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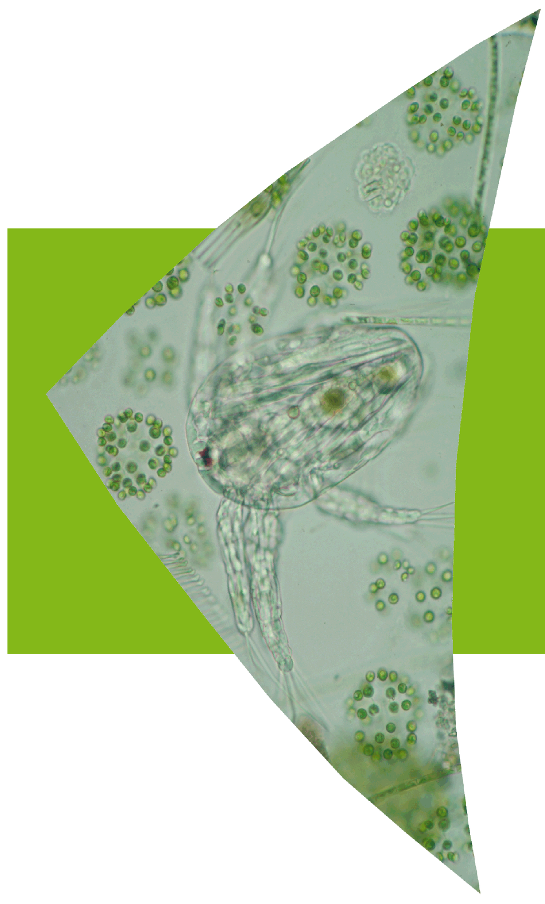

Toxicity screening of sediments from Lake Geneva using the freshwater ostracod *Heterocypris incongruens* (ISO 14371)

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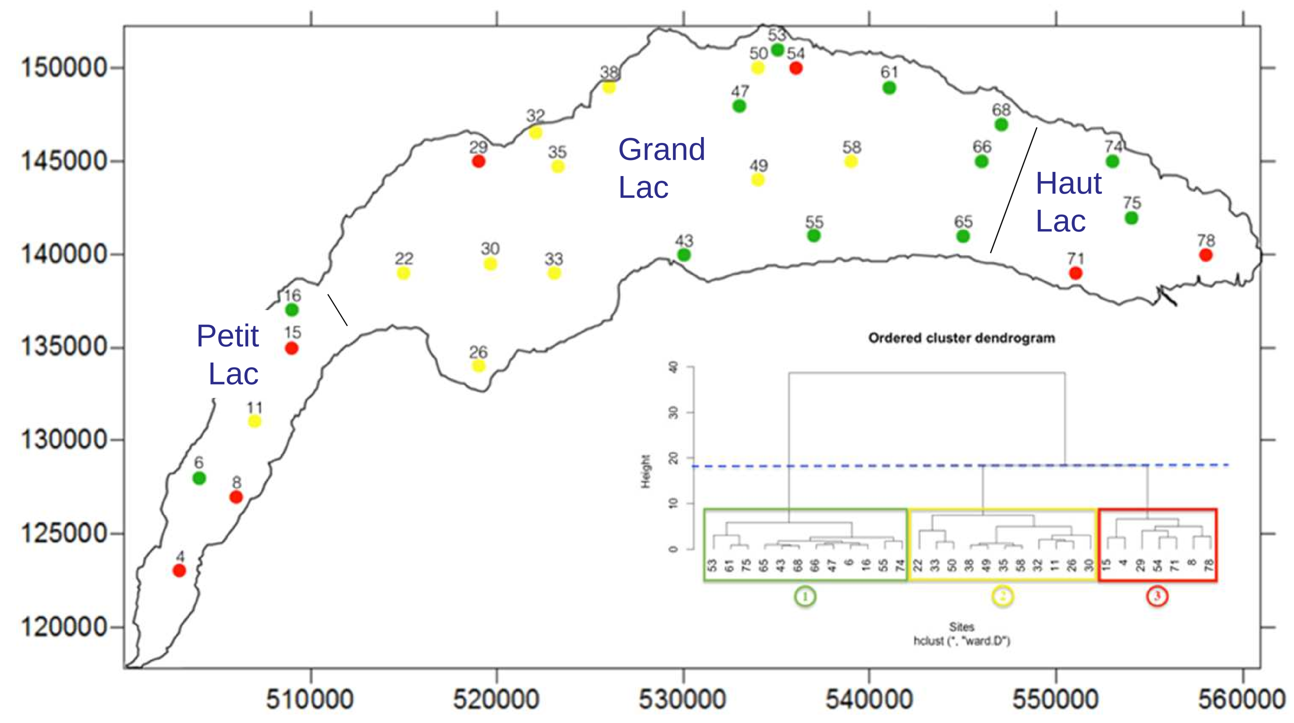
Introduction

