NATURVÅRDSVERKET
SWEDISH ENVIRONMENTAL PROTECTION AGENCY

ISELAW

Integrated Studies of the Effects of Liming Acidified Waters

Can the Stream Community Predict its Acidity Regime?

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Objectives

To study effects of chronic and episodic acidification in streams on benthic macro-invertebrates and fish. Can stream pH-regime be indicated by the stream community?

Material and methods

Water quality was sampled monthly in 23 (acid, episodically acid, limed or neutral) streams in the ISELAW-programme. In autumns (1997-2003) quantitative electro-fishing was performed as well as quantitative (modified Surber) sampling of benthic macro-invertebrates (2000-2002). Means of chemical variables were calculated for the hydrological year prior the biological sampling, October to September. Additionally extreme values were used, i.e. minimum or maximum levels for the same period. The streams were divided into three types by minimum pH: **acid (pH<5)**, **episodically acid (pH~5.5)** and **neutral streams (pH>6)**. Multiple biological indices were estimated for macro-invertebrates and fish (brown trout, *Salmo trutta* L.). The relationships between the biological communities and water quality indicative of acid-stress were examined with Spearman correlations and t-test for dissimilarity from episodically acid streams.

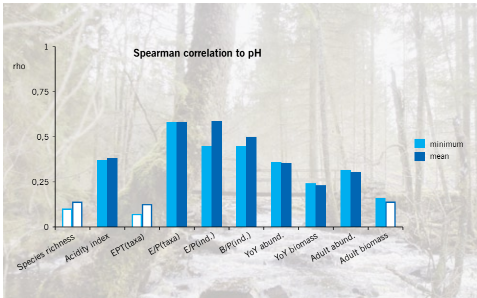

Figure 1. Correlation (Spearmans rho) between biological indices and mean or minimum pH. Solid columns – significant correlation (p<0.05), open columns – not significant. Benthic macro-invertebrates indices (E=*Ephemeroptera*, P=*Plecoptera*, T=*Trichoptera*, B=*Baetis*), abundance and biomass of young-of-the-year (YoY) and adult brown trout from electro-fishing.

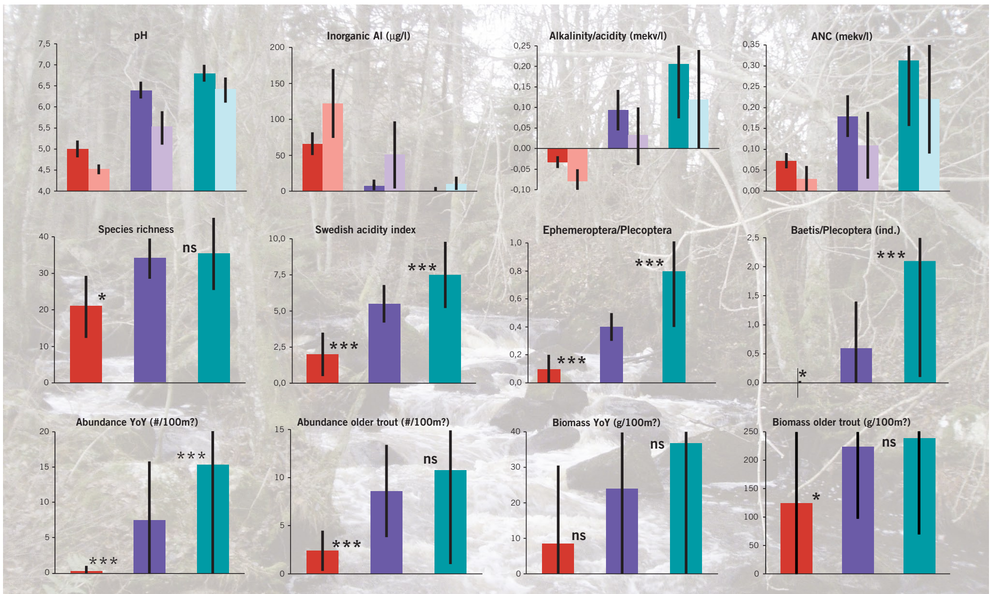

Figure 2. Streams divided into acid (pH<5), episodically acid (pH~5.5) and neutral streams (pH>6) (means and standard deviations). In top row – water quality, mean (dark) and extreme values (light) for pH, inorganic Al, alkalinity/acidity and ANC – all classifies significantly (p<0.001). In the middle row – benthic macro-invertebrates indices and in base row – abundance and biomass of young-of-the-year (YoY) and adult brown trout. Significant separation from episodically acid streams are shown (p<0.001 ***, p<0.01 **, p<0.05 * and ns, not significant).

Results

The correlations for pH to biological indices are compared in figure 1. In descending rank the indices E/P (*Ephemeroptera/Plecoptera*) taxa and ind., B/P (*Baetis/Plecoptera* ind) and acidity index showed significant correlation to pH (both mean and minimum pH), however the correlation to species richness and EPT (sum *Ephemeroptera-Plecoptera-Trichoptera* taxa) was not significant. The correlation with acidity to brown trout biomass was weaker than to abundance.

The water acidity variables could significantly classify stream acidity type both by mean and extreme values (figure 2). Several indices of benthic macro-invertebrates and fish could also successfully classify streams into types: E/P taxa ratio, acidity index and YoY (young-of-the-year) brown trout) abundance.

Conclusions

Biological indices of the stream community could classify streams into three acidity regimes (acid, episodically acid and neutral). The typology is therefore ecologically relevant and not only chemically significant.

The biological indices *Ephemeroptera/Plecoptera* taxa ratio, acidity index and young-of-the-year brown trout abundance were well correlated with the stream acidity regime and can be used as indicators in future work with ecological quality criteria (EQC) in running waters.

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