

## Ecological Determination of the New Ctenophora-*Beroe ovata* Invasion in the Black Sea

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**Introduction.** In results of the high eutrophication and antropic impact during the last twenty years [15] the Black Sea becomes favourable for the development of many invaders (Zatzev, Mamaev, 1997). The stable settlement of some of them leads directly to drastic changes in the plankton fauna diversity and its quantitative development (Konsulov, Kamburska, 1997) and indirectly influences the other parts in the food chain. This concerns in great extent the representatives of Ctenophora which are important carnivores in planktonic food chains (Fraser, 1962).

Until 1985 only one representative of class Ctenophora was known as a part of the Black sea plankton composition-*Pleurobrachia pileus* (= *Pleurobrachia rhodospis*). This species has never had mass development (Konsulov, 1991).

In spring of 1986, 20-30 miles east from Cape Emine, a new one for the time being species of Ctenophora was identified as *Mnemiopsis leidyi* (Konsulov, 1989). *M. leidyi* has arrived through ship ballast waters from North Atlantic (Vinogradov, 1989 et al.). The reason for this species settlement and its development into the Black Sea basin is the high degree of eutrophication of the

Black Sea environment which ensures the best conditions for development and reproduction of the invader *M. leidyi*. Despite of the annual and seasonal fluctuation this species has been the dominant component in the Black Sea ecosystem during the last 10 years with maximal abundance in 1988-1989 (Bogdanova, Konsulov, 1993) and minimal abundance in 1991-1992 (Konsulov, Kamburska, 1997). Feeding on zooplankton *M. leidyi* appears as an important rival of the pelagic fish, which results in a decrease of their commercial resources (Nelson, 1925). On

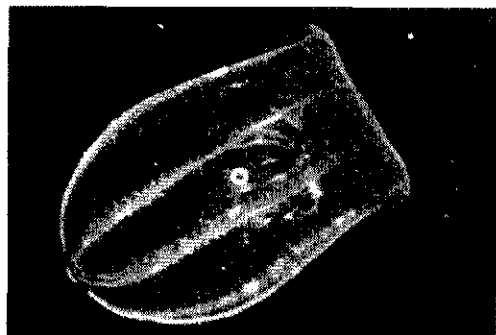


Fig. 1. *Beroe ovata* with engulfed individual of *Mnemiopsis leidyi*

the other hand elimination of herbivorous zooplankton (especially *Copepoda*) increases the phytoplankton abundance and biomass (Deason, Smayda, 1982) respectively to a high level of eutrophication.

Because of the serious disturbances in the pelagic ecosystem caused after the mass development of this species reaching total biomass more than 5 kg/m<sup>2</sup> (Malashev, Archipov, 1992) GESAMP outline a strategy for its control in the Black Sea (GESAMP, 1997). One of the proposals is to apply a biological control through introduction of its predator of the genus *Beroe*. This item has advantages and disadvantages. This measure is unnecessary because of the natural invasion of *Beroe ovata* in the Black Sea. In October 1997, in the vicinity of Shabla, a new species belonging to class Ctenophora and identified as *Beroe ovata* was located.

The aim of this paper is to present the main reason for the migration of *Beroe ovata* into the Black Sea waters. Up to now this predatory species has not been reported for the basin's fauna.

**Materials and Methods.** The samples for analysis and identification were collected by means of SCUBA diving technique. Species were gathered in a glass vessel and moved live to the laboratory. During sampling operations representatives of the species were shot with underwater camera in their natural environment as they move and eat. They were identified under laboratory conditions after observations of live individuals and species fixed in 4 % formalin solution and 3 % glutaraldehyde.

**Results and Discussion.** The results of morphostructural analysis of the Ctenophora allow us to assume that this is a newcomer in the Black Sea known as *Beroe ovata* species. Its body is egg-shaped with well expressed mouth-circling rim. Ciliated belts are laid meridionally and linked with crosswise arches.

