# Shifts in the Baltic Sea summer phytoplankton communities in 1992-2006

**Information from the Phytoplankton Expert Group (PEG)**

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## Key Message

Statistical analysis revealed opposite biomass trends for some taxonomical groups of phytoplankton (cyanobacteria, dinophytes, prasinophytes and chlorophytes) in different sub-basins; for example cyanobacteria decreased in the Baltic Proper during last decade, but increased in the Bothnian Sea

The autotrophic ciliate *Mesodinium rubrum* indicated upward trend

## Relevance of the indicator for describing developments in the environment

Phytoplankton is an important element in the marine environment because of its fundamental role to the productivity of higher trophic levels, and is indicative of both environmentally driven change as well as manmade undesirable disturbance.

However, there are very few time series documenting clear trends of change in biomass of total phytoplankton, taxonomical and functional groups or single taxa coincident with trends of for example increasing nutrient concentrations. Most of "working" indicators are still based on phytoplankton chlorophyll *a* concentrations – a proxy of biomass. This is also valid for the Baltic Sea and the potential indicators regarding phytoplankton community, e.g. indicator species have not succeeded yet in being practical and easily measurable. Ideally, indicators for phytoplankton composition should be indicative and sensitive to eutrophication and nutrient loading. The community indicators should include key species or groups, which are important in the production and fate of biomass and preferably applicable for validation of ecosystem models. Even though potential candidates have been studied, the analyses have often been done with limited amount of data and their applicability for the whole Baltic is not known (see Kuuppo et al. 2006).

## Policy relevance and policy references

The forces governing selection, dynamics, diversity and stability often remain ‘mysteries’ despite an enormous investigative effort to understand the factors regulating species composition in the phytoplankton (Tilman, 1996). The factors governing those changes are likely easier to measure directly, but change in phytoplankton itself is already important and may have a higher impact to the ecosystem (e.g. food chain) than a slight change for instance in oxygen or nutrient concentration. Moreover, in the case of moderate eutrophication changes in mutual relationships of dominant species occur prior to shifts in community structure (Hajdu et al., 1997).

ICES/HELCOM phytoplankton databank needs revision and is trustable only for abundant and well-identified species. It makes hard to analyze trends on the species level, which may serve as indicators. However, regular phytoplankton monitoring in the Baltic Sea has been carried out since 1980s and a bulk of material has gathered. Until revisions have not made, phytoplankton expert group (HELCOM PEG) decided to investigate temporal changes on group level and to restrict the period backwards to the beginning of 1990s, when national monitoring programmes started in most of riparian countries.

## Assessment

Most of the Baltic sub-basins were dominated by cyanobacteria during the evaluated summer period (June-September, 1992-2006). Diatoms dominated only in estuaries (Öre, Daugava) and in the southern Baltic Proper (Arkona Basin). The autotrophic ciliate *Mesodinium rubrum* was the main contributor to the total biomass in Bothnian Bay. Statistical analysis revealed opposite biomass trends for some taxonomical groups of phytoplankton (cyanobacteria, dinophytes, prasinophytes and chlorophytes) in different sub-basins.

In Bothnian Bay, decreasing trends were detected in cyanobacterial and chlorophycean biomass. In Bothnian Sea, cyanobacterial biomass increased during the last decade. In different basins of the Baltic Proper, no changes or decrease in total cyanobacterial biomass accompanied with slight increase in diatom and *Mesodinium rubrum* biomass (Fig. 1). A decrease in dinophytes during last periods is related to overall biomass decrease in some sub-areas (Eastern Gotland Basin, Landsort Deep). In the Gulf of Riga, changes in cyanobacterial biomass were statistically insignificant, but their contribution to the total phytoplankton biomass decreased. Prymnesiophytes have become more abundant, however, this group needs review at least in some areas of the Baltic Sea. In the vicinity of Daugava River mouth and in the Curonian Lagoon chlorophytes showed increasing trends during the investigation period.

