THE PRIMARY PRODUCER OF SEA ECOSYSTEM UNDER THE INFLUENCE OF DREDGING

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Dredging

is the excavation of material from a water environment for a different purpose, which include:

- improving existing water features;
- reshaping the land and water features to alter drainage;
- navigability;
- constructing dams;
- beach nourishment
- etc.

In the most part of works the excavation is undertaken by a dredger.

Environmental impact of dredging:

- The great value of suspended matter inputs into the water column
- Resuspending materials on the other water areas, especially underwater dumps;
- Release of toxic substances from bottom sediments.

Long term effects:

- Changing hydro-morphological conditions
- Changing sediment type
- Reduction of spawning areas

Distribution of the turbidity water plume during construction of the avanport «Bronka» in Landsat-8 Oli images from May 17 and July 2, 2015 (with an enlarged fragment in the inset) with a spatial resolution of 30 m.

From "Results of investigations of the Neva Bay technosphere at RSHU" M.B. Shilin, V.I. Sychev, V.L. Mikheev, Y.P. Istomin Yu.A. Lednova, S.V. Luk'yanov, V.M. Abramov //Hydometeorilogy and ecology.2020.№60.

The consequences of dredging for aquatic communities:

- mechanic impact on the plankton organisms and deteriorate of filter feeders;
- decreasing of the photic zone depth and deterioration of condition for photosynthesis;
- destruction and burial of benthic communities;
- decreasing of reproduction possibility of fish;
- the toxic impact of hazardous substances which dissolved into the water column.

Dredging works

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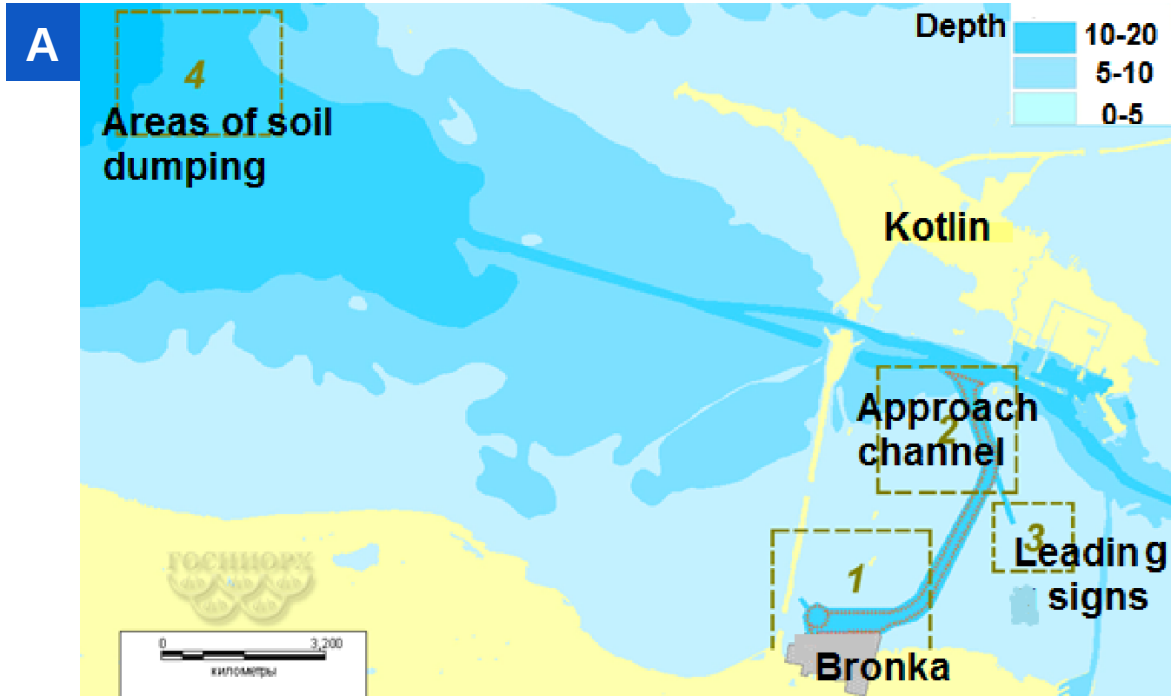
The main task of investigation:

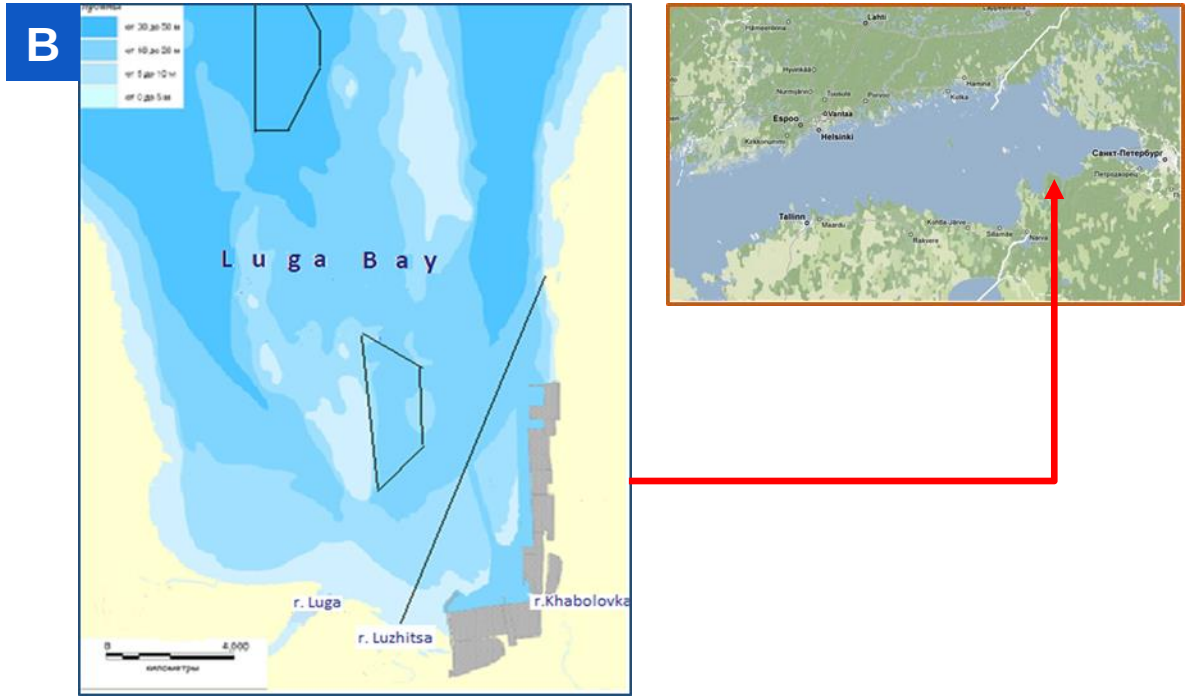
estimation of influence of dredging on the phytoplankton of the Eastern part of the Gulf of Finland as the main primary producers and the base of food webs in the seas ecosystems.

Study areas

- Luga Bay (2005-2018, during of Ust-Luga commercial seaport construction);
- Neva Bay (2011-2015, during of Multipurpose Sea Cargo Complex Bronka construction).



A. Neva Bay near the Complex Bronka construction

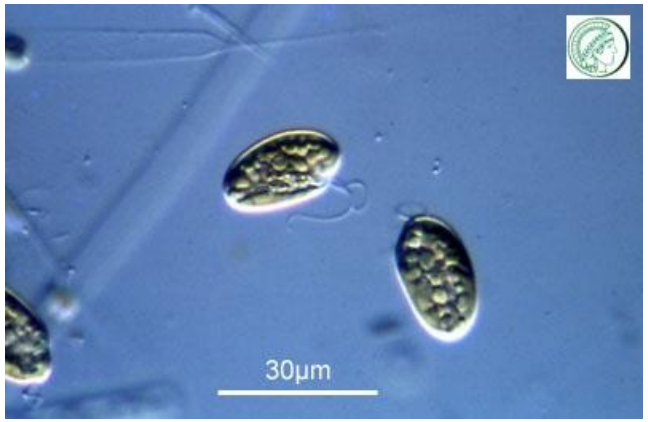


B. Luga Bay. Area of constructing the Ust-Luga port (1) and areas of soil dumping (2)

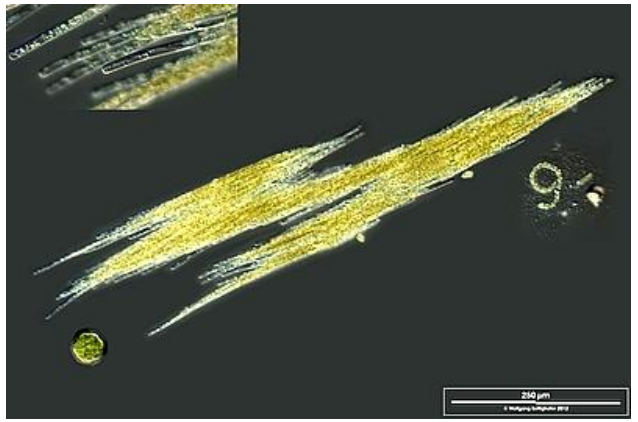
The Luga and Neva Bays phytoplankton are formed previously by the cosmopolitan and eurybiontic species which are typical for the Eastern part of the Gulf of Finland. The most quantitative development was marked for cyanoprokaryotes, cryptomonads, diatoms, and green algae.

The main dominants:

Aphanizomenon flos-aquae | Planktothrix agardhii | Woronichinia compacta Pseudanabaena sp.
Skeletonema costatum | Cryptomonas sp. | sp. Aulacoseira islandica | Cyclotella sp. | Stephanodiscus hantzschii | Aulacoseira subarctica | Tabellaria fenestrata



Cryptomonas sp.



