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Modelling the impact of seaweed cultivation on the marine protist community

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To transition towards a bio-based society, there are efforts to increase seaweed cultivation in the North Sea. Seaweed takes up nutrients during winter, grows during spring and is harvested in early summer. Should seaweed cultivation increase on a large scale, the additional uptake of nutrients through seaweed could decrease the availability of nutrients needed for the growth of protists.

Protists are unicellular eukaryotes and they form the base of aquatic food webs. Protist communities consist of phytoplankton, mixoplankton and protozooplankton. Phytoplankton perform photosynthesis and use dissolved nutrients to grow, while protozooplankton acquire nutrition from prey via phagotrophy. Mixoplankton combine photosynthesis with phagotrophy, so mixoplankton can access nutrient and carbon sources that phytoplankton and protozooplankton cannot. As phytoplankton, mixoplankton and protozooplankton employ different trophic strategies, the additional uptake of nutrients through seaweed could impact the trophic structure of protist communities. A decreased availability of dissolved inorganic nutrients could favor mixoplankton as they do not rely solely on dissolved inorganic nutrients as their source of nutrients. However, mixoplankton are often not simulated in aquatic ecosystem models.

Recently, a module, called PROTIST, was implemented into the aquatic ecosystem model software Delft3D-WAQ. The module PROTIST simulates the growth and interactions between phytoplankton, protozooplankton and mixoplankton. To gain insight into the possible impacts of seaweed cultivation on the protist community, the 3D Dutch Continental Shelf Model - Flexible Mesh of the North Sea was modified to simulate seaweed as well as diatoms, phototrophic non-diatoms, protozooplankton and mixoplankton. Two scenarios were run with (seaweed scenario) and without (reference scenario) taking the growth of seaweed into account. Preliminary model results display a relative decrease of dissolved inorganic nitrogen and phosphate concentrations as well as a relative shift of the trophic composition of the protist community towards mixoplankton and diatoms.

Thus, seaweed aquaculture has the potential to impact the trophic composition of protist communities. As many harmful algal bloom species are mixoplankton, and diatoms (due to their high nutritional value) are the preferred diet of many higher trophic levels, changes to the trophic composition of protist communities could impact marine ecosystems. In the future, seaweed cultivation will interact with other types of

aquaculture, e.g., mussel aquaculture, in an integrated marine trophic aquaculture (IMTA) setting. The module PROTIST provides a tool to analyze the effect these anthropogenic changes can have on the trophic composition of protist communities.

Keywords: seaweed, protist community, mixoplankton, 3D model, North Sea