Although the autotrophic ciliate *Mesodinium rubrum* was not included in the autotrophic biomass in some areas (Gulf of Finland until 1997 and Gulf of Riga), this was the only species indicating similar upward trend in different sub-basins, especially during late 1990s and the beginning of 2000s. Into the freshwater Curonian Lagoon *M. rubrum* penetrates occasionally mostly during storm surge from the Baltic Sea.

Overall rise was found in chlorophyll *a* concentrations, except the Bothnian Sea and the northern Baltic Proper. This is probably due to an increase in small flagellates, however, their modest contribution to the total phytoplankton biomass and probable misidentifications did not allow bringing out statistically significant differences on group level.

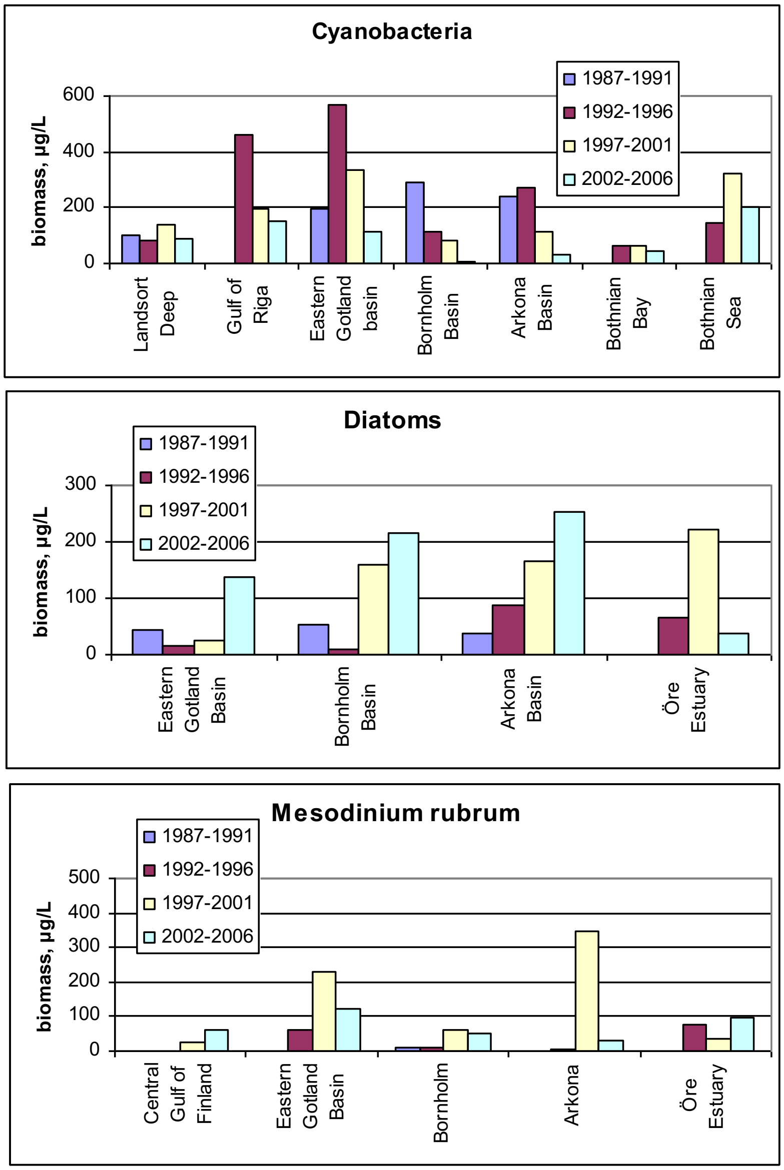


**Figure 1.** Seasonal biomass (µg/l) of cyanobacteria, diatoms and the autotrophic ciliate *Mesodinium rubrum* averaged by 5-year-periods in selected sub-basins of the Baltic Sea. Graphs presented only for areas, where statistically significant changes have taken place between different time-periods.

