Pseudo-nitzschia australis blooms are not always toxic

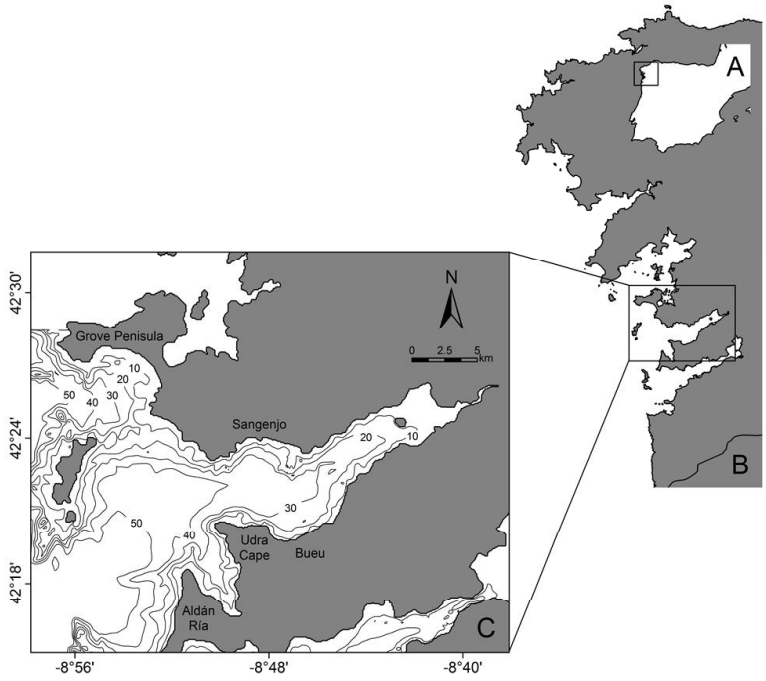

Fig. 1. Maps showing A) Iberian Peninsula; B) Galician Rias Baixas and C) Study area in Ría de Pontevedra.

Diatom species of the genus *Pseudo-nitzschia* H. Peragallo are regular components of the microphytoplankton assemblages in the Galician Rías (NW Spain). Twelve species of this genus have been confirmed as producers of domoic acid (DA) [1, 2], a neurotoxin which causes Amnesic Shellfish Poisoning (ASP). Eight potentially toxic species of *Pseudo-nitzschia* have been reported so far in Galician coastal waters [3]. But the occurrence of domoic acid in shellfish above regulatory levels (ASP outbreaks) in this area has mainly been associated with high concentrations (> 10^5 cell L^{-1}) of *Pseudo-nitzschia australis* Frenguelli [3, 4]. Phytoplankton succession in the Galician Rías [5] is closely related to the seasonal (March to October) upwelling pattern [6]; *Pseudo-nitzschia* species appear at an intermediate stage in the upwelling-downwelling cycles (late spring-summer), following large centric diatoms [5]. Since June 1992, the Technological Institute for the Control of the Marine Environment in Galicia (INTECMAR) carries out a weekly monitoring of potentially toxic phytoplankton (including *Pseudo-nitzschia* spp.) and phycotoxins, according to EU Directives, on Galician coasts (Fig. 1). ASP outbreaks in the region have proven to be short-lived events leading to mussel harvesting bans of one to a few weeks duration. Nevertheless, they represent a serious threat to sustainable exploitation of pectinids (*Pecten maximus, P. jacobeus*). These species have slow depuration rates for DA (0.007 day^{-1} in *P. maximus*) [7] and may need months or even years to eliminate toxins.

Since the first event reported in the Galician Rías in autumn 1994 [4], ASP outbreaks have been reported almost every year in northwest Iberia [8], including the coast of Portugal [9]. The long retention time of DA in pectinids and its impact on the scallop industry in Galicia and Scotland led to implementation of specific regulations (Commission Decision 2002/226/EC) to control DA in pectinids in the European Union [10].

