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First records of *Ostreopsis heptagona*, *O.* cf. *siamensis* and *O.* cf. *ovata* – in the Azores archipelago, Portugal

During summer 2008, surveys were carried out around São Miguel island in the Azores archipelago (36–39ºN, 25–31ºW) (Fig. 1). The sampling area is located between the main paths of the Azores Current (AC) and North Atlantic Current. The average SST around the island, was above 21ºC, denoting a greater influence of the AC. Seawater samples were collected with a Niskin bottle, and preserved with neutralized formalin, for phytoplankton observations and cell counting. Species of *Ostreopsis* were morphologically characterized with an Olympus BX50 equipped with epifluorescence, following Penna *et al.* [1]. The three *Ostreopsis* species were found together in the water, exclusively on the north side of the island where the waters were warmer. The highest concentration of *Ostreopsis* spp. was 90 cells L^{-1}.

The measurements (Table 1) and plate patterns observed suggest the presence of three species of *Ostreopsis*: *O. heptagona* Norris, Bomber et Balech, 1985 (Fig. 2), *O.* cf. *siamensis* Schmidt, 1982 (Fig. 3) and *O.* cf. *ovata* Fukuyo, 1981 (Fig. 4).

Since sampling was not focussed on

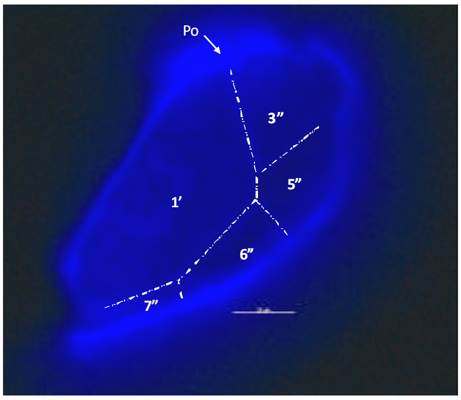

Fig. 2. O. heptagona, *LM, epithecal view (scale bar = 20 µm). The distinct feature of plate 5", pentagonal, in contact with 1', can be observed.*

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First records of *Ostreopsis* cf. *siamensis* in Moroccan Atlantic upwelling waters

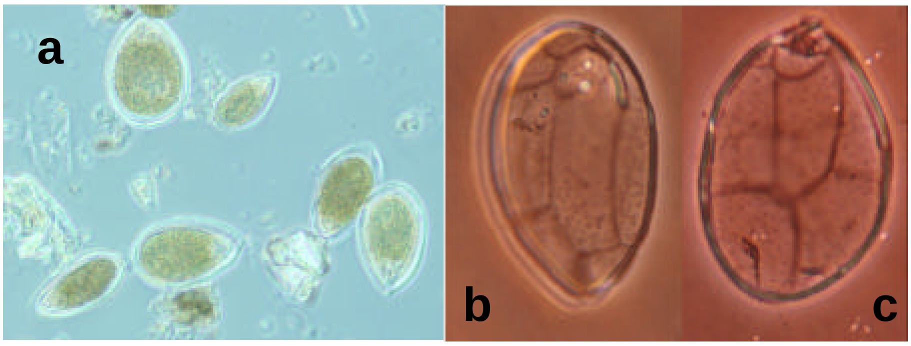

Fig. 1. Ostreopsis *cf.* siamensis *from a sample off Cape Ghir. Light microscopy– phase contrast (a). Epitheca (b) and hypotheca (c) views. (right).*

We report the first records of *Ostreopsis* cf. *siamensis* Schmidt detected in the NE Africa Atlantic upwelling system by the Moroccan HAB and phycotoxins national monitoring programme. The species was identified by phase contrast (Fig. 1) and epifluorescence microscopy during the Morocco-Portugal project of scientific cooperation on HABs and marine biotoxins. Identification was confirmed by sequencing the 5.8S –ITS and LSU ribosomal genes [1].

Ostreopsis blooms were first observed in seawater samples from the Cape Ghir region (30°N, 9°W) on 5 October 2004, reaching 3.7 x 10^3 cell L^{-1}. Blooms recurred in the following years, and increased in concentration and duration, reaching 9.8 x 10^3 to 1.2 x 10^4 cell L^{-1} in 2008, and a maximum of 10^5 cell L^{-1} observed in August 2009. In 2007, *O.* cf. *siamensis* cells were observed from late summer to early autumn, in 2008 from early summer to late autumn, and in 2009 from spring to late autumn. The blooms occurred with surface temperatures ranging from 20 to 24°C, with maxima recorded in August and September. In parallel, the detection of toxins by mouse bioassay in mussels collected from the same area indicated the presence of neurotoxins.

