First Record of Vegetative Cells of *Pyrodinium bahamense* (Gonyaulacales: Goniodomataceae) in the Gulf of California[1]

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Abstract: As part of an ongoing monitoring study of phytoplankton in coastal lagoons on the east side of the Gulf of California, *Pyrodinium bahamense* Plate, 1906 var. *bahamense* was collected in the Topolobampo–Santa Maria–Ohuira coastal lagoon system in the Gulf of California in May 2005. Average concentrations of *P. bahamense* were 100 cells liter^{-1}. This finding is the first observation of vegetative cells of this tropical species in the Gulf of California and represents its northernmost occurrence to date.

As part of an ongoing investigation on the east coast of the Gulf of California, we have been monitoring phytoplankton to document its temporal variability and assess the impact of untreated wasterwater discharge generated by diverse human activities on the phytoplankton community. Phytoplankton blooms along the coast benefit the coastal system as food for benthic organisms. However, proliferation of some species represents a risk to public health by production of toxins. One potentially toxic species is *Pyrodinium bahamense* Plate, 1906 var. *bahamense* (Plate 40), which can produce saxitoxin (Landsberg et al. 2006) and can produce large blooms (Phlips et al. 2004). Our objective in this paper is to add *P. bahamense* to the inventory of phytoplankton species in the Gulf of California.

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Materials and Methods

This survey was conducted in the Topolobampo–Santa Maria–Ohuira lagoon system (25° 33′ to 25° 42′ N, 109° 09′ to 109° 16′ W), along the northern coast of the state of Sinaloa, Mexico. From February to May 2005, 33 water samples from near the surface were taken with a Van Dorn bottle at eight stations and preserved with 1% Lugol solution to determine the abundance of phytoplankton. Identification and quantification of all fixed samples was made in 10-cm^3 settling cylindrical chambers at 400x with an inverted microscope (Olympus), employing the Utermöhl method (Hasle 1978). In addition, a 20-μm plankton net was towed at the surface for 5 min to collect and identify phytoplankton species of lesser abundance. Samples from the net were preserved with 1% Lugol solution.

Results

Pyrodinium bahamense was, for the first time, observed in survey samples in May 2005 in Topolobampo Lagoon at an average density of 100 cells liter^{-1}. All cells had morphological features corresponding to the variety *bahamense* (Figure 1). The mean anterior-posterior length was 44.23 μm, and mean transverse diameter was 43.14 μm ($n = 32$). Mean length of the horn was 7.22 μm; apical spines were well developed, with a mean length of 5.6 μm, and the mean length of the antapical spine was 20 μm. The left sulcal list was well developed, the girdle was displaced by one girdle width, and the girdle list

