SEVENTH FRAMEWORK PROGRAMME

THEME 6: Environment (including Climate Change)

Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems

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PU	Public
PP	Restricted to other programme participants (including the Commission Services)
RE	Restricted to a group specified by the consortium (including the Commission Services)
CO	Confidential, only for members of the consortium (including the Commission Services)

Abstract

Science- Policy Brief 1 is one of the series of policy oriented documents based on the REFRESH output from WP1-6. This deliverable aims at translating part of the scientific results on European lakes regarding the biological quality elements used for assessing their ecological status, highlighting the implications for the EU Water Framework Directive.

SCIENCE POLICY BRIEF 1, January 2014

Zooplankton: an integrative Biological Quality Element for assessing the Ecological Status of lakes

Synthesis

- ✓ The EU Water Framework Directive environmental objectives are established on the basis of ecological status assessment, focused on five species groups (macroinvertebrates, fish, phytoplankton, macrophytes and phytobenthos) but not considering zooplankton.
- ✓ Results from the REFRESH project demonstrate that zooplankton is an important, integrative and cost-efficient indicator of the ecological quality of lakes and of recovery after restoration.
- ✓ Including zooplankton metrics among mandatory biological quality elements for lakes will improve our capacity for lake management under future climate and land use changes.

Why zooplankton?

Zooplankton is considered a central component of the pelagic foodweb in lakes. It integrates ecological information from effects controlled by fish (its predator) and phytoplankton (its food resource), thus reflecting subtle changes occurring in higher and lower trophic levels. Zooplankton responses are well known, can be predicted *a priori*, and allow to elucidate changes in the ecological structure and function of lakes that cannot be covered by fish and phytoplankton without a very comprehensive and costly effort. Moreover, zooplankton sampling is easy and inexpensive, and, when taking samples from the sediment, it provides information on past environmental and/or trophic conditions.

"Zooplankton has a strong indicator value, which cannot be covered by sampling fish and phytoplankton without a very comprehensive and costly effort"

(Jeppesen et al., 2011)

Can zooplankton be a good indicator of the ecological status?

Does zooplankton respond to anthropogenic pressures? By compiling evidence from contemporary data mainly from Denmark, Estonia and UK, research findings from the REFRESH project show that the zooplankton clearly responds to *eutrophication*. Furthermore, the use of palaecological data provides evidence that cladoceran remains were indicative of *fish feeding pressure, eutrophication*, *acidification* or hydromorphological changes over time.

Can zooplankton respond to the effects of climate change? When reviewing contemporary data along climatic gradients in Europe and other parts of the world, results from REFRESH conclude that effects on trophic structure of lakes due to climate change will be evidenced in the zooplankton community. For instance, small-sized omnivorous fish feeding on zooplankton are expected to increase in lakes under a future warmer climate. This will result in a decrease of zooplankton abundance and, consequently, in a reduced potential to control phytoplankton blooms. , often consisting of toxic cyanobacteria. Independently of these trophic responses, various zooplankton groups such as cladocerans are sensitive to changes in salinity and water level, two major indirect effects of climate change projected for southern regions of Europe.

Does zooplankton respond to management practices? In agreement with the above explained responses, zooplankton community clearly reacts to nutrient loading reduction and to management practices related with the fish comunity, such as biomanipulation or fish introductions, but also to fish invasions. In this sense, when long term biomonitoring data is not available, the use of palaeoecological samples can provide a valuable tool for tracking management activities over time.

Which are the best indicators? Based on the response to anthropogenic pressures but also to the recovery after management practices, REFRESH results suggest several indicators based on contemporary samples from zooplankton- (1) zooplankton biomass, size and proportion of specific taxonomic groups (e.g. Cladocera, Calanoid copepods or Rotifers) and (2) zooplankton: phytoplankton biomass ratio- and on surface sediment samples - (1) size and proportion of resting eggs (i.e. *Daphnia* spp.) and (2) the proportion of pelagic cladoceran remains.

What are the implications for the Water Framework Directive considering global change?

The six-year River Basin Management planning cycle of the WFD offers an opportunity to review, the methods for the adequate assessment of the ecological status of EU water bodies, which take into account the potential of climate change to affect the biological, chemical, hydrological parameters. In this context, zooplankton has been shown to be crucial for the understanding of Lake Ecosystem functioning and to provide a cost- effective BQE to be included in the current list of organism groups (i.e. phytoplankton, benthic diatoms, macrophytes, benthic invertebrates and fish). Studying zooplankton could partly compensate for the lack of fish tools in UK freshwaters where gill nets are illegal and are widely seen as unacceptable. Thus, it can provide an essential tool improve our capacity for lake management in light of future climate and land use changes, and opens a door for its potential application also in transitional waters and large rivers in Europe.

"We strongly recommend the EU to include zooplankton as a central BQE in the WFD assessments"
(Jeppesen et al., 2011)

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http://www.refresh.ucl.ac.uk/

Additional scientific information

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