# Metadata

## Technical information

1. **Source**:

Estonian, Latvian, Lithuanian, German and Swedish national monitoring data. Sampling locations are presented in Fig. 2.

2. **Description of data**:

Annual weighted summer (June-September) average of phytoplankton group biomasses (µg/l), incl. autotrophic ciliate *Mesodinium rubrum*). Additional data – chlorophyll *a* (mg $m^{-3}$)

Original purpose of the data: Phytoplankton monitoring programs

3. **Geographical coverage:**

Entire Baltic Sea

4. **Temporal coverage:**

June-September 1992 (1987)-2006.

5. **Methodology and frequency of data collection:**

Information based on national monitoring samples. Sampling frequency 4-9 times per season. Data from the same sub-basin pooled. Phytoplankton samples analyzed and identified by phytoplankton experts, using the mandatory HELCOM methods (http://sea.helcom.fi/Monas/CombineManual2/PartC/CFrame.htm).

6. **Methodology of data manipulation:**

Weighted average biomass values for phytoplankton taxonomical groups were calculated in order to equalize variance in sampling frequency. The results were divided into 5-year periods and differences between timespans were tested using t-tests. Only statistically significant ($p<0.001$) changes were considered.

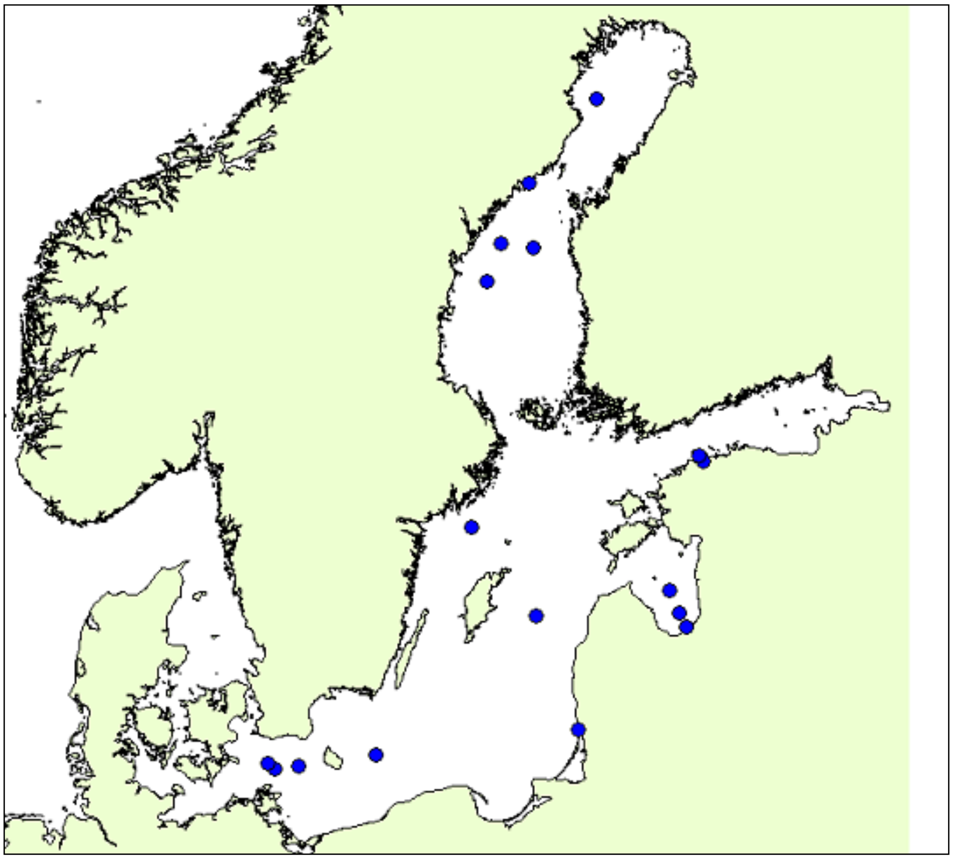

**Figure 2.** Selected sampling points for phytoplankton monitoring.

## References

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## Footnotes

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