Zooplankton response to long term liming of 13 Swedish acid lakes

Gunnar Persson

Department of Environmental Assessment,
University of Agricultural Sciences, Uppsala , Sweden

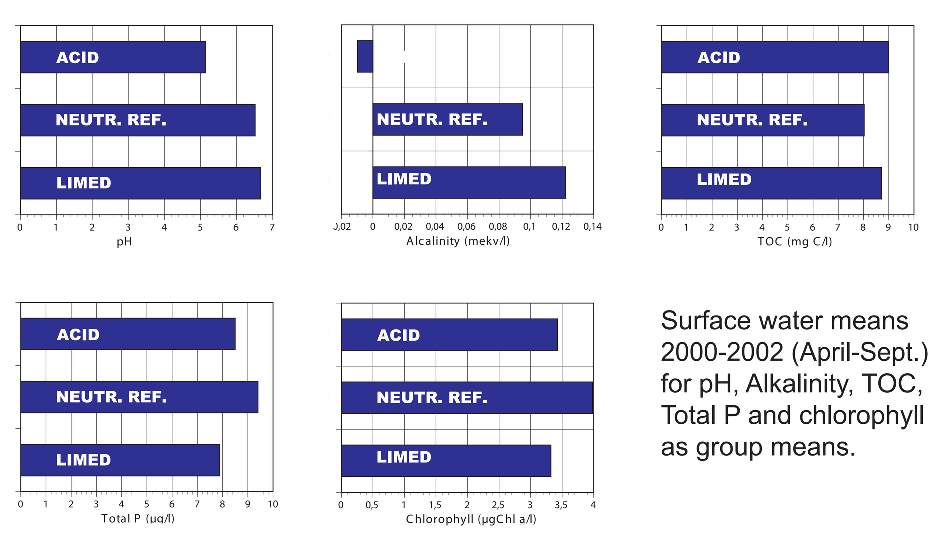
ISELAW

Integrated Studies of the Effects of liming Acidified Waters

1 Objective Ecosystem development in lime-treated waters in Sweden has been followed since 1989 in a programme for integrated studies of the effects of liming in acidified waters (ISELAW). Liming effects on zooplankton communities is discussed in terms of changes in community composition and in standing crop

2 Approach Nutrient and biotic conditions were assessed in 13 long-term (15-28 y) limed Swedish lakes to study the effects of liming (Fig.1). Parallell studies of 10 untreated circumneutral lakes (pH 6.0-7.0) and 5 acid lakes were used to reveal differences between the three studied lake groups. Older records obtained during a pre-acidification period as well as during the acid period preceeding the initial liming where compared to records from the limed period when available.

Fig.1. Mean hydrochemical conditions and chlorophyll conc.



Surface water means 2000-2002 (April-Sept.) for pH, Alkalinity, TOC, Total P and chlorophyll as group means.

Fig. 1

Fig. 2 Before and after liming records of zooplankton taxon Nos.

