

An evidence base for setting nutrient targets to protect river habitat

This document has been produced to underpin decisions about defining appropriate environmental targets to control adverse effects of enrichment by the major plant nutrients (phosphorus and nitrogen) on the characteristic flora and fauna of UK rivers. Whilst its primary aim is to underpin the review of UK Common Standards guidance on setting conservation objectives for rivers with special wildlife designations for their river habitat, the evidence contained within it is also relevant to the control of river eutrophication under the Water Framework Directive, Urban Waste Water Treatment Directive and the UK Biodiversity Action Plan.

What was done

A targeted search of the published literature was undertaken to provide an up-to-date characterisation of the effects of nutrient enrichment on the biological communities of river systems. This included an evaluation of mechanisms of impact, environmental factors confounding simple relationships between nutrient levels and biological responses, and quantitative relationships between the gradient of nutrient enrichment stress and biological responses. An evaluation was also made of analyses undertaken in the UK to inform the definition of nutrient standards to support High and Good Ecological Status under the Water Framework Directive.

Results and conclusions

A list of key messages was drawn from the evidence base. The biological responses of riverine communities to nutrient enrichment are highly complex, confounding simple relationships between nutrient availability and biological status. Adverse effects are propagated through the biological community through direct effects on the plant community, with

consequences for invertebrates, fish and other animals. Overall, the published literature suggests that phosphorus availability should be maintained as close to natural conditions as possible to avoid adverse effects on characteristic biological communities.

Natural England's viewpoint

This evidence base provides an important foundation for making decisions about ecologically acceptable levels of nutrient enrichment in rivers.

Selected references

Nearly 70 references were used in the construction of this evidence base. A selection of key references is provided below:

Biggs, B.J.F. 2000. Eutrophication of streams and rivers: dissolved nutrient –chlorophyll relationships for benthic algae. *Journal of the North American Benthological Society*, 19, 17-31.

An evidence base for setting nutrient targets to protect river habitat

Bowes, M.J., Smith, J.T., Hilton, J., Sturt, M.M., Armitage, P.D. 2007. Periphyton biomass response to changing phosphorus concentrations in a nutrient-impacted river: a new methodology for phosphorus target setting. *Canadian Journal of Fisheries and Aquatic Science*, 64, 227–238.

Elser, J.J., Bracken, M.E.S., Cleland, E.E., Gruner, D.S., Harpole, W.S., Hillebrand, H., Ngai, J.T., Seabloom, E.W., Shurin, J.B. and Smith, J.E. 2007. Global analysis of nitrogen and phosphorus limitation of primary producers in freshwater, marine and terrestrial ecosystems. *Ecology Letters*, 10, 1135-1142.

Harper, D.M., Wasiak P. & Wasiak, K. 2009 Effects of phosphorus upon freshwater lotic ecosystems. Appendix 4 In: ADAS (2009) Linking agricultural land use and practices with a high risk of phosphorus loss to chemical and ecological impacts in rivers (the PARIS project). Research Project Final Report (SID5) to Defra. Defra, London.

Rosemond, A.D., Mulholland, P.J. and Elwood, J.W. 1993. Top-down and bottom-up control of stream periphyton: effects on nutrients and herbivores. *Ecology*, 74, 4, 1264-1280.

Townsend, C.R., Uhlmann, S.S. and Matthaei, C.D. 2008. Individual and combined responses of stream ecosystems to multiple stressors. *Journal of Applied Ecology*, 45, 6, 1810-1819.

Further information

For the full details of the research covered by this information note see Natural England Research Report NERR034 - *An evidence base for setting nutrient targets to protect river habitat*.

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