Ecotoxicological tools for freshwater management

Bioaccumulation and toxic response in caged organisms

Field studies in freshwater ecotoxicology often rely on the use of autochthonous organisms to perform the quantification of environmental contaminants or to measure toxic responses. This approach is highly valuable, but it is submitted to the potential influence of many factors, making it more difficult to assess the actual indication. Active biomonitoring suppresses most of these confounding factors. Active biomonitoring refers to the use of allochthonous organisms which are always sampled at the same location, housed in the lab, then thoroughly selected, transported and caged on study sites. The fact that the organisms all come from the same source population and the use of the caging procedure itself remove most of the biological (age, gender, potential local adaptations) and the habitat-related (interspecific competition, food availability) confounding factors. Along with the control of environmental (physico-chemical) factors, this approach enables to isolate the influence of contamination on the concentrations and on the toxic responses measured in caged organisms. The development of active biomonitoring with the freshwater amphipod *Gammarus fossarum* enables the acquisition of contamination and toxic data on a robust and repeatable basis, which allows spatial and temporal comparisons.

Additionally, pragmatic reference values beyond which a situation of abnormal contamination is revealed have been determined for several contaminants (metals, pesticides, HAPs, PCBs, etc.) as well as for toxic responses (several sub-individual and individual level biotests).

Moreover, providing information about the impact of pollutants at higher organisational levels is a crucial challenge to aquatic ecotoxicology. In this perspective, we have focused the work on active biomonitoring on two aspects. First, empirical comparisons, in the lab, of biomarker responses and alteration of life history traits, along with the development of population models, allowed the definition of quantitative links between early biomarker responses (which can be measured after a short exposure period) or individual effects (e.g. reproductive output) and higher organisational-level adverse outcomes. This makes possible to establish a potential ecological impact scale. Second, we determined threshold values of elemental concentrations or of toxic responses in caged *G. fossarum* above which the individual abundances in free-ranging macroinvertebrate families are significantly lowered.

As active biomonitoring might be used as a first tier tool for chemical status assessment of some priority substances in the context of the Water Framework Directive, it seems also important to clearly understand the underlying assumptions as well as limitations. We will especially examine temporal shifts in C/N isotopic ratios in two caged organisms (*Chironomus riparius* and *G. fossarum*) and compare concentrations in caged organisms to homologous taxa in the field. These observations are likely related to caged organisms exposure routes. Subsequent implications for monitoring will be introduced.