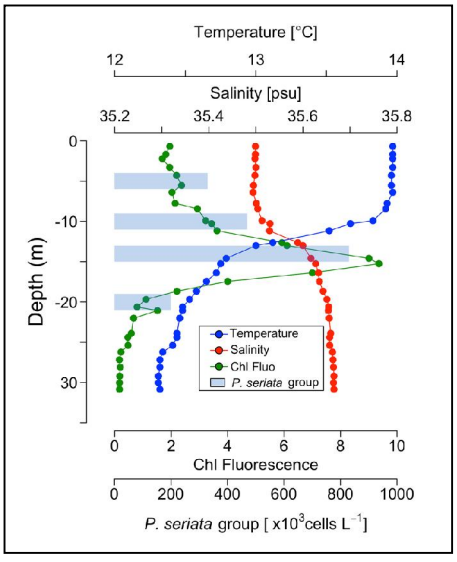

Fig. 2. Vertical distribution of temperature (blue), salinity (red), chl-a fluorescence (green) and Pseudo-nitzschia seriata *group cells density (blue bars) recorded during the survey on 28 May 2007.*

A dense bloom of *Pseudo-nitzschia* spp. was recorded during the *HABIT-Pontevedra 2007* survey carried out in Ría de Pontevedra, from 28 May to 7 June 2007 [11]. *Pseudo-nitzschia* species were identified following Hasle [12]. Particulate DA concentrations were analyzed by liquid chromatography-multiple tandem mass spectrometry (LC-MS) according to Furey et al. [13]. Weekly monitoring results from INTECMAR during the cruise period also reported the occurrence of a *Pseudo-nitzschia* spp. bloom (> 10^6 cells L^{-1}) that reached its annual maxima on 28 May 2007 [14].

Results from the cruise showed that the bloom formed a thin layer of *Pseudo-nitszchia seriata* group spp., dominated by *P. australis* at 14 m depth, associated with marked density gradients in the water column (Fig. 2). Despite the predominance of *P. australis* (Fig. 3), DA was not found (detection level 0.02 µg DA mL^{-1}) in any of the samples with high *Pseudo-nitzschia* densities. Nor were shellfish harvesting bans implemented by the Galician authorities due to the occurrence of ASP toxins in mussels during the cruise period.

It is well known from laboratory cultures of toxigenic *Pseudo-nitzschia* species that large differences in cellular toxin content can be observed during population growth, with the maximum per cell usually found during the late exponential or stationary phase [2]. It could be argued here that the toxin content of *Pseudo-nitzschia* was below detection limits during the cruise and increased later in the season. But there were no mussel harvesting bans in Galicia due to ASP for the whole of 2007 (www.intecmar.org). This can only be explained by the existence of very weakly toxic or non-toxic strains of *P. australis*.

Our results show the occurrence of a non-toxic *Pseudo-nitzschia* bloom, dominated by *P. australis*, the species

commonly associated with ASP on the Atlantic coast of Iberia (Spain and Portugal). Therefore, the detection of high densities of "known" toxigenic species of *Pseudo-nitzschia* is not enough for monitoring purposes, if it is not accompanied by toxin analyses to confirm the presence of domoic acid. In this context, monitoring based on ASP toxin content per volume of water in addition to routine *Pseudo-nitzschia* cell counts, would be a more realistic early warning tool for seafood safety management. This is applied in the monitoring programme of the U.S. west coast [15], where a combination of microscopic monitoring of the algae and assessment of cellular toxicity (expressed as "particulate DA") using test strips (Jellett Rapid Tests) gives an effective early warning of shellfish toxification events, reducing the risk associated with potential toxicity in razor clams.

