Anthropogenic impact on the historical phytoplankton community of Lake Constance as reconstructed by multimarker analysis of sediment-core eDNA

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Lake Constance (Germany)

During the 20th century, many lakes in the Northern Hemisphere were affected by increasing human population and urbanisation along their shorelines and catchment, resulting in aquatic eutrophication. Ecosystem monitoring commenced only after the changes became apparent, precluding any examination of timing and dynamics of initial community change in the past and comparison of pre- and post-impact communities. Peri-Alpine Lake Constance underwent a mid-century period of eutrophication followed by re-oligotrophication since the 1980s, and is now experiencing warm temperatures. We extended the period for which monitoring data of indicator organisms exists by analysing the historical environmental DNA (eDNA) from a sediment core dating back some 110 years using microbial eukaryotes (EUK), diatoms (DIA) and cyanobacteria (CYA) communities.

The three molecular markers showed a high degree of congruency, but with remarkable temporal offsets. Multivariate analyses depicted distinct communities in each of the trophic phases, with a first major change in the 1930s-1940s, and an additional, second change in the 1950s until reaching full eutrophic conditions in the 1970s. We suggest that the first disturbance may reflect the historical increase in human population and urbanisation during the 1920s, to which the diatoms, traditionally used as paleo-bioindicators, showed the slowest response.

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References

