



## Gulf of Trieste, northern Adriatic Sea: first record of *Ostreopsis ovata* bloom

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### Introduction

In the Adriatic Sea *O. ovata* was first detected in the southern regions and later in the northern areas. Monti et al. (2007) report the first record of *O. cf. ovata* in the Gulf of Trieste in October 2006. Notwithstanding up to summer 2009 in the Gulf of Trieste we have not been aware of any blooms in the water column. From June to August 2009 the Italian government (Ministero dell'Ambiente e della Tutela del Territorio e del Mare) funded a national "Monitoring Project" to check the presence of *O. ovata* along Italian coasts. The Regional Environmental Protection Agency of Friuli Venezia Giulia (ARPA-FVG) investigated four different sampling areas but no blooms were detected during the monitoring period. At the end of September 2009 a bloom of *O. ovata* was revealed in a different area not included within the monitoring project areas. The purpose of the present study was to investigate the meteorological characteristics, the hydrological and nutrient conditions that characterized summer 2009 during the period immediately prior to the occurrence of the bloom event.

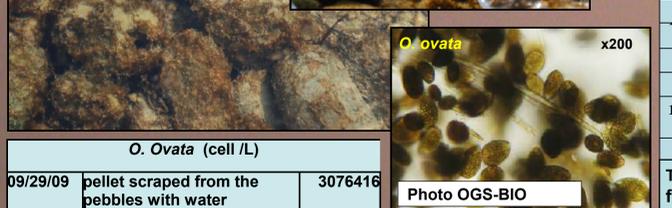
### Study area

The eastern and south-eastern parts of the Gulf of Trieste are characterized by cliffs with overhanging rocks, bays and pebbly beaches, while the north-western part is characterized by the Marano and Grado lagoonal system with low lying sandy coasts.

### The bloom event

On 29th September Prof. G. Honsell (Udine University-Italy) reported the presence of the *O. ovata* bloom in Canovella De'Zoppoli.

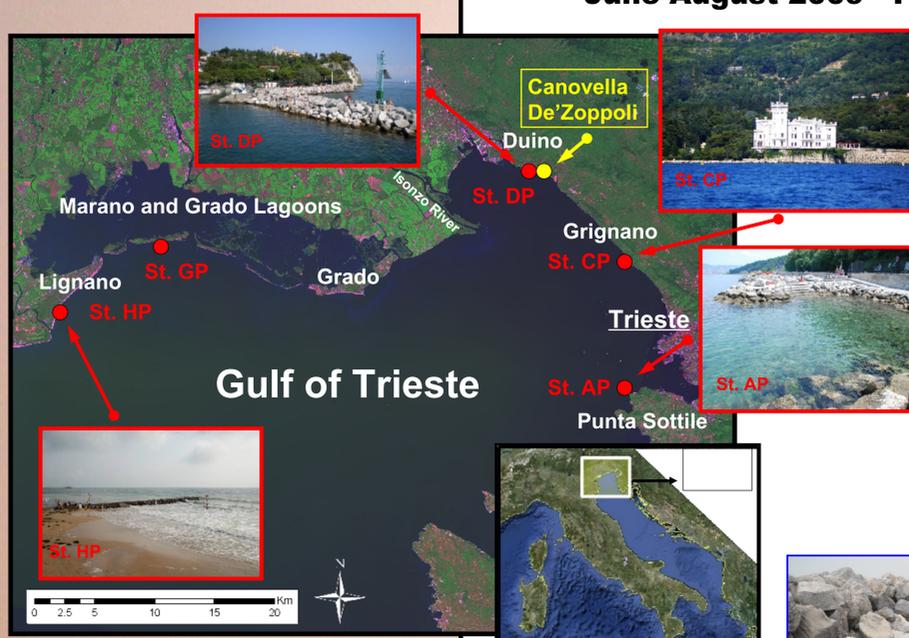
Canovella De'Zoppoli is located in a coastal area in the Gulf of Trieste. It is characterized by the presence of a tidal pool well demarcated from the rest of the beach and in contact with the open sea by means of a rocky reef. The tidal pool has a pebbly bottom and it is sheltered from wind blowing and from wave actions by the rocky reef. Tidal pool maximum depth is 1.5m and macroalgae are almost absent. During the bloom the water showed an opalescent aspect and a lot of gas bubbles were present on the water surface.



