Aquatic Invasions (2006) Volume 1, Issue 4: 299-302
DOI 10.3391/ai.2006.1.4.17

Short communication

First record of *Mnemiopsis leidyi* A. Agassiz 1865 in the Baltic Sea

Jamileh Javidpour[1], Ulrich Sommer[1] and Tamara Shiganova[2*]
[1]*Leibniz-Institute of Marine Sciences, Düsternbrooker Weg 20, 24105 Kiel, Germany*
E-mail: usommer@ifm-geomar.de
[2]*P.P.Shirshov Institute of Oceanology RAS, Nakhimovsky avenue, 36, 117997 Moscow, Russia*
E-mail: shiganov@ocean.ru
**Corresponding author*

Received 9 December 2006; accepted in revised form 14 December 2006

Abstract

The invasive ctenophore *Mnemiopsis leidyi* was first recorded in the Kiel Bight (western Baltic Sea) on 17 October 2006 during a regular weekly sampling program. The *M. leidyi* abundance gradually increased from 29.5±12.7 ind.m^{-3} in mid-October to 92.3±22.4 ind.m^{-3} in late November 2006. The occurrence of *M. leidyi* in the Baltic Sea is of great concern as this invader has caused negative impacts in the southern seas of Europe.

Key words: ctenophores, alien species, *Mnemiopsis leidyi*, *Bolinopsis infundibulum*, ballast water, first record

The ctenophore *Mnemiopsis leidyi* A. Agassiz 1865 was introduced into the Black Sea in the 1980s (Vinogradov et al. 1989). It showed an explosive mass development there since 1988 and expanded to the Azov, Marmara, and eastern Mediterranean Seas and in 1999 it was introduced into the Caspian Sea likely with ballast water of oil tankers (Studenikina et al. 1991, Shiganova 1993, Shiganova et al. 2001, Ivanov et al. 2000).

The native habitat of *M. leidyi* includes estuaries and coastal regions along the eastern coast of North and South America (GESAMP 1997). *M. leidyi* is a polymorphic species with wide tolerance to environmental factors and high phenotypic variability (reviewed in GESAMP 1997). Therefore it could establish in different environmental conditions of the southern Eurasian seas. *M. leidyi* strongly affected all levels of ecosystems and fishery in the productive Black, Azov and Caspian; however no remarkable effects were recorded in the oligotrophic Aegean Sea (Shiganova et al. 2001, Shiganova et al. 2004a, b).

M. leidyi has not been observed along western and northern European waters until recently, although its wide tolerance to salinity (4-38‰) and temperature (4-32°C) (reviewed in GESAMP, 1997) make most of the Baltic Sea a suitable environment. Low water temperature in winter and a relatively low temperature in summer may negatively impair its reproduction.

On 17 October 2006 J. Javidpour and U. Sommer observed swarms of *M. leidyi* for the first time in the Kiel Bight (western Baltic Sea). The ctenophores were collected during a regular weekly sampling program in the Kiel Bight, which started in February 2005. The sampling station is located in the Kiel Fjord (54°19.7' N, 10°09.5' E). Vertical hauls from 10 m depth were carried out with a plankton net (opening diameter 80 cm, mesh size 500 µm). The collected animals were determined and counted alive. The preliminary identification of *M. leidyi*

was confirmed by T.A. Shiganova and also DNA sequencing was carried out by the private lab AGOWA (www.agowa.de/struktur/newsbasis.html).

M. leidyi (Figure 1) can morphologically be distinguished from the native ctenophore *Bolinopsis infundibulum*. The main difference is the position of the oral lobes. In *M. leidyi*, the oral lobes originate near the infundibulum, in *B. infundibulum* the oral lobes originate approx. half-way between the mouth and the infundibulum (Mayer 1912, see also Faasse and Bayha 2006, this issue). Individuals of *M. leidyi* from the Baltic Sea are more similar to specimens caught in the Sea of Azov and the Caspian Sea compared to individuals from the Black Sea (Shiganova et al. 2004a, b). The Baltic Sea individuals are smaller and adult individuals do not have oral lobes as long as the Black Sea individuals (Figure 2).

During weekly surveys *M. leidyi* was found in high numbers first on 17 October 2006 (29.5±12.7 ind.m^{-3}). Its abundance gradually increased to 92.3±22.4 ind.m^{-3} in the sample taken on 28 November 2006 (Figure 3). This very high density is comparable with the density of *M. leidyi* during the first years of its outbreak in the Black Sea (Vinogradov et al. 1989). During the first observation more than 80 % of individuals were equal or smaller than 5 mm in total length, the maximal length was 5 cm.

