



## Rapid Communication

## The invasive tropical scyphozoan *Rhopilema nomadica* Galil, 1990 reaches the Tunisian coast of the Mediterranean Sea

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### Abstract

The alien Erythraean jellyfish *Rhopilema nomadica* was first recorded in Tunisia waters (Gulf of Gabes) in 2008. Subsequently it was sighted in the Bizerte Channel and Gulf of Tunis where it has been regularly observed since 2010 during summer and autumn months.

**Key words:** invasive species; jellyfish; South-Western Mediterranean

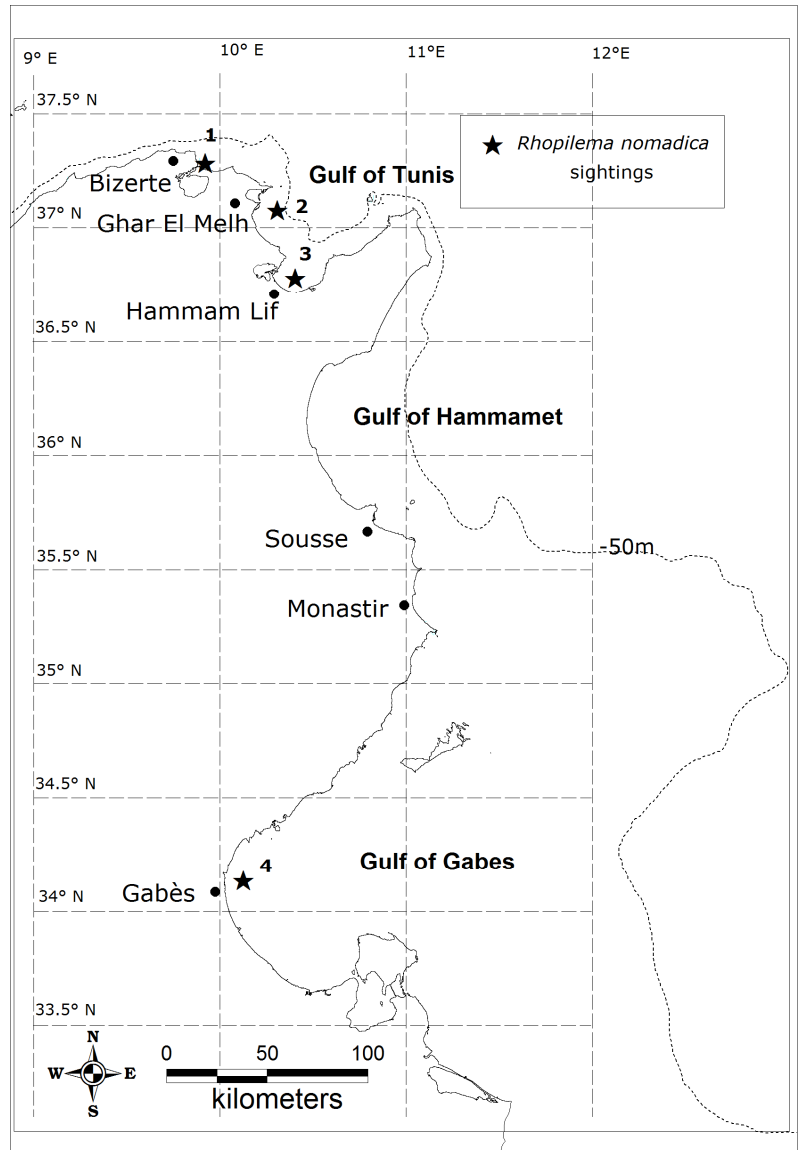
### Introduction

Listed as one of the “100 worst invading species” in the Alien Invasive Species Inventories for Europe (DAISIE 2009), the tropical scyphozoan *Rhopilema nomadica* Galil, 1990 apparently entered the Mediterranean Sea through the Suez Canal. First recorded in 1977 along the coast of Israeli (Galil et al. 1990), it has since extended its range successively to Lebanon and Syria (Lakkis et al. 1990; Ikhtiyar et al., 2002), Egypt, Turkey (Kideys and Gücü 1995; Gülşahin and Tarkan 2011), and has reached Greece and Maltese Islands (Siokou-Frangou et al. 2006; Deidun et al. 2011). Since the mid 1980's, large swarms have been recorded annually in the Levantine Sea, mainly during the summer months (Lotan et al. 1992; Galil 2007; 2012), while only few specimens were observed elsewhere (Siokou-Frangou et al. 2006; Deidun

et al. 2011). *Rhopilema nomadica* “blooms” have both economic and environment consequences. They interfere with fishing and coastal trawling by clogging nets and, by blocking water intake pipes, they threaten cooling systems of ships and coastal power plants (Galil 2007). This species represents a health threat to fishermen and the bathers because the stings can be severe enough to require hospitalization (Öztürk and İşinibilir 2010). Thus outbreaks or blooms of can lead to significant economic losses to tourism, coastal industries, and the fisheries sectors (Galil 2012). The population decline in the eastern Mediterranean of the native scyphozoan *Rhizostoma pulmo* (Macri, 1778) corresponds with expansion of abundance and distribution of the invasive *R. nomadica* (Galil 2000).

