

# First Report of *Ostreopsis siamensis* in Syrian coastal waters (Eastern Mediterranean)

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## ABSTRACT

The first abundant occurrence of *Ostreopsis siamensis* was observed in two stations along the Syrian coasts. The monthly and spatial variations of its density in water samples were carried out at two different stations from January to December 2018. The most important results that *O. siamensis* is present in both stations in February and March when the surface water temperature is 20,6°C. The maximum value of *O. siamensis* reached in this period  $6.2 \times 10^6$  cells in March. The depilation of Orthophosphates was proportionately more rapid than of Nitrate, highlighting the strong P demand of dinoflagellate *O. siamensis*.

**Keywords:** Eastern Mediterranean, Syria, *Ostreopsis siamensis*, nutrients

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## 1. INTRODUCTION

In recent year, The presence of toxic algae has been observed and this has led to the accumulation of toxins in seafood have been studied in many Mediterranean countries (Zingone, 2010; Abi Saab et al., 2017; Bizselet et al., 2018, Açağ et al., 2020). Blooms of benthic dinoflagellates belonging to the genus *Ostreopsis* have been reported as an increasingly common phenomenon in temperate regions worldwide (Gilbert et al., 2010, Shears & Rosss, 2009; Aligizaki, 2010; Gladan et al., 2019). During the last decade, reports on the occurrence of genus *Ostreopsis* have been increased rapidly along eastern Mediterranean coasts: in Egyptian coast (Ismael & halim, 2006). Populations with numerous individuals of *Ostreopsis* species were usually recorded during the warm period, while sommer blooms of these species, detected in the Tyrrhenian and south Adriatic seas in Italian coasts have been associated with human health problems, such as respiratory and skin irritations (Sansoni et al., 2003; Honsell et al., 2011; Accoroni, 2016; Brissard et al., 2019; Marin-Pierre, 2020).

In Syria, until now, studies on phytoplankton have been shown no occurrence of *Ostreopsis* species (Darwich, 1999, Hamoud 2000; Darwich & Suliman 2010, Darwich & Al Mirei 2020).

There are extensive studies from Syria on other harmful microalgae such as those causing harmful algal blooms that were detected along the Syrian coastal waters (Darwich, 2021, Darwich & AlAkash 2021).



The aim of our current study is to look into the temporal and spatial variations of the density of *O. siamensis* in water samples and its possible relationships between abundance and environmental factors at two different sites along Syrian coast.

## 2. MATERIALS AND METHODS

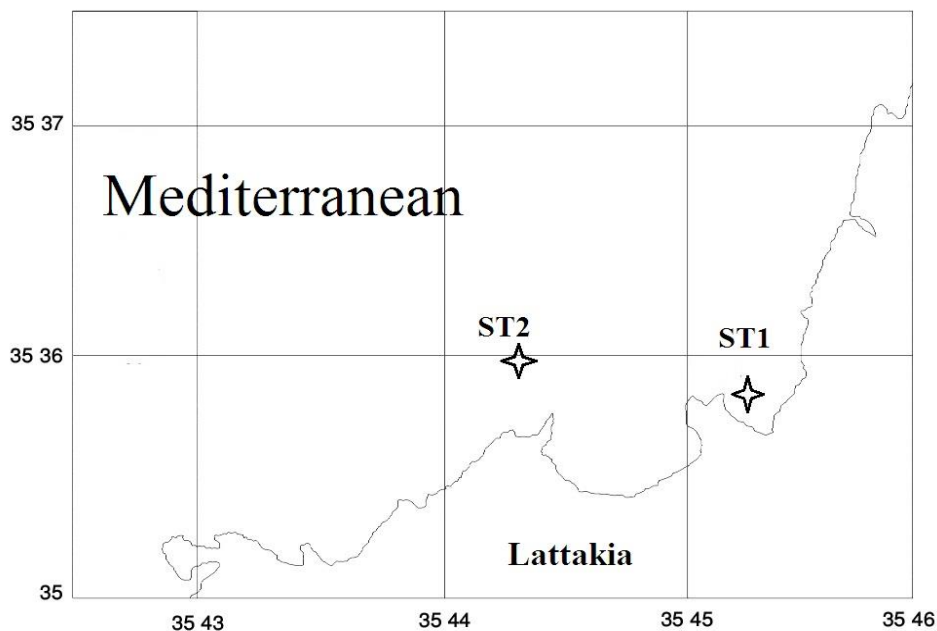
Two stations were selected covering a part of Latakia coast; the description and position of two investigated stations are presented in Table (1) and Fig (1).

Surface water samples were collected on monthly basis in the morning from January to December 2018 at both stations. Surface water temperature (SST) and salinity (SSS) were measured by using YSI model YSI. Samples for orthophosphate (P-PO<sub>4</sub>) and nitrate (N-NO<sub>3</sub>) concentrations were analyzed according to (Strickland & Parsons 1968). Standard phytoplankton net with 20- $\mu$ m mesh size was used for phytoplankton sampling. Lugol's solution was added to the water samples in order to estimate the abundance of dinoflagellates in water samples using Utermoehl's method (1958). Species were determined based on international taxonomic references (Sournia, 1986, Starmach, 1989).

Spearman non-parametric correlation matrix was applied in order to investigate possible relationship between *O. siamensis* density and environmental parameters on 12 samples from two stations using SPSS software.

**Table 1.** Coordinates and characteristics of two stations monitored on Latakia coastal waters

<i>Station &amp; code</i>	<i>Locality In Syria</i>	<i>Coordinates</i>	<i>Depth (Z) and distance from the coast (D)</i>
ST1	North	E 35° 45' 31.68 N 35° 36' 36.52	Z=0.5m D=50m
ST2	North	E 35° 44' 84'' N 35° 35' 36.55	Z=0.5m D=2km



**Fig (1)** Location of sampling stations.

### 3. RESULTS AND DISCUSSION

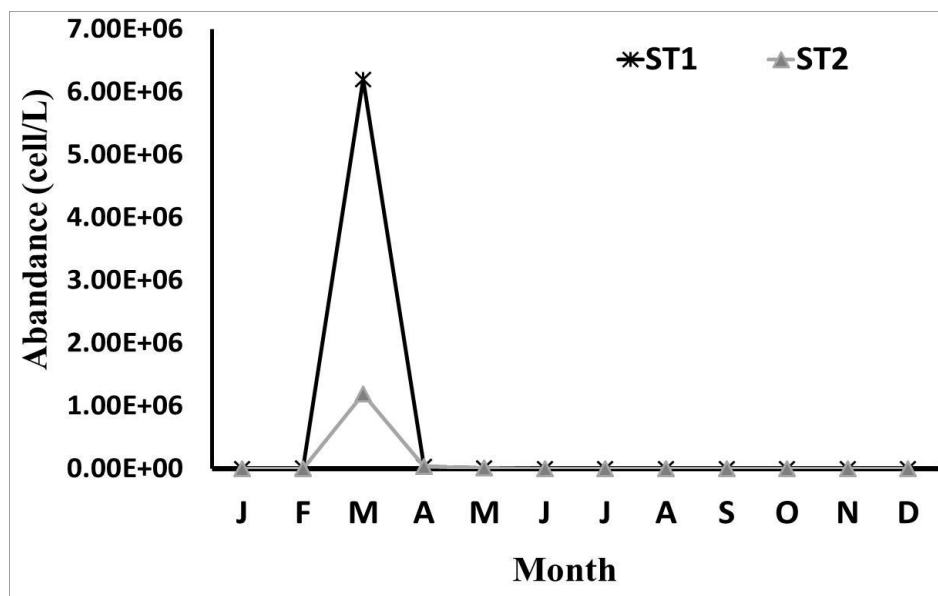
During the study period, in all sampling stations, the values of sea surface temperature varied between 17 °C in January (ST2) to a maximum 29.5 °C in August (ST2). For Nitrate concentrations, the values vary from 0.2 μM/L in July at ST2 to 9.1 μM/L in January at ST1 (Table. 1). The values of orthophosphate ranged between 0.002 μM/L in June at ST2 and 1.1 μM/L in January at ST1 (Table 2).

**Table 2.** Descriptive statistics (Minimum and Maximum values) of the parameter measured at two stations between January and December 2018 in the Syrian coastal waters.