- **Context of the study:** In 2015 the International Commission for the Protection of Lake Geneva (CIPEL) financed a specific project to study the presence of micropollutants in surficial sediments from Lake Geneva and evaluate the risks of transfer to the zoobenthos. Project components include:
  - Physico-chemistry: ancillary parameters, metals, organic micropollutants prioritized according to substance properties and previously attested presence in Lake Geneva.
  - Macrozoobenthos: qualitative (composition of oligochaetes, insects and mollusks) and quantitative (density, biomass) indicators.
  - Paleolimnological indicators: chironomids, diatoms, microcrustaceans in sediment cores.
- **This study:**
  - screening of toxicity of sediments from 30 sites subject to extended physico-chemical characterization (blue squares in Fig. 1 below).
  - Test the effect of sample storage conditions (freezing) on the toxicity test endpoints.

Visual abstract



Material and Methods

STUDY AREA AND SAMPLING SITES

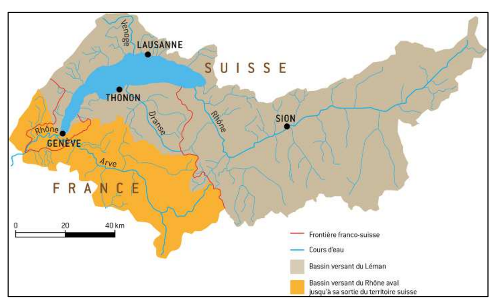
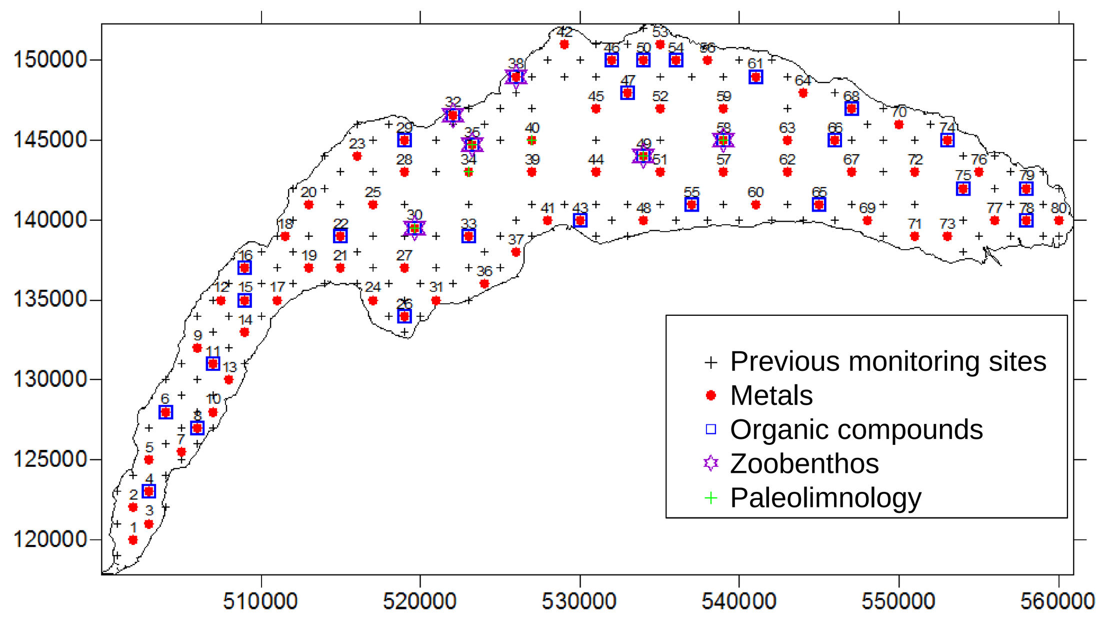


Figure 1: Sampling sites selected using a stratified random methodology. N°53 added due to its location in the Vidy Bay (next to the wastewater treatment plant effluent of Lausanne).



