BioInvasions Records (2013) Volume 2, Issue 3: 191–194
doi: http://dx.doi.org/10.3391/bir.2013.2.3.03

Open Access

Rapid Communication

A moveable feast: *Beroe cucumis sensu* Mayer, 1912 (Ctenophora; Beroida; Beroidae) preying on *Mnemiopsis leidyi* A. Agassiz, 1865 (Ctenophora; Lobata; Bolinopsidae) off the Mediterranean coast of Israel

Bella S. Galil[1]* and Roy Gevili[2]

1 *National Institute of Oceanography, Israel Oceanographic and Limnological Research, POB 8030, Haifa 31080, Israel*
2 *Rogozin 54/25, Ashdod 77440, Israel*

E-mail: bella@ocean.org.il (BSG), gevil8@walla.com (RG)

**Corresponding author*

Received: 20 May 2013 / Accepted: 9 August 2013 / Published online: 12 August 2013

Handling editor: Vadim Panov

Abstract

In the winter months of 2012 and 2013 aggregations of the native comb jelly *Beroe cucumis* were observed and photographed along the Israeli coast preying on the invasive American comb jelly *Mnemiopsis leidyi*. It is suggested that native beroid may take part in controlling populations of the invasive ctenophore.

Key words: *Beroe cucumis; Mnemiopsis leidyi*; intraguild predation; invasive species; Mediterranean Sea

Introduction

Gelatinous plankton plays an important part of the marine food web, and its disruptive outbreaks have increasingly drawn the interest of researchers (Licandro et al. 2010; Costello et al. 2012; Brotz et al. 2012). In the Mediterranean Sea, gelatinous plankton outbreaks have long been noted, but whether anthropogenic perturbations, such as eutrophication, overfishing, the removal of top predators, global warming or the increase of manmade marine hard substrates serve as drivers for the outbreaks has not been established (CIESM 2001). However, whereas most recurring outbreaks in the western and central Mediterranean concern indigenous species, alien gelatinous species have taken over in the Levant, a region unique in hosting four alien scyphozoans and two alien ctenophorans, *Mnemiopsis leidyi* A. Agassiz, 1865 and *Beroe ovata* Mayer, 1912, possibly transported in vessels arriving from ports in the Black Sea (Galil et al. 2011; Galil 2012).

The first-confirmed observations of *M. leidyi* in the Eastern Mediterranean took place in 1990 in the western Aegean Sea (Shiganova et al. 2001b). It was subsequently recorded off the Aegean and Mediterranean coasts of Turkey (Uysal and Mutlu 1993; Kideys and Niermann 1994), Syria (Shiganova 1997) and Israel (Galil et al. 2009). Since January 2009, its swarms have been intermittently observed along the Israeli coast, fouling fishing gear and blocking desalination plants intake pipes, forcing increased frequency of backwash cycles and the discharge of coagulants such as ferric sulfate, and, ultimately, reducing output (Galil 2012). In June 2011 and in January 2012, specimens of *B. ovata*, a specialized predator of *M. leidyi*, were recorded and photographed outside the Port of Ashdod, Israel (Galil et al. 2011). In the present paper the first occurrence off the Israeli coast of the native beroid, *Beroe cucumis sensu* Mayer, 1912 (= *B. ovata sensu* Chun) is recorded.

Methods

While SCUBA diving, photographs of individuals and swarms of *Mnemiopsis leidyi* and *Beroe cucumis* were taken using GoPro HERO2 camera. The former species was identified from high

