

First record of *Mnemiopsis leidyi* A. Agassiz, 1865 (Ctenophora; Lobata; Mnemiidae) off the Mediterranean coast of Israel

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Received 17 June 2009; accepted in revised form 22 June 2009; published online 25 June 2009

Abstract

The American comb jelly, *Mnemiopsis leidyi*, was first noted off the central Mediterranean coast of Israel on 3 March 2009, when a swarm interfered with the operation of a desalination plant. Throughout the spring dense populations have been recorded along the entire Israeli coast. The occurrence of *M. leidyi* in the SE Levant is of great concern because its notorious impacts on fisheries and because its swarms clog seawater intake pipes and hamper the operation of coastal installations.

Key words: *Mnemiopsis leidyi*, Ctenophora, invasive species, Mediterranean, Israel

Mnemiopsis leidyi A. Agassiz, 1865, indigenous in western Atlantic coastal waters (40°N to 46°S), has spread in the past three decades to the Black, Caspian, Baltic and North seas (Mianzan 1999; Shiganova et al. 2001a; Javidpour et al. 2006; Faasse et al. 2006). Together with over-fishing and increasing water pollution, the introduction of the zooplanktivorous *M. leidyi* to the Black Sea in the 1980s set in motion a dramatic chain of events that culminated with a crash of the sea's major fishery and losses estimated in the hundreds of millions of US dollars that secured the species a slot on the International Union for Conservation of Nature (IUCN) list of 100 'World's Worst' invaders. Given the severe ecological and economical harm elsewhere, the spread of *M. leidyi* to the SE Levant is of major concern.

The first occurrence *M. leidyi* in the Mediterranean Sea was noted in spring-summer 1990 in the Gulfs of Saronikos and Elefsis in the western Aegean Sea (Shiganova et al. 2001b, Shiganova et al. 2004a) (Annex 1). In the spring of 1992 the species appeared in the Bay of Mersin on the Mediterranean coast of Turkey, in

1993 in Kusadasi on the Aegean coast of Turkey (Uysal and Mutlu 1993; Kideys and Niermann 1994), and in off the Syrian coast (Shiganova 1997). As all those locales were in the vicinity of ports, and no population persisted long, it was suggested that *M. leidyi* has been introduced with ballast water (Shiganova et al. 2001a). Between 1991 and 1996 and again in 1998, *M. leidyi* swarms were observed in the summer months in the northern Aegean Sea off Lesbos, Skyros, Limnos, Alonissos Islands and Halkidiki Peninsula. Shiganova et al. (2001a, 2004b) proposed these swarms may have been swept with the outflow of the Black Sea water masses. Indeed, in the summer of 1998, their greatest abundance was noted in the proximity of the Dardanelles. *Mnemiopsis leidyi* was observed several times in the Berre Lagoon near Marseille and in the Bay of Piran, in the northern Adriatic Sea (Shiganova and Malej 2009), where they may have been "... released with ballast water originating from the Black Sea, as there is direct connection between the Port of Koper and various Black Sea ports." (Shiganova and Malej 2009: 64). No decrease in mesozooplankton

biomass has been observed in the Mediterranean Sea following the appearance of *M. leidyi* in the area (Shiganova et al. 2001a, 2004a).

The coastal waters of the southern Levantine Sea are ultraoligotrophic (Berman et al. 1984, 1986), sea surface salinity in the summer months tops 39.5 psu (I. Gertman, pers. comm.), and the temperature – 31.5°C (L. Raskin, pers. comm.). The upper layer, to depth of 100 m, is mixed in most winters, whereas during the remainder of the year a sharp halocline and thermocline begins at 10 m depth. The native habitat of *M. leidyi* is in temperate to subtropical estuaries along the Atlantic coast of the Americas. Though tolerant of a wide range of salinity (4–38 psu), temperature (4–31°C) and water quality conditions over a broad range of inshore habitats (GESAMP 1997), it has flourished when introduced to bodies of water of low salinities and temperatures and high productivity – The Black Sea, the Sea of Azov, the Caspian Sea and the Baltic Sea. In the Mediterranean too, it has been found in lagoons and gulfs influenced by high river runoffs with their reduced salinity and terrigenous nutrient input: its highest abundance in the northern Aegean Sea was noted in Thermaikos and Strymonikos gulfs (Siapatis et al. 2008). Yet, from 3 March 2009 to the present (mid-June 2009), large swarms of *M. leidyi* have been observed along the entire Israeli Mediterranean coast from Ashkelon to Rosh HaNikra, from the intertidal to depth of 20 m, inside ports and along the open shore (Figure 1). *Mnemiopsis* blocked water intake pipes pose a threat to cooling systems of coastal power plants and desalination plants, a series of which have been constructed along the Mediterranean coast of Israel. The presence of comb jelly swarms forced plant engineers to modify their operation by increasing the frequency of backwash cycles in the pretreatment stage and consequently increasing the discharge of coagulants such as ferric sulfate into the sea, and ultimately to reduce output.