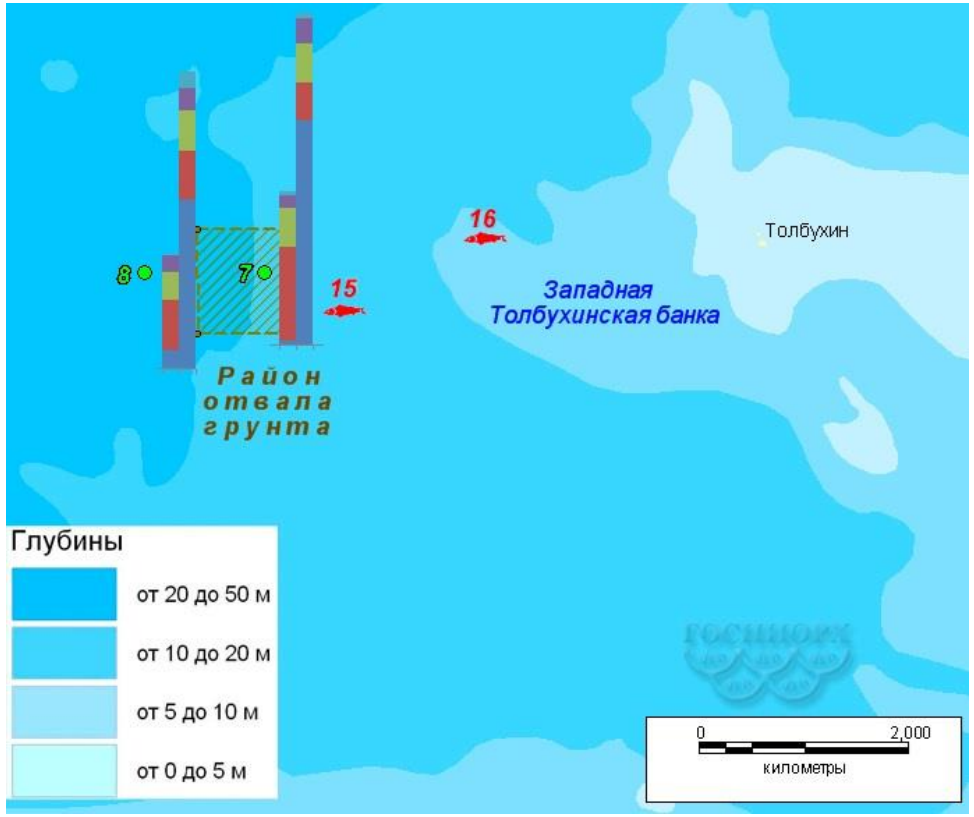
Aphanizomenon flos-aquae

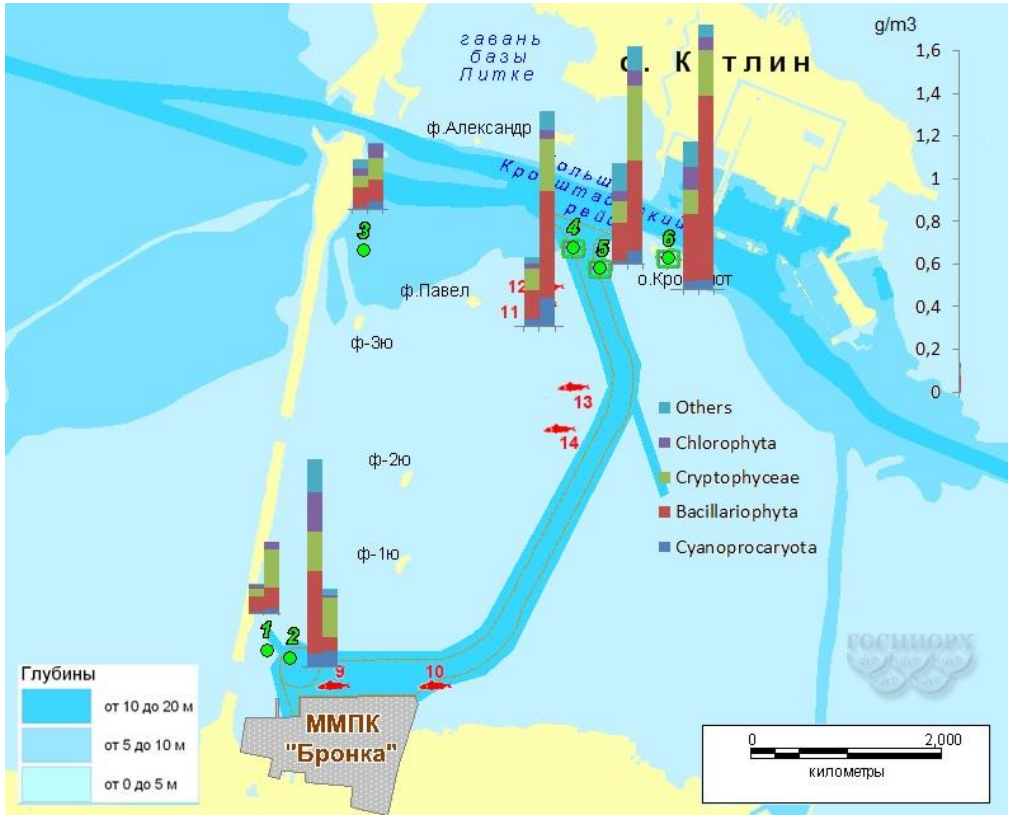
Aulacoseira islandica

https://planktonnet.awi.de/index.php?contenttype=image_details&itemid=57916#contet

