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The Spring Outbreak of the Invasive Scyphomedusa *Rhopilema nomadica* Galil, Spannier & Ferguson, 1990 in the Antalya Bay, the eastern Mediterranean

Mehmet Cengiz Deval*, Mustafa Tunca Olguner

Akdeniz University, Faculty of Fisheries, Campus, Antalya, Turkey

Abstract

The present paper reports the spring bloom of the alien scyphomedusa *Rhopilema nomadica* in the Antalya Bay, in northern Levant Sea. This study also provides additional information with its distribution and biomass values of the species in the eastern Mediterranean.

Keywords:
Rhopilema nomadica, Lessepsian Jellyfish, Antalya Coast, Levantine Basin
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Introduction

Lessepsian migrant Nomad jellyfish *Rhopilema nomadica*, Galil, Spannier & Ferguson, 1990 entered the Mediterranean through the Suez Canal in the 1970s, which was first described on the Israeli coast in 1990 (Galil et al., 1990). *R. nomadica* was first recorded off the coast of Mersin in Turkey (Kideys & Gücü, 1995) and then in Iskenderun Bay (Avsar et al., 1996). The scyphomedusa continued its spread from east to west in the southern coast of Turkey, and a few vagrant individuals observed in Finike in 2006, in Kaş in 2009 (Öztürk & İşinibilir, 2010) and in Marmaris (Gülşahin & Tarkan, 2011). This Lessepsian migrant has rapidly expanded westward within the central and western Mediterranean during the past eight years. The species was recorded from Malta (Deidun et al., 2011), Tunisia (Yahia et al., 2013) and the Italian island of Pantelleria (Crocetta et al., 2015). *R. nomadica* is one of the most invasive marine species in the Mediterranean (Zenetos et al., 2010) and one of the most impacting species in European Seas (Katsanevakis et al., 2014). *Rhopilema nomadica* is venomous and the active toxic substances contained in jellyfish nematocysts inflict painful stings on humans, characterized by erythematous eruptions, itching, and burning sensations, as well as systematic symptoms that include fever, fatigue, and muscular aches (Balistreri et al., 2017). Antalya is one of the world's best-loved tourist resorts, with numerous five-star hotels, holiday villages and entertainment establishments. These touristic-hotspots scattered

*Corresponding Author: Mehmet Cengiz Deval, E-mail: deval@akdeniz.edu.tr

all along the coastline of the Antalya Bay. Due to this reason, the venomous *R. nomadic*a swarms may have negative impacts on tourism in this region. In the present paper, we report the spring outbreak of the scyphomedusa *R. nomadica* in the Antalya Bay in the Northern Levantine Basin, Turkey.

Material and Methods

The alien Nomad jellyfish were collected in depths of 25-65 m (Table 1) on the coast of Antalya Bay (Figure 1) within the framework of a monthly sampling program with the R/V "***Akdeniz Su***".

Table 1. Geographic coordinates and depths of sampling stations.

Stations	Latitude	Longitude	Depth
1	N36°49.140	E30°56.500	37
2	N36°49.300	E30°59.770	32
3	N36°48.450	E31°04.190	25
4	N36°49.150	E31°01.030	35
5	N36°49.390	E30°57.780	27
6	N36°48.980	E31°02.520	30
7	N36°47.630	E31°07.420	44
8	N36°47.740	E31°09.200	30
9	N36°48.130	E31°02.833	49
10	N36°49.090	E30°58.510	38
11	N36°48.450	E31°02.714	35
12	N36°48.270	E31°06.080	25
13	N36°47.580	E31°02.290	65

The sampling design was set for the fisheries surveys and no intention was specifically made to sample *R. nomadica*. A bottom trawl net was used for sampling with a mouth opening of 1.5 m. Hauling speed was about 2.4 knots and duration was 1 hour. All sampling was conducted during daylight.

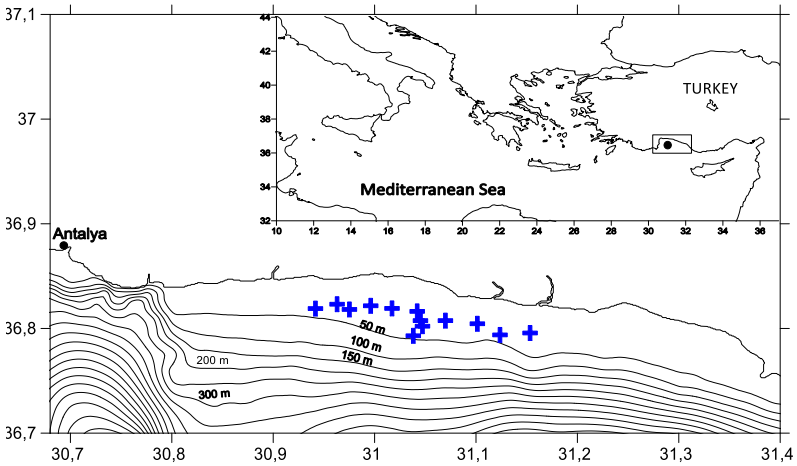

Figure 1. Bathymetry map of the sampling area in the Antalya Bay.

The nomad jellyfish identified by observation and scientific paper as stated in Galil et al. (1990). The distribution of the species were mapped (percentage of the species in the total catch

amount, kg) with Surfer 13.0 (Golden Software, Inc.). Bottom and surface water temperatures were obtained with the measuring device (Tinytag TG-4100) mounted to the trawl.

