The westernmost record of *Rhoplema nomadica* (Galil, 1990) in the Mediterranean – off the Maltese Islands

Alan Deidun¹*, Shaun Arrigo² and Stefano Piraino³

¹IOI-Malta Operational Centre, University of Malta, Msida, Malta
²Calm Seas, Malta
³Evolutionary and Developmental Biology of Marine Invertebrates, Dipartimento Scienze e Tecnologie Biologiche ed Ambientali (DISTEBA), University of Salento, Lecce, Italy

E-mail: alan.deidun@um.edu.mt (AD), heinemann@waldonet.net.mt (SA), stefano.piraino@unisalento.it (SP)

*Corresponding author

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Abstract

In late autumn and early winter of 2004, two individuals of the Erythrean alien *Rhoplema nomadica* were sighted at two locations off the Maltese Islands, marking the westernmost records of this species in the Mediterranean Sea. Since only two adult specimens were ever reported from Maltese waters, the species has yet to establish a reproducing population in the Sicily Channel. The record is considered as yet another hallmark of the warming trend of the Mediterranean Sea.

Key words: *Rhoplema nomadica*, Maltese Islands, Erythrean alien, warming trend

Introduction

*Rhoplema nomadica* Galil, 1990, is a tropical scyphozoan which purportedly first entered into the Mediterranean Sea via the Suez Canal since the late 1970’s. Since then, this planktrophic jellyfish species has regularly formed swarms of considerable proportions (some stretching for 100km) along the Levantine coast, decimating this ultra-oligotrophic part of the Mediterranean Sea of plankton resources and impinging in a detrimental fashion on tourism, fisheries and coastal installations (Galil 2007).

*Rhoplema nomadica* is considered as one of the “100 worst invading species” in Europe within the Delivering Alien Invasive Species Inventories for Europe (DAISIE), this designation being justified by its rapid spread and high densities in the easternmost parts of the Mediterranean Sea. Ever since its introduction more than 30 years ago, the native Mediterranean *Rhizostoma pulmo* Macri, 1778, has ceased to be the important scyphozoan species in the Levant in terms of biomass and abundance (Lakkis and Zeidane 2010). *Rhoplema nomadica*’s prodigious spread in the Levantine Basin is spurred by its peculiar life cycle, which features polyp asexual reproduction and resting periods via podocyst formation, and polydisc strobilation leading to liberation of multiple ephyrae from each individual polyp.

Lotan et al. (1992) conducted tests on the temperature dependence of the strobilisation process of the species’ polyps and concluded that the synchronisation and annual occurrence of *Rhoplema nomadica* may be controlled by seasonal variations in water temperature regimes. This jellyfish species inflicts painful stings on swimmers and fishermen, characterised by erythematous eruptions, itching and burning sensations. Systematic symptoms include fever, fatigue and muscular aches (as reviewed in Gusman et al. 1997). As early as the summer of 1987, severe jellyfish envenomations requiring hospitalization had been reported in the medical literature (Galil 2010). We report herein the first finding of adult *R. nomadica* in Maltese waters, the westernmost record of the species in the Mediterranean Sea.
Materials and methods

An underwater film footage was shot by Shaun Arrigo (Planet Sea) in late autumn and early winter of 2004 at shallow waters at two coastal locations in the Maltese Islands (Figure 1) using a Sony DV Camcorder PD150 fitted within an Amphibico Housing. The video footage was gleaned within the ambit of the ‘Spot the Jellyfish campaign’, a citizen science jellyfish species monitoring initiative operated by the International Ocean Institute-Malta Operational Centre of the University of Malta. Through the initiative, a number of gelatinous species were recorded for the first time from the Maltese Islands – Porpita porpita Linnaeus, 1758, Aequorea sp., Olindias phosphorica Delle Chiaje, 1841, Leucothea multicornis Quoy and Gaimard, 1824, Beroe forskaliit Milne Edwards, 1841 and Beroe cucumis Fabricius, 1780 (Deidun 2010; Deidun 2011).

Results and discussion

The footage taken in 2004, had been made available to the authors of this study only recently. The photos clearly record the first images of Rhopilema nomadica in Maltese waters, reported at two separate sites (Table 1, Figure 1). The identification and morphological analysis of two individuals of R. nomadica was made through a detailed perusal of the underwater footage. Figures 2a and 2b show the two jellyfish individuals in question, extracted as still images from the same video footage.

Both recorded jellyfish were actively swimming trailing long extended tentacle filaments, at shallow depths ranging between 1 and 5m. Bell diameter was estimated around 40 cm for both specimens. Gonad pouches were not distinguishable, suggesting both specimens had spent gonads.

From the available literature, it is possible to reconstruct a chronogeonomic map of
Rhodila nomadica records from the Maltese Islands

Figures 2. The two Rhopilema nomadica individuals caught on film in 2004 in Maltese coastal waters. Photos extracted from footage taken by Shaun Arrigo.

Table 2. Landmark records of Rhopilema nomadica for eastern Mediterranean sites (as plotted in Figure 3).

<table>
<thead>
<tr>
<th>Coastal zone</th>
<th>Coordinates/locality</th>
<th>Record dates</th>
<th>Population status</th>
<th>Published reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>El Dor (30 km south of Haifa)</td>
<td>30.09.1976</td>
<td>First record</td>
<td>Galil et al 1990</td>
</tr>
<tr>
<td>Israel</td>
<td>Beit Yanai</td>
<td>June 1986</td>
<td>Many specimens</td>
<td>Galil et al 1990</td>
</tr>
<tr>
<td>Israel</td>
<td>Hashdod, Hahotrim, Haifa,</td>
<td>Summer 1989</td>
<td>Outbreaks</td>
<td>Galil et al 1990</td>
</tr>
<tr>
<td>Lebanon</td>
<td></td>
<td>1988</td>
<td>First record</td>
<td>Lakkis and Zeidane 1991</td>
</tr>
<tr>
<td>Lebanon, Syria</td>
<td>Jounieh, Lattakia</td>
<td>1991</td>
<td>Outbreaks</td>
<td>Lakkis and Zeidane 1991,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lotan et al 1994</td>
</tr>
<tr>
<td>SE Turkey</td>
<td>Mersin,</td>
<td>1995</td>
<td>Outbreaks</td>
<td>Kideys and Gucu 1995</td>
</tr>
<tr>
<td>SW Turkey</td>
<td>Iskendurun Bay</td>
<td>1996</td>
<td>Outbreaks</td>
<td>Avsak et al 1996</td>
</tr>
<tr>
<td>Sicily Channel</td>
<td>Malta waters (see Table 1)</td>
<td>Late autumn 2004</td>
<td>Single specimen</td>
<td>Galil and Zenetos 2002</td>
</tr>
<tr>
<td>Sicily Channel</td>
<td>Skoutury, Lakonikos gulf</td>
<td>2006</td>
<td>Two specimens</td>
<td>Present record</td>
</tr>
<tr>
<td></td>
<td>Marmaris, SW</td>
<td>36°50'50.90&quot;N,</td>
<td>Single specimen</td>
<td>Ozturk and Isinibilir 2010</td>
</tr>
<tr>
<td></td>
<td>28°16'13.29&quot;E</td>
<td>June 2011</td>
<td>Two specimens</td>
<td>Siokou-Frangou et al. 2006</td>
</tr>
</tbody>
</table>

Rhopilema nomadica invasive dispersal. Since its entrance in the Mediterranean Sea, this jellyfish embarked on a north-eastward range expansion (Figure 3), first colonizing Israeli and Lebanese waters (Galil et al 1990, Lakkis and Zeidane 1991), being recorded successively in southeastern Turkey off the coast of Mersin (Kideys and Gucu 1995) and in Iskenderun Bay (Avsar 1996), then in 1998 westward near Izmir (Ionian coast of Turkey) (Galil and Zenetos 2002) and in Lakonikos gulf, Greece, in 2006 (Siokou-Frangou et al. 2006). Supporting information to Figure 3 is provided in Table 2. The spread pattern of R. nomadica, in common with that of other Erythrean aliens, follows the Levantine current (Malanotte-Rizzoli et al. 1999), with other planktonic components, including zooplanktonic copepods, exhibiting a similar dispersal pattern within the Mediterranean Sea (Lakkis 1990; Siokou-Frangou et al. 1999).

Lotan et al. (1992, 1994) had hypothesized that the future dispersal of R. nomadica would be restricted to the eastern Mediterranean as a result of the sensitivity of the scyphistoma (polyp) stage to low temperatures. The findings of this
Figure 3. Hypothesized expansion route taken by *Rhopilema nomadica* throughout the Mediterranean Sea to date. Key: red years, records of outbreaks; black years: records of few individuals. Supporting information to the records reported in this figure is given in Table 1.

The study may not necessarily contradict such a hypothesis as drifting jellyfish may reach the entrance to Western Mediterranean, but the full completion of the *R. nomadica* life cycle may be prevented by the low winter temperatures affecting scyphistoma or podocyst stages survival.

On the other hand, the invasiveness of *Rhopilema nomadica* might be determined by acclimation processes requiring one to several years. The progressive expansion toward the Israeli, Lebanese, and southeastern Turkish coasts, with initial occurrence of a few pioneer individuals followed by large outbreaks, demonstrated that the establishment of large established populations may occur in a few years.

The fact that *Rhopilema nomadica* was filmed within Maltese coastal waters and within the Sicily Channel in 2004, and that no further sightings of the species were made in the Sicily Channel or in the western basin suggests that the species has not established any reproductive populations in the Sicily Channel and that it is still strictly restricted to the eastern half of the Mediterranean Sea, particularly to the Levantine Basin.

The occurrence within Maltese coastal waters of *R. nomadica* follows the recording in 2009 of another alien jellyfish species - *Cassiopea andromeda* Forskall, 1775 (Schembri et al. 2009). Similarly, Boero et al (2009) recorded the isolated record of *Phyllorhiza punctata* Von Lendenfeld, 1884, off Sardinia, suggesting that the conditions of the Mediterranean Sea are becoming increasingly conducive to the spread of species of warm water affinity. The recording of *R. nomadica* in Maltese waters may be considered as another hallmark of the current warming trend of the Mediterranean Sea.

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