Date	Sample description	Abundance (cell/L)
09/29/09	pellet scraped from the pebbles with water surrounding the pebbles	3076416
09/29/09	surface water surrounding the pebbles	2636928
09/29/09	surface water inside the dock	46800
10/01/09	surface water	5020
10/07/09	surface water	400

### Discussion and conclusion

During "The Monitoring Project" the abundance of *O. ovata*, *Coolia monotis* and *Prorocentrum lima* were generally low. *O. ovata* was principally found in stations characterized by rocky shoreline after a period with high water temperature (>25°C). The maximum abundance of *O. ovata* was recorded in st. CP in a water mass characterized by relative high values of temperature, salinity, dissolved oxygen and nitrate concentration as already observed by other authors in different places. *O. ovata* bloom occurred at the end of September 2009. Since August the basin presented air and sea water temperature higher than those observed during 1999-2008 reference period. In general, in the Gulf of Trieste, an increase of 0.12-0.23 °C/year in the surface sea water has been demonstrated from 1991 to 2003 (Malačič et al., 2006). This positive trend is still evident. Monthly data collected in twelve coastal stations of the gulf in 1999-2008, showed in September a sea surface mean temperature of 22.4±1.6°C. In September 2009 the sea surface temperature was comparable (22.7±0.4°C) to that of the reference period, but since August 2009 an increase in temperature of 1.2°C was detected. The August 2009 thermal increment was also pointed out by daily observations of sea surface temperature. In September 2009 the air temperature was 20.8±1.3°C while it was 18.0±0.8°C for the reference period. The sea surface temperature was 21.5±0.4°C for the reference period, while it was 22.4±0.3°C in September 2009. These high temperatures were probably related to increased solar radiation and the decrease in the number of windy days (see figures). Although water temperature is one of the most important factors that triggers *O. ovata* blooms it is not the sole one that influences its growth. Salinity, nutrients, light (intensity and duration), water movement and the presence of pebbly bottom also affect the development of this microalga. Probably the geomorphological characteristic of the tidal pool, its sheltered position from the wind and wave action, together with the good weather and nutrient conditions, have supported the development of *O. ovata* bloom. The lack of macroalgae inside the tidal pool did not affect the development of the bloom. Notwithstanding the identification of toxins in samples collected inside the tidal pool during the bloom (see table) no problems for human health were recorded.



### June-August 2009 "The Monitoring Project" - Sampling stations

Sampling stations were chosen taking into consideration the most suitable geomorphological characteristics of the coast for the growth of epiphytic dinoflagellates, the areas where *O. ovata* has been formerly found, bathing areas and the areas already investigated in order to have hydrological data time series.

St. AP is located in a rocky littoral area with pebbly beach; st. CP nearby a dock that develops in a bay with overhanging rocks; st. GP is placed in St. Andrea Island on the external border of Marano Lagoon near a breakwater, this station was monitored only in June and subsequently it was substituted by the st. HP near a breakwater in a sandy beach of Lignano.

### Sampling method



Samplings were carried out twice a month from June to August 2009.

In each sampling station 3 macroalgal talli were collected in 3 different places along the seashore. The composition and the abundance (cell gr<sup>-1</sup> wet weight of macroalgae) of the epiphytic community was analyzed following UNI EN 15204 (2006) protocol. Water samples were also collected for nutrient analysis performed employing standard autoanalyzer techniques.

### The Monitoring Project - Results

During samplings benthic communities never showed distress signs. Different genera and species of brown and red macroalgae were picked up.