It is well known that the species of the genus *Beroe* have previously been considered

to be exclusively carnivorous on other ctenophores (Greeve, 1970). Nelson (Nelson, 1925) reports that *Beroe ovata* feeds only on *M. leidy* species. Our investigation reveal that from 2 to 7 individuals of *M. leidy* with size 10-20 mm have been discovered in the guts of the live samples of *Beroe ovata*. Pieces of the prey with size 10-40 mm were also found as well as fragments of its sexual arches. The underwater photographs which helped for the identification of the species from class Ctenophora completely confirmed the results of the laboratory observations for the presence of *M. leidy* in *Beroe ovata*'s stomach contents [Fig. 1]. If the prey is smaller than the *Beroe ovata*, it is completely engulfed. Small individuals of *Beroe* cut with lips parts from the tissue of the *M. leidy* (Swanberg, 1970).

The technical mechanism for transfer of larvae and adult representatives of *M. leidy* and *Beroe ovata* is one and the same-ballast waters. Despite of this their invasion did not occur simultaneously but within a time gap of 10 years.

The analysis of the data referring zooplankton state, *M. leidy* quantity and eutrophication degree shows that in 1986 when *M. leidy* was discovered in the Black Sea waters, the zooplankton biomass was 192.36 mg/m<sup>3</sup> and the number of ctenophora was 8 ind/m<sup>3</sup>. In 1990 the zooplankton biomass decreased to 135.84 mg/m<sup>3</sup> and the number of *M. leidy* increased to 85-150 ind/m<sup>3</sup> (Bogdanova, Konsulov, 1993). An increasing trend of zooplankton biomass (about 210 mg/m<sup>3</sup>) was noticed after 1992 when the number of *M. leidy* was very low-6 ind/m<sup>3</sup>. In the period 1995-1997 its average abundance was 277 ind/m<sup>3</sup> (Konsulov, Kamburska, 1997). Under these ecological and trophic conditions of the Black Sea shallow shelf zone off the Bulgarian coast the same year we have discovered adult and juvenile stages of *Beroe ovata*. The reason for this is the high *M. leidy* abundance which *Beroe ovata* uses to feed

on, give us enough grounds to assume that the invasion of the new for the Black Sea Ctenophora is trophically determined.

Eliminating one of the reason for a high level of eutrophication-*Mnemiopsis leidyi*, the new ctenophora species *Beroe ovata* could reach high biomass. This can lead to a new disturbance in the Black Sea ecosystem as mass development of ctenophores drastically modifies the structure of an otherwise stable community (Bishop, 1967). The above

considerations rise some questions : whether would settle permanently and whether a species feeding on it will migrate in the Black Sea, because local predators of *Beroe ovata* are not known?

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## References

Bishop, J. W. 1967. Feeding rates of the Ctenophore *Mnemiopsis leidyi*.-In: Chesapeake Sci, **8**, 259-264. Bogdanova, D., A. Konsulov. 1993. On the distribution of the new Ctenophora species *Mnemiopsis leidyi* in the Black Sea along the Bulgarian coastline in the summer of 1990.-In: Comptes rendus de l'Academie bulgare des Sciences, no 46, **3**, 71-74. Deason, E. and Smayda, T. J. 1982. Ctenophore-zooplankton-phytoplankton interactions in Narragansett Bay, Rhode Island, USA during 1972-1977.-In: J. Plankton Res, **4**, 203-217. Fraser, H. F. 1962. The role of Ctenophores and salps in zooplankton production and standing crop. Rapp. P.-v. Reun.-In: Cons. perm. int. Explor. Mer, **153**, 121-123. GESAMP. 1997. Opportunistic settlers and the problem of the ctenophore *Mnemiopsis leidyi* invasion in the Black Sea.-In: Reports and studies, 258. Greeve, W. 1970. Cultivation experiments on North Sea ctenophores. Helgolander Wiss. Meeresunters, **20**: 304-317. Konsulov, A. 1989. One more New-comer. A New Species in the Black Sea-Dangerous or Harmless for Ecology.-Morski Svjet **2**, 8. Konsulov, A. 1991. Investigation on Biology, Ecology and the Meaning of the Zooplankton in the Black Sea in Front of

