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MARINE FOOD WEBS UNDER CHANGING CLIMATE

Impacts on food web efficiency and quality

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Abstract

Climate change has shown to have global impacts on marine ecosystems by increasing temperature and altering hydrology. The consequences for marine food webs are less known, but it has been suggested that both the nutritional quality and production will change in such a way that the energy transfer up the food web becomes lowered. The ratio between the production by upper and basal trophic levels, i.e., the food web efficiency, may decrease. In this thesis, I investigated the effects of climate change-induced environmental alterations on the food web efficiency and quality in the northern Baltic Sea, i.e., the Gulf of Bothnia, using multiple approaches including field surveys, a mesocosm experiment, and time-series analyses of long-term monitoring data. In the field study, I found that seawater browning in the Bothnian Bay has caused reductions in the nutritional quality of mesozooplankton. Through the mesocosm experiment, I found that intensified cyanobacterial blooms, a likely consequence of climate change, would reduce the zooplankton's nutritional quality and food web efficiency. The time-series analyses indicated that the lowered salinity and increased dissolved organic carbon, resulting from climate change, have reduced the nutritional quality of herring in the Bothnian Bay. Further, I found that the retention of essential fatty acids in coastal fish predators largely depends on their taxonomy, habitat use, and the nutritional quality of their prey. Therefore, climate-related environmental changes, which alter the nutritional quality of prey resources, are predicted to alter the retention of essential fatty acids in fish. Overall, the results suggest that climate change-induced environmental stressors such as increased browning and cyanobacterial blooms, and reduced salinity in the northern Baltic Sea have negative impacts on the food web efficiency and quality. These changes may imply a potential decline in fish production and environmental health.

Keywords

Climate change, Fatty acids, Food web efficiency, Food web quality, Cyanobacteria, Roach, Perch, Browning, Zooplankton, Bacterial production, Phytoplankton production

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