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INFLUENCE OF ANTHROPOGENIC NUTRIENTS ON HARMFUL ALGAL BLOOMS

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ABSTRACT

Harmful algal blooms (HABs) with disastrous consequences for the environment have increased in number, areal distribution and biomass per unit water surface or volume during the last decades. There is now evidence that some of the harmful algal blooms in Swedish marine and brackish waters have intensified in occurrence and size since 1960s. This is most likely a direct consequence of the increased input of nutrients to the Baltic Sea after the 1940s due to rapid increase in the utilization of artificial agriculture fertilizers and increased discharge of untreated municipal sewage. Thus there was a delay of about 20 years before the increased input of nutrients, especially nitrogen, manifested itself as an increase in the biomass of harmful algae. In 1985 it was decided to decrease the loads of nitrogen to the levels of 1950. This has been connected to increased loading of nitrogen and phosphorus from land and air to these waters. Thus the values for the year 1950 have been used as a threshold when the recipient still could adsorb and coop with the nitrogen input without showing disturbance signs as e.g. HABs. Although the Swedish marine waters were not at a pristine state during this time, the values of 1950 were used as prior to this time analytical determination of N are not reliable. Although the loads of nitrogen and phosphorus have decreased the resilience of the Baltic Sea has made that the levels of these two nutrients is still increasing, HABs of old and new species is still occurring and oxygen levels in the deeper waters is decreasing. At the same time evidence is gathering that many of the HAB-species are able to utilize N and P from dissolved or particulate organic sources. The discharge of humic material to these waters has also increased and no countermeasures have been taken to decrease this input. Another problem concerning the harmful algal blooms is that toxicity is also connected to the availability of nitrogen or phosphorus (depending on the algal species). For algae which toxins are nitrogen rich, phosphorus limitation induces a higher production of toxins compared to that of cells grown under nitrogen limitation or under nutrient sufficient conditions. This has been suggested as a mechanism enabling the algae to store the excess nitrogen in the growth medium, since the toxins have high nitrogen content. However, for the species whose toxins do not contain either N or P, toxin production increases when the algae are growing under nutrient limiting conditions, independent if phosphorus or nitrogen is the limiting nutrient. The lowest cellular toxin content for all the species is found when the species are grown under N and P sufficient balanced conditions to the algae needs. Mitigating the effects harmful algal blooms hardly exists, and the ones that exist can only be used in restricted areas. The ultimate mitigation is without a doubt to restore the world's marine waters to more pristine conditions in

relation to nitrogen and phosphorus concentrations by decreasing the input of these nutrients from the coastal areas/ precipitation of acid rain.