Phytoplankton biomass and species succession in the Gulf of Finland, Northern Baltic Proper and Southern Baltic Sea in 2008

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Key message
Phytoplankton biomass was in July higher than the long term average in all sea areas

Results and assessment

![Chlorophyll-a, Gulf of Finland](image-url)
Fig. 1. Annual variation of chlorophyll $\alpha$ (mg m$^{-3}$) in the western Gulf of Finland (upper), the northern Baltic Proper (middle), and the Southern Baltic Proper (lower). The blue curve represents the average for the years 1992-2007, the black diamonds the measurements made in 2008. Image: FIMR/Alg@line.
Relevance of the indicator for describing developments in the environment
Eutrophication is considered one of the most serious threats against the Baltic Sea. It is defined as an increase in the rate of supply of organic matter to an ecosystem, and is most commonly caused by nutrient enrichment. Chlorophyll a concentration, representing phytoplankton biomass, assesses the eutrophication-driven alterations of the Baltic Sea. More importantly, it can address with an adequate precision the intensity and occurrence of cyanobacterial blooms. It must be kept in mind, however, that although highly responsive to changes in surface nutrient concentrations, chlorophyll a is also a product of parameters not related to eutrophication, namely other biological factors, hydrography and climate.

Policy relevance and policy references
Although being a natural phenomenon per se, the algal bloom events have become more frequent, intense, and extensive due to the eutrophication of the Baltic Sea. Since the mid-90’s, the strength of cyanobacterial blooms have increased to levels to raise wide public concern. Currently, noxious and often harmful cyanobacterial blooms disrupt the functioning of the Baltic ecosystem, limit the recreational and economic use of the sea, and represent a clear and present health risk for humans and domestic animals. No signs of decrease of cyanobacterial blooms have been seen yet.

Assessment for the Gulf of Finland 2008
The spring bloom started in early April, one week earlier than in the previous year and it reached its peak in late April. The ice-free-winter changed somewhat species composition, so the diatoms *Thalassiosira levanderi*, *T. baltica*, *Chaetoceros ceratosporus*, *C. holsaticus*, *C. wighamii* and *Skeletonema costatum* coll. dominated the beginning of the bloom while usually very abundant species *Achnanthes taeniata* occurred but scarcely. The dinoflagellates *Woloszynskia halophila*/*Scrippsiella hongoei* and *Peridiniella catenata* became dominant during the peak and remained moderately common until late May.
The cool and windy weather prevented the growth of blue-green algae and prolonged the summer minimum phase to early July. No surface accumulations of blue-green algae occurred during June. Nanoflagellates were dominant (the prasinophycean *Pyramimonas* spp., the dictyochophycean *Pseudopedinella elastica* and *P. tricostata* and the euglenophycean *Eutreptiella gymnastica*), while the potentially toxic haptophyte *Chrysochromulina polylepis* occurred only minor amounts. In July water rust red to brownish discolouring blooms of the non-toxic dinoflagellate *Heterocapsa triquetra* occurred in the archipelagos in the western Gulf of Finland, but it did not occur in bloom quantities in the open sea. This dinoflagellate does not form blooms as regularly and over as widespread areas as blue-green algae.

The amount of the blue-green algae *Aphanizomenon flos-aquae*, *Anabaena* spp. and chroococcalean colonies increased towards end July and when weather became warm and calm first surface accumulations were observed in the archipelagos of the Gulf of Finland. In the open Gulf large amounts of blue-green algae were mixed in the water column. In the beginning of August the recently formed blooms were scattered by strong winds. Later in August the blue green algae decreased, and nanoflagellates (mainly *Chrysochromulina* spp.) became dominant. No late autumn diatom or dinoflagellate bloom was observed. Nanoflagellates (cryptophytes, prasinophytes and *Eutreptiella* spp.) codominated with chroococcalean colonies (*Woronichinia compacta*) in mid October.

**Assessment for the Northern Baltic Proper 2008**
An exceptional mass occurrence of *Chrysochromulina polylepis* (Prymnesiophyceae) started to develop in early winter in the western parts of the Northern Baltic Proper. It was more prominent in the Central Baltic Proper around Gotland. The spring bloom started in early April and reached its peak in late April. The species dominating the bloom were diatoms (*Thalassiosira* spp., *Chaetoceros* spp., *Skeletonema costatum* coll.) and dinoflagellates (*Scrippsiella hangoei/Woloszynska halophila*, *Peridiniella catenata* and *Heterocapsa* sp.). Later in May nanoflagellates, especially the euglenophyte *Eutreptiella gymnastica*, the dinoflagellate *Heterocapsa rotundata* and the chrysophyte *Dinobryon balticum* became abundant. The haptophyte *Chrysochromulina polylepis* was very abundant in early May in the western parts of the Northern Baltic proper near the Swedish coast (Hajdu et al, 2008).

The blue-green algae *Aphanizomenon flos-aquae* and *Anabaena* spp. at first, later also *Nodularia spumigena* started to increase in mid June, but mainly they remained mixed in the water due to windy weather. When weather became calm in late July, surface accumulations of blue-green algae covered large parts of the Baltic Proper. In early August winds dispersed the surface aggregations and the amount of blue-green algae decreased. Narrow oscillatorealean filaments (*Pseudanabaena* sp.), *Aphanizomenon flos-aquae* and nanoflagellates (*Chrysochromulina* spp., the cryptophycean *Plagioselmis prolonga* and *Teleaulax* spp. and the prasinophycean *Pyramimonas* spp.) were the most abundant taxa in August.

Diatoms (*Coscinodiscus granii*, *Actinocyclus octonarius*, *Skeletonema costatum*, *Cyclotella choctawhatcheeana*) and nanoflagellates were moderately common in mid October. Among the nanoflagellates the haptophyte *Chrysochromulina polylepis* has started to increase again as during the previous late autumn, but it does not yet dominate the nanoplankton fraction.

**Assessment for the Southern Baltic Proper 2008**
An exceptional mass occurrence of *Chrysochromulina polylepis* (Prymnesiophyceae) developed in November 2007 in the western parts of Central Baltic Proper around Gotland. This species dominated since early winter also in the southern parts of Baltic Sea Proper and changed somewhat species succession and abundances. The diatoms *Skeletonema costatum* coll., *Chaetoceros* spp. and *Thalassiosira* spp. which
usually occur during spring bloom started to increase in late March but they did not become dominating. Also the dinoflagellate *Peridiniella catenata* was observed, but only in moderate amounts.

*Chrysochromulina polylepis* bloom continued until mid June, when other nanoflagellates (*Chrysochromulina* spp. with smaller cell size, the prasinophycean *Pyramimonas* spp., the cryptophycean *Teleaulax* spp. and *Plagioselmis prolonga* and the dinophycean Gymnodiniales spp.) became more abundant. The small sized diatom *Cyclotella choctawhatcheeana* usually occuring in late summer was observed in mid June.

Blue-green algae, particulary small colonial species (*Cyanodictyon* spp., *Aphanothece* spp.), became dominant towards the end of June and first observations of surface accumulations occurred in the beginning of July. The filamentous species (*Nodularia spumigena, Aphanizomenon flos-aquae, Anabaena* spp.) dominated in July, while in August the chrooccalean species became again abundant. The invasive alien dinoflagellate *Prorocentrum minimum* and the diatoms *Nitzschia paleacea, Cylindrotheca closterium, Cyclotella choctawhatcheeana, Coscinodiscus grani* and *Actinocyclus octonarius* became also common.

Diatoms (*Coscinodiscus* spp., *Chaetoceros* spp., *Pseudo-nitzschia* spp. *Skeletonema costatum, Cerataulina pelagica*) dominated also in mid October. The invading species *Chaetoceros concavicornis* occurred in small numbers. Other nanoflagellates (*Pyramimonas* spp., *Plagioselmis prolonga, Hemiselmis virescens, Eutreptiella gymnastica*) were more common than *Chrysochromulina polylepis*, even though it clearly has started to increase.

**References**


**Metadata**

**Technical information**


2. Description of data: Original unit of measure: mg chl a m-3. Semiquantitative phytoplankton analysis are based on the ranks 1 to 5 describing relative sample-based abundance of an algal species. In the cyanobacterial bloom map, visual observations are included.

   Original data in WGS84-coordinates

   Original purpose of the data: Phytoplankton monitoring of FIMR, Alg@line project

3. Geographical coverage: Gulf of Finland, Northern Baltic Proper, Southern Baltic Proper

5. Methodology and frequency of data collection: The data has been collected using an automated flow-through sampling system on merchant ships, sampling depth ca. 5 m, weekly sampling during the period February/March-October/November in each year. Detection device Jasco 750 spectrofluorometer.

6. Methodology of data manipulation: No data manipulation

**Quality information**

1. Strength and weakness (at data level)

   **Strength:** Very high both temporal and spatial sampling frequency

   **Weakness:** Satellite images are achieved only on clear weather. Ship-of-opportunity measurements are restricted to the ship’s route, and dependant on its schedule; diurnal changes of data are not taken into account.

2. Reliability, accuracy, precision, robustness (at data level): Filtration and extraction of Chlorophyll a from samples according to accredited method SFS-EN ISO/IEC 17025. Procedure uncertainty: 5%.

3. Further work required (for data level and indicator level): More sophisticated statistical analysis

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