RECURRENT BLOOMS OF *ALEXANDRIUM CATENELLA* IN MEDITERRANEAN CONFINED WATERS

Magda Vila [1] *, Mercedes Masó [1], Esther Garcés [1], Nagore Sampedro [1], Isabel Bravo [2], Antonella Luglié [3], Kees van Lenning [1], Silvia Anglés [1], Blanca Puig [1] and Jordi Camp [1]

[1] Institut Ciències del Mar, Barcelona, Spain - *magda@icm.csic.es
[2] Instituto Español de Oceanografía, Vigo, Spain
[3] Dipartamento Botanica ed Ecologia Vegetale, Sassari, Italy

Abstract

Paralytic Shellfish Poisoning (PSP) events related to phytoplankton blooms have increased worldwide. In the Mediterranean Sea, species belonging to the genus *Alexandrium* are chiefly associated with PSP events, and *A. catenella* is one of its most toxic. Before *A. catenella* had been detected in the Mediterranean Sea, that species was related to productive, cold upwelling regimes. However, in the Mediterranean Sea, *A. catenella* blooms are often localised phenomena that occur in enriched and confined coastal waters (harbours, bays). An intensive study was carried out during a huge bloom of this species in the Tarragona harbour in 2002.

Keywords: Harmful Algal Blooms, Alexandrium catenella, harbours, Paralytic shellfish poisoning, dinoflagellate

The most widespread *Alexandrium* that can be detected in the Mediterranean Sea is *A. minutum*. This species was first described in the Alexandria harbour (1), but it was thirty years later when that species was reported to be linked to toxicity in Mediterranean waters (2). Since then, numerous PSP outbreaks caused by *A. minutum* have been detected in the Mediterranean Sea. *A. minutum* was the unique *Alexandrium* species related to toxic events in the Mediterranean Sea for several years. It is important to mention that *A. minutum* blooms have always been described as localised phenomena related to harbours and lagoons (see 3 for revision). In the summer of 1998 the first widespread PSP event in the Mediterranean Sea occurred along the Catalan coast (100 Km affected) and it was caused by *A. catenella*. In the summer of 1999 a similar event took place again (4).

Along the southern Catalan Coast, *A. catenella* showed a clear seasonal pattern, being detected in several harbours from May to October. In 2002, a huge bloom of that species occurred in the Tarragona harbour (max. $9x10^6$ cells·l^{-1}, end September) at 22°C, producing a reddish-brown discoloration of the waters. The Tarragona harbour is one of the biggest harbours in the Mediterranean (4,5 km long; 600m to 2Km wide) with considerable commercial and fishing activities. This harbour receives freshwater inflows from the Francolí river. The river discharge is situated near the mouth harbour (inside side). *A. catenella* blooms have taken place there yearly, at least since 1998.

In 2002, *A. catenella* moderated cell densities (<10^4 cells·l^{-1}) were detected in the Tarragona harbour from mid-May, but it started blooming at the end of September (Fig. 1). It coincided with a salinity decrease (32) and with a high nutrient load (nitrate, ammonium, silicate and orthophosphate peaks of 40, 18, 37 and 1.8 µM, respectively). The nearly monospecific outbreak of *A. catenella* in Tarragona was intensively studied according to space and time. The bloom was followed every 3-4 days at 3 stations. In addition, a cruise was carried out when the organism rose to 10^6 cells·l^{-1}. The cruise consisted in a transect (6 stations from the most confined parts of the harbour to the mouth) which was repeated three times during that day: in the morning (9:00-10:30h, GMT), at midday (13:30-15:15) and at noon (16:30-18:00). CTD casts were performed at each station and samples were taken every metre from the surface to a depth of 10m. *A. catenella* (total cell number and cells per chain), chlorophyll and total inorganic nutrients were analysed. Pigments and PSP toxins were analysed by HPLC at surface level during the midday transect. Sediment samples were taken by scuba diver 8 months later (April 2003) to study the potential seedbeds.

The horizontal spatial variability of the organism was linked to the water confinement. The highest concentrations of *A. catenella* were detected in the inner part of the harbour (around $6{\cdot}10^6$ cells·l^{-1}) and diminished in the mouth (10^4-10^5 cells·l^{-1}). That pattern remained the same the whole day. The vertical distribution was characterised by a thick layer of 6m that contained the bulk of the population. A clear vertical pattern associated to temporal variability was not observed, except for the inner stations. In the three cruises, the average number of single cells was high (about 75%). The relative number of chains increased according to depth and proximity to the mouth of the harbour. Results of the sediment sampling could explain the recurrence blooms of *A. catenella* (max. conc. 3480 cysts·cm^{-3} of wet surface sediment).

Results indicate that the *A. catenella* blooms in the Mediterranean Sea are small-scale phenomena, related to confined waters and originated by autochthonous seedbeds. Nevertheless, exportation of cells to open waters could cause widespread PSP events. For instance, during the same year an *A. catenella* bloom occurred in the Olbia harbour (Sardinia, Italy). Unexpectedly, at the end of the bloom, the highest densities were detected out of the harbour area (max. $4{\cdot}10^4$ cells·l^{-1}). This distribution could probably be due to cell exportation and accumulation. Comparative studies between the two affected sites (Tarragona and Olbia harbour) are carried out.

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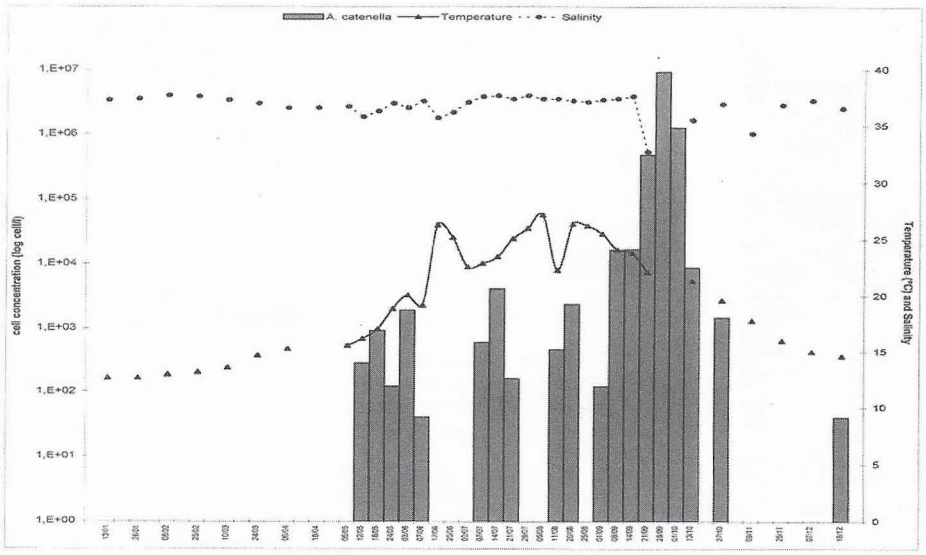

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