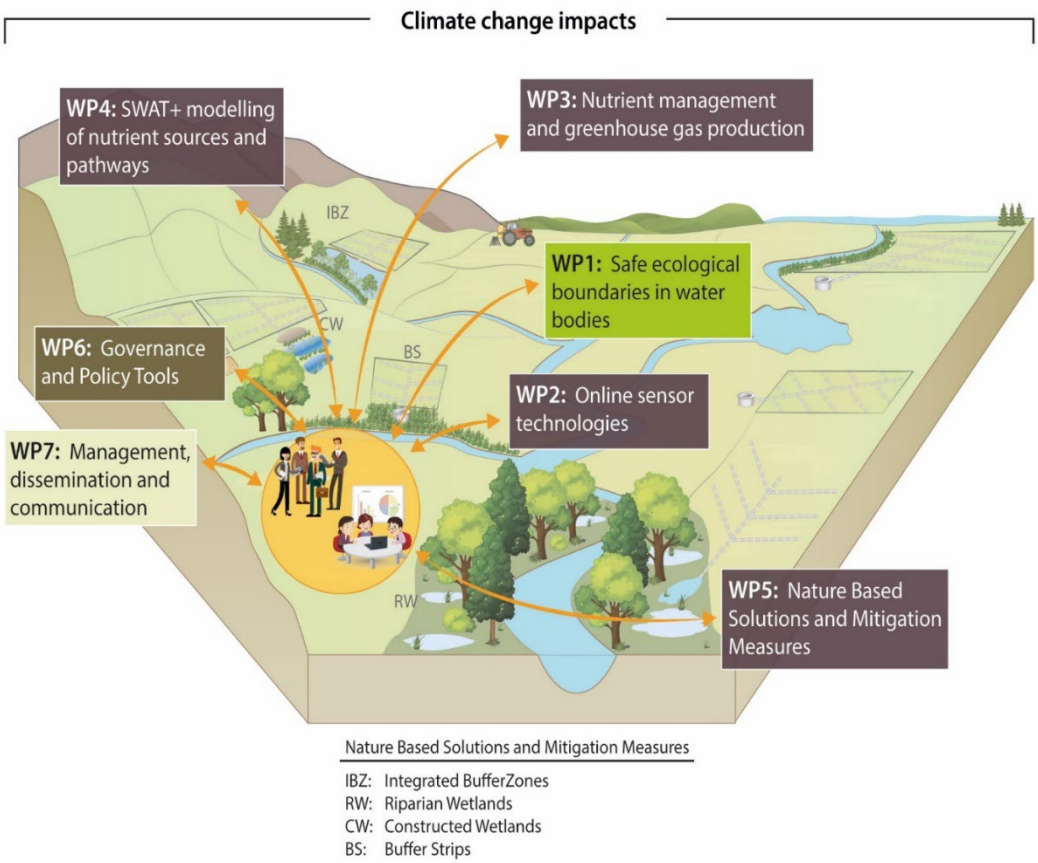

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Setting safe ecological boundaries for nutrients and exploring climate impacts on biological resilience in lowland lakes and rivers in the Nordic and Central European regions

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Abstract:

Phosphorus and nitrogen concentration-limits meant to support good ecological status for freshwater biota in European lakes and rivers have been set by EU-countries and Norway. These concentration-limits vary by more than an order of magnitude within comparable waterbody types, raising concerns that some of these limits may not ensure good ecological status. This study aims to determine safe nutrient boundaries compatible with good ecological status for phytoplankton in lakes and phytobenthos in rivers and explore climate impacts on their resilience to nutrient pollution.

Using binomial logistic regression and datasets from six countries, we estimated nutrient boundaries that are in line with good ecological status corresponding to a normalized ecological quality ratio (nEQR) of 0.6 for several common types of lakes and rivers in the Nordic and Central regions of Europe. The new estimates were matching the existing nutrient boundaries for most of the countries but were stricter than those applied in Finland and Poland for some waterbody types.

We found that effects of climate variables on ecological status were variable and relatively weak, although phytoplankton responded negatively to increasing summer temperature in all stratified lake types. Phytobenthos in Nordic humic rivers responded negatively to increasing precipitation during the growing season. These results suggest that climate change may reduce biological resilience to nutrient pollution, although the effects of climate were small compared to the effect of nutrients. Consequently, river basin managers are advised to implement more stringent nutrient reduction measures to mitigate climate-driven risks to freshwater biota.