Station	St. AP						St. CP			St. GP		St. HP	
	06/06/09	06/25/09	07/03/09	07/28/09	08/11/09	08/25/09							
(cell gr <sup>-1</sup> ww)													
<i>C. monotis</i>	46	0	923	460	271	123							
<i>O. ovata</i>	0	0	0	0	5.4	31							
<i>P. lima</i>	550.5	425.5	692	153	163	277							
St. CP													
<i>C. monotis</i>	59.5	2514.5	1136	593	274	109							
<i>O. ovata</i>	0	0	0	85	0	763							
<i>P. lima</i>	224	785.5	142	339	91	218							
St. GP													
<i>C. monotis</i>	180	332	1639	462	278	33							
<i>O. ovata</i>	0	0	22	0	0	167							
<i>P. lima</i>	1350	44	0	252	0	0							
St. HP													
<i>C. monotis</i>	1500	775	0	242	0	0							
<i>O. ovata</i>	0	55	0	0	0	0							
<i>P. lima</i>	0	55	0	0	0	0							

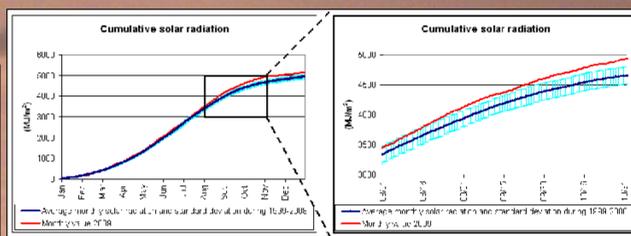
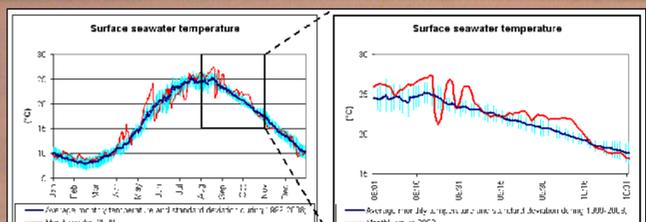
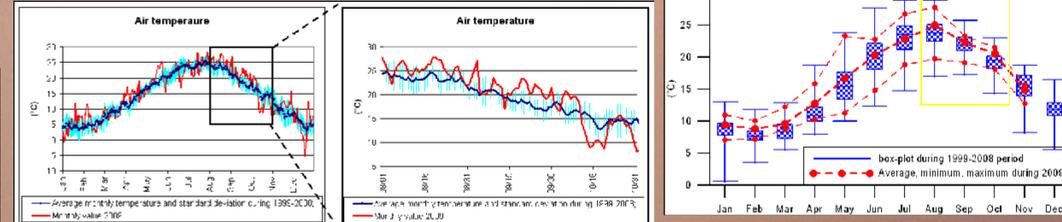
In all the investigated sites *O. ovata* was found in association with *Coolia monotis* and *Prorocentrum lima*. In general, the abundance of these species never exceeded 2.5x10<sup>3</sup> cell gr<sup>-1</sup>ww. In June and July *C. monotis* and *P. lima* prevailed while in August with the increasing of *O. ovata*, *C. monotis* and *P. lima* decreased. In 2009 hydrological data and nutrients were comparable to those ones observed in previous years.

Station	Date	Temp. (°C)	Salinity (psu)	D. Oxygen (% sat.)	Chl a (µg/L)	NO <sub>3</sub> (µM)	PO <sub>4</sub> <sup>3-</sup> (µM)
AP	06/04/09	19.06	35.60	110.5	0.5	1.3	0.1
AP	06/25/09	21.81	34.46	115.6	0.4	4.3	0.2
AP	07/03/09	22.20	35.18	108.5	0.8	3.5	0.2
AP	07/28/09	26.26	35.28	116.3	0.9	1.1	0.1
AP	08/11/09	26.00	35.58	94.6	0.4	1.2	0.1
AP	08/25/09	23.19	37.24	106.4	0.7	0.7	0.1
CP	06/01/09	18.31	36.81	110.5	0.4	1.3	0.0
CP	06/25/09	21.88	33.99	108.7	0.4	5.3	0.1
CP	07/03/09	23.30	32.95	99.5	0.6	6.8	0.2
CP	07/28/09	25.70	35.46	117.9	0.3	2.7	0.1
CP	08/11/09	25.36	35.01	89.5	0.3	2.5	0.1
CP	08/25/09	23.75	36.86	112.3	0.6	34.8	0.3
DP	06/04/09	18.62	35.67	100.1	0.4	3.2	0.1
DP	06/25/09	21.77	32.83	106.7	0.7	30.1	0.2
DP	07/03/09	23.34	31.85	96.8	0.7	12.8	0.2
DP	07/28/09	26.31	30.46	106.9	0.8	11.4	0.1
DP	08/11/09	25.36	32.66	105.0	0.6	11.3	0.2
DP	08/25/09	25.12	30.91	113.0	0.7	2.9	0.2
GP	06/03/09	24.47	29.01	99.1	1.1	27.5	0.6
GP	06/25/09	22.40	27.84	117.4	1.2	28.6	0.7
HP	07/03/09	27.52	27.01	100.1	0.7	32.8	0.8
HP	07/28/09	26.21	30.87	109.5	0.4	18.6	0.5
HP	08/11/09	28.28	30.49	93.0	0.5	18.9	0.4
HP	08/25/09	25.18	32.37	105.6	0.8	13.0	0.5

