Green sea urchin (Strongylocentrotus droebachiensis) population trends related to bioclimatic and biogeochemical variables: A spatio-temporal analysis in the North Atlantic and Arctic Ocean

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Kelp forests are highly productive ecosystems, providing habitats for many marine species, storing carbon dioxide and protecting costal areas. The value of the ecosystem services that kelp forests offer is widely acknowledged. However, sea urchin species such as *Strongylocentrotus droebachiensis* are grazing on the kelp, increasing the desertification and leaving barren grounds behind. The need to protect and restore the kelp forests has been highlighted in literature. Over the last decades, several phase shifts between productive kelp forests and sea urchin dominated barren grounds have been documented along the Norwegian coast. Sea urchins are affected by the bioclimatic and biogeochemical variation of the ocean. In that context, it is relevant to understand: what are the bioclimatic and biogeochemical variables influencing the population of the sea urchin in the Troms archipelago? To answer this question, the study presented here focuses on the following variables: dissolved oxygen, pH, surface partial pressure of CO_2, iron, nitrate, phosphate, chlorophyll, phytoplankton, silicate, primary production of biomass, salinity, sea ice, sea surface temperature (SST) and air temperature. The datasets used are the Global Ocean Biogeochemistry Hindcast[1] and as well as the Global Bioclimatic Projections dataset[2]. These variables are linked with sea urchin observational datasets from the global Ocean Biodiversity Information System *OBIS* and from *Artsdatabanken* in Norway. The study conducts various spatio-temporal analyses within ten study areas in Northern Atlantic and Arctic coastal regions in order to identify which variables are the most relevant to the sea urchin population in Troms. Six study areas have been selected from Norway and four from the Atlantic coast of Northern America. The analysis follows fives steps before interpretation. The datasets of the tested variables are compiled and processed by study areas, followed by a first assessment of the significance of each variable. Variables with low relevance are excluded from further analysis, while others require the creation of trend lines extending back to 1950 to align with the target timespan. The trends are statistically validated by additional in-situ observational biogeochemistry and climatological data. Subsequently, each variable and trend is statistically analysed in relation to the sea urchin population over the years. The results of these analyses are used to identify the relevant influencing variables and understand their impact on sea urchin population development in

the Troms Archipelago.

[1] Global Ocean Biogeochemistry Hindcast. E.U. Copernicus Marine Service Information (CMEMS). Marine Data Store (MDS). DOI: 10.48670/moi-00019 (Accessed on 29-05-2024)

[2] Wouters, H., Berckmans, J., Maes, R., Vanuytrecht, E., De Ridder, K., (2021): Global bioclimatic indicators from 1950 to 2100 derived from climate projections. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.a37fecb7 (Accessed on 29-05-2024)