This study showed that, after Maltese waters (Deidun et al. 2011), Tunisian waters were the westernmost record of *Rhopilema nomadica* in the Mediterranean Sea.

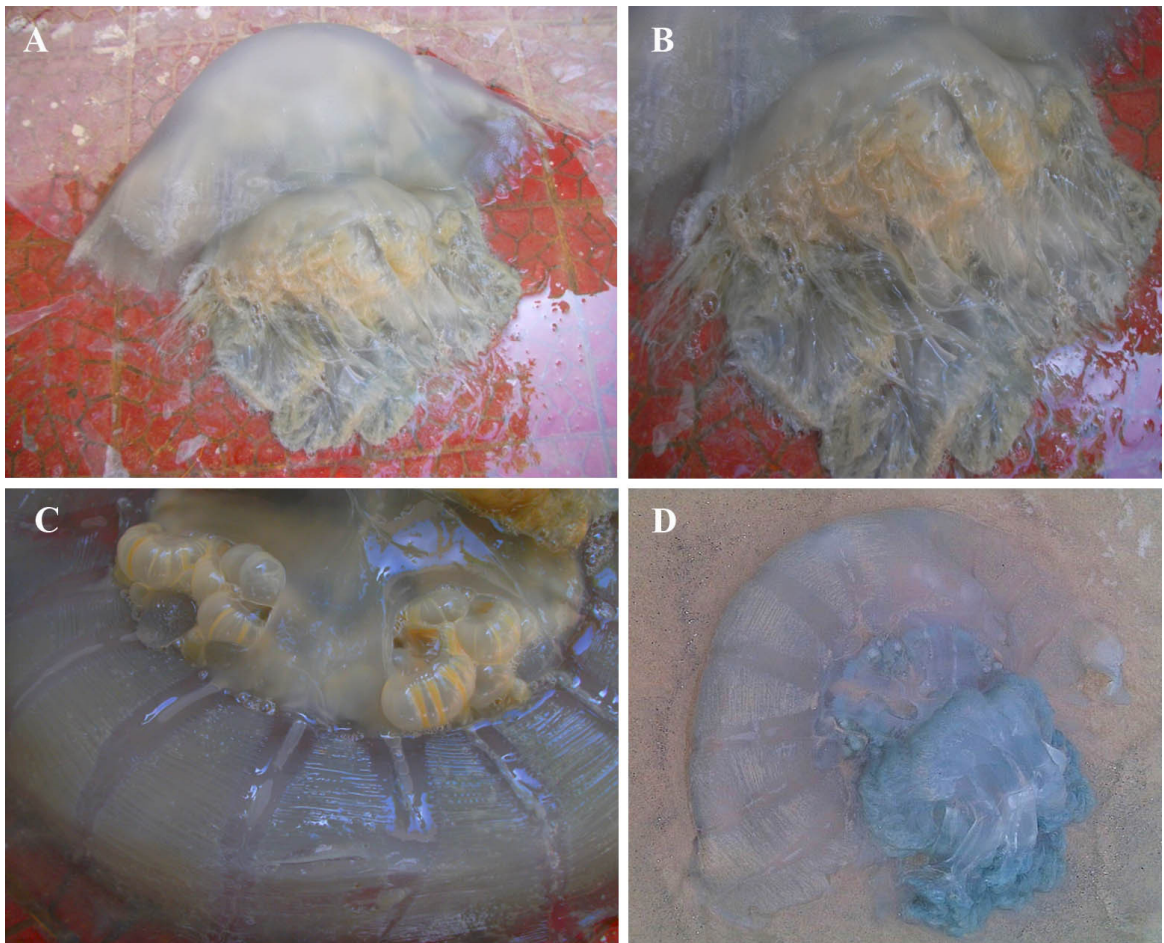
**Figure 1.** Locations of *Rhopilema nomadica* sightings along the Tunisian coast (see Appendix 1 for coordinates).



