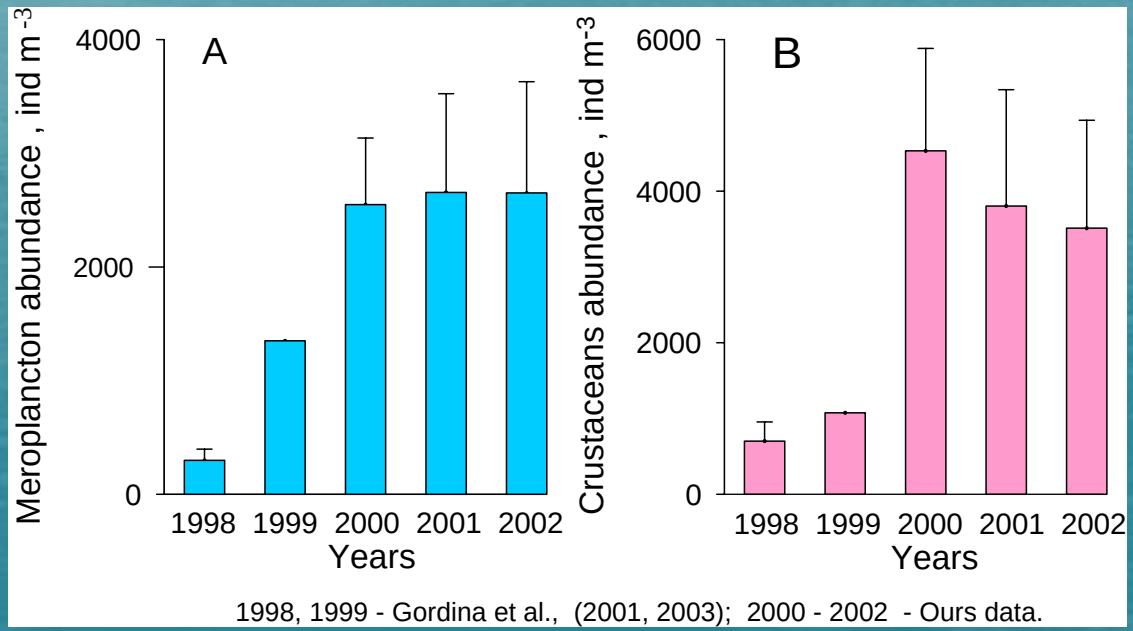
M. leidyi population predatory impact on fodder zooplankton was found to reduce in the years of *Beroe* availability: if in 1995 it was 30% of zooplankton biomass daily, in summer of recent years it ranged from 2 ± 0.4 to 12 %. Only in 2004 when *Mnemiopsis* dwelled in plankton for a long time its predatory impact was prolonged and high.



Interannual dynamics of abundance of meroplankton (A) and planktonic crustaceans (B)