http://nordicmicroalgae.org/taxon/Aulacoseira%20islandica

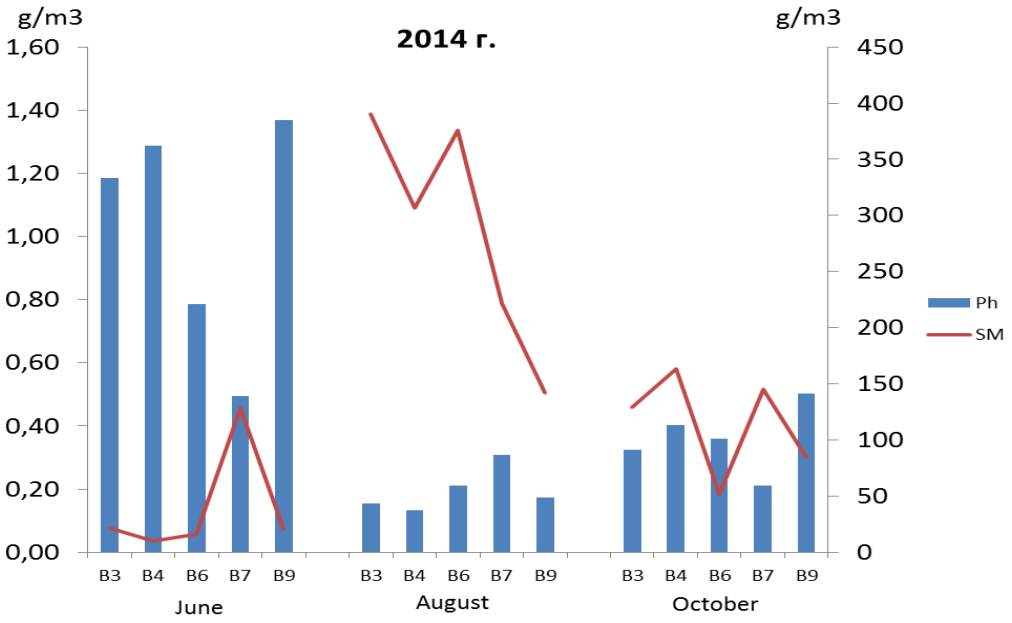
Phytoplankton biomass in 2014 during the Bronka construction and other dredging works June (on the left) and September (on the right)

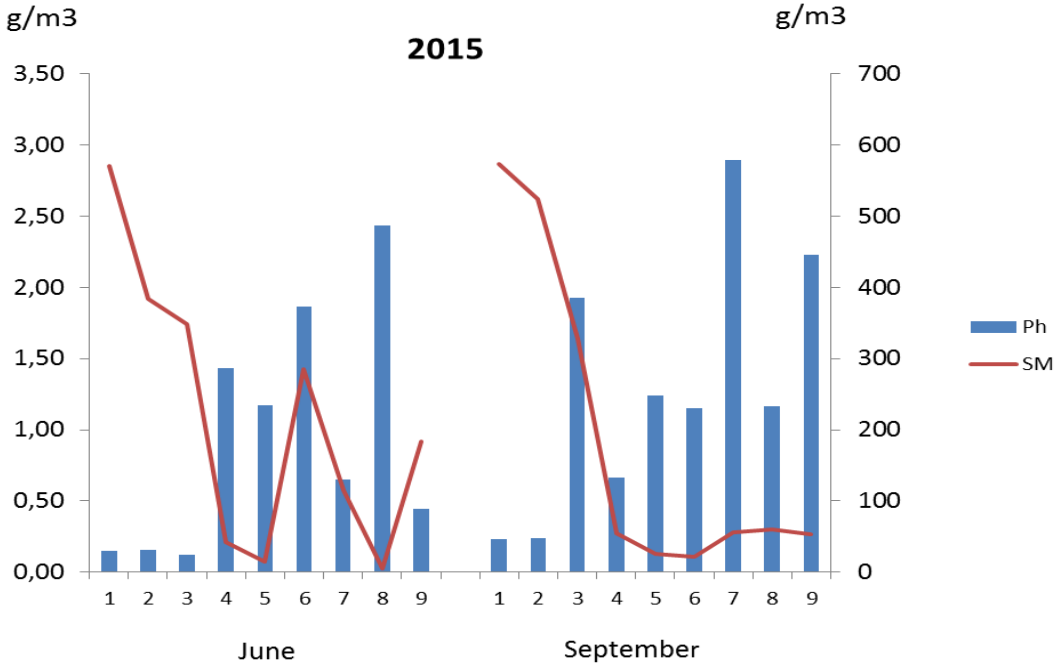




Correlation between phytoplankton biomass and suspended matter content

Biomass Suspended matter
r = - 0,54
(**surface layer**) n=16, p=0,01





At the first steps of port construction in 2011, the structure and quantitative development of Neva Bay phytoplankton on the seaport water area was typical for Neva Bay according to periods of seasonal succession. In 2013-2015 on the water areas of offshore civil works the evidence of the negative influence of dredging as decreasing of total biomass, a number of filamentary forms of cyanoprokaryotes and increasing of the proportion of mixotrophic cryptomonads were marked.

n=30, p=0,01	Biomass			
Suspended matter (surface layer)	Cyanoprokaryotes	Diatoms	Cryptomonads	Total
	r =- 0,63	r =- 0,65	r =- 0,54	r =- 0,72

