



Mariia A. Shulgina / Olga G. Shevchenko

A.V. ZHIRMUNSKY NATIONAL SCIENTIFIC CENTER OF MARINE BIOLOGY, FAR EASTERN BRANCH, RUSSIAN ACADEMY OF SCIENCE

SCIENTIFIC AND EDUCATIONAL CENTRE "PRIMORSKY AQUARIUM" FAR EASTERN BRANCH, RUSSIAN ACADEMY OF SCIENCE

FAR EASTERN STATE TECHNICAL FISHERIES UNIVERSITY.



Long-term trend of the diatom *Thalassiosira nordenskiöldii* population dynamics

BACILLARIOPHYTA

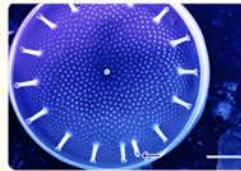
FROM THE NORTHWESTERN SEA OF JAPAN

ANNOTATION

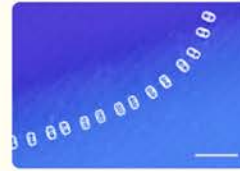
Thalassiosira nordenskiöldii is one of the most widely distributed species of planktonic diatoms, forming winter-spring blooms in temperate waters of the World Ocean.

We provide data on seasonal and long-term dynamics in abundance of *T. nordenskiöldii*, as well as to discuss specific aspects of the ecology of the diatom from the northwestern Sea of Japan.

2 A valve with strutted processes, a labiate process is indicated by arrow, scale = 5 µm, SEM



3 Cells are united into a colony, each cell having numerous chloroplasts, scale = 40 µm, LM



4 Internal valve face with a labiate process marked by arrow, scale = 5 µm, SEM



1 General appearance of cells, octagonal in grid view, rounded in valve view, scale = 5 µm, SEM



MATERIAL AND METHODS



Phytoplankton was sampled year-round at the station in Amur Bay (43°11'58"N 131°54'57"E) from 2005 to 2015 and in Paris Bay, the Eastern Bosphorus Strait, (43°00'44" N 131°54'45" E) from 2013 to 2015. Samples were taken with a 5-litre Niskin bottle from the surface horizon twice a month. One liter of sample water was fixed with Utermöhl's solution and concentrated by sedimentation (Utermöhl, 1958). To specify the main diagnostic features of the species, the material was examined with a scanning electron microscope Carl Zeiss Sigma 300 (SEM). Material for SEM was prepared according to the standard procedure (Truby, 1997).

RESULTS AND DISCUSSION

The study has revealed that *Thalassiosira nordenskiöldii* was present in the phytoplankton all year round, reaching its greatest abundance in winter and early spring. The species developed intensively under the sea ice at a surface water temperature of -1.8 to 0°C and a salinity of 33.0–35.0‰; in warm seasons, colonies were found in the plankton less often.

According to the literature, *T. nordenskiöldii* is an arctic-boreal cold-water species (Makarova, 1988). Its occurrence off the coast of South Korea and southeastern Brazil, in the Yellow, East China and South China Seas (21–25° N) (Tremarin et al., 2008; Li et al., 2013; Park et al., 2016), as well as in the study area (in summer), indicates that the species has a tropical-arctic-boreal distribution according to the phytogeographical zonation system used in Russia (Beklemishev et al., 1977).

A quantitative study of the phytoplankton showed that a bloom formed by *T. nordenskiöldii* had occurred in Paris Bay, the Eastern Bosphorus Strait, in March 2014, with the species reaching a concentration of 1.5×10^6 cells/L. In Amur Bay the highest abundance of *T. nordenskiöldii*, 412.8×10^3 cells/L, was recorded in late January 2010. From 2005 to 2010, the species comprised a substantial part of the phytoplankton communities in Amur and Paris Bays - up to 94% and 98% of the total phytoplankton population, respectively. An analysis of the long-term quantitative dynamics demonstrated that significant proliferation of *T. nordenskiöldii* in the winter-spring period had taken place in Amur Bay each year from 2005 to 2010, and one to two peaks of cell concentrations, up to $250\text{--}400 \times 10^3$ cells/L, had occurred yearly from December till March. In 2010–2012 the numbers of *T. nordenskiöldii* in Amur Bay were equal to or less than 50×10^3 cells/L, single growth peaks were registered in winter. Since 2013 the species has not been a dominant one of the bay in the winter-spring period.

At the same time, in Paris Bay a sharp increase in the population of *T. nordenskiöldii* occurred as follows: in 2013 its abundance did not exceed 20×10^3 cells/L, and in 2014 the species dominated the spring phytoplankton bloom. In 2015 the diatom was absent from the plankton of the bay.

Since 1970s *T. nordenskiöldii* has been known to form winter-spring blooms in temperate waters of the World Ocean (Cleve, 1873; Degerlund, Eilertsen, 2010). In 2000s *T. nordenskiöldii* was noted to constitute a less significant part of planktonic communities as compared to 1970s and earlier years. (Degerlund, Eilertsen, 2010; Flickinger, 2016). Since 2014, the species has been completely absent from some water areas, for instance from Narragansett Bay (Flickinger, 2016). In the northwestern Sea of Japan, winter blooms of the species were recorded in 1950s–1970s (Kononova, 1987). In Peter the Great Bay mass growth of *T. nordenskiöldii* occurred in winter and spring during the period from 2005 to 2010. In 2015 the species was not dominant in the winter-spring phytoplankton community.

