

Nyman, H.G. 2003. Regulation of biotic structure and nutrient flux: examples from soft water lakes.

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Abstract – The factors that determine biotic structure, nutrient flux and trophic status in lakes are of central importance in aquatic ecology, from practical as well as theoretical perspectives. The regulating factors can work from two directions, “top down” influences from consumer levels in the ecosystem downwards, and “bottom up” from the chemical-physical level. Existing ecosystems are probably always a mixture of both kinds of regulating forces, but top down regulation has often been underestimated. In the present thesis I examine aspects of regulation of aquatic biotic structure and nutrient flux in soft water lakes from several perspectives, based on field observations and experiments in lakes in SW Sweden.

The top down impact of the fish population on trophic properties of lake water was studied in an oligotrophic forest lake. The influence of biotic feedback on abiotic factors was tested in an experiment with other environmental factors under control. Fish removal resulted in a change in oligotrophic direction, as shown by the drop in limnetic primary production, pH, total phosphorus, total nitrogen and increased transparency. Biotic manipulation of the predation pressure from fish can thus change the trophy level of lakes.

Top down regulation is important in acidified and limed lakes. A change from a predator-prey system dominated by fish to one dominated by invertebrates may be responsible for many of the ecological changes reported from acidified lakes. This is suggested by comparison of the biological effects of a fish removal experiment in a non-acidified lake with changes in acidified waters.

The outcome of a liming experiment in a recently acidified lake with a non-reproducing fish population, indicates that the “setup” of predators at the time for the liming is crucial for the impact on the zooplankton community. In a field experiment with two invertebrate predators; larvae of the phantom midge *Chaoborus obscuripes* and the corixid *Glaenocoris propinqua*, we found that they influence their prey populations in ways suggesting that such predators may be responsible for much of the structuring of zooplankton reported from acidified lakes.

Experimental examination of mechanisms active in regulation of aquatic nutrient flux reveals that a shift from cladoceran towards calanoid zooplankton may lead to increased loss of phosphorus from the pelagial. Field experiments indicated that benthic invertebrates such as dragonfly larvae, common in acid lakes, can act as oligotrophicating agents, trapping nutrients in faecal pellets, and that a *Sphagnum* mat may be an important nutrient sink.

Acidification affects many lakes in northern Europe and other areas. Many of the lakes are not acidified below normal pH but their buffering capacity is lowered. Some of these lakes are also eutrophicated. When their buffering capacity is reduced, the pH fluctuates more easily and can rise at incidents of intense primary production. I suggest that such lakes run a risk of negative effects, which also can influence nutrient flux in littoral areas. A survey suggests that pH is generally higher in littoral areas than in central parts of lakes.

One likely effect is disturbance of zooplankton grazing on phytoplankton, and this was investigated in laboratory experiments. The results show that the cladoceran *Daphnia galeata* is affected by an elevated pH, which reduces the filtration rate and induce escape responses in the animals. Reduced filtration and avoidance of productive areas might reduce the predation pressure on the phytoplankton, thus enhancing primary production. This mechanism might lead to a self-reinforcing increase in pH.

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