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The eutrophication history of a naturally eutrophic watercourse

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For efficient inland water protection, it is essential to know the natural states of lakes or, at least, the reference conditions before intensive human impact. The estimation of the natural state is particularly difficult for geologically anomalous areas, where naturally eutrophic lakes are located within nutrient-poorer regions. This is because of the lack of monitoring data and pristine reference lakes and the poor functioning of regional paleoecological nutrient models in such anomalous areas. A paleoecological model that is specifically targeted to the anomalously eutrophic area, however, could be used to interpret the eutrophication histories and natural states of the naturally eutrophic lakes in that area.

We applied a targeted paleoecological diatom-total phosphorus transfer function to examine the natural eutrophy and eutrophication history of a central basin and two upstream lakes of the anomalously nutrient-rich Iisalmi watercourse in Eastern Finland. In addition to the nutrient reconstruction based on stratigraphic diatom samples, we studied chrysophyte cyst to diatom ratio, taxonomic diversity and the magnetic susceptibility of the sediment core to find further evidence for possible changes in the lakes and their catchments. The results show that the three lakes are naturally eutrophic with average background total phosphorus levels between 40 μg/l - 60 μg/l. However, human-induced eutrophication has also affected the lakes, which can be seen as rapid changes in the diatom assemblages and magnetic susceptibility between the sediment depths of 40 cm and 90 cm. The modeled lake water total phosphorus concentration has increased less abruptly, approximately 20 μg/l altogether, and the reconstructions of the top sediments mainly correspond well with the water quality observations of the last few decades.

The results of this study indicate that a targeted paleoecological nutrient model can be used to interpret the natural state and the eutrophication history of a locality that has anomalous water quality characteristics compared to its surroundings and where regional models perform poorly. Despite their exceptional natural conditions, these localities may often be very important economically, recreationally or historically, which is why we need to be able to focus water protection measures rationally and efficiently to them as well.