Phytoplankton biomass (PH) and suspended matter concentration(SM) in the Neva Bay on the water area of the Multipurpose Sea Cargo Complex Bronka construction and adjacent areas

n=24, p=0,01	Biomass		
	Diatoms	Cryptomonads	Total
Suspended matter surface layer	r=- 0,55	r=- 0,46	r =- 0,59

Correlation between phytoplankton biomass and suspended matter content in the Neva Bay on the water area of the Multipurpose Sea Cargo Complex Bronka construction and adjacent areas

Phytoplankton biomass (PH) and suspended matter concentration(SM) in the Luga Bay on the water area the of Ust-Luga commercial seaport construction and adjacent areas

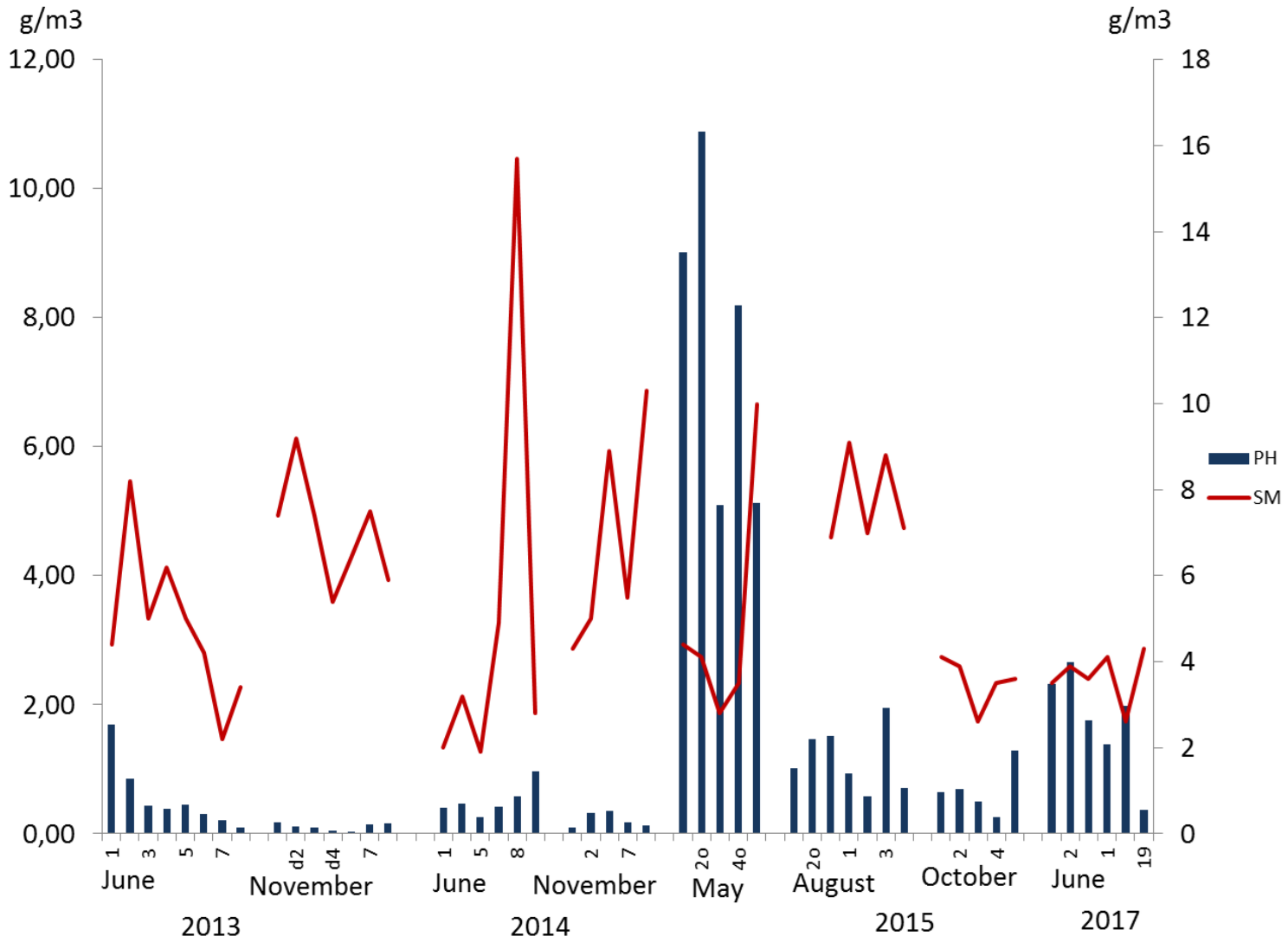
Correlation between phytoplankton biomass and suspended matter content in the Luga Bay (2013-2017)

n=30, p=0,01

Suspended matter (surface layer)