The surface water temperature in the Kiel Bight reached 22.6°C in July 2006, which was 1.7°C higher than in the same period in 2005 (Figure 4). The water temperature was 5°C higher in October and November 2006 compared to 2005. The salinity ranged from 13.1 to 22.2‰ which is comparable with the Black Sea salinity (14-22‰) (Ovchinnikov and Titov 1990). These conditions are optimal for *M. leidyi* reproduction (Kremer 1994). In the Black Sea *M. leidyi* begins to reproduce at water temperatures above 21°C, reaches a peak at 23°C and continues until the water temperature drops below 14°C in autumn (Shiganova et al. 2001).

The main factors to control the *M. leidyi* population size are temperature and prey availability (Kremer 1982, 1994, Sullivan 2001). The southwestern Baltic is considered as a high productive area during winter and a high abundance of copepods has been investigated in winter months compared to the summer mesozooplankton community (Schneider 1987). It is therefore assumed that the *M. leidyi* population in the Baltic Sea developed high

Figure 1. *Mnemiopsis leidyi* from the Baltic Sea (Photograph by J. Javidpour)

Figure 2. *Mnemiopsis leidyi* from the Black Sea (Photograph by T. Shiganova)

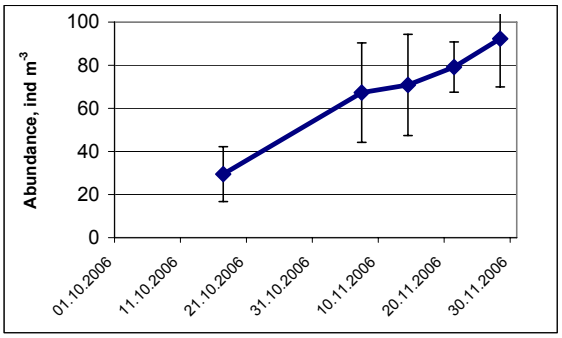

Figure 3. Temporal abundance (individuals per cubic meter) of *M. leidyi* in 2006 in the Kiel Bight

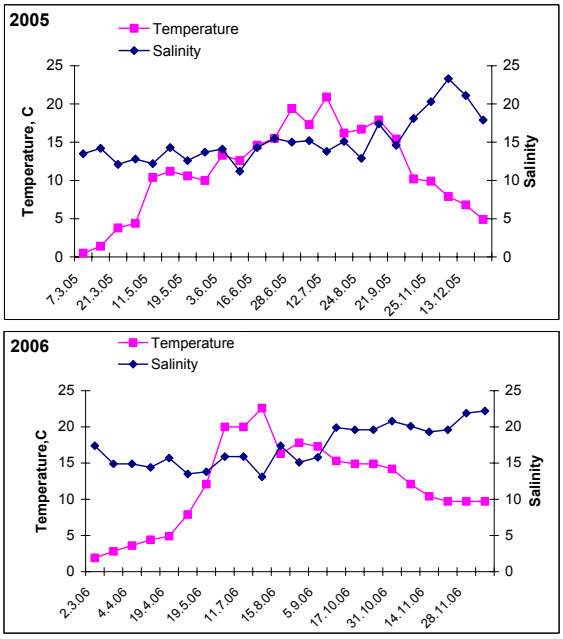

Figure 4. Seasonal temperature and salinity variations in 2005 and 2006 in the Kiel Bight

densities in October 2006, although it may have arrived earlier.

Two pathways could have brought *M. leidyi* into the Kiel Fiord. Firstly, Kiel is one of the busiest ports in the Baltic Sea and therefore *M. leidyi* may have been released with ballast water from America or the Black Sea region. Secondly, *M. leidyi* could have been transported into the Baltic by currents from the North Sea, where *M. leidyi* was observed earlier (Boersma et al. in press; Faasse and Bayha 2006, this issue; Hansson 2006, this issue).

It is unknown if the *M. leidyi* population is able to survive in winter in the Baltic Sea. However, the Kiel Bight temperature is very low in winter (0.4 to 2°C in March 2005 and 1.7 to 2°C in February and March 2006 (Figure 4) and we assume that it will probably not survive such temperatures at the rather low salinities. In contrast, *M. leidyi* survives winter temperatures <4°C in its native range if salinities are higher, but it does not survive colder temperatures in low salinity waters of the Black, Azov and the Caspian Seas (Purcell et al. 2001). However *M. leidyi* may be re-introduced into the Baltic Sea with water currents from the North Sea next year.

The expansion of *Mnemiopsis leidyi* in the Baltic Sea is of great concern as this aggressive invader has already damaged several productive ecosystems of the southern seas of Europe. Its high density in the Baltic Sea as well as in the North Sea estuaries in 2006 is an indication of a possible *M. leidyi* establishment in northern European coastal waters.