Results

During the surveys in January and February 2019, no individuals of *R. nomadica* was sampled and observed on the sea surface. At the beginning of March, intense complaints from the hotels and guests with the observations from the shores revealed the presence of *R. nomadica* individuals in the Antalya Bay. In the March survey, 293 specimens of *R. nomadica* was collected as bycatch by bottom trawl operations (Table 2). *R. nomadica* comprised 34.3% (240 kg) of the total catch (616.9 kg). In the four trawl hauls in April (April 3 - 18, 2019), only two individuals were sampled with a sudden decrease in the amount of *R. nomadica* (Table 2). In the May no individuals of *R. nomadica* was sampled in 21 hauls with a total of 21 hours or trawling. In the March survey, the catch per unit effort (number/hour) and the percentage (in kg) of the *R. nomadica* (Figure 1) in the total catch fluctuated between 4 and 50 (22.5 n/haul), and between 18.6% and 69.6% (mean= 41.9% ± 7.5), respectively. The bottom and surface water temperatures in March and April were 17.3 and 20.7, 17.4 and 21 ºC respectively.

Table 2. Trawl operations in March and April 2019.

Haul		Sampled *Rhopilema nomadica*		
Date	No	Number	Weight (kg)	% of the total catch
20 Mar	1	4	7.2	36.8
	2	10	10.1	19.3
	3	10	7.9	29.4
	4	9	7.9	21.0
	5	25	19.4	30.8
	6	31	30.4	51.9
	7	25	16.0	56.8
21 Mar	8	50	48.1	66.2
	9	14	7.9	18.6
	10	38	26.4	60.7
	11	24	23.2	69.4
	12	28	17.5	41.0
27 Mar	13	25	18.2	43.0
3 Apr	14	-	-	-
4 Apr	15	1	0.8	1.9
17 Apr	16	-	-	-
18 Apr	17	1	0.2	0.0
	18	-	-	-

Discussion

The fact that the eastern Mediterranean and the Red Sea have similar abiotic factors and the ability of the Lessepsian migratory species to find suitable areas in the Mediterranean Sea in terms of their feeding habits, habitats and the distribution by the means of depths, affect the migration of these

species (Torcu, 1995). Iskenderun Bay is 2 to 4 times more efficient in terms of primary production compared to neighbouring areas and the continuity of this production creates a close similarity with the Red Sea. In addition, the low average depth causes surface water temperature heats up to 26ºC and consequently increase the salinity to 39.3%; these characteristics lead to the emergence of suitable habitat for the Lessepsian migrant *R. nomadica* (Avşar, 1999). After a decade from the first finding in the Mediterranean, the abundance of *R. nomadica* in the Haifa Bay was reported to be about 300 000 n km^{-2} (Lotan et al., 1992). The density of *R. nomadica* in Mersin Bay formed two peaks in 1987 (February and March / April) and decreased to the minimum level from mid-May to mid-June (Gucu, 1987; Kıdeyş, 1987), it was reported that the species was found between April and August in 1991. Another important coast of the Eastern Mediterranean - the coast of Yumurtalık in the Bay of Iskenderun on the west, the warmest months of the year between the June - October *R. nomadica* increased as a bloom by the amount of biomass and reached 10.6 tons km^{-2} (Avsar et al., 1996). Significant blooms took place in summer 2009, during late winter–early spring periods in 2010 and 2011 again in the Mersin Bay (Sakınan, 2011). Starting from the Bay of Iskenderun in the north-eastern Mediterranean extending to the west coastline to Anamur the decrease in the density is observed (Avşar, 1999). First time in Antalya Bay (also Iskenderun and Mersin Bays), jellyfish bycatch data with different fishing gears (purse seine, trawl and gillnet - trammel net) (Table 3) and generally, *R. nomadica* represent 60% of the total catch for all fishing gears in the eastern Mediterranean coast of Turkey during March-April 2011 (Turan et al., 2011). Observations off the Turkish coast indicate that the density of jellyfish decreases from east to west. The findings presented in this paper support the first results of the Turan et al. (2011) for the Antalya Bay after 8 years.

Table 3. The Lessepsian migrant jellyfish (*R. nomadica*) bycatch data with different fishing gears in the eastern Mediterranean.

		% of the catch (in kg)					
Area	**Date**	**Trawl**	**Purse Seine**	**Gillnet & Trammel Net**	**D (n km^{-2})**	**BI (kg km^{-2})**	**References**
Haifa	Summer 1989	-	-	-	297 000	-	Lotan et al. (1992)
İskenderun Bay	Jul - Aug 1995	-	-	-	-	10 600	Avsar et al. (1996)
Mersin Bay	Mar - Apr 2011	46% (724 kg)	70% (7750 kg)	14% (10.5 kg)	-	-	Turan et al. (2011)
Antalya Bay		15% (40 kg)	3% (220 kg)	24% (33 kg)	-	-	
Antalya Bay	Jan - May 2019	32% (241 kg)	-	-	-	-	This study

The *R. nomadica*, which reaches the Bay of Antalya at the beginning of the spring where tourist activities are limited rather than the intense season between June and September with the effects of currents and surface winds, did not lead a negative impact on the tourists and tourism in the Antalya where 10 million foreign visitors come annually. However, as in the Iskenderun and Mersin Bays, the possible blooms of *R. nomadica* in the Bay of Antalya in the summer season may have a greater negative impact on tourism. The future studies on the coupling of both current and

wind regimes with the distribution of *R. nomadica* at a given time/area might lead to give indications of possible future scenarios in the eastern Mediterranean.

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