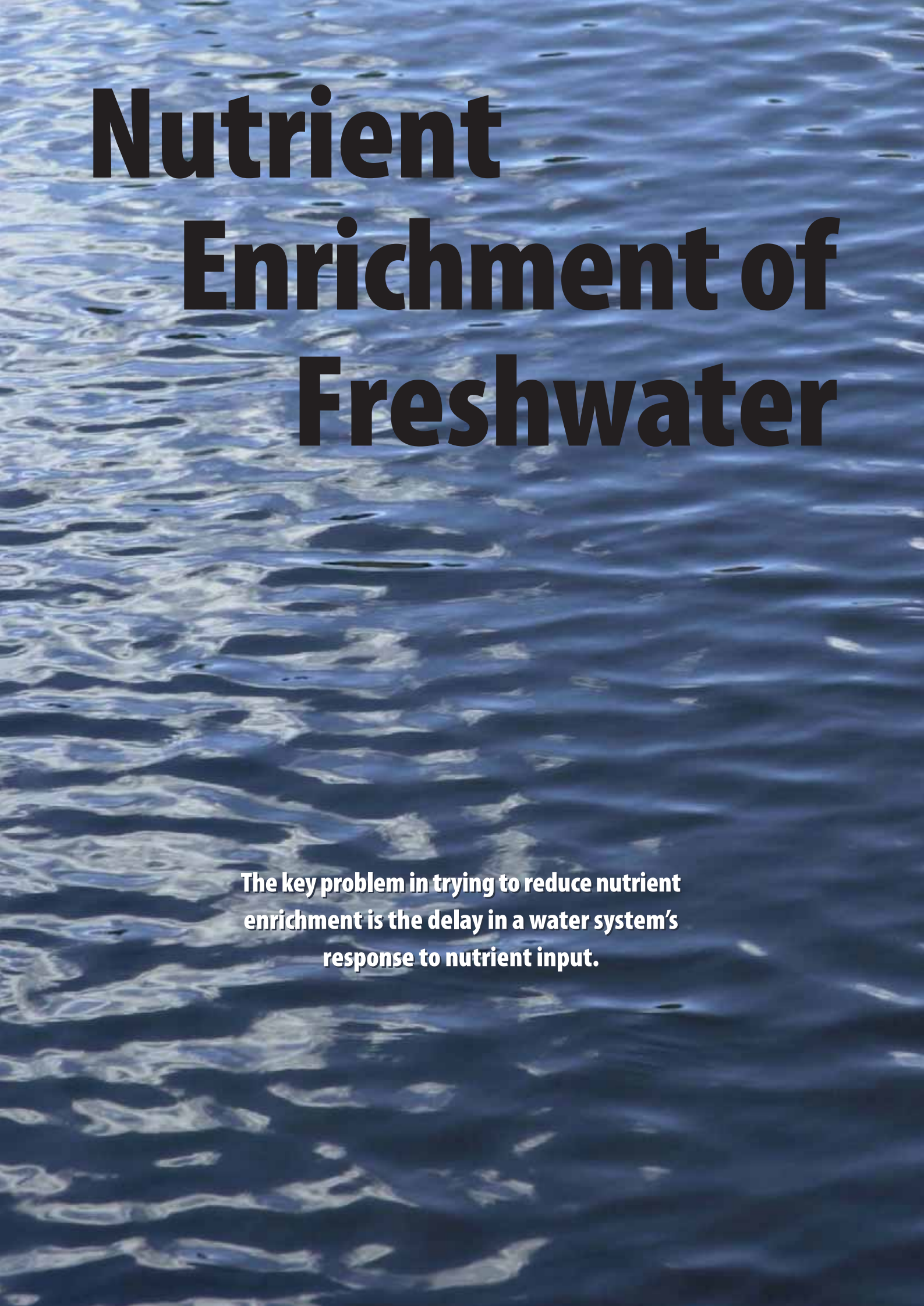
Nutrient Enrichment of Freshwater



The key problem in trying to reduce nutrient enrichment is the delay in a water system's response to nutrient input.

What's wrong with nutrient enrichment?

When a water system receives too many nutrients, algae begin to grow in the water, a process called eutrophication. As they develop, the algae turn the colour of the water from clear blue to "pea-soup" green. Although this is a natural process, human activities, such as agriculture and industry, can speed it up. These conditions make the water unsafe for recreation and endanger the health and diversity of organisms living in the water.

Where do the nutrients come from?