Biomass

r = - 0,15



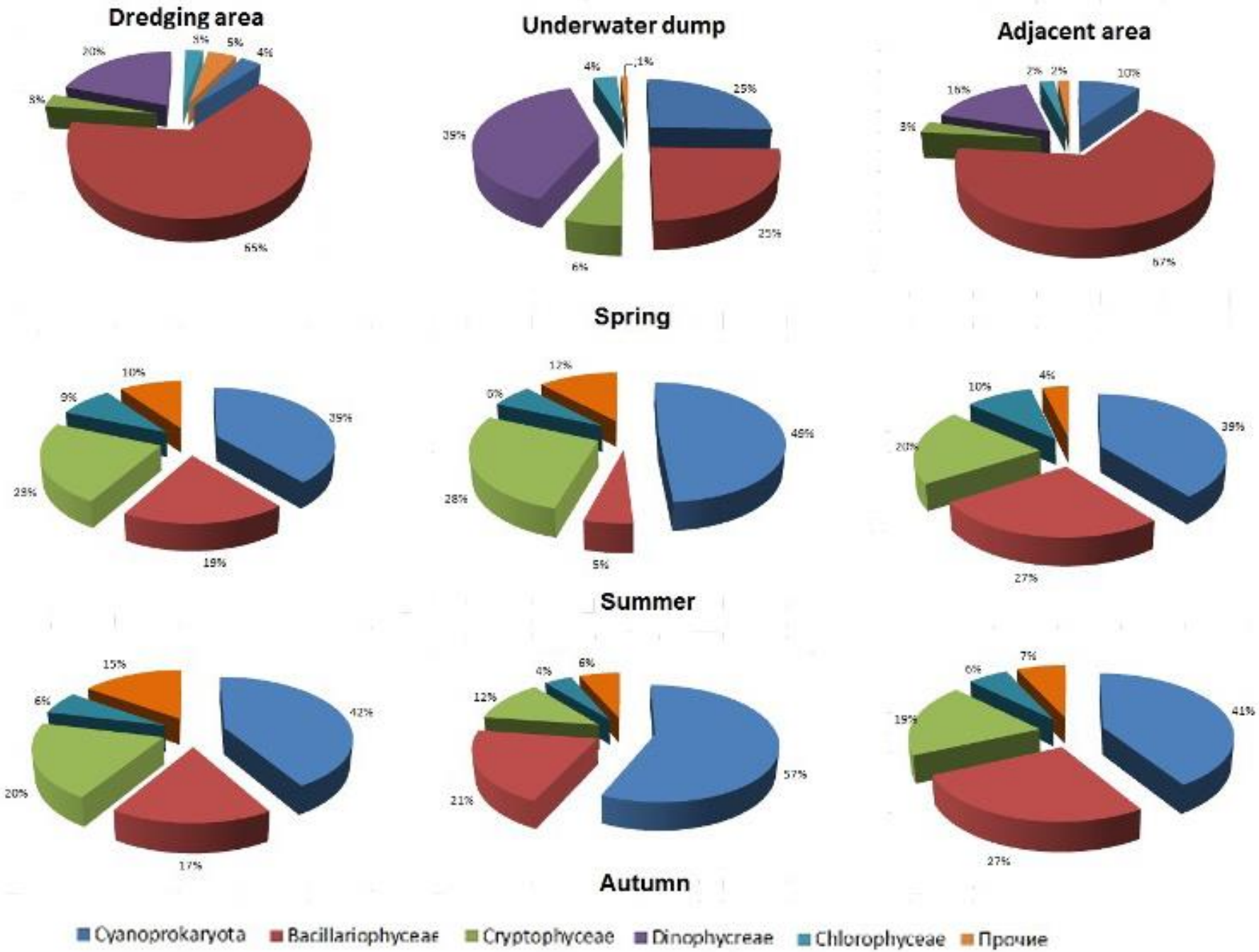
By the results of a long-term investigation of Luga Bay phytoplankton the fast recovery of the phytoplankton structure after the dredging was detected.

Average values (g/m^3) of phytoplankton biomass on the Luga Bay water area in different seasons of ice-free period in 2005-2018