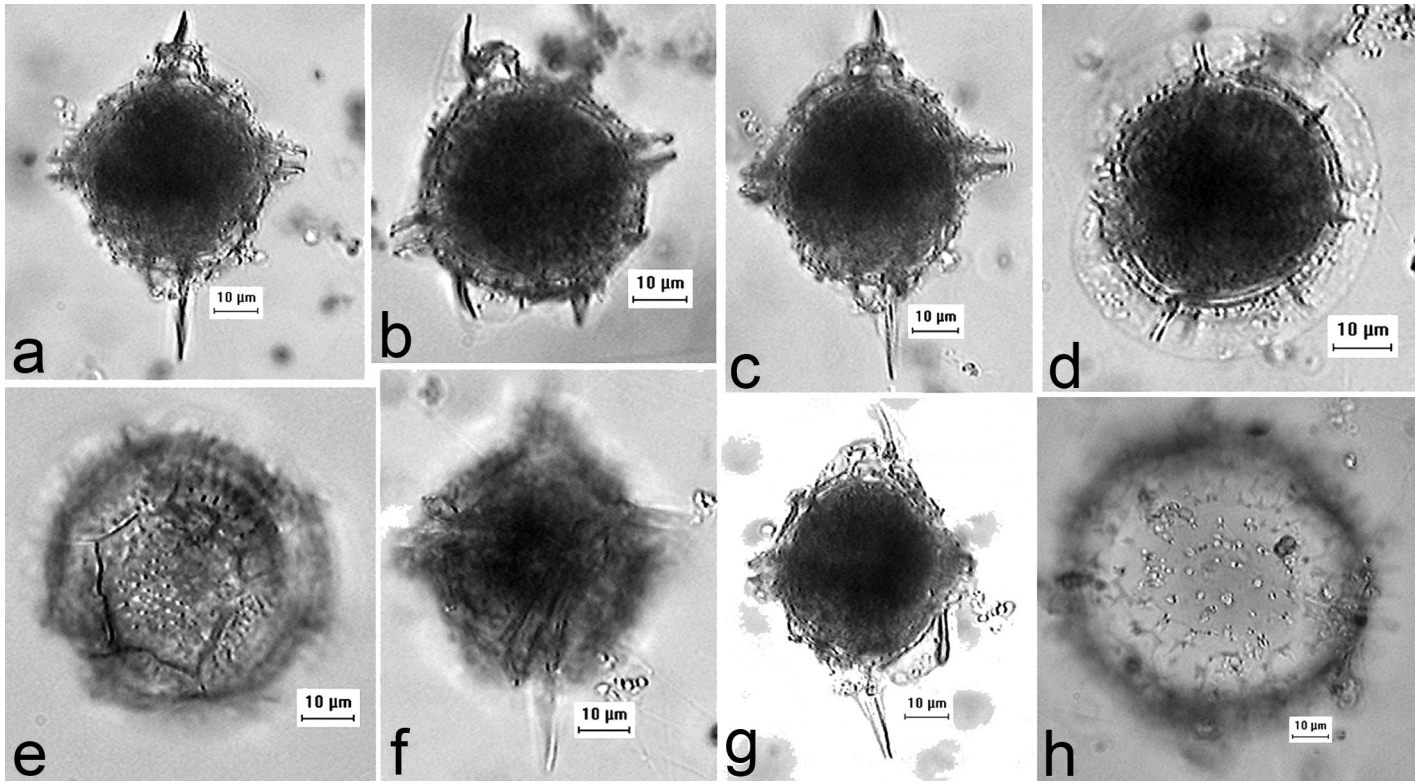

FIGURE 1. Light microscopy images of *Pyrodinium bahamense* var. *bahamense* from samples collected in the Topolobampo Lagoon, Gulf of California, in May 2005. Ventral view of cells showing apical and antapical spines (*a–c*); apical view of specimen (*d*); antapical view of specimen showing plates (*e*); ventral view of cells showing antapical spine and sulcal region (*f–g*) and cyst (*h*).

was strongly developed. The degree of cellular compression observed was minor as compared with *P. bahamense* var. *compressum*. Cysts were also present in the sample, with a mean diameter of 79 μm (Figure 1).

DISCUSSION

Pyrodinium bahamense is a tropical-subtropical species, first described by Plate (1906) in samples from the Atlantic Ocean. Since its discovery, *P. bahamense* has been collected in the Indo-Pacific region and more tropical Atlantic waters (Rosales-Loessener et al. 1989, Badylak et al. 2004). Two varieties (*compressum* and *bahamense*) have been recognized since 1980 (Steidinger et al. 1980, Taylor and Pollingher 1987, Badylak et al. 2004). The genetic differences between varieties have not been resolved and are still a point of contention (Balech 1985). Vargas-Montero and Freer (2003) suggested that the morphological differences could be a response to environmental conditions and not genetically based.

Historically, it was accepted that *P. bahamense* var. *compressum* (Böhm) Steideinger et al. 1980, was limited to the Indo-Pacific and produced paralytic shellfish poisoning events (Harada et al. 1982). By contrast, *P. bahamense* var *bahamense* was confined to the Atlantic and not associated with toxin production (Steideinger et al. 1980). However, Landsberg et al. (2006) provided evidence that *P. bahamense* var. *bahamense* also produces saxitoxins. More recent studies showed that *P. bahamense* var. *compressum* along the southern Mexican Pacific coast extended as far north as Manzanillo (De La Garza-Aguilar 1983, Saldate-Castañeda et al. 1991, Secretaría de Salud 1992, Colmenares and Barradas-Sánchez 1996, Cortés-Altamirano et al. 1996, Ramírez-Camarena et al. 1996, Orellana-Cepeda et al. 1998), and *P. bahamense* var. *bahamense* occurred in the Gulf of Mexico and Mexican Caribbean (Cortés-Altamirano et al. 1996, Gómez-Aguirre and Licea 1998, Herrera-Silveira 1999). The first report of *P. bahamense* var. *bahamense* in the Pacific came from Osorio-Tafall (1942) off the Mexican coast. His report showed the forms corresponding to the two varieties proposed in the 1980s. More recently, the *bahamense* variety was observed in an extensive bloom off the Pacific coast of Costa Rica co-occurring with *P. bahamense* var. *compressum* (Vargas-Montero and Freer 2003).

This study is the first report of vegetative cells of this tropical species in the Gulf of California, extending its northernmost distribution since the observations of Osorio-Tafall (1942), although others have reported *P. bahamense* cysts in the Gulf of California (Martínez-Hernández and Hernández-Campos 1991, Licea-Durán et al. 1995). Despite the low abundance (100 cells liter^{-1}), the uncertainty of the toxic nature of the variety *bahamense* warrants future monitoring.

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