Long-term monitoring of phytoplankton in the Belgian part of the Scheldt estuary

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Long-term monitoring data are indispensable for evaluating the cumulative and often interacting effects of environmental change and anthropogenic pressures on aquatic ecosystems. In the framework of the OMES program, phytoplankton communities in the freshwater and brackish tidal part of the Scheldt estuary have been monitored nearly uninterrupted since 1996 with a monthly-to-bimonthly frequency using microscopy and HPLC analysis of algal pigments.

The time series analysis reveals an overall decreasing trend in phytoplankton biomass since 1996, especially in the brackish part of the estuary. From 2002 to 2018, we identified 3 time periods with distinct phytoplankton community structure. The first period (2002) is dominated by green algae (Tetrastrum, Scenedesmaceae, Crucigenia) and the diatom genera Aulacoseira, Chaetoceros, and Nitzschia and is characterized by higher concentrations of ammonium and dissolved silicon, and low concentrations of oxygen. The second period (2003-2011) starts with higher nitrate and total phosphorus concentration. The indicator species for this period are the cryptophytes Cryptomonas and Rhodomonas, euglenoids, the green alga Actinastrum and the diatom Navicula. By the end of this period, nutrient levels were decreased due to the implementation of waste water treatment, while suspended particulate matter (SPM) and particulate organic carbon (POC) had increased. From 2012 onwards, the phytoplankton community structure has become dominated by Cyanobacteria, the green alga Pediastrum, and the diatom taxa Fragilaria, Thalassiosirales, and Pennales. The Regularized Discriminant Analysis (RDA) suggests that apart from a decrease in inorganic nutrient availability, phytoplankton community dynamics were significantly influenced by changes SPM concentration of the Zeeschelde, as well as climatic conditions including precipitation and temperature.

Our results show that phytoplankton in the Scheldt estuary responded rapidly to reducing nutrient inputs at the start of the millennium, but also highlight that ongoing changes in SPM levels, increasing saltwater intrusion and variable riverine inflow have become important drivers of phytoplankton community assembly and the importance of key functional groups.

Keywords: Long-term; Phytoplankton; Scheldt estuary; Biodiversity; SPM