Above the line – average with an error, below the line - the limits of change

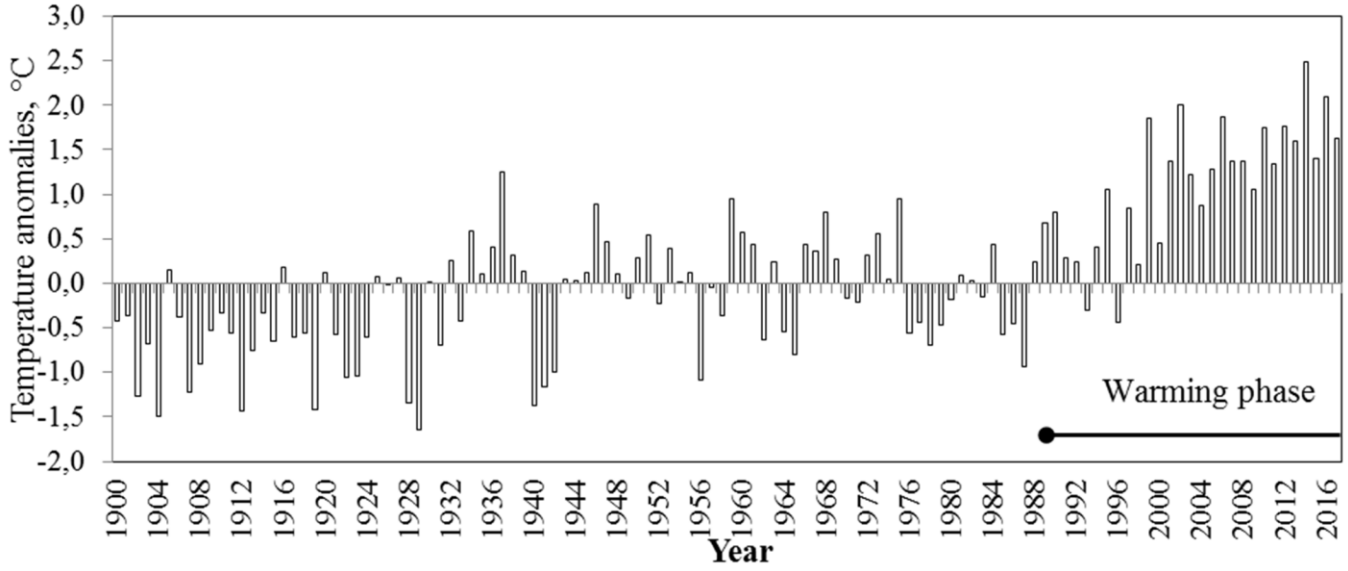
Dredging areas	Underwater damp	Adjacent areas
Spring		
3,01±0,51	1,35±0,45	2,26±0,49
0,04-13,08 n=51	0,15-5,61 n=12	0,04-14,20 n=36
Summer		
1,14±0,11	1,03±0,17	1,79±0,20
0,01-3,63 n=62	0,21-2,63 n=16	0,10-5,12 n=45
Autumn		
0,26±0,04	0,54±0,19	0,32±0,06
0,03-1,53 n=64	0,03-3,70 n=21	0,02-1,57 n=37

The share of the main systematics groups of algae in phytoplankton biomass in the dredging area, underwater dump, an adjacent area in different seasons according to 2005-2018.



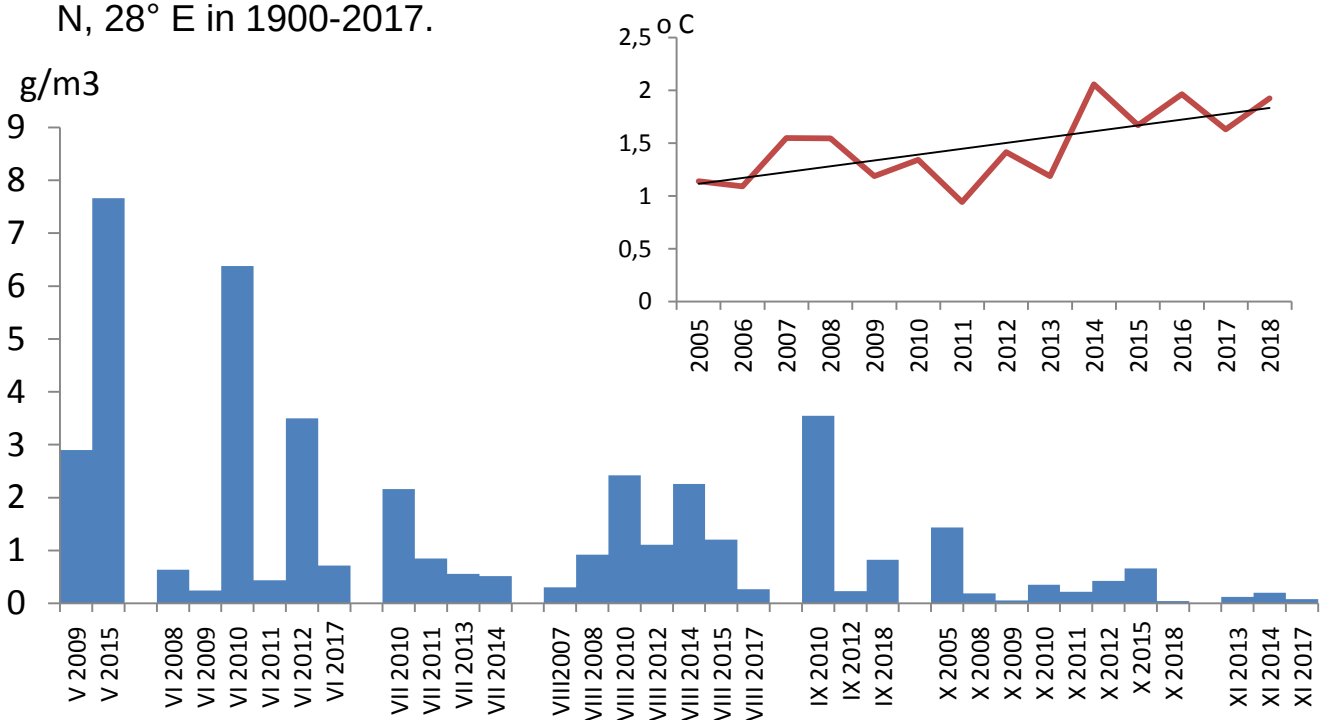
The evident trend of the phytoplankton quantitative development change according to the annual water temperature increases was not found.

