

Indications of climate warming of lake Vattern; Sweden

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Lake Vattern is one of the largest lakes in Europe and hold a large water body (74 km³). It is characterized as a cold-water lake with low nutrient content. The ecosystem is also characterized for caold water conditons and the lake holds species that normaly is found int higher latitude lakes. However, the last decades ice has been rare on the lake, and the temperature rices in the water with a speed that is i the magnitudes foreseen by the IPCC. Data, indications of climate change on biota and nutrient within the lake will be discussed.

Inter-annual climate variability and zooplankton: applying teleconnection indices to two deep subalpine lakes (Lake Maggiore and Lake Garda)

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In recent years, increasing interest has been shown on impact of inter-annual climate variability to zooplankton. Especially in North American great lakes, and in the large subalpine lakes north of the Alps, research has focused on impact of NAO-derived indices on biomass, population density and phenology of zooplankton. Such indices were successfully applied to explain inter-annual variations in zooplankton and phytoplankton seasonal dynamics. In large, deep lakes south of the Alps, however, the link between large-scale climatic indices appeared in most cases weak, and attempts to link such indices to interannual variations in limnological parameters and plankton seasonal dynamics did not result into clear patterns to justify common forcing.

A recent study, however, analysed five teleconnection patterns potentially important for the interannual climate variability over the Mediterranean region and southern Europe. Among these indices, the East Atlantic pattern and the Eastern Mediterranean Pattern showed a clear relationship with the variables directly connected with the winter climate and limnological variables of Lake Garda, the largest Italian subalpine lake, tightly connected with phytoplankton development through cascading effects. We extended the same approach to zooplankton of both Lake Maggiore and Lake Garda, the two lakes located at the most western and eastern sides of the southern subalpine region. We selected a time frame during which changes in trophy could be ruled out, focusing on Daphnia, the large filter feeder which has the strongest impact on lake water transparency. Patterns obtained from the two lakes were quite consistent, indicative of a clear link between interannual climate fluctuations and the phenology and abundance of Daphnia. Overall, the results suggested that other, so far neglected, large scale atmospheric modes of variability might be worth of being investigated to detect, and predict, impact of climate change on freshwater ecosystems over regional scale.

Microbes promote ice formation on large lakes

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We present evidence for the directed formation of ice by planktonic microbes in a freshwater ecosystem. Recent annual winter surveys reveal ice nucleation activity associated with assemblages of filamentous diatoms sampled from the ice-covered Laurentian Great Lakes. We posit that these non-motile phytoplankton exploit the ability to promote ice formation to attach to overlying ice and thereby maintain a favorable position in the photic zone. However, it is unclear that the diatoms themselves promote ice nucleation. Rather, the ice nucleation activity may be attributed to bacteria; scanning electron microscopy revealed associations of bacterial epiphytes with the dominant diatoms of the phytoplankton assemblage and bacteria isolated from the phytoplankton showed high temperatures of crystallization (T_c) to -3°C . Ice nucleation-active (INA) isolates were identified as belonging to the genus *Pseudomonas*; their ability to serve as ice nucleation sites may in turn promote the growth of their diatom hosts. This novel cooperative mechanism illuminates a previously-undescribed stage of the life cycle of pseudomonads in the environment, and offers a model of mutualism relevant to aquatic ecosystems having seasonal ice cover around the world.