An unusual phytoplankton event five years later: the fate of the atypical range expansion of marine species into the south-eastern Baltic

Information from the PEG (Phytoplankton Expert Group): Irina Olenina[1], Janina Kownacka[2]

Key Message

The species composition of phytoplankton in the Baltic Sea is changing. After the atypical range expansion of marine diatoms to the south-eastern part of the Baltic Sea (Hajdu et al. 2006) some of them still occur in phytoplankton, while other disappeared. In 2003-2006 a new marine diatom species appeared in Polish and Lithuanian waters which now often dominate in autumn phytoplankton community.

Relevance of the indicator for describing developments in the environment

Phytoplankton is an important indicator of the status of aquatic ecosystem: structural changes in its community may indicate the beginning of environmental alteration. In 2005 we witnessed an atypical range expansion of the marine diatom species, which never before have been found in the less saline south-eastern Baltic since the beginning of observations in 1981. Five years of further monitoring revealed that the range expansion was not a sporadic event and now these diatoms occur in autumn phytoplankton more or less regularly. Such structural change (addition of new marine species and even their dominance in phytoplankton community) may indicate changes in the pelagic ecosystem, which probably were overlooked by means of physical monitoring.

Assessment

In 2005, the marine diatoms typically living in more saline waters of Kattegat and western Baltic were found for the first time in the south-eastern part of the Baltic Sea (Hajdu et al. 2006). Since then, two species (*Cerataulina pelagica* and *Dactyliosolen fragilissimus*) occur in autumn plankton sporadically (Fig. 1, 2).

After the mass development of *C. pelagica* in the Lithuanian waters in 2005, the species was not found in phytoplankton for three years, while in 2009 it was appeared at all national monitoring stations from October to December. The species abundance and biomass were rather low (80-800 cells·L^{-1}; 1-23 µg·L^{-1}), making insignificant portion of the whole phytoplankton community (0.1 % on total abundance and 2% - on biomass). In the Gulf of Gdańsk *C. pelagica* was found for the first time in 2008 (maximum abundance 4060 cells·L^{-1}, biomass 25 µg·L^{-1}). In autumn 2009 the maximum biomass of that species increased 39 times in comparison to 2008, reaching 978

µg·L^{-1} (abundance 64344 cells·L^{-1}) and this diatom became a dominant species in phytoplankton community in the region.

Fig. 1. Dynamics of the abundance (cells•L^{-1}) of *Cerataulina pelagica* (average ± st.deviation) in the Lithuanian waters of the south-eastern part of the Baltic Sea and the Gulf of Gdańsk in 2005-2009.

The most abundant "newcomer" of 2005, *D. fragilissimus,* was absent in the phytoplankton samples in 2006; while in the subsequent years it became a usual component of the autumn phytoplankton both in the Lithuanian and Polish (the Gulf of Gdańsk) coastal waters (Figure 2). However, its abundance did not reach the 2005 level.

The third diatom species, *Chaetoceros brevis*, recorded in 2005 in mass quantities, have not been found in phytoplankton in the subsequent years. Another species of the same genus, *Chaetoceros* cf. *lorenzianus* (Figure 3) was recorded for the first time in the Polish coastal waters in 2003 (Kownacka et al. in preparation) and in the Lithuanian waters in 2006 (Olenina, unpublished). Since then this species became a dominant component of the autumn phytoplankton, constituting up to 32 % of total abundance (65% biomass) (Figure 4). The highest abundance and biomass (441 922 cells·L^{-1} and 696 µg L^{-1}) were recorded in November 2009.

