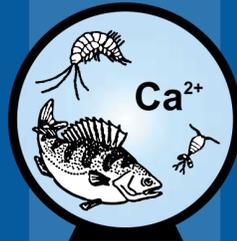


Does intermittent liming of lakes affect water quality?

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ISELAW

Integrated Studies of the Effects of Liming Acidified Waters

1 Objective The hypothesis is that a higher pH-value will stimulate biological processes in the lake.

2 Introduction Ecosystem development in lime-treated waters in Sweden has been followed in a programme (ISELAW). Data for six lakes, limed one to three times during the observation period (1989-2000), are used in the evaluation.

pH-values increase immediately after liming and fall until the next dose. A higher pH-value could induce lower concentrations of the biogenic elements; nitrate, total phosphorus, TOC, absorbance and silica.

Changes in total-phosphorus, nitrate and silicate can be attributed to phytoplankton (diatom) production. Microbial and photochemical processes regulate organic matter, TOC and colour (absorbance).

3 Results The liming techniques influence the water chemistry with respect to Ca and concomitantly pH-value.

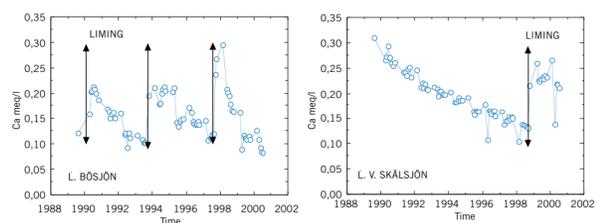


Figure 1. Examples of liming.

Natural seasonal variation together with liming activities result in pH-variations (Fig. 2). Some of the limed lakes exhibit relatively low pH-values.

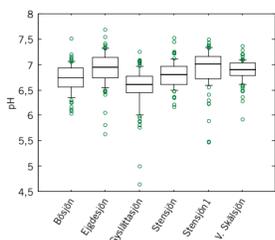


Figure 2. Variation in pH-value.

Evaluations are based on:

- actual concentrations.
- residuals after correction for seasonal variation.
- short time-periods before and after liming.

Evaluation based on concentrations

In general there is a relationship between pH-value and the concentrations of the biogenic elements.

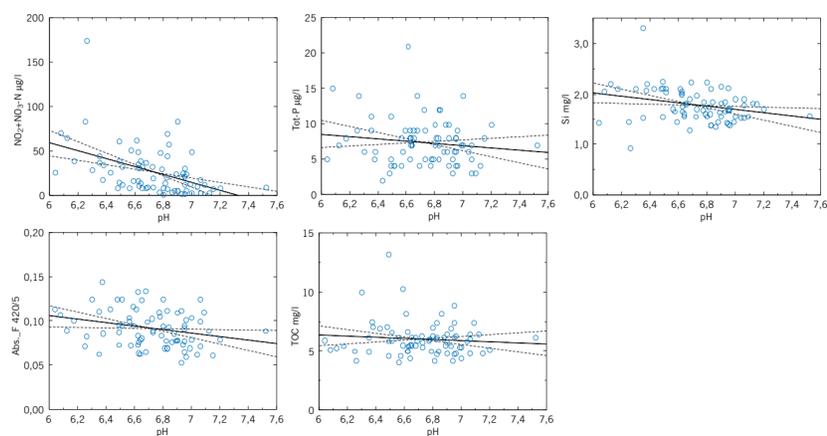


Figure 3. Relationship between pH-value and biogenic elements. Lake Bösjön.

But part of this correlation is caused by natural, seasonal variation in both pH-value and the studied variables. Evaluation based on residuals after correction for seasonal variation

One way to compensate for the seasonal variation is to model the seasonal variation and calculate the residual.

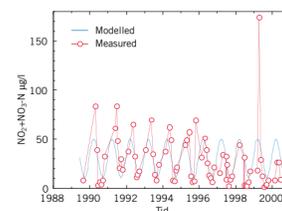


Figure 4. Measured and modelled values (sine curve). Lake Bösjön.

Use of the residual reduces influence from seasonal variation.

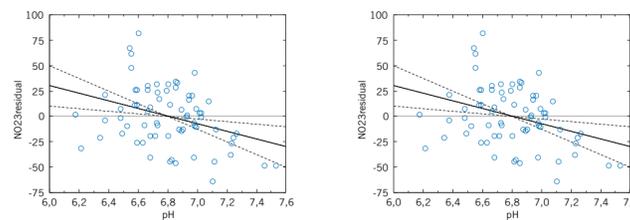


Figure 5. Regression between pH-value and nitrate concentration and residual after seasonal correction. Lake Stensjön 638317.

Correlation's decrease in general when modelled values are used.

Evaluation based on short time-periods before and after liming. Since the liming effect may be of short duration, there is reason to limit the comparisons to short periods before and after the liming.

Table 1. Comparison between before and after liming using residuals. T-test p-value * = 0.95, ** = 0.99 and *** = 0.999.

Lake	Mean pH-difference	pH	NO23-N	Tot-P	TOC	Silica	Absorbance
Gylättasjön	0,54	***	-	- **	+	- **	-
Stensjön 638317	0,30	***	-	-	+ *	+ ***	-
Ejgdesjön	0,40	***	-	+	-	-	+
Stensjön 656419	0,28	***	+	-	+	-	+
V. Skålsjön	0,21	***	-	-	- *	+	+ ***
Bösjön	0,25	***	-	+	+ **	+	+ **

The reactions differ between the lakes. This has been shown for colour; changes varied due to the status before liming.

4 Conclusion

- Variations in pH-values are significant but relatively small (0.2–0.5 pH-units) and rarely below 6.0.
- Only for individual lakes and biotic parameters do the evaluations indicate significant effects of intermittent liming.
- For nitrate are changes consistent; after liming were concentrations lower in five of the six lakes. Total-P, TOC and Si concentrations increased in three lakes and decreased in the remaining three. Inconsistent reactions may be due to different initial conditions.
- Intermittent liming leading to this level of pH-variation is not likely to induce general and vital effects on biotic elements. However this study did not include biota.



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