Four monitoring stations were sampled in the Agadir area (Fig. 2). Highest *Ostreopsis* concentrations were always observed in samples from Cape Ghir and a station further north, at Tamri, both sites located on a rocky coastline highly exposed to northerly (upwelling favourable) winds and waves

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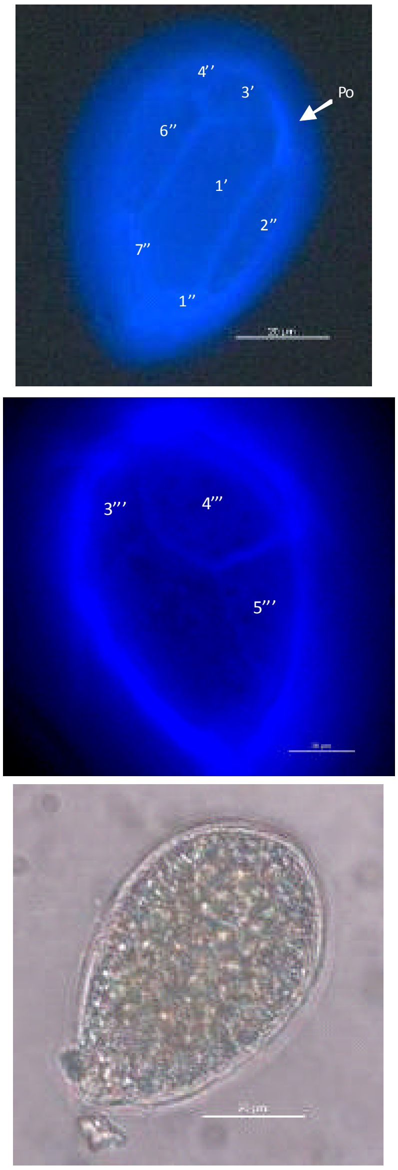

Fig. 3. O. cf. siamensis, LM, epithecal (top) and hipotechal views (center) (scale bar = 20 μm).

Fig. 4. O. cf. ovata, LM, epithecal view (top) (scale bar = 10 μm).

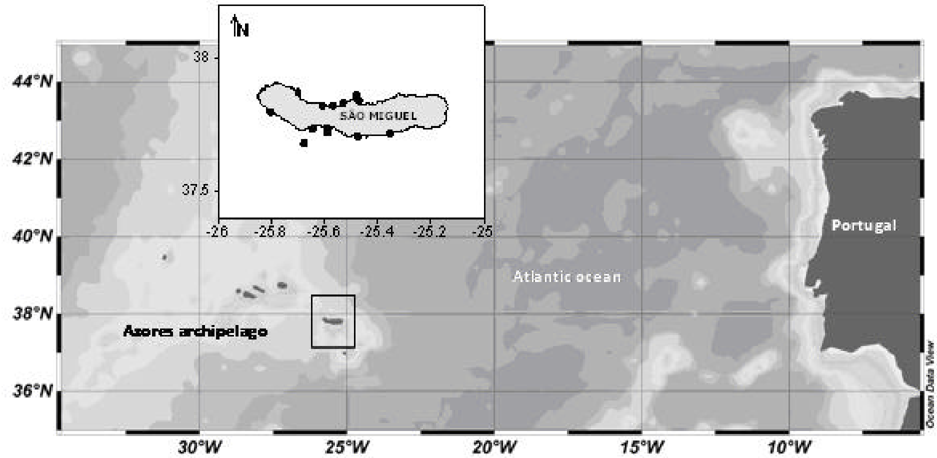

Fig. 1. The Azores archipelago: São Miguel (oriental group).

Table 1. Dorsoventral and transversal measurements.

	Dorsoventral diameter (μm)	Transverse diameter (μm)
O. heptagona (Fig. 2)	80–83	53–55
O. cf. *siamensis* (Fig. 3)	60–70	34–42
O. cf. *ovata* (Fig. 4)	49–51	22–30

the study of this genus, the fixative used did not allow complementary phylogenetic analysis. Future research will comprise genotyping *Ostreopsis* strains by PCR based assay.

This preliminary work in Azores waters is expected to contribute to the biogeographical distribution of HAB species, and to clarify their role as environmental tracers in Atlantic waters and as climate indicators.