Acknowledgements

We gratefully acknowledge the crew of the vessel Polarfuchs for their help to collect the material. We would also like to thank Erik Mielke for his assistance during the field and laboratory work. We appreciate the assistance of Prof. Hanel who provided knowledge for prospective DNA analysis. The authors would like to acknowledge editorial suggestions by S. Gollasch and an anonymous reviewer.

References

Boersma M, Malzahn AM, Greve W and Javidpour J. The first occurrence of the Ctenophore *Mnemiopsis leidyi* in the North Sea, Helgoland Marine Research, in press.

Faasse MA and Bayha KM (2006) The ctenophore *Mnemiopsis leidyi* A. Agassiz 1865 in coastal waters of the Netherlands: an unrecognized invasion? Aquatic Invasions 1(4): 270-277

GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) (1997) Opportunistic settlers and the problem of the ctenophore *Mnemiopsis leidyi* invasion in the Black Sea. Rep. Stud. GESAMP 58: 84 pp.

Hansson HG (2006) Ctenophores of the Baltic and adjacent Seas - the invader *Mnemiopsis* is here! Aquatic Invasions 1(4): 295-298

Ivanov VP, Kamakin AM, Ushivtsev VB, Shiganova TA, Zhukova OP, Aladin NV, Wilson SI, Harbison GR and Dumont HJ (2000) Invasion of the Caspian Sea by the comb jellyfish *Mnemiopsis leidyi* (Ctenophora). Biological Invasions 2: 255-258

Kremer P (1982) Effect of food availability on the metabolism of the ctenophore *Mnemiopsis mccradyi*. Marine Biology 71: 149-156

Kremer P (1994) Patterns of abundance for *Mnemiopsis* in US coastal waters: a comparative overview. ICES Journal of Marine Science 51: 347-354

Mayer AG (1912) Ctenophores of the Atlantic coast of North America. Publ. Carnegie Inst. Wash. 162: 1-58

Ovchinnikov IM and Titov VB (1990) Antycyclonic eddies of currents in the coastal area of the Black Sea. DAN USSR 314: 739-746

Purcell JE, Shiganova TA, Decker MB and Houde ED (2001) The ctenophore *Mnemiopsis leidyi* in native and exotic habitats: U. S. estuaries versus the Black Sea basin. Hydrobiologia 451: 145-176

Schneider G (1987) Role of advection in the distribution and abundance of *Pleurobrachia pileus* in Kiel Bight. Marine. Ecology Progress Series 41: 99-102

Shiganova TA (1993) Ctenophore *Mnemiopsis leidyi* and ichthyoplankton in the Sea of Marmara in October of 1992. Oceanology 33: 900-903

Shiganova TA, Mirzoyan ZA, Studenikina EA, Volovik SP, Siokou-Frangou I, Zervoudaki S, Christou ED, Skirta AY, Dumont HJ (2001) Population development of the invader ctenophore *Mnemiopsis leidyi* in the Black Sea and other seas of the Mediterranean basin. Marine Biology 139: 431-445

Shiganova TA, Dumont HJD, Mikaelyan A, Glazov D, Bulgakova MYV, Musaeva EI, Sorokin PY, Pautova LA, Mirzoyan ZA and Studenikina EI (2004a) Interaction between the Invading Ctenophores *Mnemiopsis leidyi* (A. Agassiz) and *Beroe ovata* Mayer 1912, and their Influence on the Pelagic Ecosystem of the Northeastern Black Sea Eds. Dumont H, Shiganova T and Niermann U: The Ctenophore *Mnemiopsis leidyi* in the Black, Caspian and Mediterranean Seas and other aquatic invasions. NATO ASI Series, 2. Environment. Kluwer Academic Publishers: 33-70

Shiganova TA, Christou ED, Bulgakova JV, Siokou-Frangou I, Zervoudaki S and Siapatis A (2004b) Study on the distribution and biology of the invader *M. leidyi* in the northern Aegean Sea, comparison with indigenous species *Bolinopsis vitrea*. Eds: Dumont H, Shiganova T and Niermann U. The Ctenophore *Mnemiopsis leidyi* in the Black, Caspian and Mediterranean Seas and other aquatic invasions. NATO ASI Series, 2. Environment. Kluwer Academic Publishers: 113-135

Studenikina YeI, Volovik SP, Mirzoyan IA and Luts GI (1991) The ctenophore *Mnemiopsis leidyi* in the Sea of Azov. Oceanology 31: 722-725

Sullivan BK, Van Keuren D and Clancy M (2001) Duration and size of blooms of the ctenophore *Mnemiopsis leidyi* in relation to temperature in Narragansett Bay, RI. Hydrobiologia 451: 113-120

Vinogradov ME, Shushkina EA, Musayeva EI, and Sorokin PY (1989) A new exotic species in the Black Sea: the ctenophore *Mnemiopsis leidyi* (Ctenophora: Lobata). Oceanology 29(2): 220-224