Bloom of *Pyrodinium bahamense* var. *compressum* at the Southern region of the Mexican Pacific

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Abstract

A bloom of *Pyrodinium bahamense var. compressum* was registered in Acapulco Bay (Guerrero, México) from July 7th to August 4th 2010. This bloom started in the state of Oaxaca (towards the East). The HAB didn´t cause water discoloration, possibly because the highest densities were from 3 to 5 m below the surface. Heavy rains were present before the event. The longest chains had 16 cells, with a mean of 8 cells; occasionally bigger and less compressed single cells were found. Among the dinoflagellates, *Pyrodinium* was dominant (88%), although few *Prorocentrum (P. gracile, P. triestinum*) and also some naked dinoflagellates (*Karenia* sp., *Gymnodinium catenatum* and *Gyrodinium fusus*) were found. The highest *Pyrodinium* cell densities (1.4. 10^6 cell l^{-1}) were from outside the Bay; inside the Bay the cell densities were 7.7. 10^5 cell l^{-1} at 3 m depth and 5.2. 10^5 cell l^{-1} at 5 m. Small diatoms were present; *Pseudo-nitzchia* spp. were important reaching densities of 14.0 10^3 cell l^{-1}. Saxitoxin concentration reached values of 2092 µg STX eq. 100 g^{-1} in violet oyster (*Chama mexicana*) near Puerto Marques Bay.

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Introduction

Pyrodinium bahamense var. *compressum* is one of the most toxic saxitoxin-producing species that causes PSP. There have been several *Pyrodinium bahamense* HAB events in the South Eastern Mexican Pacific, with an approximate periodicity of five and six years. The late 1995 and early 1996 HAB, on the coast of Guerrero and Michoacan, caused many poisonings and 6 people died. Concentration of saxitoxin in shellfish was 6,337 µg STXeq 100g $^{-1}$ in *Ostrea iridiscens* (Orellana *et al*., 1998).
A bloom together with *G. catenatum*, occured from August 2001 to February 2002 and had densities of 3. 10^6 cells l^{-1}, relative abundance 88%, 100 people were poisoned and 9 died, fishing was banned 180 days and 48 tons of dead fish were recovered. Saxitoxin in shellfish was up to 7,309 µg STXeq 100g $^{-1}$ (Ramírez-Camarena *et al*. 2005)

Study Area

Acapulco Bay is located in the tropical Mexican Pacific on the coast of Guerrero state, between 16°35'24'' to 17°28'12'' LN and 99°25'12'' to 110°33' LW (Fig. 1).

Method

Samples were collected from the column water with a Van Dorn bottle in 8 locations at different depths: 1, 3, 5, 10 m and

bottom, fixed with acetate Lugol. Sedgwick Rafter and Utermhöl´s chambers were used to count the cells. Weekly samples for cells counting were taken on July 10, 17, 24 and August 4th. Dates for saxitoxin evaluation were July 7, 8, 12, 19, 26 and 29th. Toxicity was tested using a mouse bioassay.

Figure 1. Map of study area.

Results

Cell morphology

Solitary or chains up to 16 cells, with a mean of 8 cells (Figs.2-3). Occasionally bigger and less compressed single cells were found or along with cells in chains (Figs. 4-5). Long antapical spine (Fig. 6). Cingulum displaced (Fig.7). Plate 1' is very reduced (Fig. 8) and 2 antapical plates (Fig. 9). Cysts (Figs. 10-11) were found on May 15th, however at that time no vegetative cells were observed. New cysts were observed in the water column again on August 4th.

Cell morphometry

The measurements include small and big cells. Total Length: 32.5-69.5 µm, Average: 55; Body Length: 24.78-49.6 µm, Average: 39.5; Transdiameter: 24.8-54.2 µm, Average: 39.9.