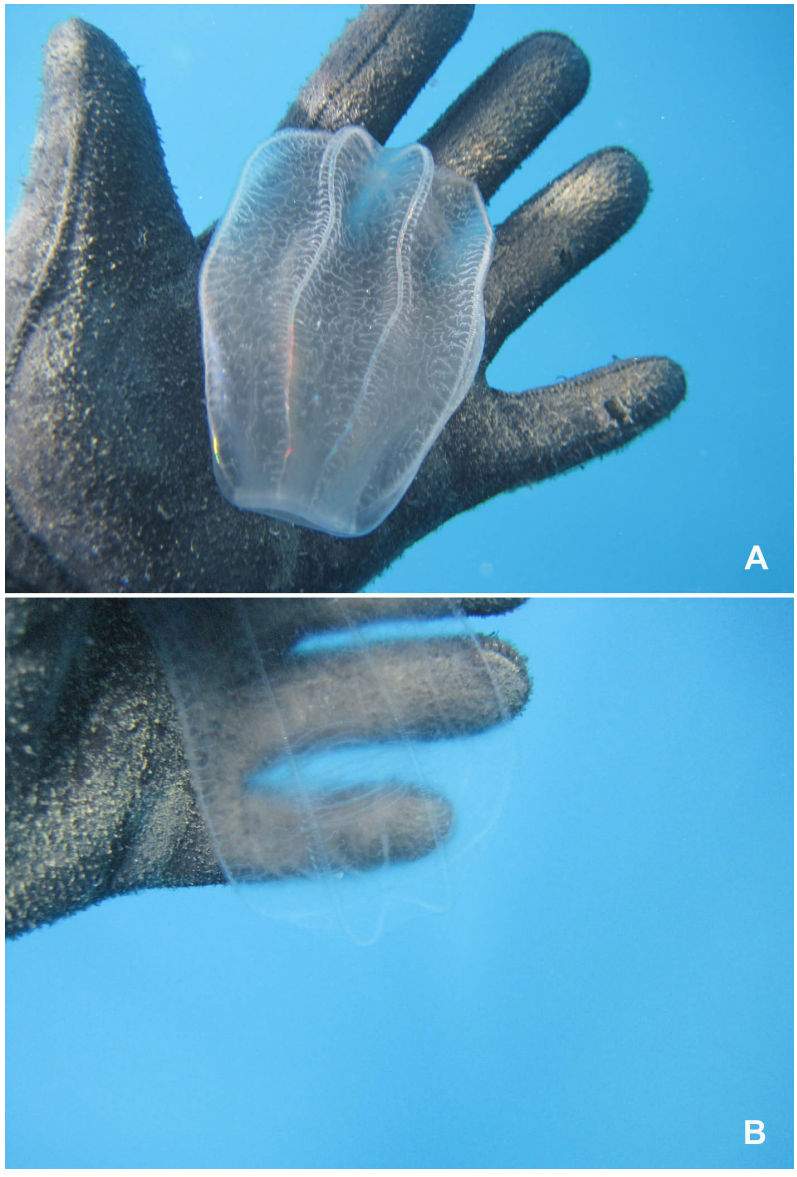

Figure 1. A. *Beroe cucumis sensu* Mayer, 1912. Photographed off Ashdod port breakwater, February 21 2013 (Photograph by R. Gevili). **B.** *Beroe cucumis sensu* Mayer, 1912 with whole undigested *Mnemiopsis leidyi* A. Agassiz, 1865 visible in it gut. Photographed off Ashdod port breakwater, February 21 2013 (Photograph by R. Gevili).

resolution photographs based on descriptions by Shiganova and Malej (2009), while the latter's identity was confirmed by Prof. Shiganova.

Results

From October 2011 to January 2012, and again from December 2012 to May 2013, individuals and dispersed swarms of *M. leidyi* were sighted along the Israeli coast from Maagan Michael (34°53'E, 32°33'N) to Ashkelon (34°33'E, 31°41'N). Confirmed sightings of *B. cucumis* were rarer: all but two took place off Ashdod (34°38'E, 31°48'N), on December 2011 and January 2012, and again in December 2012, and February, April and May 2013. On 21 February 2013, a swarm was photographed off Ashdod at 20 m depth. The swarm was composed of large-sized individuals (50–100 mm TL) (Figure 1A). On 8 May 2013, another swarm was photographed off Ashkelon ((34°34'E, 31°39'N), at depth of 15–20 m. Individual *B. cucumis* were noted and photographed as engulfing *M. leidyi* whole and undigested *M. leidyi* were clearly visible in the gut of *B. cucumis* (Figure 1B).

Discussion

Mnemiopsis leidyi has spread in the past three decades to the Black, Caspian, Baltic and North seas (Mianzan 1999; Shiganova et al. 2001a,b; Javidpour et al. 2006; Faasse et al. 2006). Its introduction to the Black Sea in the 1980s set in motion a dramatic chain of events that culminated in a crash of the sea's major fishery and earned it a slot on the International Union for Conservation of Nature (IUCN) list of 100 'World's Worst' invaders (http://www.issg.org/worst100_species.html). Given the severe ecological and economical harm elsewhere, its introduction into the Mediterranean is of major concern. Though first recorded in the Mediterranean Sea in 1990 (Shiganova et al. 2001b), in 2009 large swarms appeared along the Ligurian, Tyrrhenian and Ionian shores of Italy, the Mediterranean coast of Spain and the Balearic Islands, and the SE Levant (Boero et al. 2009; Fuentes et al. 2009; Galil et al. 2009). As the population of *M. leidyi* in the Black Sea was greatly reduced following the introduction of *B. ovata* (Kideys 2002), information is eagerly sought concerning predators that may play a part in regulating its abundance.

The Mediterranean records of *B. cucumis* are few, and spatially and temporally scattered (Bayha et al. 2004; Shiganova and Malej 2009). It had not been previously recorded off the Israeli coast though special attention has been paid in recent years to scyphozoans and ctenophorans (Galil 2012). Its recently documented occurrences along the Israeli coast provide us with the first record in the region, as well as evidence for predation on the invasive *M. leidyi.*

Recently, experimental quantification (Hosia et al. 2011) of predation rates of the North Sea native *Beroe gracilis* Künne, 1939 on the recently introduced *M. leidyi* have indicated whole prey maximum clearance rates of 0.42–0.97 individuals per predator h^{-1}, which, when applied to *in situ* abundances, impact slightly on the population of *M. leidyi.* These intraguild interactions are size-dependent and thus complicated by possible size refuge from predation afforded larger individuals and possible predation of *M. leidyi* on young *B. gracilis*. However, *B. cucumis*, which can grow to 10 cm in length, has been known to prey on *Bolinopsis infundibulum* (O.F. Müller, 1776), similar to *M. leidyi* in size (Falkenhaug, 1996). In fact, *B. cucumis* was observed feeding on *M. leidyi* in captivity, and owing to its larger size it is unlikely *M. leidyi* would enjoy size refuge (Hosia et al. 2011).

The spatial and temporal occurrences of the two beroids in the SE Levant overlap to some degree with that of *M. leidyi*. Exploiting their high feeding and growth rate potentials, *B. ovata* and *B. cucumis* may be capable of controlling the populations of *M. leidyi*.

Acknowledgements

The authors are deeply grateful to Prof. Tamara Shiganova (Russia) for kindly identifying *Beroe cucumis sensu* Mayer, 1912 (= *B. ovata sensu* Chun) listed in this study. This research was partly supported by the European Community's Seventh Framework Programme (FP7/2007-2013) for the projects Vectors of Change in Oceans and Seas Marine Life, Impact on Economic Sectors (VECTORS), and *Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential* (COCONET) (BSG).

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