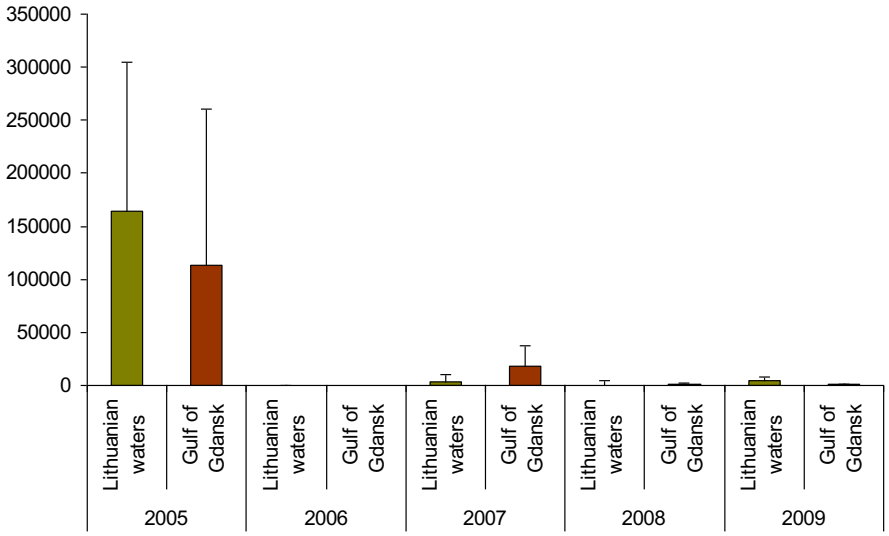

Fig. 2. Dynamics of the abundance (cells•L^{-1}) of *Dactyliosolen fragilissimus* (average ± st.deviation) in the Lithuanian waters of the south-eastern part of the Baltic Sea and the Gulf of Gdańsk in 2005-2009.

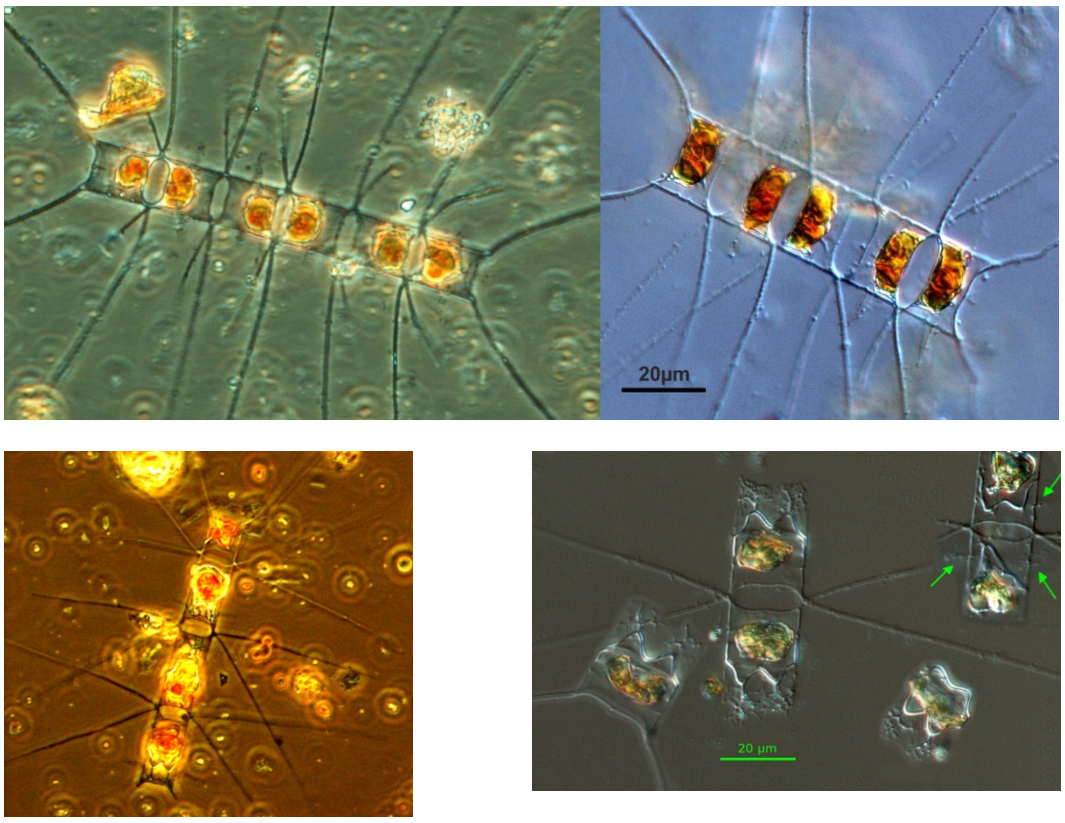

Fig. 3. LM pictures of *Chaetoceros* cf. *lorenzianus* from Lithuanian (left) and Polish (right) waters (Photo: Irina Olenina, Janina Kownacka)