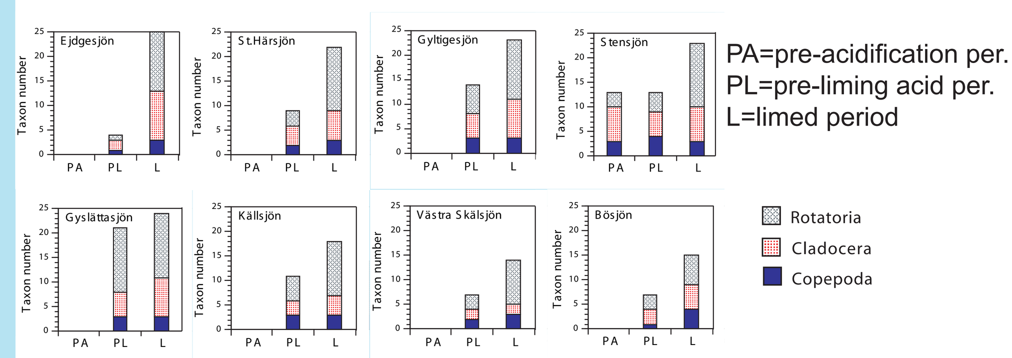
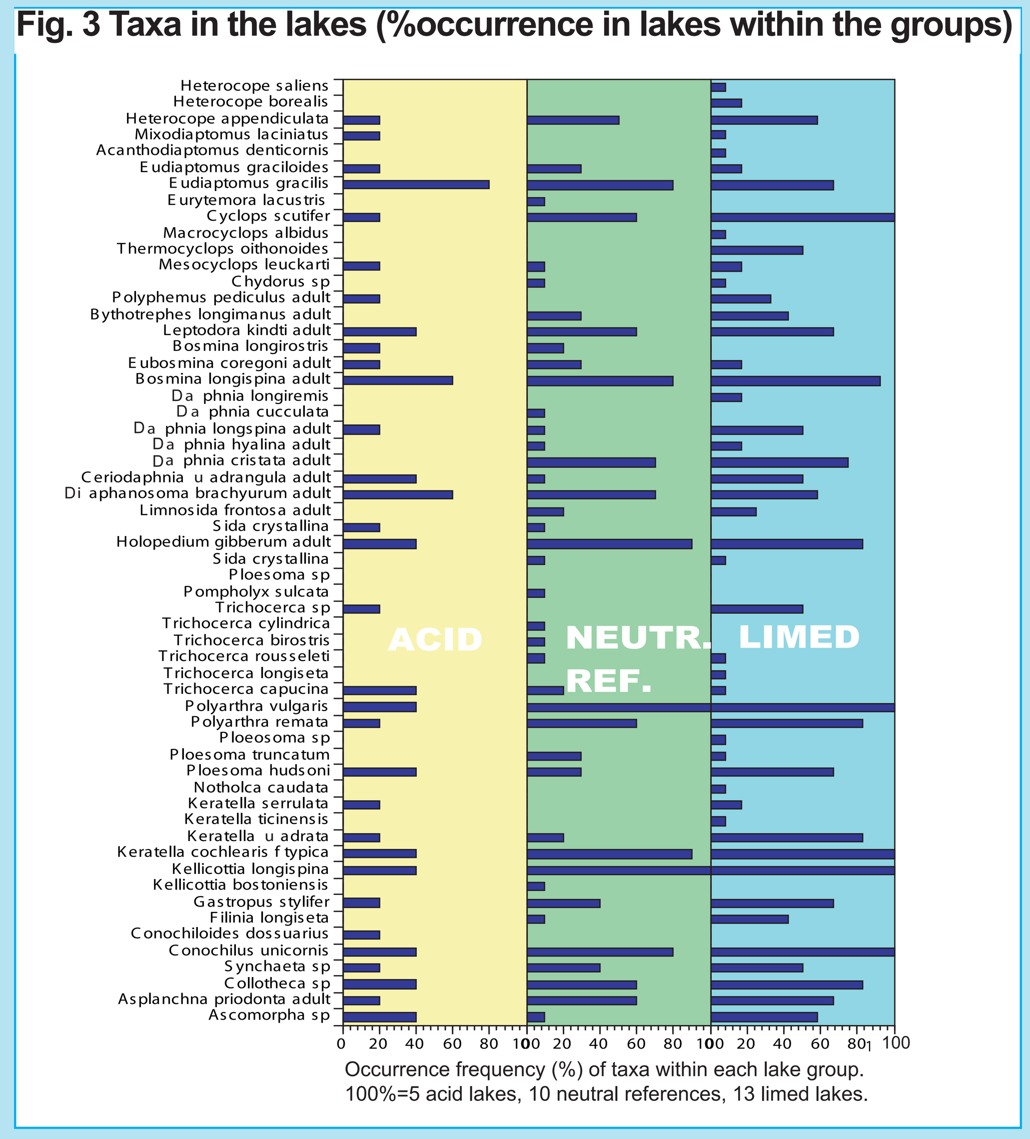