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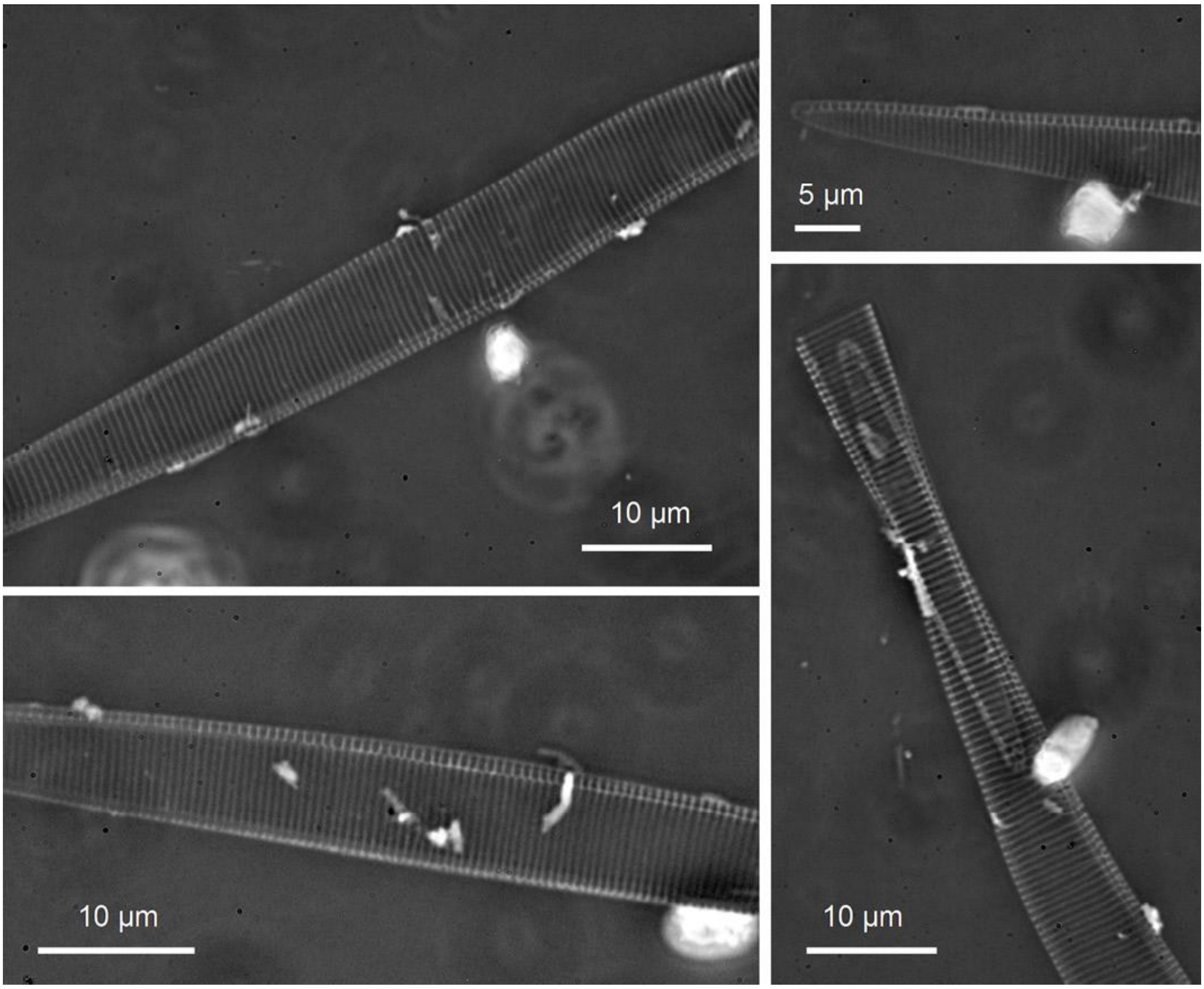

Fig. □. Phase contrast micrographs of Pseudo-nitzschia australis *found in Ría de Pontevedra (NW Spain), during a bloom in May 2007.*