

Dominant microalgae species in Paris Bay (Peter the Great Bay, Sea of Japan) near the net pens with marine mammals

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Scheme of the monitoring site location (A) in the Paris Bay

INTRODUCTION

Species composition and quantitative characteristics of phytoplankton communities indicate the health of a marine environment, and therefore it is very important to thoroughly study microalgae in marine protected areas or aquaculture sites such as Paris Bay. Toxic algal species of marine and brackish-water plankton, as well as nontoxic microalgae, which are capable of initiating harmful blooms, cause a detriment to human health (seafood poisoning) and often lead to a total crisis of coastal water ecosystems. During the study period (June–December 2019), no toxic species bloom was found. However, the abundance of *Skeletonema dohrnii* ($4,6 \times 10^6$ cells/L) and *Skeletonema japonicum* ($2,3 \times 10^6$ cells/L) indicates a significant level of trophicity in summer and autumn.

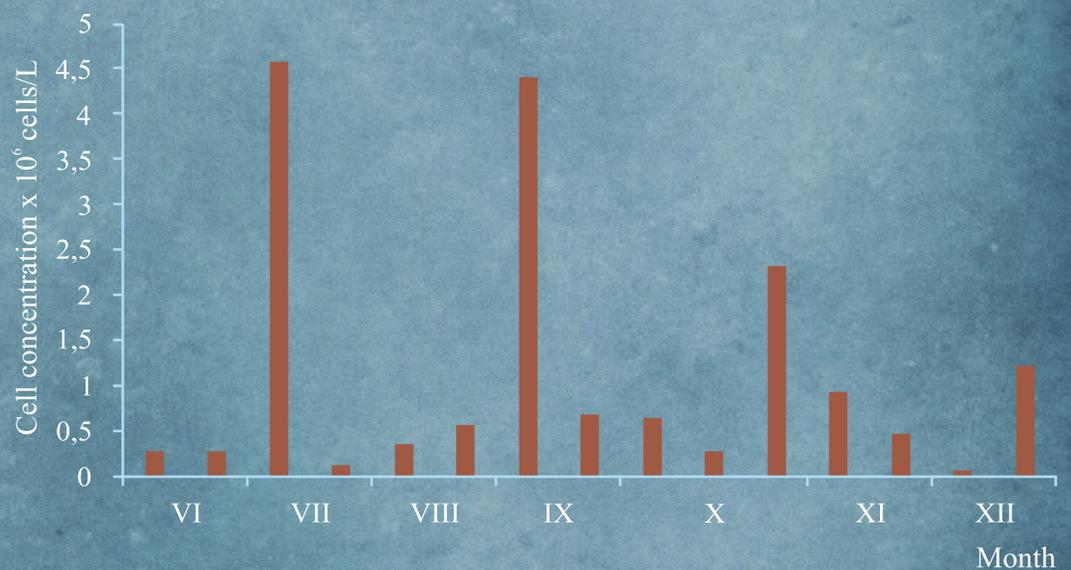
MATERIAL AND METHODS

Quantitative samples of phytoplankton for this study were collected in 2019 in Paris Bay near the Center for the Study of Marine Mammals of the Research and Education Center Primorsky Aquarium. Paris Bay, a smaller subordinate bay in Peter the Great Bay, is located off the northeastern coast of Russky Island. This shallow bay has a depth of 14 m in the central part. The waters of Paris Bay may be influenced by the adjacent waters of Amur and Ussury bays, connected through the Eastern Bosphorus Strait. In summer, water temperatures in Paris Bay reach their highest values in August, with surface waters warming up to 25.5 °C.