## Materials and methods

In the framework of the Tunisian National Program on Jellyfish monitoring, launched by the Laboratory of Aquatic Systems Biodiversity and Functioning in 2001, various coastal areas have been investigated for outbreaks of scyphozoans as related to selected environmental variables (Gulf of Tunis and Gulf of Gabes). Recently, in the framework of MED-JELLYRISK project, three areas (Bizerte, Sousse and Monastir) were selected for monitoring of jellyfish stranding and

outbreaks (Figure 1). Regular shoreline surveys were carried out using a standard line-transect method. Jellyfish were identified to species and tallied to give an indication of relative abundance (estimate sampling volume: 1000 to 5000 m<sup>3</sup> depending on the abundance of jellyfish) in each monitoring station of the selected coastal location. All specimens were measured (bell diameter) and some individuals were preserved in 4% buffered formaldehyde for the collection of the Faculty of Sciences of Bizerte.



**Figure 2.** *Rhopilema nomadica*. **A-C:** from Hammam Lif, South-Western of Tunis Gulf on 20<sup>th</sup> August 2010 (Photos by M.N. Daly Yahia), **D:** From Ghar El Melh, North of Tunis Gulf on 9<sup>th</sup> September 2013 (Photo by W. Manai).

## Results and discussion

Sea surface temperature (SST) along the Tunisian coast reaches its maximum value in August (29.4°C in 2008 for the Gulf of Gabes; 28.9°C in 2010 and 28.4°C in 2013 for the Gulf of Tunis). High values of SST remain until October (26.6°C in 2008 in the Gulf of Gabes; 25.2°C in 2010 and 25.8 in 2013 in the Gulf of Tunis).

The first specimen of *R. nomadica* was observed in the Gulf of Gabes, on the southern Tunisian coast, in August 2008. In August 2010, several specimens were recorded from Hammam Lif in the Gulf of Tunis (Figure 2A-C). Each year since, between August and October, specimens (1–10 individuals/1000 m<sup>3</sup>) have been regularly sighted in the Gulf of Tunis. On 9 September 2013, swarms (10–100 individuals/1000 m<sup>3</sup>)

were observed off Ghar El Melh in the Gulf of Tunis, and the beach was strewn with stranded specimens (1 individual/m<sup>2</sup>) (Figure 2D). Off Bizerte, *R. nomadica* were observed in the channel in September and October 2011, but not in subsequent years (Table 1).

Deidun et al. (2011) reconstructed a chrono-geonomic map of *R. nomadica* (Figure 3). It seems that the species spread followed the Levantine current (Malanotte-Rizzoli et al. 1999). Outbreaks have been restricted thus far to the southeastern Mediterranean. Kideys and Güccü (1995) associated these “blooms” with high productivity and pollution. Both the Gulf of Gabes and the Gulf of Tunis suffered degradation of water quality due to eutrophication during the past decade (Souissi et al. 2000; Drira et al. 2008), but no outbreak of *R. nomadica* was recorded.



**Figure 3.** Hypothesized expansion route taken by *Rhopilema nomadica* throughout the Mediterranean Sea to date with the new records in Tunisian coasts. Key: red years, records of outbreaks; black years: records of few individuals (Deidun et al. 2011, modified).

**Table 1.** Locations, dates, and density estimates for *Rhopilema nomadica* in Tunisian waters.

Coastal zone	Locality/region	Record dates	Population density (ind./1000m <sup>3</sup> )
S Tunisia	Metouia/Gabes Gulf	7-19 August and 7 October 2008	First record (< 0.1)
N Tunisia	Hammam Lif/Tunis Gulf	20 August 2010	< 0.1
	Hammam Lif/Tunis Gulf	August to October 2011, 2012, 2013	1 - 10
	Bizerte channel	September and October 2011	1 - 10
	Ghar El Meleh (N Tunis Gulf)	9 September 2013	10 - 100

Also, the species was recorded from the unpolluted Lakonikos Gulf, Greece (Siokou-Frangou et al. 2006), as well as the unpolluted Bizerte coastline.

Lotan et al. (1992; 1994) proposed that the presence of *R. nomadica* will be restricted to the southeastern Mediterranean because it is a tropical stenothermal species. The presence of the species on the southern rim of the western Mediterranean may indicate adaptation to lower temperatures or, more likely, the warming of the Mediterranean Sea.

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**Appendix 1.** Records of *Rhopilema nomadica* from Tunisia (Southwestern Mediterranean Sea). Numbers refer to sites shown in Figure 1.

Record No. (map ref.)	Location	Record coordinates		Record date	Reference
		Latitude	Longitude		
1	North Tunisia, Bizerte	37°16'11.26"N	09°52'44.38"E	9 September 2013	Present study
2	North Tunisia, Ghar El Melh	37°10'17.82"N	10°15'20.17"E	September to October 2011	Present study
3	North Tunisia, Tunis, Hammam-lif	36°44'22.36"N	10°21'03.58"E	20 August 2010, August to October 2011, 2012, 2013	Present study
4	South Tunisia, Gabes, Metouia	34°00'54.56"N	10°03'23.65"E	7-19 August 2008, 7 October 2008	Present study