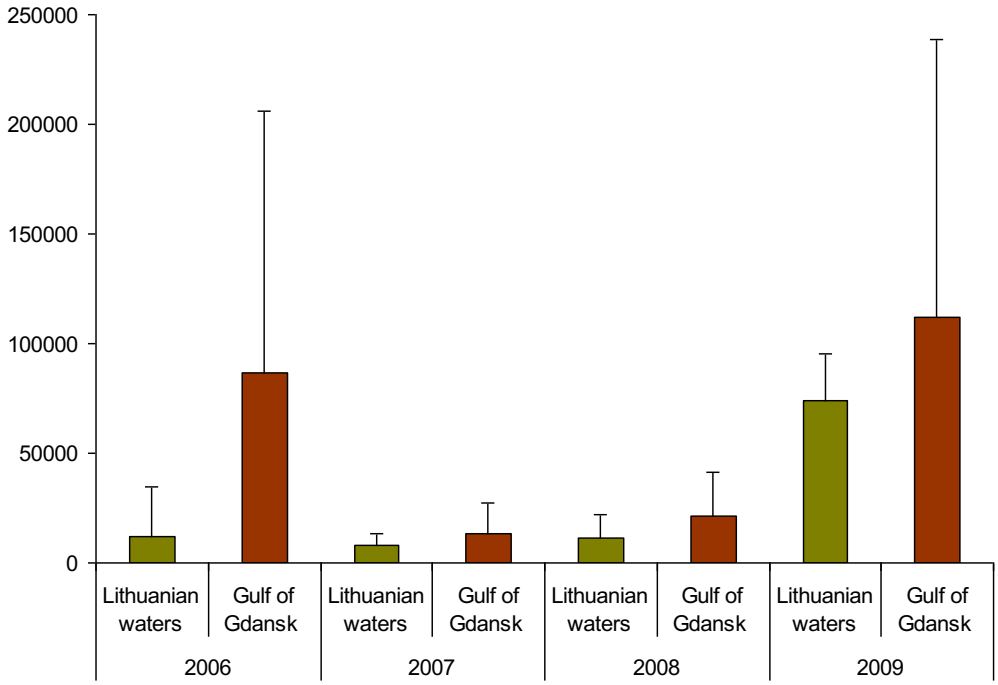

Fig. 4. Dynamics of the abundance (cells•L^{-1}) of *Chaetoceros* cf*. lorencianus* (average ± st.deviation) in the Lithuanian waters of the south-eastern part of the Baltic Sea and the Gulf of Gdańsk in 2006-2009.

It was suggested earlier (Hajdu et al. 2006) that the above mentioned diatom species could be transferred into the south-eastern Baltic proper in October - November 2005 by an unusual inflow of Kattegat water (18 PSU) which may have stayed close to the surface long enough because the water was warm (14 °C). It is probably also that such inflows could have happened before 2005; however, species brought by warm and relatively saline water inflow would not survive in conditions of less saline SE Baltic. The fact that these species have established themselves in the area may indicate that environmental conditions became more tolerable for these marine species.

Metadata

Technical information

1. Source: Lithuanian and Polish national monitoring data.

2. Description of data: Abundance (cells L^{-l}), biomass (µg L^{-1}), and distribution of marine diatom species (*Cerataulina pelagica,Dactyliosolen fragilissimus, Chaetoceros brevis* and *Chaetoceros* cf. *lorenzianus)* at integrated samples (0-10 m) from monitoring stations in the Lithuanian and Polish (the Gulf of Gdańsk) waters of the Baltic Sea.

3. Geographical coverage: South-Eastern Baltic Sea

4. Temporal coverage: 2005-2009.

5. Methodology and frequency of data collection: Information based on national monitoring samples. Phytoplankton samples analyzed and identified by phytoplankton experts, using the mandatory HELCOM methods (http://www.helcom.fi/groups/monas/CombineManual/AnnexesC/en_GB/annex6). Species identification were performed according to specific morphological features of vegetative cells and shape of resting spores (for *C. brevis* and *C.* cf. *lorencianus*). Data from nearby stations were pooled. Sampling frequency was monthly or seasonally. Maximum abundances on these stations might be underestimated because of sporadic sampling.

6. Methodology of data manipulation: Data from nearby stations are pooled.

Reference

Hajdu S, Olenina I, Wasmund N, Edler L, Witek B, 2006. Unusual phytoplankton events in 2005. HELCOM Indicator Fact Sheets 2006. Online. [2010-08-28], http://www.helcom.fi/environment2/ifs/ifs2006/en_GB/phyto.

Kownacka J., Edler L., Gromisz S., Łotocka M., Ostrowska M.; *Chaetoceros* cf. *lorenzianus* Grunow 1863 – a new component of the autumn phytoplankton in the Gulf of Gdańsk, southern Baltic Sea and its similarity with *C. decipiens* P.T.Cleve 1873 (in preparation).

FOOTNOTES

[1] Environmental Protection Agency, Marine Research Department, Taikos av. 26, 91149 Klaipeda, Lithuania; i.olenina@aaa.am.lt

[2] Sea Fisheries Institute, Department of Fisheries Oceanography and Marine Ecology, Str. Kołłątaja 1, 81-332 Gdynia, Poland.

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