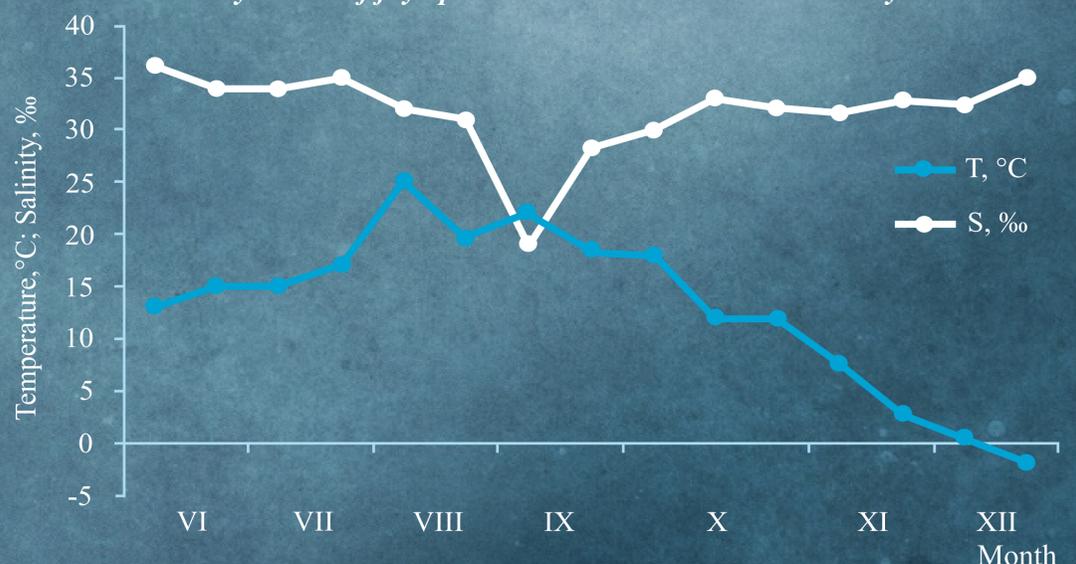
The waters of Paris Bay are regularly polluted with marine debris brought with waters transported from the Eastern Bosphorus Strait and Ussury Bay to the north-west. This water transfer poses a high threat of pollution to such northern bays as Paris Bay. Phytoplankton samples were taken with a 5-litre Niskin bottle from a depth of 0,5 m twice a month. One liter of sample water was fixed with Utermöhl's solution until it turned pale-yellow. The samples were concentrated by reverse filtration, using a 2 µm polycarbonate filter membrane, or by sedimentation.

RESULTS AND DISCUSSION

From June to December 2019 (water $t_{max} = 25^\circ\text{C}$, $S = 36\text{‰}$; water $t_{min} = -1,8^\circ\text{C}$, $S = 19\text{‰}$), 108 species and intraspecific taxa of microalgae from five phyla – Bacillariophyta, Dinophyta, Ochrophyta, Cryptophyta и Euglenophyta – were recorded in Paris Bay. Only members of the phylum Bacillariophyta, namely *Skeletonema dohrnii*, *S. japonicum*, *Cyclotella* spp. and *Thalassiosira* spp., were found to form blooms in the study area. In July ($t = 15^\circ\text{C}$, $S = 34\text{‰}$), the abundance of *Skeletonema dohrnii* reached $4,6 \times 10^6$ cells/L, which accounted for 91,6% of the total microalgae abundance. The next outbreak of phytoplankton was observed in September; there was a rapid increase in the population ($4,4 \times 10^6$ cells/L) of several *Cyclotella* species (72%, $t = 22^\circ\text{C}$, $S = 19\text{‰}$). A peak in abundance of *Skeletonema japonicum* ($2,3 \times 10^6$ cells/L) was also noted in autumn (92%, $t = 11,8^\circ\text{C}$, $S = 32,1\text{‰}$). In December, the plankton was dominated ($1,2 \times 10^6$ cells/L) by *Thalassiosira* species (95,6%, $t = -1,8^\circ\text{C}$, $S = 35\text{‰}$). Comparative analysis of the quantitative data with the results of the phytoplankton study conducted in Paris Bay in 2014–2015 showed no consistent trend in the composition and density of microalgae community in the area.



Dynamics of phytoplankton abundance in the Paris Bay in 2019



Dynamics of water temperature and salinity in the Paris Bay during the study period