Records of environmental change and sedimentation processes over the last century in a Baltic coastal inlet

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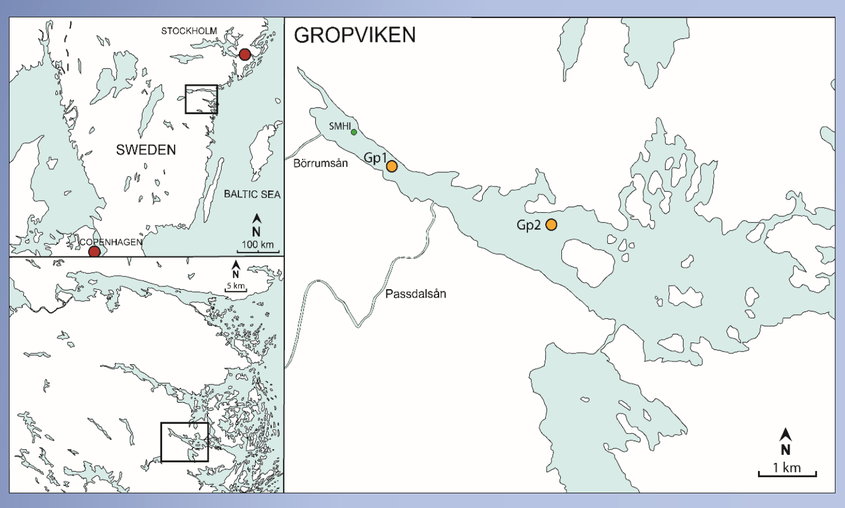
The marine ecosystem in the Baltic Sea is affected by multiple stress factors, e.g. eutrophication and deoxygenation, overfishing and anthropogenic pollution. Here we evaluate the short-term trends of dissolved oxygen in bottom waters and changes in the primary productivity within a coastal inlet in the Baltic Sea.

Undisturbed sediment cores (sedimentation rate 0.5 cm yr^{-1}) were retrieved from the inner and outer part of a coastal inlet, Gropviken, and dated using ^{210}Pb and ^{137}Cs. A multi-proxy approach (grain-size analysis, organic carbon and nitrogen content, biogenic silica and elemental analysis) has been used to provide a better understanding of the environmental change within the inlet. Four large changes were observed during the last century in oxygen deficiency, sedimentation rate and phytoplankton composition. The deeper area in the inlet has naturally low oxygen conditions due to slow water exchange, but high values of the redox proxies can be observed already in the beginning of the 1930´s, with an increase to a maximum in the 1980´s. The contributing factor could be an increase of eutrophication from expanded farmland in the area. Signs for increased eutrophication are also seen in higher biogenic silica and organic carbon content beginning in the 1920´s. A switch in the phytoplankton composition is observed from the late 1960's onwards and due to the change in nutrient ratios and lower secchi depth.



Map of the site in Gropviken with the two locations of the sampling.

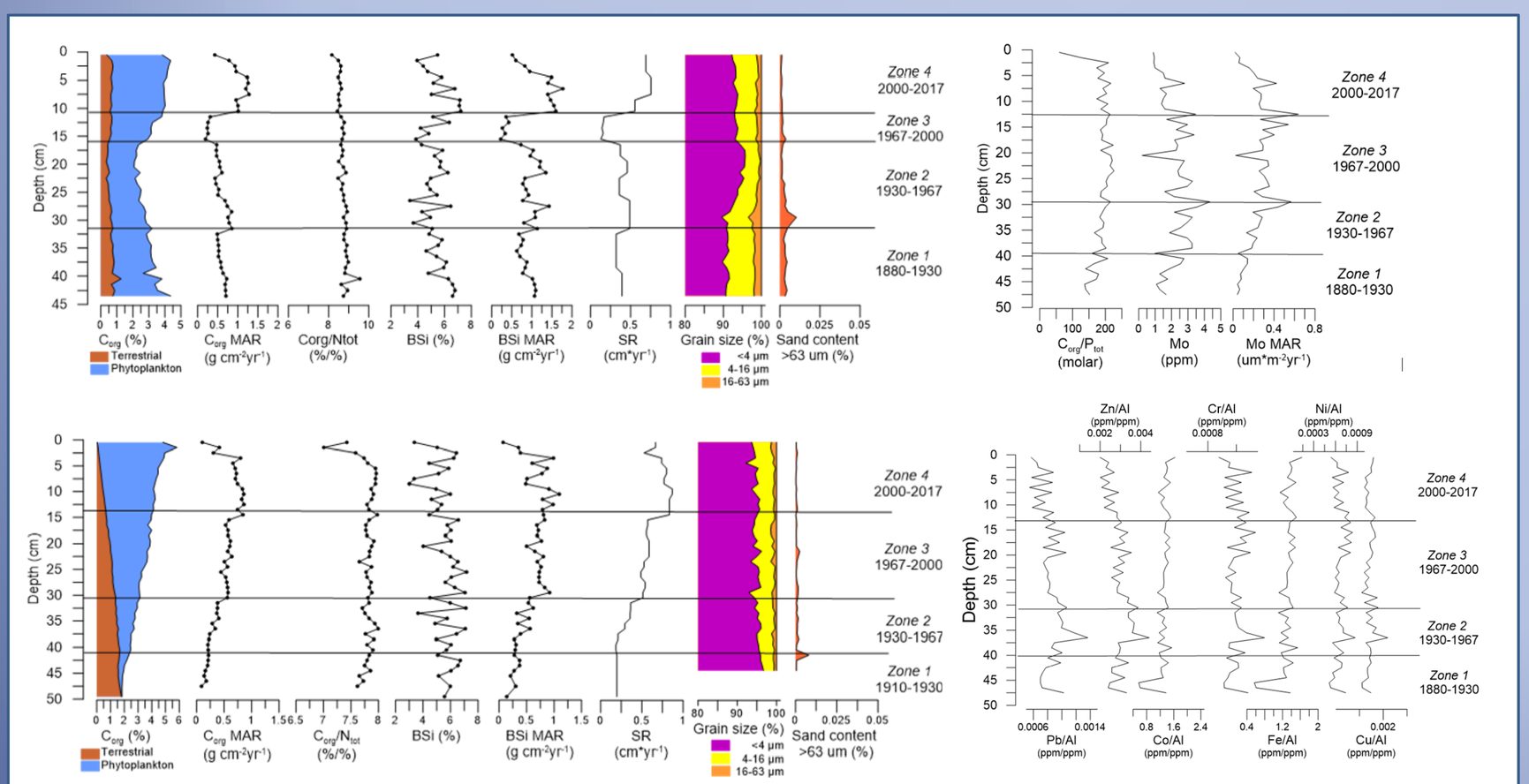
Study site

Undisturbed sediment cores were collected by the Live2Tell team on the 27th and 28th of June 2017 during an expedition cruise with *R/V Electra*. Four sediment cores have been sampled from two sites in Gropviken.

- GP1 (water depth 19 m, position N 58° 20,44' E 016° 39,37')
- GP2 (water depth 30 m , position N 58° 19.92' E 016° 42.35')

The aims of the study are:

- To investigate the historical development of organic matter of two locations in the inlet of Gropviken.
- To evaluate and compare the development of the sediments and sedimentation rates within the inlet.
- To estimate potential variability in anthrophonic input of nutrients and pollutants.



Methods:

Grain-size analysis

→ Proxy for past hydrodynamic condition, frequency distribution and sedimentary environments.

Organic carbon and nitrogen analysis

→ Infer the relative proportion of organic matter and the origin (aquatic or terrestrial)

Biogenic silica content

→ Estimate of aquatic productivity (past diatom productivity)

Elemental analysis & ^{210}Pb and ^{137}Cs data

→ Estimate anthropogenic pollutant
→ Constrain an age-depth model

This thesis presents a high-resolution environmental reconstruction from a narrow inlet of St. Annas archipelago in the Baltic Sea, covering the time span 1880 and 2017. A multiproxy approach was applied to four high-resolution sediment cores. The organic matter was dominated by aquatic origins in the coastal inlet. The terrestrial matter input to the inlet was stable whereas the aquatic material increased during the century. The sedimentation increased in the outer part of the coastal inlet. Increased precipitation during this event could have changed the sedimentation rate within the inlet, with a decrease in the shallower area and an increase in the deeper part. As a result of increased precipitation, the riverine input increased and brought more nutrient and weathered particles to the open waters. The location closer to land was fluctuating more due to resuspension and riverine input.

The key conclusions from the study are that more particles accumulated after the 1950s, when the agriculture increased in the area. Signs of an ongoing eutrophication in Gropviken are visible due to a gradual increase of primary productivity and a decrease in dissolved oxygen concentrations at the deeper location of the inlet. Changes in the primary productivity are also seen in 1965 and a rapid increase of C_{phy} that could be correlated with increasing carbon and nutrient input from the streams. This may have affected the biological values of the area. Indications of a rapid increase in metal pollutants during the 1950´s are given as well.

These four sediment cores will contribute to an increased understanding of short-term environmental changes and sedimentation processes taking place in a near-coast area of the Baltic Sea.