TOXICITY TESTING

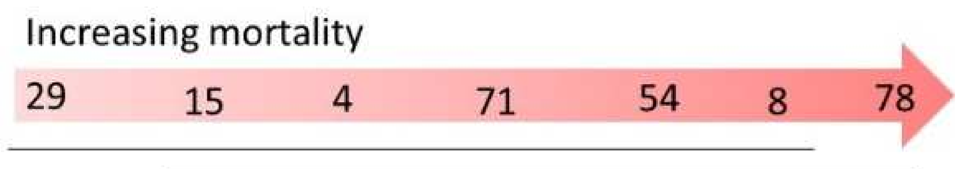
- **Test method:** ISO 14371 with no modification.
- **Materials:** commercial test kit Ostracodtoxkit® from Microbiotests (Gent, Belgium).
- **Endpoints:** growth and mortality.
- **Data evaluation and analysis**:
  - Control-normalized mortality and growth
  - Kruskal-Wallis non-parametric test (p=0.05)

- **Is freezing an alternative for storing samples for toxcity screening?**
  - Fresh sediment samples
  - Frozen sediment samples

Results and Discussion

TOXICITY SCREENING

- **Mortality (Fig. 2):**
  - Seven out of 30 samples has mortality statistically different from controls. Statistically homogeneous samples are defined by a continuous line.



- **Growth inhibition (Fig. 3):**
  - Higher incidence of toxicity than for mortality endpoint, including samples with increased control-normalized mortality: 11, 22, 26, 30, 32, 33, 38, 49.
  - Low impact of toxicity threshold used for toxicity classification of samples.
- **Clustering of sites** (Fig. 4) and visual representation of toxicity (visual abstract).

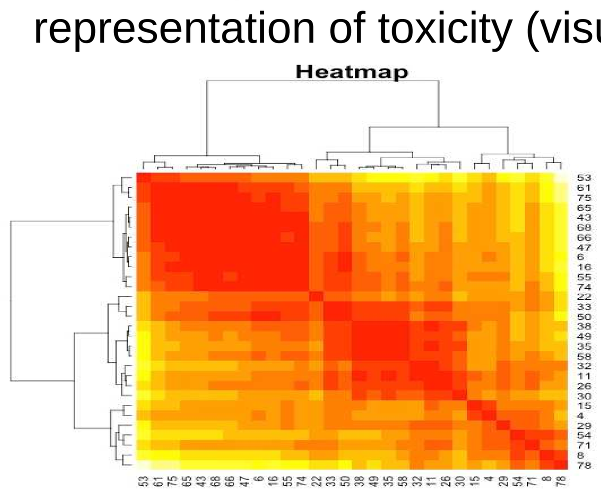


Figure 4: Heatmap. Clustering of the thirty sites according to the results of both endpoints mortality and growth inhibition.

- **Spatial trends in toxicity (visual abstract):**
  - Hot spots:
    - the Haut Lac, an area closed to the Rhone mouth.
    - the Grand Lac, the deepest area, and two areas with urban influence.
    - the south-eastern part of the Petit Lac.

Figure 2: Control-normalized mortality results (%) for the sites under study. Statistical significance from controls is marked with an asterisk. The red line indicates the acceptability criterion for the controls.