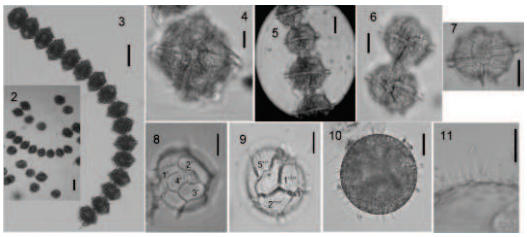
Pyrodinium cell density

The highest *Pyrodinium* cell densities were $1.4.10^6$ celsl l^{-1} outside the bay at 3 m; inside the bay the cell densities were $7.7.10^6$ cells l^{-1} at 3 m depth and $5.2 .10^3$ cells l^{-1} at 5 m. On July 10th, maximum phytoplankton biomass was 46.2 mg Chl *a* m^{-3}. There were no color changes on the surface. The diversity index (H') values ranged from 3.84 to 0.91, with the lowest values in places where *Pyrodinium* was dominant.

Toxicity: Saxitoxin concentration reached values of 26 to 2,092 µg STX eq. 100 g^{-1}, the mean value of 30 oyster samples collected in different localities from July 8th to August 5th was high: 639.05 µg STX eq. 100 g^{-1}. Always the highest concentration occurred in local violet oyster (*Chama mexicana*) near Puerto Marques Bay, therefore a ban was established.

Accompanying species

Among the dinoflagellates *Pyrodinium* was dominant (88%), although few *Prorocentrum (P. gracile, P. triestinum*) were found, also some naked dinoflagellates (*Karenia mikimotoi*, *K. brevisulcata*, *Gymnodinium catenatum* and *Gyrodinium fusus*) were present. Small diatoms in chains were present: *Chaetoceros curvisetus*, *Skeletonema* sp. (very narrow) and *Pseudo-nitzschia* spp. The latter were important reaching densities of $1.04. 10^6$ cells l^{-1}.



Figures 2-11. *Pyrodinium bahamense* var. *compressum* from Acapulco Bay. 2. Bloom with solitary cells and chains. 3. Chain with 16 cells. 4. Ventral view of biggest cell. 5. Large and small cells in the same chain. 6. Cells with a long antapical spine. 7. Ventral view. 8. Apical internal view. 9. Antapical view, showing the posterior attachment pore (Pa). 10. Full cyst. 11. Typical bifurcate spines of *Pyrodinium* cysts.

Scales: Figs. 2-3 = 50 μm. Figs. 5-10 = 20 μm. Figs. 4, 11 = 10 μm.

Physico-chemical Parameters

Temperature ranged from 28.9 to 29.1 ° C. Mean temperature increased one degree from June to July (27.7-28.7°). Before the heavy rainfall the salinity was 30 psu; and then decreased by two units due to the effect of the rainy season. The maximum concentrations of the nutrients appeared to be related to the formation of the HAB, especially for phosphates, whose concentrations varied from 0.02 to 5.7, Average = 3.34 mM L-1; ammonium 0.03-26.4, Average = 1.9 mM L-1, and nitrates 0.03-17.73, Average = 2.43 mM L-1, concentrations were higher in the previous months. Using monthly averages of daily images from Modis-Aqua, it was observed that the HAB apparently started in May, 2010, in the Costa Rica Dome, moving to the Tehuantepec Gulf in June, and in July arrived to the Guerrero coasts, were Acapulco Bay is located. Finally it disappeared in August.

There exist strong correlations between the ENSO (El Niño-Southern Oscillation Events) and the *Pyrodinium* HAB in the W Pacific (Maclean, 1989) and in the first part of 2010 there was an El Niño event.In conclusion, the HAB observed was moderate compared to those that occurred in 1995-1996 and 2001-2002. It came from the oceanic area, and then picked up strength in the Acapulco Bay. During the HAB large and small cells occurred, but all were of compressed form. Since different sizes were found in the same chain, we could consider the formation of gametes or zygotes. The HAB was possibly favored by rains that increased nutrients, as cysts were noted since May but not vegetative cells.
The finding of the HAB of *Pyrodinium bahamense* var. *compressum* in the Bay of Acapulco was interesting, coexisting mainly with diatoms, mostly of the genus *Pseudo-nitzschia* and *Chaetoceros*.

Acknowledgements

CONABIO for the financial support for project development (HJ014).

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