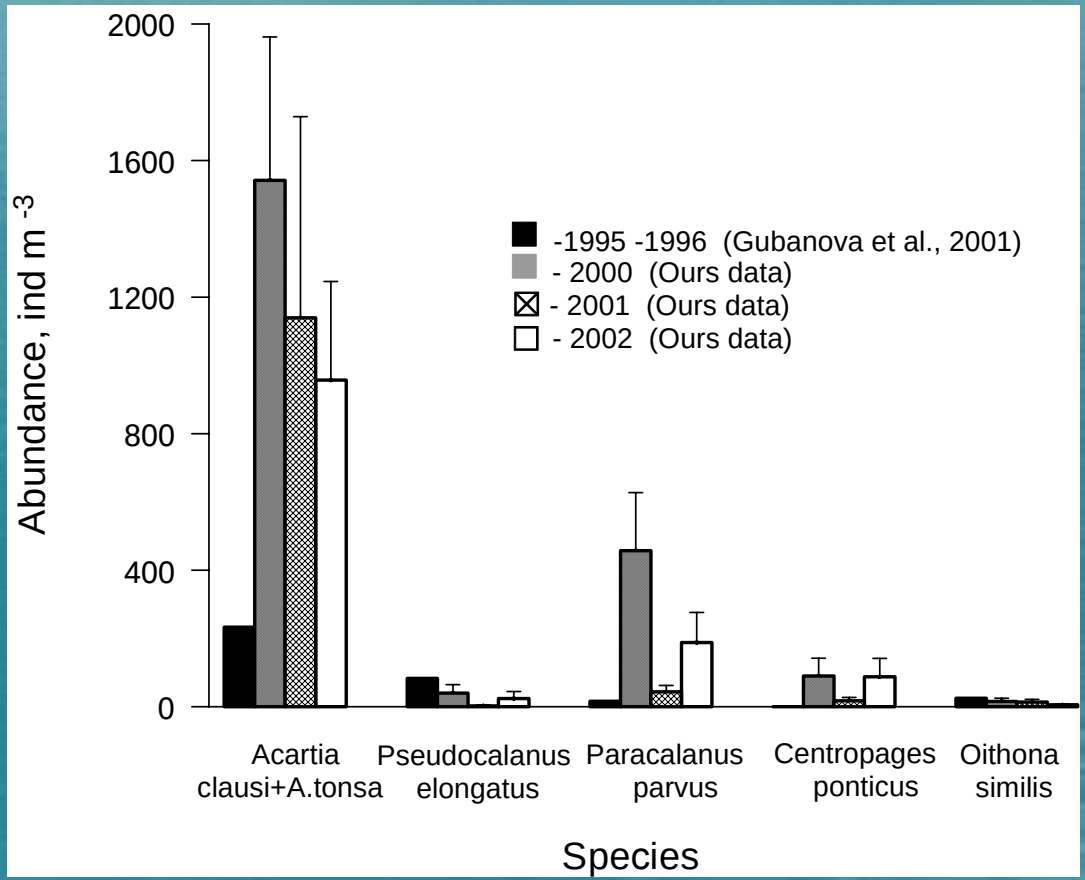
The mean abundance of crustacean in spring – autumn 2000 - 2005 increased 8 times in compare to 1998.

The abundance of meroplankton increased in 2000 – 2002, but during the last 3 years it became lower



Interannual dynamics of Copepoda species in Sevastopol Bay in 1995 -2005

- Considerable increases in mean annual abundance of some planktonic species especially warm-requiring Copepoda *Centropages ponticus* have been observed recently. Their share increased from 6 to 20% of total zooplankton abundance