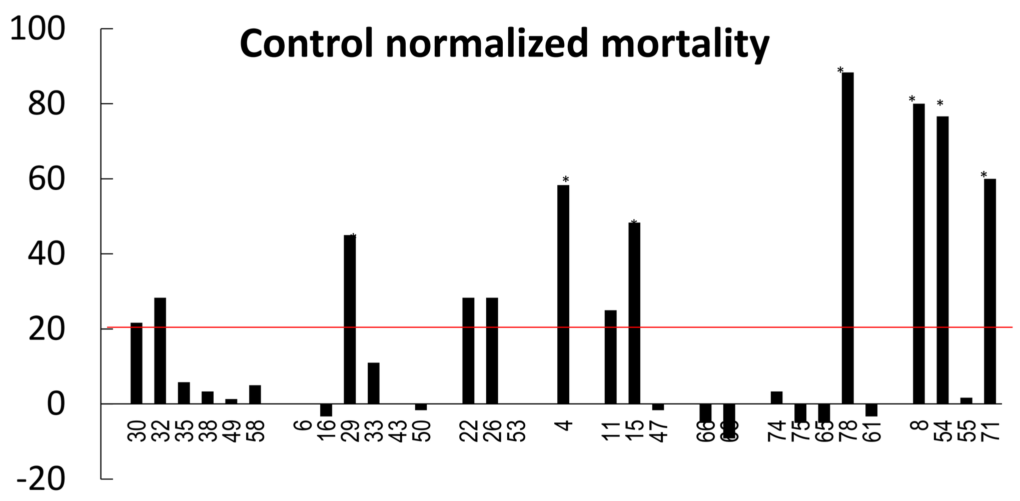
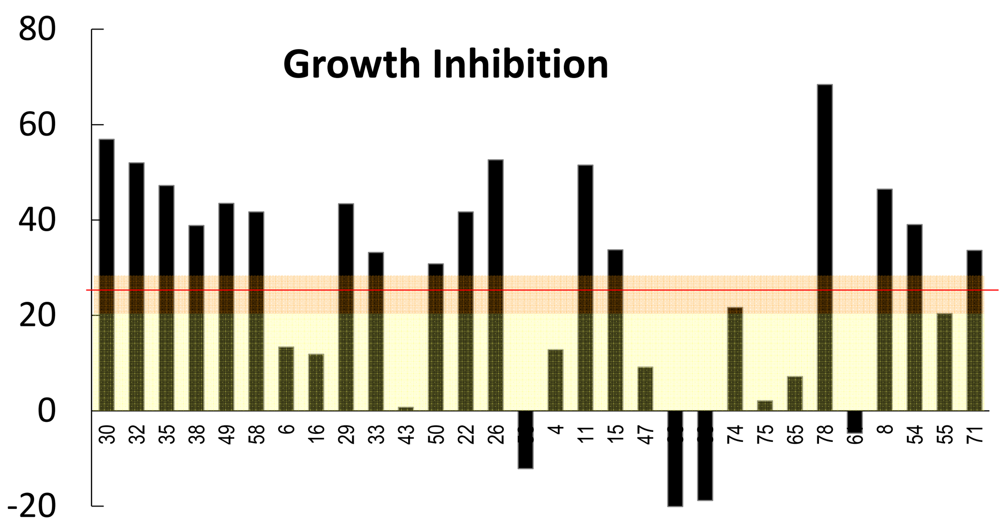