The principal factors believed to rein in the species' population size are temperature and prey availability, yet the high sea surface temperature and salinity and paucity of plankton in the SE Levant are far from the values deemed optimal for the species' reproduction (Kremer 1994; Sullivan et al. 2001). A predator on zooplankton, primarily copepods, cladocerans, mollusc larvae, and pelagic fish eggs and larvae (Tzikhon-Lukanina et al. 1991), *M. leidyi* may prompt cascading effects through the food web. Fish



Figure 1. The American comb jelly, *Mnemiopsis leidyi*, collected off Tel Aviv, June 2009. Photo by Guy Paz

stocks in the Black and Caspian seas have suffered due to predation on eggs and larvae, with repercussions felt at all trophic levels, including the top predators, the dolphin and Caspian seal (Shiganova et al. 2004b,c). Off the Israeli coast the appearance of swarms of *M. leidyi* coincided with the spring plankton peak. Their high density along the coast may have reduced the local zooplankton stock, in which case it may moderate the size of the swarms of the equally voracious invasive scyphozoan jellyfish, *Rhopilema nomadica* Galil, 1990, that appear in early summer (Galil 2007).

The Mediterranean Sea is highly susceptible to ship-transported bioinvasions: one fifth of the alien species recorded in the Mediterranean have been primarily introduced by vessels (Galil 2009). And no wonder - in 2006, 13,000 merchant vessels made 252,000 calls at Mediterranean ports and an additional 10,000 vessels transited through the sea (REMPEC/WG.29/INF.9). The increase in shipping-related invasions was noted in recent publications, and may be attributed to the increase in shipping volume throughout the region, changing trade patterns that result in new shipping routes, improved water quality in port environments, augmented opportunities for overlap with other introduction vectors, and rising awareness and research effort (CIESM 2002; Galil 2006). *Mnemiopsis leidyi* may have been transported to Israel in vessels arriving from ports in the Black Sea, northern Adriatic, Baltic or North seas or from its native range on the Atlantic coast of the Americas. The density observed by us is, however, too high to accord with a recent deballasting event. *Mnemiopsis* was probably introduced a while ago but remained unrecorded until its populations greatly increased.

Acknowledgements

The authors thank Eng. Y. Rodal, operation manager of Palmachim desalination plant for his help.

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Annex 1Records of *Mnemiopsis leidyi* in the Mediterranean Sea

Location	Geographic coordinates		Survey date	Reference
	Latitude, N	Longitude, E		
Greece, Saronikos and Elefsis gulfs	37°43'	23°46'	1990	Shiganova et al. 2001b
Greece, Lesvos	39°13'	26°12'	1995-1996	Shiganova et al. 2001b
Greece, Skyros	39°00'	24°05'	1991-1996	Shiganova et al. 2001b
Greece, Limnos (Moudros Bay)	39°55'	25°15'	1991-1996, 2001	Shiganova et al. 2001b; Shiganova et al. 2004a
Greece, Alonissos	39°15'	23°50'	1991-1996	Shiganova et al. 2001b
Greece, Halkidiki	40°05'	23°19'	1991-1996	Shiganova et al. 2001b
Greece, Thermaikos Gulf	40°15'	22°45'	2004	Siapatis et al. 2008
Greece, Strymonikos Gulf	40°48'	24°01'	2004	Siapatis et al. 2008
Greece, Evoikos Gulf	40°05'	23°19'	2004	Siapatis et al. 2008
Turkey, Bay of Mersin	36°48'	34°38'	1992	Uysal and Mutlu 1993
Turkey, Kusadasi	37°52'	27°14'	1993	Kideys and Niermann 1994
Syria, Latakia	35°31'	35°48'	1993	Shiganova 1997
France, Berre Lagoon	43°44'	05°21'	2006	Shiganova and Malej 2009
Slovenia, Bay of Piran	45°52'	13°56'	2005	Shiganova and Malej 2009
Israel, Ashkelon	31°38'	34°32'	March, 2009	Present study
Israel, Palmahim	31°55'	34°42'	March, 2009	Present study
Israel, Tel Aviv	32°00'	34°09'	June, 2009	Present study
Israel, Rosh HaniKra	33°04'	35°06'	June, 2009	Present study