Acknowledgements

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Reference:

1. Penna A *et al* 2005. *J Phycol* 41: 212–225

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(Fig. 2). In contrast, other dinoflagellate species were favoured at stations south of Agadir, in the shadow of the Cape, on a sandy coast with calmer waters. This suggests that turbulent conditions north of the cape favoured resuspension of this epiphytic species in the water column although not dispersing the cells. Villa *et al.* [2] also pointed out that *Ostreopsis* sp. prefers more turbulent conditions than other benthic dinoflagellates such as *Coolia monotis*. In contrast, the abundance of *Ostreopsis ovata* in the Adriatic Sea was significantly higher in sheltered sites compared with exposed ones, indicating a major role of hydrodynamism in regulating bloom dynamics [3].

According to a recent study of the phylogeography of *Ostreopsis* species based on several strains isolated from the Mediterranean and Northeast Atlantic [1], *O.* cf. *siamensis* was, until now, only observed in the Mediterranean, while *O.* cf. *ovata* was found both in the Mediterranean and NE Atlantic, *e.g.* in Madeira and the Canary Islands. However, neither species was observed on the upwelling coasts of Iberia, such as the Galician *rías* (Santiago Fraga, pers. com.), or NW Africa where the species was not investigated before. Simultaneously, during the Morocco blooms, a strain of *O.* cf. *siamensis* was isolated from macroalgae off the SW coast of Portugal [4]. It is possible that this species is actually spreading in this region of the Atlantic due to an exchange between the Atlantic and the Mediterranean basins or even to a warming of these coastal upwelling waters [5]. However, it is not yet clear whether this apparent biogeographical expansion is real since HAB monitoring only became routine on the Agadir coast after 2002, and there is still no monitoring programme for microphytobenthic communities along the Moroccan coast. After these *Ostreopsis* blooms and due to their annual re-occurrence, the HAB monitoring programme has included this genus among the potentially harmful species of the Atlantic and Mediterranean coasts of Morocco.

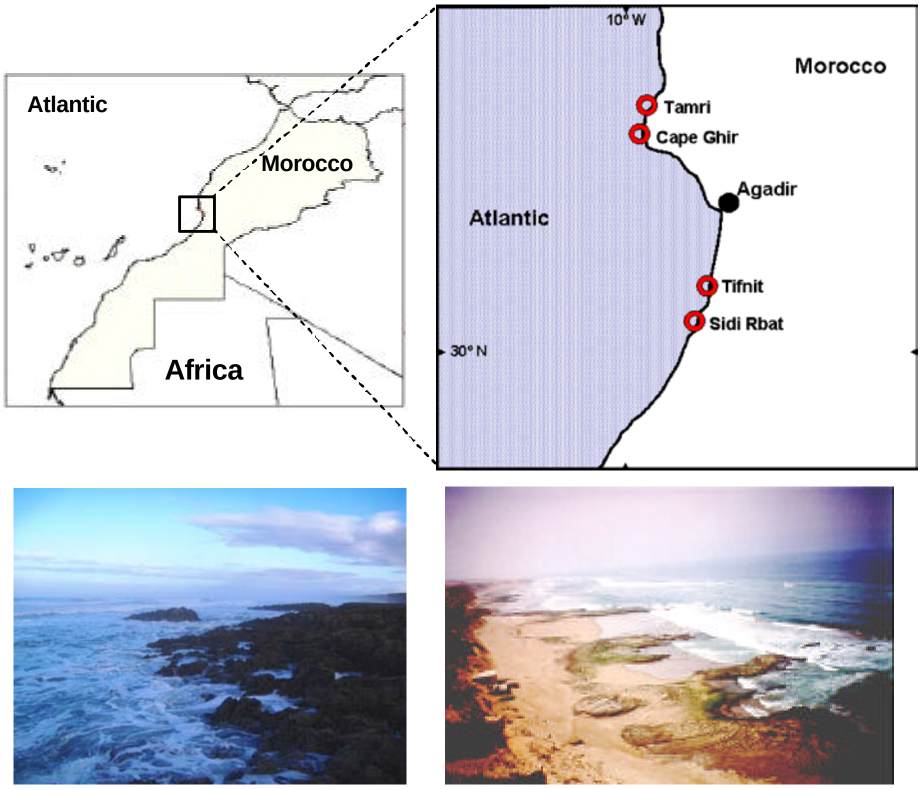

Fig. 2. Location of Moroccan monitoring stations in Agadir region and photo of Cape Ghir (lower left) and Sidi Rbat (lower right) monitoring sites.

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1. Penna A *et al* 2010. *J Biogeogr* 37: 830–841
2. Vila M *et al* 2001. *Aquat Microb Ecol* 26: 51–60
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5. Relvas P *et al* 2009. *Geophys Res Lett* 36: L22601, doi:10.1029/2009GL040504

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