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1. LC-IMPACT is supported by the European Commission under the Seventh Framework Programme. See: http://lc-impact.eu/

2. IMBALANCE-P is a European Research Council project. See: http://imbalancep-erc.creaf.cat/

3. http://ec.europa.eu/environment/water/water-framework/index_en.html

European Commission

Science for Environment Policy

Risks of biodiversity loss posed by nitrogen and phosphorus pollution in European freshwaters

The risk of eutrophication as a result of nitrogen and phosphorus pollution in Europe's freshwaters fell by 22% in lakes and by 38% in rivers between 1985 and 2011, new research has shown. The researchers analysed data across 88 European river basins using a new statistical approach which could be used to help identify factors which increase eutrophication risks.

Nitrogen and phosphorus can reach streams and lakes as run-off from agricultural fertiliser use or from sewage discharges. This nutrient pollution may then cause eutrophication, resulting in blooms of algae which cloud the water, starving deeper plant life of sunlight and depleting the available oxygen in the water, suffocating fish.

For this study, which was funded by the EU projects LC-IMPACT[1] and IMBALANCE-P[2], researchers proposed a statistical approach to determine whether nitrate or phosphorus causes the highest risk of eutrophication in freshwater lakes and streams. This method has the advantage that it can provide predictions even when there are few data available, the researchers say.

The approach involved calculating the 'ecological risk' posed to a species by nitrate or phosphorus, as an indicator of eutrophication. The ecological risk is the probability that a species will be exposed to a stressor — in this case nitrate or phosphorus — above its threshold to tolerate it, in a given year. Calculating the ecological risk requires knowing both the sensitivity of a species to the stressor and the probability that it will be exposed to it.

The research focused on invertebrate species, such as insects, snails and worms, commonly used as indicators of water quality — such as for the Ecological Quality Ratio used in the Water Framework Directive[3]. The researchers calculated ecological risk using existing data on how tolerant different invertebrate species were to the pollutants and their exposure. Nitrate tolerance was assessed for 390 species and phosphorus for 804 species. To calculate the probabilities of exposure, the researchers used data from 1985–2011 on the nitrate and phosphorus levels in lakes or streams covering a total of 88 European river basins.

Invertebrate species found in lakes were typically more at risk of nitrate and phosphorus pollution than those in streams. Presumably, the authors say, because the increase in phosphorus concentrations resulting from past discharges is more slowly remediated in lakes than in streams, in addition to the fact that species in lakes appear to be more sensitive to increasing nutrient levels than stream species.

The ecological risk was found to have decreased by 22% in lakes and 38% in streams since 1985, suggesting a general improvement in nitrogen and phosphorus pollution over this time. However, in 2011 the ecological risk still averaged 50%, indicating a 50% probability that a species is not observed a given year, as a result of high nutrient levels. The risk posed by nitrate was higher than that of phosphorus in both lakes and streams. For example, between 2001 and 2011 46–77% of river basins had higher ecological risk for nitrate than phosphorous. This may be a result of the marginal declines in nitrate concentrations during the period, as opposed to the more successful reductions in phosphorus concentrations (mainly in rivers) resulting from effective environmental protection policies in the past.

The authors did note a number of limitations to their work. For example, they considered the effects of the two nutrients separately rather than in combination. However, this statistical approach could feed in to environmental policy decisions, as it can be used to show whether nitrate or phosphorus carry the highest risk of eutrophication, which European river basins are most subjected to eutrophication risks, and how these risks have changed over time.