Fig. 3 Taxa in the lakes (%occurrence in lakes within the groups)

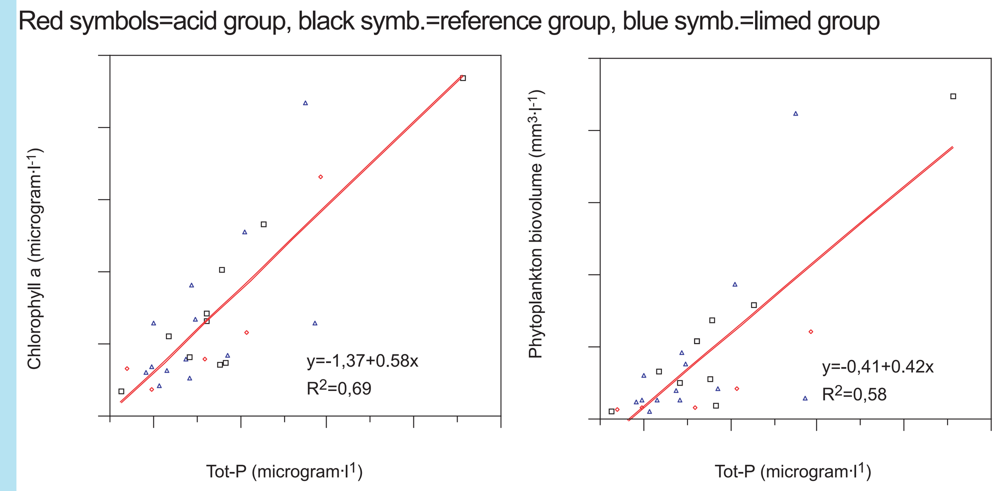


3 Material & methods Samples for species identification were taken by vertical tows with plankton nets (63 and 25 microm mesh size, formalin preservation) during the years 1990-1992. Older data from the acid period preceeding the liming were gathered from various sources, most notably from C. Ekstršm, who also analysed the samples from the early 1990-ies. Quantitative zooplankton samples were taken with a Limnos sampler (4.3 l) at 2 m intervals down to 8 m depth, pooled and preserved in acid Lugols solution before species identification and enumeration under the inverted microscope. The most shallow lakes had to be sampled in a 6, 4 or 2 m stratum. The lakes were sampled in June, July, August and September. Median values for a 3-yr period (2000-2002) are given.
Vertically integrated phytoplankton samples were taken with a tube sampler (mostly 0-4 m) mid-monthly during April-September, preserved with acid Lugols solution and counted under the inverted microscope. Median biovolumes the years 2000-2002 are given.
Pelagic fish was caught in floating gillnets, with a standardized set of mesh sizes, anchored centrally in each lake and protuding downwards 0-6 m, 6-12 m etc. A 3 yr median biomass catch (2000-2002) per surface area of the used nets (unit effort) are presented. In shallow lakes (< 10 m) catch-data from benthic nets were used.

4 Results Species number of zooplankton before liming were available from 8 lakes (Fig.2). The number of taxa increased 2 times or more in 6 lakes after liming. The species richness increased mainly within the rotifer group followed by Cladocera. Pre-acidification data from Lake Stensjšn indicate low rotifer species number, probably due to coarse net size. The number of zooplankton taxons in the limed lakes typically spanned 15-20 in northern Sweden and 20-25 in southern Sweden. The species analyses for the limed lakes and the two reference groups shoved 32, 41 and 47 taxa in the acid, the neutral and the limed lakes respectively (Fig. 3). The differences were smallest between the limed and circumneutral lakes and would be even smaller if natural distribution patterns of copepods were considered. In the acid lakes there were no species common to all lakes, as compared to the other groups where several taxa were common to all lakes.
There was a correlation between total phosphorus and phytoplankton biomass in all lakes (Fig. 4) showing that phytoplankton biomass differences within the lake groups followed total phosphorus. However, in the acid lakes the phytoplankton/phosphorus ratio was less than half that of the other groups (Fig. 5a).
The zooplankton abundance differed between lake groups; rotifers were more abundant in the acid group and copepods were more abundant in the neutral group (Fig. 5b). Total zooplankton biovolume showed small differences between the groups (Fig. 5c) which was explained by a higher share of taxa with a small body size in the group of neutral references. This was particularly obvious within the rotifer group, where *Asplanchna* spp was dominant in several lakes (Fig. 5d). Fish predation pressure was indicated by catched biomass of pelagic fish, which was much higher in the reference and acid groups than in the limed group (Fig 5e).