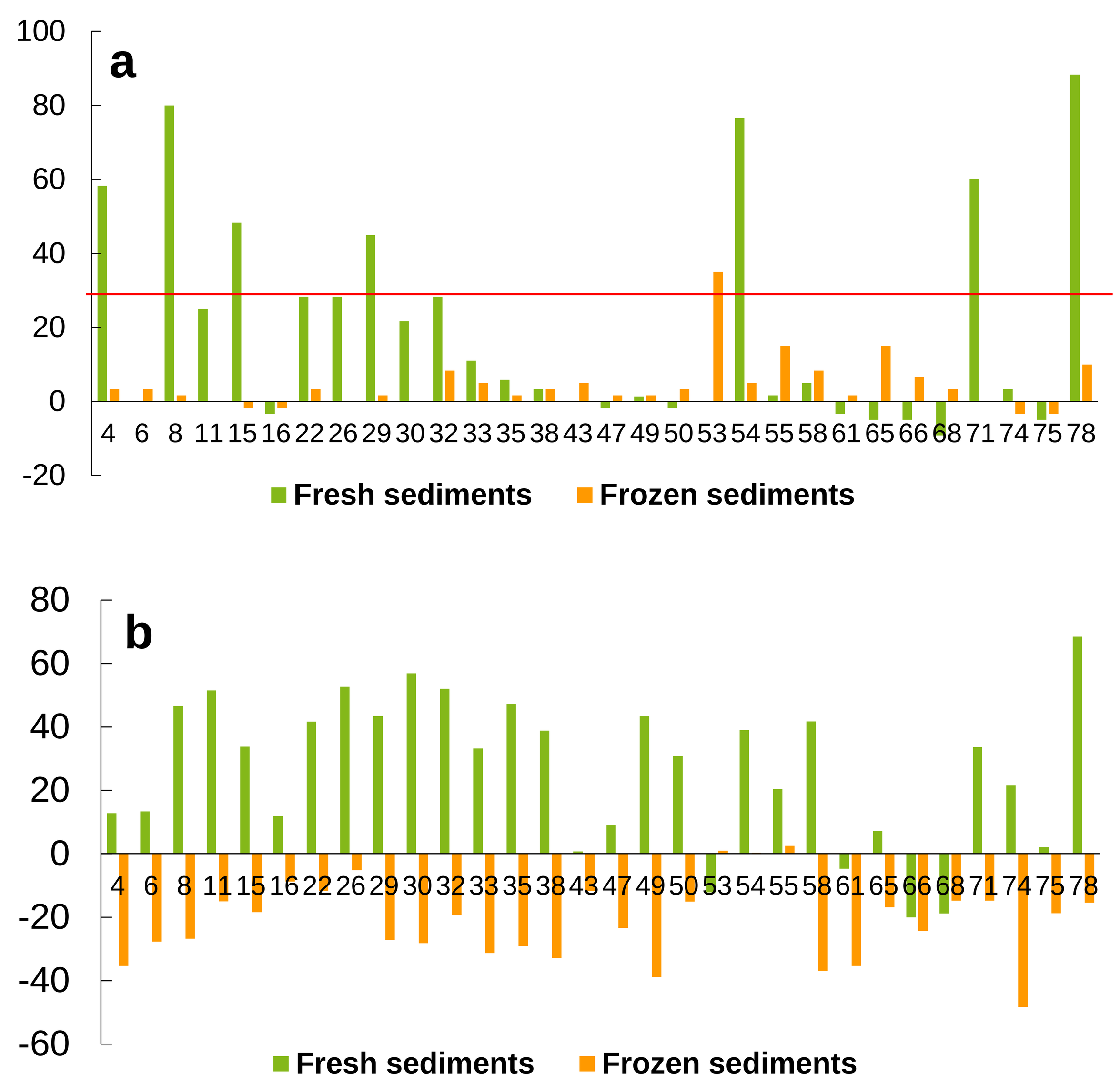
Figure 3: Growth inhibition compared to the corresponding control (%). The red line indicates the statistical significance threshold against the corresponding control growth. In yellow the section below the acceptability criterion for controls and in orange the natural variability of the endpoint for uncontaminated sediments. [Casado-Martinez et al. 2016]



EFFECT OF SAMPLE STORAGE CONDITIONS

- **Direct sensitivity comparison (Fig. 5):**
  - Both mortality and growth inhibition decreased to low levels of toxicity for all samples stored frozen for approximately 6 months.
  - The exception was sample n°53, from the area impacted by the Lausanne WWTP at Vidy bay. Chemical analyses are ongoing.

Figure 5: Control-normalized mortality results (a) and growth inhibition (b) compared to the corresponding control for the sites under study. Results (%) are a direct sensitivity comparison of samples tested fresh and after freezing for approximately 6 months.



REFERENCES

Casado-Martinez MC, Burga-Perez K, Bebon R, Férard JF, Wermeirssen E, Werner I. Chemosphere (2016).

ISO14371 (2012), `Water quality determination of fresh water sediment toxicity to *Heterocypris incongruens* (crustacea, ostracoda)'.

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