**BIOLOGICAL INDICATORS OF EPISODIC ACIDIFICATION**

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**Material and methods**

This study is based upon results from 3 years (2000-02) monitoring; monthly water sampling complemented with more frequent high flow sampling in eight (acid or limed and neutral) streams in the ISELAW-programme (Integrated Studies of the Effects of Liming Acidified Waters).

In autumn a quantitative electro-fishing was performed and qualitative (M42-kick-method) and quantitative (modified Surber) sampling of benthic macro-invertebrates was performed in spring and autumn.

Means of chemical variables were calculated for the hydrological year, October to September. In addition - variables that were expected to have most effect at high flows was also estimated as extreme values i.e. minimum levels of pH and alkalinity/acidity and maximum levels of inorganic aluminium (Al(III)) for the same period. Several biological indexes and relative abundances for trout were calculated and correlations with water quality were established (*p<0.05, **p<0.01, ***p<0.001). Also ANOVA and t-tests were run on the biological results of the stream groups.

Young brown trout (1-2 years) was gathered in springtime (5 streams - once, 2000 and 2 streams - thrice, 2001). The load of Al on the gills and Hg in muscle was determined in at least 6 fishes per sampling.

**Results**

The streams could chemically be divided into three groups; acid, episodically acid and streams with rare pH-depressions (minimum pH>5.5, Table 1). The episodically acid streams were not statistically significantly separated from the other two groups by the biological results.

The number of benthic macro-invertebrate taxa and the relative abundance of brown trout showed an expected good correlation to minimum pH (Figure 1 and 2).

Trout biomass was correlated to number of macro-invertebrate taxa (Figure 3) - this can be a collinear response to sub optimal water quality as well as a food chain effect. The metal burden of young brown trout (1-2 years) could be described with gill-Al and muscle-Hg; which were correlated (Figure 4). The highest values were found in the acid stream and in a limed episodically acid stream with very fluctuating pH.

The effect of acid episodes can be detected in the stream fauna but the results must be evaluated together with the water chemistry.

**Important questions:**

- Are acid episodes reflected in abundance and community composition of these organisms?
- Can acid episodes be detected by an elevated metal burden in brown trout?

**Aim** - to study biological effects of acidity at high flow episodes in streams, among benthic macro-invertebrates and fish.

**Table 1. Groups of streams and chemical character.**

<table>
<thead>
<tr>
<th>Stream group</th>
<th>n</th>
<th>pH</th>
<th>pH min</th>
<th>pH max</th>
<th>pH alkalinity/acidity</th>
<th>Al</th>
<th>Al max</th>
<th>Al min</th>
<th>MEQ/L</th>
<th>µg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanently acid stream</td>
<td>1</td>
<td>4.9</td>
<td>4.0</td>
<td>5.9</td>
<td>255</td>
<td>0.01</td>
<td>0.00</td>
<td>0.12</td>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>Episodically acid stream</td>
<td>4</td>
<td>6.3</td>
<td>4.9</td>
<td>7.0</td>
<td>105</td>
<td>0.08</td>
<td>0.03</td>
<td>0.14</td>
<td>145</td>
<td>8</td>
</tr>
<tr>
<td>Streams with rare pH-depressions</td>
<td>3</td>
<td>6.7</td>
<td>6.0</td>
<td>7.5</td>
<td>150</td>
<td>0.15</td>
<td>0.05</td>
<td>0.25</td>
<td>43</td>
<td></td>
</tr>
</tbody>
</table>

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