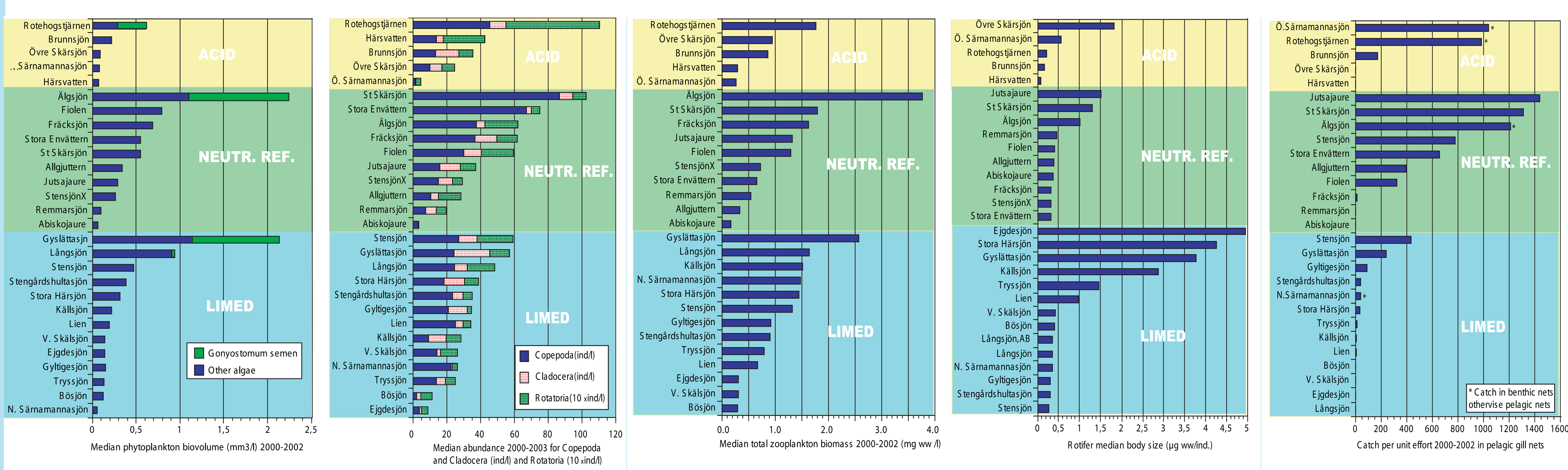
Fig. 4 Phosphorus-chlorophyll and phytoplankton relationships

Red symbols=acid group, black symb.=reference group, blue symb.=limed group



5 Conclusions
Zooplankton communities of acid lakes were poorer than those of circumneutral non-perturbed lakes. Liming of acid lakes gave communities with a somewhat different structure as compared to naturally limed lakes. A lower predation pressure from pelagic fish in the group of limed lakes might reduce diversity. Similar zooplankton biomasses in limed lakes relative to high-predation neutral lakes would also imply lower zooplankton production there (or similar production and high losses through other pathways).

Fig. 5 Comparison between the lakes within the three groups: a) phytoplankton biovolume, b) zooplankton abundance, c) zooplankton biovolume, d) rotifer mean body size, e) pelagic fish catch



Swedish Environment Protection Agency

Swedish National Board of Fisheries

Swedish University of Agricultural Sciences

Stockholm University