The most likely causes are the multicomponent nature of the factors which influence the planktonic algae development and the composition of its dominant complex consisting of eurybiontic species with a wide temperature optimum zone.



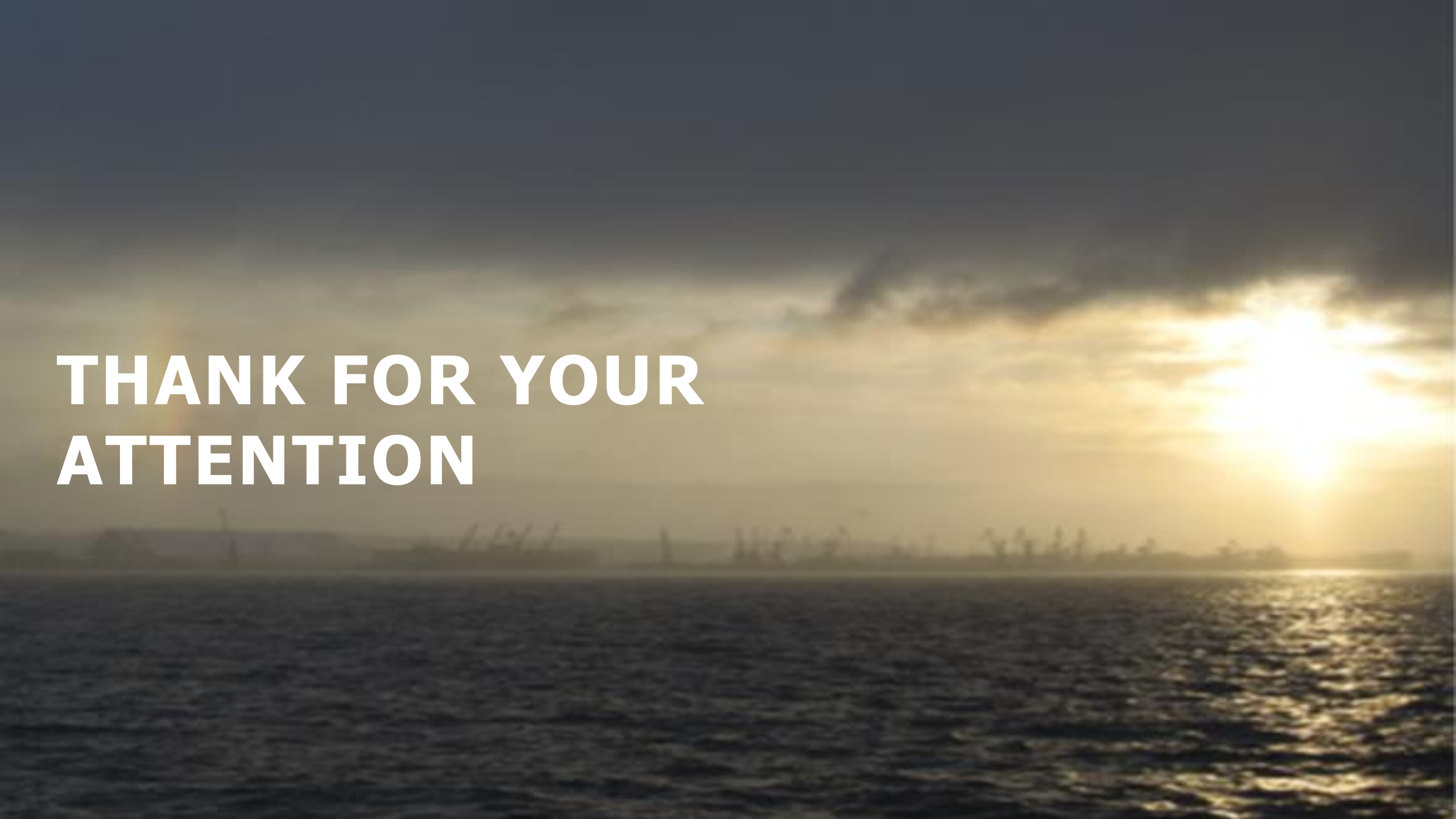
. Changes in the average anomaly of the surface temperature of the Baltic Sea in May-October in the area of 2° x 2° with center in the coordinates 60° N, 28° E in 1900-2017.

The biomass of Luga Bay phytoplankton in 2005-2018



CONCLUSION

- During the Multipurpose Sea Cargo Complex Bronka construction in 2011-2015 the negative influence of dredging works was detected. The negative correlation between phytoplankton biomass and suspended matter concentration was marked.
- The quantitative indicators of phytoplankton of the Luga Bay development were varied from year to year in all seasons of 2005-2018 but they kept in frames of values which previously observed for the water area.
- The certain differences between the quantitative development and composition of the dominant phytoplankton complex on the water areas of dredging, damping, and adjacent areas in Luga Bay were not observed.
- There was not a significant impact of dredging and dumping on the phytoplankton of the Luga Bay which indicates the stable state of its ecosystem primary producer and the preservation of the productional resource of the Luga Bay ecosystem.
- The influence of the Gulf of Finland water warming on phytoplankton development was not traced.
- **The dredging works must be regulated in time for the recovery of phytoplankton communities.**


THANK FOR YOUR
ATTENTION