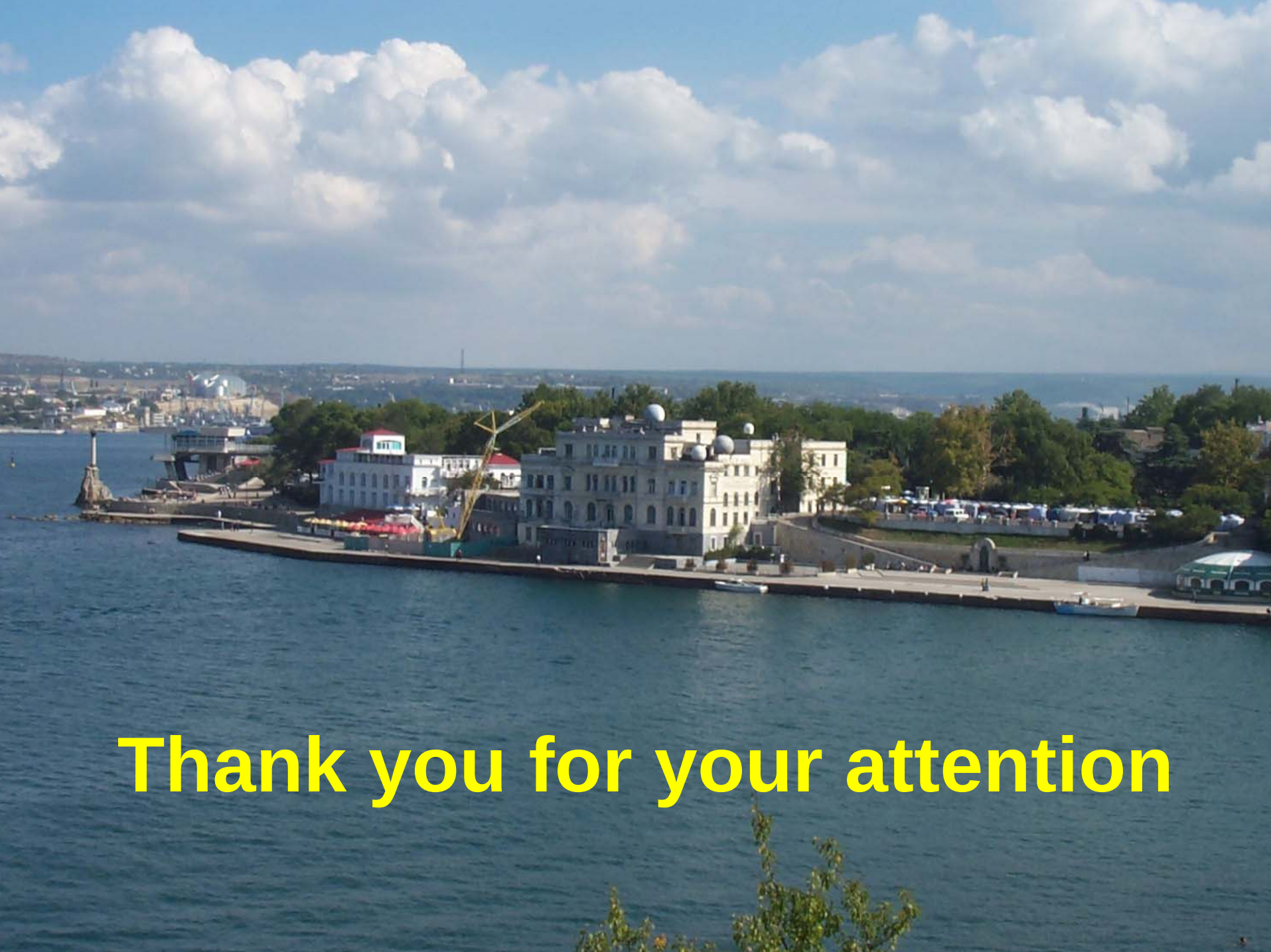
Conclusion

- In inshore waters of the Black Sea *B. ovata* was found to be very effective in controlling the abundance of their prey population. Sharp decrease of abundance and biomass of *M. leidyi* during the period when *B. ovata* occurs in the bay and shelf regions testify that *B. ovata* population does really control the *M. leidyi* population.

- The introduction of *B. ovata* to the Black Sea has shortened the time of *M. leidyi* availability in large numbers in the plankton and hence its predatory impact on the zooplankton. After *B. ovata's* arrival increases in mesozooplankton abundance, in numbers of fish larvae and eggs were observed in the Black Sea.

- Recently some features of recovery of plankton community in the inshore waters in the Black Sea were observed: shortening of duration and decrease of predatory pressure of *M. leidyi* on mesozooplankton resulted in its higher biodiversity and abundance, improvement of food supply for plankton – eating fish larvae.

- Meantime zooplankton concentration now is lower than it was in 70 – 80 ths. *Beroe* pressure did not result in the whole suppression of *M. leidyi* and its press on mesozooplankton and fish larvae but decreases the pressure. In this phase as the plankton community as the Black Sea inshore ecosystem must have turned to another level that is controlled with relation between introduced ctenophores


Thank you for your attention