Response of food-web structures to the re-oligotrophication of a deep lake and implications for the fisheries

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Abstract

Lake Geneva, which lies on the border between France and Switzerland, is the largest lake in Eastern Europe. It suffered a strong eutrophication from the 1960s until the late 1970s with total phosphorus concentrations reaching more than 80 μgP.L-1. Management measures to reduce phosphorus loading into the lake have been successful (deployment of water treatment plants, prohibition of phosphorus in detergent ...), and nowadays the phosphorus concentration dropped down to 20 μgP.L-1. According to the OCDE categorization, Lake Geneva has reached a mesotrophic status. Such strong diminutions in phosphorus loads were associated with significant decline of fisheries in several Swiss lakes and the question is now: what is the future of Lake Geneva fisheries if this concentration keeps on declining? Actually, decrease in phosphorus concentration can affect primary production and then fish production through food web amplification. However, the processes are poorly described and a holistic approach is necessary to understand how trophic flow distribution in the Lake food web is modified during re-oligotrophication process. We calibrated several mass-balanced food web Ecopath models at different periods during the re-oligotrophication (from 1980 to 2015). Flow distributions were compared and Ecological Network Analyses were performed in order to assess the evolution of Lake Geneva food web functioning and properties facing these changes in phosphorus concentration. Assumptions regarding the potential future of fisheries will then be proposed and a first attempt of dynamic Ecosim modelling will be proposed to foresee the effects of an ultra-oligotrophication on Lake Geneva fisheries.

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