Hydrological parameters during the bloom event	
Temperature (°C)	22.27
Salinity (psu)	37.29
D. Oxygen (% sat.)	142
D. Oxygen (mg/L)	9.7
pH	8.18

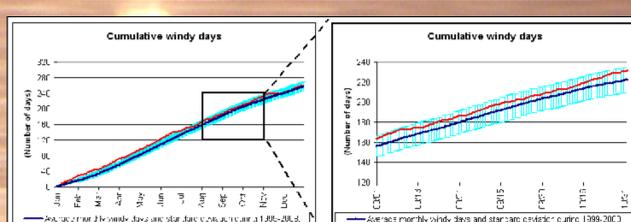
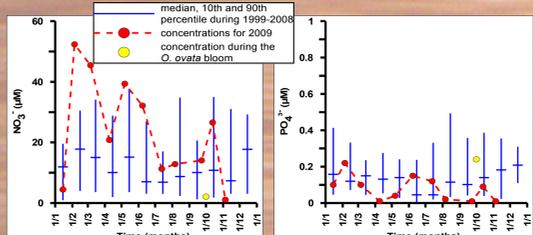
sample	Toxin	(ng/ tot)
9	pellet	Palytoxin 13954
		OVOTX-a 13243
		palytoxin 711
10/01/2009	Surface water	<Limit of quantification
		OVOTX-a
		palytoxin
		<Limit of

Toxin analysis performed by the National Reference Laboratory for Marine Biotoxins - Italy (internal method).



Sum of the thermal increment (temperatures larger or equal to 25°C) for the year 2009 and for the reference period 1999-2008					
Month	Average monthly value 1999-2008	Standard dev. 1999-2008	Average cumul. value 1999-2008	Monthly value 2009	Cumulative value 2009
June	1.3	2.2	7.8	0.0	0.0
July	8.3	9.2	10.4	8.4	8.4
August	12.8	21.7	23.2	31.7	40.1
September	0.1	21.7	23.3	1.0	41.1

Number of days with average sea temperature larger or equal to 25°C for the year 2009 and for the reference period 1999-2008					
Month	Average monthly value 1999-2008	Standard dev. 1999-2008	Average cumul. value 1999-2008	Monthly value 2009	Cumulative value 2009
June	3.3	3.8	3.3	0	0
July	11.3	10.1	14.6	14	14
August	11.7	13.7	26.3	24	38
September	0.3	14.1	26.9	4	42



References  
Malačič V., Celio M., Čermelj B., Bussani A. and Comici C., 2006. Interannual evolution of seasonal thermohaline properties in the Gulf of Trieste (northern Adriatic), 1991-2003. Journal of Geophysical Research, 111, C08009, 16 pp., 2006 doi:10.1029/2005JC003267  
Monti M., Minocci M., Beran A. and Ivesa L., 2007. First record of *Ostreopsis cf. ovata* on macroalgae in the Northern Adriatic Sea. Mar. Poll. Bull., 54: 598-601.