THE SEASONAL FEATURES OF PHYTOPLANKTON DEVELOPMENT IN THE GULF OF RIGA IN 1998 – 2000.

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Introduction

The first investigations of phytoplankton seasonal development in the Gulf of Riga appeared in 1920-s by Rappoport. Wide investigations were carried out by Nikolajevs 1950-s and Kalveka 1980-s.

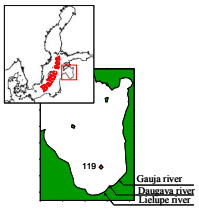
Till 1995 the succession of phytoplankton species composition and quantitative parameters in the Gulf of Riga were determined using formalin as a fixator. Therefore the importance of flagellates was not determined at the community. Besides, in the majority of cases the phytoplankton sampling had only a seasonal frequency. Therefore this study is regarded as the continuation of investigations at new higher quality, provided by detailed monitoring through the year and using the HELCOM recommended method of phytoplankton research.

Material and methods

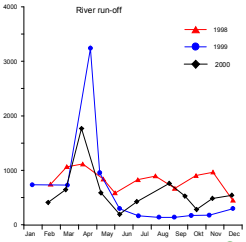
The phytoplankton material was collected about 30 km far from the Daugava's estuary at the high - frequency monitoring station 119 (57^0 18'; 23^0 51') in the southern part deep water (44m) zone of the Gulf of Riga. Integrated samples fixed with acid Lugol's solution characterizing the layer 0 - 10 m (0; 2,5; 5,0; 7,5; 10 m) were collected averagely two times a month. All samples were analysed under inverted microscope using sedimentation chambers. The total number of phytoplankton in all cases in the sample exceed 500. The cell volume for phytoplankton biomass determination was determined using geometrical formulae to put cell shape on various suitable geometrical shape.

Results

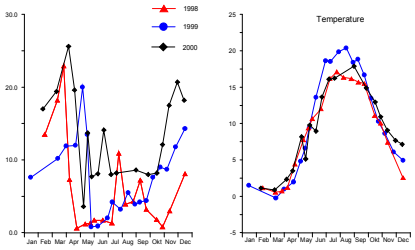
The high-frequency station in the Gulf of Riga



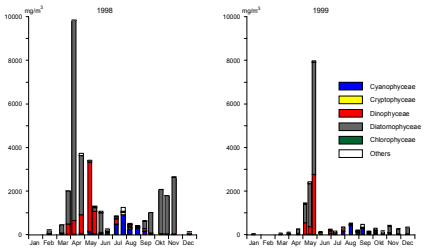
The river run-off (m^3/s) at the station 119 in 1998-2000



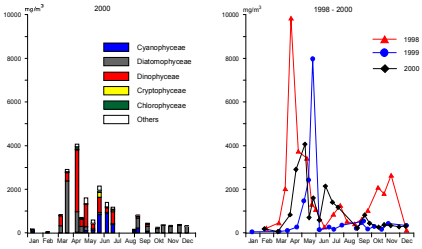
SiO_4 (µmol/l) concentrations and water temperature (ºC) at the station 119 (layer 0-10m) in 1998-2000



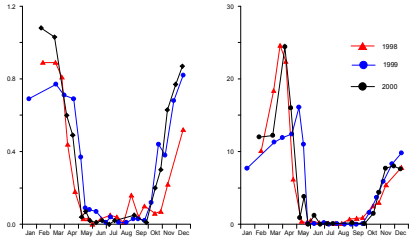
The biomass of phytoplankton (mg/m^3) at the station 119 in 1998 – 1999



The biomass of phytoplankton (mg/m^3) at the station 119 in 1999; 1998-2000



The PO_4 and NO_{2+3} (µmol/l) concentrations at the station 119 (layer 0-10m) in 1998-2000



Conclusions

Three separate maxima of biomass distinguished remarkably during the phytoplankton seasonal development. Diatoms and dinoflagellates (*Peridiniella catenata)* bloomed intensively in spring, followed by the blue-green algae in summer and diatoms in autumn. Absolute maximum of phytoplankton biomass was always observed in spring. Particular feature of year 2000 was decreased ratio between maximal spring biomass and summer biomass - 2:1, compared to 1998 – 1999 when it was 10:1. The phenomenon was caused not only by increased biomass in summer, but also by decreased development intensity in spring.

Spring bloom of 1998 started early and occurred very fast from the end of March till the middle of May, reaching maximum at the beginning of April. The intensity of the bloom was inversely proportional to its duration. Silicon was the limiting factor of diatom development in April, but still existing nitrate concentrations caused growth of dinoflagellates biomass (*Peridiniella catenata*) at the beginning of May. In 1999 spring development of phytoplankton was lasting and started about one month later as in 1998, reaching maximum at the end of May. Algae growth in April was mainly stopped by unstable water column and negative water temperature. In 2000 spring bloom started at the beginning of April, reached the maximum during the end of April and beginning of May – following the most frequent pattern of long-term observations. Maximal biomass in 2000 was two times lower as in 1998 – 1999, due to the formation of thermocline, preventing nutrient supply. As a result all nutrients were limiting almost simultaneously.

In summer maximal development of blue-green algae *Aphanizomenon flos-aquae* and *Nodularia spumigena* was always observed due to increase of water temperature and stratification of water column, causing analytical zero concentrations of phosphates and nitrates. Maximal bloom of blue-green algae was during July in 1998 and 2000, but in the middle of August in 1999.

Intensity of the bloom was two times lower in 1999 as in 1998 un 2000 caused by lower river run-off and windy weather. Second smaller maximum of blue-green algae occurred in September 1999 when water temperature continued to rise, water column had a stable stratification and nitrates were completely assimilated. Although the bloom of blue-green algae is a regular phenomena in the Gulf of Riga, no ecologically dangerous situations formed also in 1998 – 2000.

In 1998 autumn peak was observed during middle of November, caused by intensive water mixing and high river run-off, increasing concentrations of all nutrients. In 1999 autumn maximum was expressed weakly - about six times lower as in 1998, caused by slow cooling of water column, stable stratification and low river run-off. In 2000 phytoplankton autumn development was more intensive as in 1999, but less intensive than in 1998. The early autumn peak of 2000 was a specific feature as it started already at the transition period from summer to autumn although the species composition was typical for later autumn (*Coscinodiscus granii, Actinocyclus octonarius* and *Chaetoceros danicus*).

The investigations of phytoplankton at the high-frequency monitoring station showed that freshwater nutrient flow substantially influences the productivity of phytoplankton community in all seasons at the southern Gulf of Riga.

The analysis of maximums in phytoplankton development demonstrated the high year-to-year seasonal variation both in numerical values and timing of blooms.