Zooplankton

Early signals of natural recovery in acidified lakes in Norway

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Introduction

The Norwegian monitoring programme on long-range transported air pollutants include monitoring of water chemistry, macroinvertebrates, microcrustaceans and fish populations from approximately 100 lakes, of which 20 lakes with yearly sampling of invertebrates (Figure 1). These lakes cover the gradient from non-impacted reference lakes to very strongly acidified lakes. During the last 10 years most acidified lakes has shown a significant chemical recovery.

The aims of the monitoring programme are to evaluate the acidification status of Norwegian lakes and to assess the trends in acidification and biological recovery.

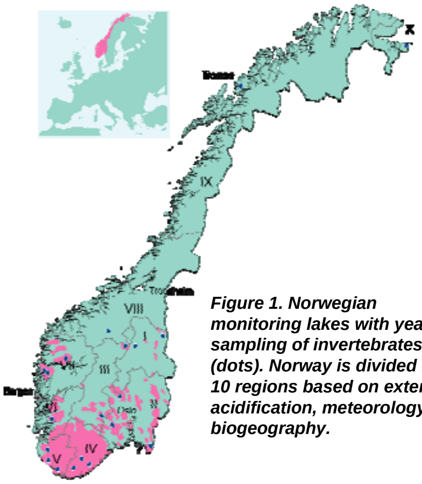

Figure 1. Norwegian monitoring lakes with yearly sampling of invertebrates (dots). Norway is divided in 10 regions based on extent of acidification, meteorology and biogeography.

Methods

The microcrustacean communities of 20 monitoring lakes (Figure 1), including three non-impacted reference lakes, have been surveyed for six to nine years. Older data exist from some of the lakes. From each lake 2-3 yearly samples (net-hauls) from pelagic and littoral parts have been taken. Cladocerans and copepods have been identified to species level. Species composition and relative abundances has been used for evaluation of acidification status and trends. Water chemistry are from late autumn samples.

Results and discussion

- ✓ Of the acidified lakes, about 50 % show signs of recovery.
- ✓ In the most severely acidified lakes these changes are related to an increased presence of the calanoid copepod *Eudiaptomus gracilis* in the plankton communities which earlier were completely dominated by the cladoceran *Bosmina longispina* (Figure 2a).
- ✓ In less severely acidified lakes *E. gracilis* and other tolerant copepods is slowly replaced by the cylopoide *Cyclops scutifer* (Figure 2b) whereas *Daphnia* spp. emerge as a new species or show increasing densities in moderately acidified lakes (Figure 2c).
- ✓ The total species richness and the fraction of acid sensitive species have also increased in some of the lakes (Figure 3).
- ✓ Reduced levels of labile aluminum is important for the biological improvements of the most severely acidified lakes (see Figure 2a).
- ✓ However, in the majority of the lakes the biological improvements are minor and unstable, and have so far not changed their ecological status. This is in accordance with earlier studies which have shown that a lag-time of one to several decades between chemical recovery and recovery of microcrustaceans should be expected. Furthermore, although significantly improved, the water chemistry may still be a limiting factor in several of the lakes.

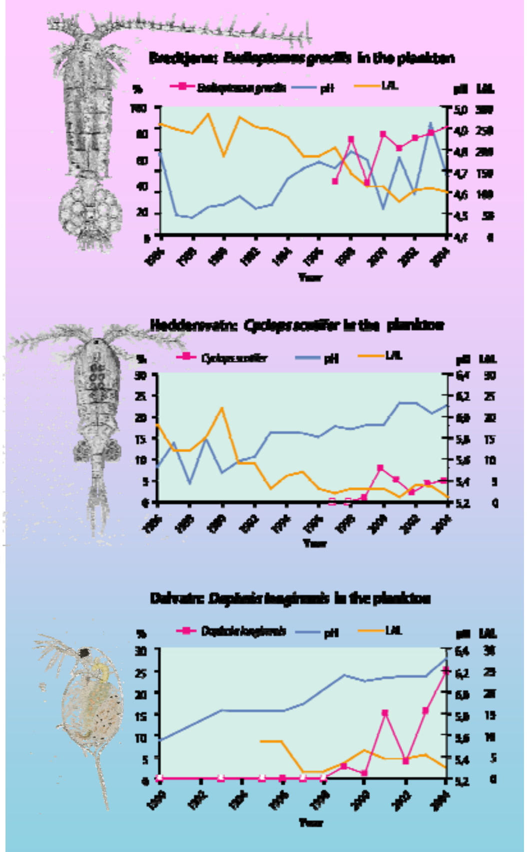

Figure 2. Presence (% of total numbers) of indicator species representing different degrees of acidification damages: a) Eudiaptomus gracilis *(most common copepods in lakes with pH 4.5 – 5.0), b)* Cyclops scutifer *(mainly found in lakes with pH > 5.0) and* Daphnia longirostris *(mainly found in lakes with pH > 6.0).*

Aknowledgement

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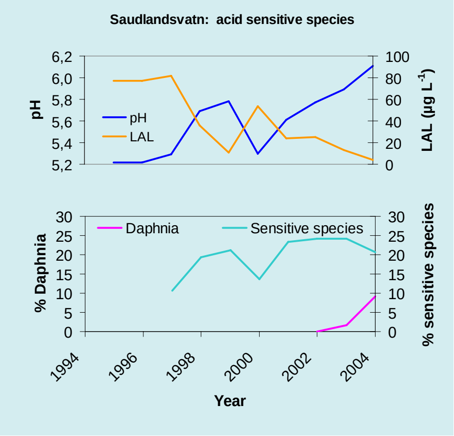

Figure 3. Relative presence of Daphnia longispina *and of acid sensitive species (Cladocera + Copepoda) in Lake Saudlandsvatn (Reg V).*