the Bulgarian Coast. D.Sc. Thesis (in Bulgarian). Konsulov, A., L. Kamburska. 1997. Sensitivity to anthropogenic factors of the plankton fauna adjacent to the Bulgarian coast of the Black Sea.-In: NATO ASI Series, **2/27**, 95-104. Malashev, V. I., Archipov, A. G. 1992. The Ctenophore *Mnemiopsis leidyi* in the West part of the Black Sea. Hydrobiology Journ. IBSS, **28/1**, 34-39. Nelson, T. C. 1925. On the occurrence and food habits of ctenophores in the New Jersey inland coastal waters.-In: Biol. Bull, **48**: 92-111. Prodanov, K. et al. 1997. Environmental management of fish resources in the Black Sea and their rational exploitation.-In: FAO: Studies and reviews, 268. Swanberg N. 1970. The feeding behavior of *Beroe ovata*.-In: Marine biology, **24**, 69-76. Vinogradov, M. E., et al. 1989. Ctenophore *Mnemiopsis leidyi* (A. Agassiz) (Ctenophora: Lobata)-New settlers in the Black Sea.-In: Oceanology, Institute of Oceanology, **29**, 293-299, Moskva. Vinogradov, M. E., et al. 1992. The Black Sea ecosystem.-Institute of Oceanology, 5-109, Moskva. Zaitzev Yu. P., V. Mamaev. 1997. Biological diversity in the Black Sea.-A study of change and decline, GEF, Black Sea Environmental series, vol. 3.

## Екологична обусловеност за навлизането на новата Ктенофора (*Beroe ovata*) в Черно море

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### (Резюме)

През последните двадесет години в резултат на повишената еутрофикация и антропогенно въздействие Черноморският басейн се явява благоприятен за трайното установяване на много прищълци. Масовото развитие на някои от тях води до драстични промени в биоразнообразието на планктонната фауна. Това се отнася изключително за представителите от клас Ctenophora. За черноморската планктонна фауна до 1997 г. са известни два представителя на този клас - *Pleurobrachia pileus* и *Mnemiopsis leidyi*. Според редица автори масовото развитие на *M. leidyi* след 1986 г. доведе до намаляване на експлоатационния запас на рибите и биоразнообразието на зоопланктона. GESAMP изработва стратегия за ограничаване развитието ѝ в Черно море. Едно от предложенията е за биологичен контрол чрез интродуциране на нейн хищник от род *Beroe*, а именно *Beroe ovata*, което има както предимства, така и недостатъци.

През октомври 1997 г. в района на Шабла бе открит нов представител на клас Ctenophora, принадлежащ към род

*Beroe* и идентифициран от нас като *Beroe ovata*. Този хищник не е съобщаван досега за фауната на басейна. Естествено то навлизане на *Beroe ovata* в Черно море направи излишна намесата на човека.

Настоящата публикация представя основната причина за навлизането на новата за Черно море ктенофора *Beroe ovata*, а именно високата численост на *M. leidyi*, която е основна храна на новия вид. Това ни дава основание да приемем, че естественото навлизане на новия вид в Черно море е трофично обусловено.

Но ако новата ктенофора се развие масово, елиминирайки една от причините за повишена еутрофност - *Mnemiopsis leidyi*, това би могло да доведе до нови драстични промени в черноморската екосистема, тъй като масовото развитие на ктенофорите видоизменя структурата дори на стабилни биологични съобщества. Остава открит въпросът дали *Beroe ovata* ще се установи трайно, кой ще бъде нейният хищник и кога ще се появи?

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