

A science base for environmental management

Bringing clarity to the issue...

Over the last century, thousands of lakes in Europe have suffered eutrophication as a result of either sewage discharges from towns and factories or nutrient run-off from farmland. Today, these nutrient inputs have usually been reduced, but many lakes still have problems of algal blooms, oxygen depletion and fish kills. An important reason for this is that nutrients that have accumulated over the years in benthic sediments can leak into the water, keeping lakes eutrophic for decades or more.

This is one example of how we are still living with past mistakes in the environmental field. Today's environmental managers are having to invest significant resources both in restoring disturbed areas of land and water, and in preventing further impacts on the environment. Where eutrophicated waters have failed to recover despite reduced nutrient inputs, remedial action has sometimes been attempted in the lakes themselves. Several of the methods tried – such as dredging – are very costly, yet they are by no means always successful.

Cost-effectiveness is obviously a key concern in environmental management, but often we have an inadequate understanding of how well different measures work. Environmental research, it is true, constantly produces new knowledge about how people can affect or protect the environment, but the results do not always attract notice and feed through into practical action. Many environmental management decisions are based on routine and tradition, rather than scientifically evaluated approaches. There is thus a danger of our continuing, out of habit,

to use methods that are not in fact fit for purpose.

EviEM links research and decision-making

Often, then, there may be cause to take a closer look at the scientific basis for the approaches used in managing the environment. A systematic review of all the relevant research findings available can clarify whether or not a particular environmental protection measure is well founded.

In Sweden, an initiative has now been taken to improve the basis for environmental decision-making in this way. The Mistra Council for Evidence-Based Environmental Management (EviEM), set up in January 2012, has been tasked with conducting systematic reviews of different environmental issues. The aim is to promote environmental management that is evidence-based, i.e. rests on the best possible scientific foundation.

Funding for the period 2012–2016 is being provided by the Swedish Foundation for Strategic Environmental Research (Mistra). The Council is governed by an independent executive committee with international experience of environmental research, work in government agencies and systematic reviews. It has a secretariat with a staff of four, based at the Royal Swedish Academy of Sciences. This ensures the new body's independence, financially and politically.

The Council examines and collates the scientific evidence on various



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Removal of roach, bream and similar cyprinids can be a way of improving water quality in eutrophicated lakes. The Mistra Council for Evidence-Based Environmental Management (EviEM) now plans to review the method's effectiveness

environmental issues, but makes no recommendations as to how the results are to be used. Instead, it is up to decision-makers and other stakeholders in the environmental field to translate the review findings into advice and guidelines on practical environmental action. All reviews should have clearly defined recipients, such as government departments or agencies, or representatives of business. Usually, these stakeholders also propose the subjects of EviEM reviews. In addition, both decision-makers and others concerned have the opportunity to submit detailed suggestions as to how reviews should be organised and the results reported.

A transparent and well-documented approach

A systematic review involves a carefully planned and documented search for every available scientific study that may be of interest in a given context. The results of the studies found to be relevant are then summarised and compared. At this stage, too, the process is meticulously documented, allowing detailed scrutiny later on of the review and the assessments reached.

This kind of transparency is necessary, not least if reviews of controversial topics are to gain wider credence. It also makes it relatively easy, if new research findings emerge, to supplement reviews and, where necessary, revise the conclusions.

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Systematic reviews tend to cover specific, well-defined issues, but, with their very thorough approach, they can still be major undertakings. Each of EviEM's reviews is expected to take one to two years to complete. They are to be carried out on a project basis by specially appointed international teams of researchers. The results will be published in detailed scientific reports, but EviEM also plans to summarise and disseminate them in a popular format.

EviEM's work in the area of evidence-based environmental management has several models in other fields and other countries. In healthcare, evidence-based treatment has been an established concept for many years, and an international network, the Cochrane Collaboration, regularly publishes systematic reviews in this field. Modelled on that network, an environmental counterpart was founded in 2007, the Collaboration for Environmental Evidence (CEE). In

the CEE framework, some 40 systematic reviews of environmental issues have been conducted around the world in recent years.

EviEM's first three reviews

One of EviEM's first reviews will examine the possibility of *restoring eutrophicated lakes by removing cyprinid fish such as roach and bream*. These species are normally dominant in nutrient-rich waters, but if their populations are decimated, the zooplankton on which they feed have a better chance of surviving. This in turn can reduce the abundance of the planktonic algae on which the zooplankton graze, often curbing algal blooms, improving transparency and raising oxygen levels in the water.

The method has been tried in many parts of the world, often with good results. However, no systematic review has been made of available knowledge in this area, and there are indications that negative results have not been reported to the same extent as positive outcomes. In Sweden this approach is still uncommon, but EviEM now will assess how useful it could be. With the introduction of the EU's Water Framework Directive, more vigorous action to tackle eutrophication is now required, and the Swedish authorities have mentioned fish removal as one of several conceivable ways of improving the state of eutrophic lakes.

Another of EviEM's reviews will explore the *capacity of man-made or restored wetlands to trap nitrogen*. Here, too, the Water Framework Directive's call for action on eutrophication has been a factor behind the choice of subject. Most experts are agreed that wetlands can remove nitrogen from the water passing through them. The mechanisms involved and the factors affecting the efficacy of wetlands as 'nitrogen sinks' are also quite well understood. But what quantities of nitrogen have individual wetlands actually been found to absorb? And how much do they vary? This is what EviEM intends to find out and summarise in its review. The idea is that a coherent picture of how

different wetlands work in varying conditions will pave the way for more effective water conservation.

The third of the systematic reviews EviEM is now embarking on concerns the *impacts of reindeer grazing on mountain vegetation*. Opinions on this issue have fluctuated over the years. A few decades ago, there was widespread concern that montane vegetation could be damaged by overgrazing. Today, fears are expressed, rather, about some mountain areas becoming overgrown because of inadequate grazing pressure, even though reindeer numbers are not much lower now than they were around 1990. EviEM will review all the relevant research results in an attempt to bring clarity to the issue.

Results translated directly into practical action

Systematic reviews are a tried and tested way of analysing and summarising scientific findings. They are particularly useful in shedding light on areas where knowledge is incomplete or perhaps disputed, but where there is still sufficient evidence to allow conclusions to be drawn.

Reviews are always carried out by researchers, but users have a considerable influence at both the planning and the reporting stage. One strength of systematic reviews is that, because of this dialogue between researchers and users, the results can often be used directly as a basis for decisions.



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