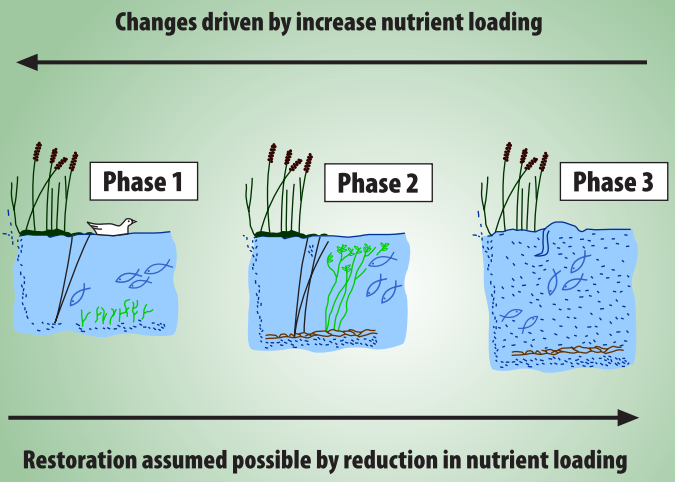
Sources

The nutrients which cause eutrophication may come from point sources, such as sewage treatment works or industrial effluents, or from diffuse sources, such as fertilisers washed from agricultural land. Unfortunately fertilisers that are added to crops to make them grow also help the algae to grow if they reach lochs and rivers.

Transport

While nutrients from point sources are directly transferred into water courses through pipes, nutrients from diffuse sources rely on groundwater and surface waters to be carried through and over the soil. Diffuse sources can be broadly divided into:

- Nitrates, which are soluble and carried along dissolved in the water, and
- Phosphorus, which is less soluble and attaches to moving sediments.



Left: Too much algae clouds the water and blocks sunlight

What are the consequences of nutrient enrichment?

The consequences are different for lochs and rivers:

Lochs

Nutrient enrichment of loch water, which sits around for a long time before being flushed out into rivers, promotes the growth of algae. By clouding the water and blocking sunlight, algae cause underwater plants to die, removing an important habitat and feeding ground for wildlife. In addition, when they die, algae use up oxygen required by organisms in the water, such as insects and fish. Excess phosphorus in lochs can promote the growth of toxic cyanobacteria. These blue-green coloured "algae" can be fatal to livestock and humans drinking the contaminated water.

Rivers

Most river water is constantly moving, so the problem of algae from nutrient enrichment is smaller than in lochs. High flow events may even prevent the growth of algae altogether in upland rivers. During very dry periods, the situation in lowland rivers may be more similar to that of lochs.

It is also important to consider the bigger scale, looking at the impact of nutrient enrichment on the catchment as a whole. Although it may not greatly affect rivers, nutrient enrichment can affect ecosystems further downstream, such as connected lochs, estuaries and coastal areas.

How can we reduce nutrient enrichment?

The key problem in trying to reduce nutrient enrichment is the delay in a water system's response to nutrient input. Nutrients are held in underwater sediments and groundwater for years at a time, which makes monitoring any changes in water quality very difficult. Any attempt to reduce the effects however, first involves looking at the source of the problem.

Controlling Point Sources

The impact of sewage treatment works depends on the size of population. Amongst the pollutants that may be discharged is phosphorous, which is used in many cleaning materials like washing powders and dish-washing products. One way to reduce nutrient enrichment is to remove the phosphorus from the effluent before it leaves the treatment works. This has been reasonably successful for deep lochs and is now applied to most treatment works that discharge into rivers. In shallow lochs however, there are more interactions between sediments and the overlying water. Since phosphorus can be held in sediments in lochs for many years, removing the source of the phosphorus may only be a starting point to solving the problem.

Controlling Diffuse Sources

Best management practices help to decrease the levels of nutrients working their way through soils into water courses from diffuse sources. One of these is to ensure that farmers spread animal waste during the drier periods of the year, to minimise the risk of nutrients being rapidly washed through the soil by heavy rainfall or flooding. Another is to develop buffer strips along the river bank to act as a barrier between the agricultural land and the water course (see chapter on Links Between Land and Water).

Removing the drainage pipes from beneath fields is another option, in areas of high conservation interests. The land may then no longer be suitable for crop production, but can be used for pasture. This might have an impact on a farmer's income, but be of benefit to the environment and society as a whole.

Harnessing the power of nature

Removing fish from water systems can actually help to restore water quality. By removing fish their food – zooplankton – can develop. The zooplankton feed on the algae, thereby controlling the algae levels of the system. This process is called Biomanipulation and leads to a restoration of clear water. Plants may then grow again by themselves, or be planted, to help maintain a stable system. Eventually fish can be reintroduced to the water. The aim of this restoration process is to re-establish a self-sustaining ecosystem – one that can survive without constant human management.