Development of potentially toxic Cyanobacteria *Aphanozomenon flos-aquae* and *Nodularia spumigena* in the Gulf of Riga during 1997 – 2004.

IVETA LEDAINE

Institute of Aquatic Ecology, Marine Monitoring Centre, University of Latvia, Daugavgrivas str., 8, Riga, LV-1048, LATVIA Tel.: +371 7 602301, Fax: +371 7601995, e-mail: iveta@monit.lu.lv

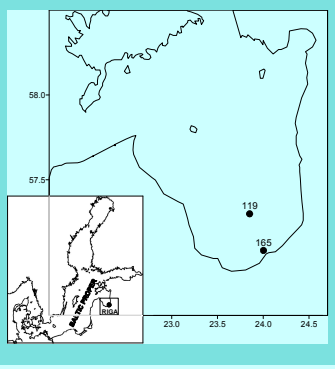
Introduction

Cyanobacterial blooms are a common phenomenon in the Baltic Sea during warm summer months and have occurred for some 7000 yr (Bianchi et al. 2000). The dominating bloom-forming species are the N_2-fixing *Aphanizomenon flos-aquae* and *Nodularia spumigena*, and its blooms are problematic, since this species is toxic (Kononen et al. 1996, Wasmund 1997). *N. spumigena* produces the algal toxin nodularin, a hepatotoxin which poses a health risk for human and animals (Kononen 1992). The significant increase of these species abundance was observed at the beginning of 90s in the Gulf of Riga. Some intoxications by toxic algae of humans and cattle were observed in the northern part of the Gulf of Riga in 1992 and 1994 and southern part in 1989 and 1993 (Balode M., Purina I. 1996). The aim of this study is to describe the development of these species during the last eight years at two monitoring stations of the Gulf of Riga.

Material and methods

The phytoplankton material was collected about 30 km and 2 km far from the Daugava's estuary at the high - frequency monitoring stations 119 (57^0 18'; 23^0 51') at the central part (44m) and 165 (57^0 04'; 24^0 02') at the southern coastal (12m) zone. Integrated samples fixed with acid Lugol's solution characterizing the layer 0 - 10 m were collected averagely two times a month. All samples were analysed under inverted microscope using sedimentation chambers. The total number of phytoplankton counted in all cases in the sample exceeded 500. The cell volume for phytoplankton biomass determination was determined using geometrical formulae to put cell shape on various suitable geometrical shape.

Study area



- Gulf of Riga – semi-enclosed water body
- the mean depth is 26m, maximum depth reaches 60m
- average water salinity is 5 to 6 PSU (in coastal zone sometimes even 1 to 3 PSU)
- seasonal pycnocline develops during spring and resides at ca. 20m depth throughout the summer
- typical temperature difference is +18°C /+ 4°C

Results

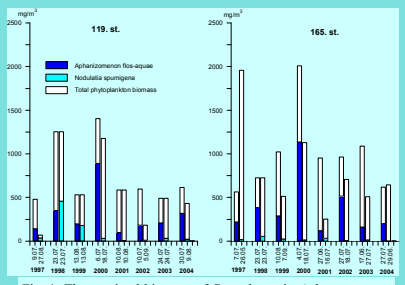


Fig. 1. The maximal biomass of Cyanobacteria *Aphanizomenon flos*-aquae, *Nodularia spumigena* and the total phytoplankton biomass at the station 119 and 165 (layer 0-10m) in 1997-2004

The concentrations of NO_{2+3} in years varied more in the coastal zone than in central part of the Gulf of Riga.

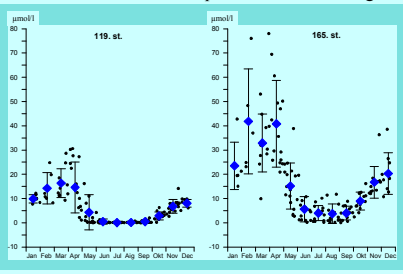


Fig. 2. The NO_{2+3} (µmol/l) concentrations at the station 119 and 165 (layer 0-10m) in 1997 – 2004

The concentrations of PO_4 in coastal station in July and August 1998 and 2000 were more than 10 µmol/l higher as in central part, but still very close to analytic zero concentrations.

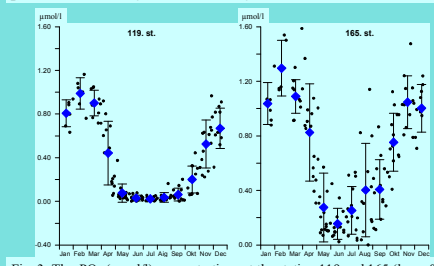


Fig. 3. The PO_4 (µmol/l) concentrations at the station 119 and 165 (layer 0-10m) in 1997 – 2004

The temperature in summer period in both stations was optimal for development of Cyanobacteria

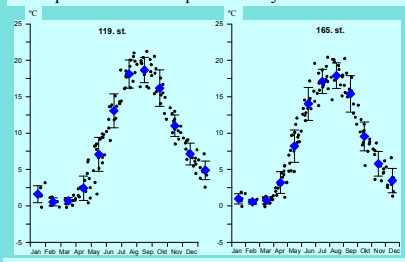


Fig. 4. Water temperature (ºC) at the station 119 and 165 (layer 0-10m) in 1997 – 2004

The freshwater input from rivers in the July and August 1998 and 2000 was more than three times higher as in other years.

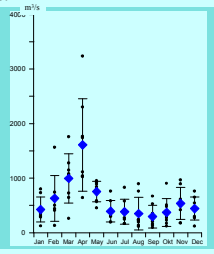


Fig. 5. The river run-off (m^3/s) at the station 119 and 165 (layer 0-10m) in 1997 – 2004

Conclusions

- *Aphanizomenon flos-aquae* is more abundant and reaches the greatest values at the coastal area while *Nodularia spumigena* was more present in open area but in small amounts.
- *A. flos-aquae* and *N. spumigena* were always observed after the increase of water temperature and stratification of water column, causing analytical zero concentrations of phosphates and nitrates.
- The highest biomass of *A. flos-aquae*, making more than 60% of the total phytoplankton biomass, was observed in 2000 at the both areas of Gulf. The largest amount of *N. spumigena* constituted 36% and 7% of total community in the central and southern stations, respectively, in 1998. The development of algae was obviously stimulated by addition of available phosphorus through the increased freshwater input in these years.
- The bloom of Cyanobacteria is a regular phenomena in the Gulf of Riga and no ecologically dangerous situations formed in 1997 – 2004.

References

Balode M., Purina I. (1996) Harmful phytoplankton in the Gulf of Riga (The Baltic Sea), Harmful and Toxic Algal Blooms, Yasumoto T., Oshima Y., Fukuyo Y. (Eds.), IOC of UNESCO, 69-72

Bianchi T.S., Engerlhaupt E., Westman P., Andren T., Rolff C., Elmgren R. (2000) Cyanobacterial blooms in the Baltic Sea: natural or human-induced? Limnology and Oceanography 45: 716-726

Kononen K. (1992) Dynamic of the toxic cyanobacterial blooms in the Baltic Sea. Finish Marine Reseearch 261: 3-36

Kononen K., Kuparinen J., Mäkelä K., Laanemets J., Pavelson J., Nõmmanns S., (1996) Initiation of cyanobacteria blooms in a frontal region at the entrance to the Gulf of Finland, Baltic Sea. Limnology and Oceanography 41: 98-112

Wasmund N., (1997) Occurrence of Cyanobacterial blooms in the Baltic Sea in relation to environmental conditions. Int Rev Gesamten Hydrobiology 82: 169-184