Station parameters	ST1	ST2
	Min-Max	Min-Max
SST (C°)	17.5-29	17-29.5
N-NO <sub>3</sub> (μM/L)	9.1-0.4	6-0.2
P-PO <sub>4</sub> (μM/L)	0.007-1.1	0.002-0.6
N/P ratio	2.5-185	2.6-542

Blooms of *Ostreopsis siamensis* was detected in both studying stations. The abundance of *O. siamensis* varied between zero at both stations and  $6.2 \times 10^6$  cell/L at ST1 in March Fig (2).

Seasonal changes in *O. siamensis* abundance showed one major peak in March in both stations (6.2 and  $1.1 \times 10^6$  cell/L respectively). The highest abundance of *O. siamensis* was found in station1, when the surface Sea water temperature was 20.6°C. *O. siamensis* was observed only in February and March in both coastal stations, while it disappeared in all other months (Fig.2). Our data show that the peak in bloom abundance was found to occur in the early spring when the temperature was increasing from seasonal minimum (17 °C) and water temperatures were higher (20.6 °C) in the bloom of *O. siamensis*.



**Fig (2).** Monthly variations of the abundance of *Ostreopsis siamensis* from January to December 2018 at two Stations (ST1, ST2).

In this study, *O. siamensis* was detected in water only in February and March and the highest densities were recorded simultaneously with the increase of water temperature and the available of nutrients (NO<sub>3</sub>, PO<sub>4</sub>) in both sampling stations. Blooms of *O. siamensis* were occurred in a condition of elevated N: P ratios, well above Redfield proportions (N: P=542) (Table2), a condition

normally taken to be indicative of P limitation. Interestingly, the bloom of *O. siamensis* leads to almost P depletion in sampling water.

The differences in *O. siamensis* abundance among stations was also significant ( $p < 0.01$ ), higher abundance was observed at station 1 due to the direct influence of continental discharges in its vicinity that are loaded with fertilizers and other domestic waste, (Aligizaki, 2018; ISPR, 2017). Recent studies have provided more evidences of a link between nutrient enrichment of coastal waters (anthropogenic eutrophication) and harmful algal event (Pezzolesi *et al.*, 2012, Pezzolesi *et al.*, 2014, Vila *et al.*, 2016, Accoroni *et al.*, 2017). However, there is very limited information on relationships between nutrient concentrations and trend in development of benthic dinoflagellates blooms *O. siamensis*. In NM Mediterranean Sea (Shears & ross, 2009; Giussani *et al.*, 2014, Mangialajo *et al.*, 2011, Satta *et al.*, 2018) did not find any relations between *O. siamensis* and nutrients, while (Pasron & Preskitt, 2007) found that *Ostreopsis* abundance was positively correlated with all inorganic nutrients concentrations in the waters. Our results find that the bloom cells of *O. siamensis* consumed nutrients especially phosphate, There was no relationship was found between nutrient concentrations and *O. siamensis* abundances. In this study *O. siamensis* achieve maximum growth rates at N:P above Redfield proportions (Zhang & Hu, 2011, Glibert *et al.*, 2010, Glibert *et al.*, 2012). It was found that in the bloom onset period  $PO_4$  concentrations were significantly lower than in pre-bloom conditions. Both (Vanucci *et al.*, 2012, Pezzolesi *et al.*, 2014) found that the depletion of P was proportionately more rapid than of N, highlighting the strong P demand of this dinoflagellates.

However, other factors both biotic and abiotic, such as ability to use organic forms of nutrients and interactions with other organisms, should be investigated to further clarify the *Ostreopsis siamensis* natural bloom mechanism. Actually, many HAB genera can use organic (dissolved or particulate) forms of nutrients for their nutritional demands (Cucchiari *et al.*, 2008, Ben-Gharbia *et al.*, 2016; Tartaglione, 2017, Penna *et al.*, 2018).

#### 4. CONCLUSION

In conclusion, our data suggest that in Syrian coastal water *Ostreopsis* blooms was triggered by combination of calm hydrodynamic conditions, optimal temperature and favorable nutrients. Calm conditions are a prerequisite for bloom, and only when this condition exists do temperature and nutrient start to have a decisive effect. This preliminary study presents a baseline for future studies. Further studies should consider benthic sampling.

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#### Conflicts of interests

The authors declare that there are no conflicts of interests.

#### Data and materials availability

All data associated with this study are present in the paper.

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