Session Biosphere: April 12th 11.30 hrs

1s4 Towards circular marine food production | Sustainable mariculture

MODELLING SEAWEED CULTIVATION ON THE DUTCH CONTINENTAL SHELF

VILMIN L 1), VAN DUREN L 1), NAUTA R 2), JANSEN H 2)

1) Deltares, the Netherlands,

2) Wageningen University & Research, the Netherlands

While Saccharina latissima seaweed is currently cultivated in the Netherlands at a small scale, there is a major drive towards increasing sustainable offshore cultivation. Future windfarm areas are seen as potential development locations. Harvesting seaweed leads to nutrient removal from the ecosystem, which can subsequently affect phytoplankton primary production, the basis of the marine food web. In this study, we investigate the spatial variability in ecosystem responses to seaweed cultivation in the Dutch North Sea. We focus on the interaction of seaweed and phytoplankton productivity with respect to nutrients and the effect of size, location and distribution of farms. Therefore, we integrated a module simulating seaweed nutrient uptake and growth dynamics into a fully coupled 3D hydrodynamic-water quality model of the North Sea. We ran different cultivation scenarios over a production year and compared them to a run without seaweed cultivation. Although these scenarios are hypothetical, they increase our knowledge on farm-ecosystem interactions that are relevant for spatial planning and management. Results showed that offshore locations are slightly more productive for seaweed cultivation than those closer to the coast, and that it is beneficial to split the cultivation area into relatively small plots. Growth of total seaweed biomass is mainly driven by temperature and light, since the fronds do not run out of reserves before harvest. Extreme upscaling of seaweed production to 25% of all Dutch designated offshore windfarm areas would have a strong impact on the ecology, with local decreases in spring phytoplankton production as high as 30%. The effect on nutrient concentrations and phytoplankton primary production is directly related to the size of the farms. The effects of large farms can extend far downstream. For example, seaweed cultivation over ~25 km2 at Borssele leads to a decrease in spring primary production >1% over more than 3,000 km2, all the way North from the Dutch Wadden Islands. Therefore, the location of seaweed farms with respect to each other is also an important factor to consider when upscaling seaweed production. Placing a new seaweed farm in the area of influence of another one can lead to higher local reductions in nutrient concentrations and phytoplankton primary production. As at this point in situ data is limited, the seaweed module should be further calibrated and validated based on additional field data for Dutch waters to endorse the reliability of its predictions. This model could then be

used to refine our estimates of the ecological carrying capacity of the Dutch North Sea for seaweed cultivation.

Keywords: