PARAWARM

From communities to individuals: development of an early warning system to assess the relationship between climate warming and pollution in European freshwater ecosystems

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The aim of the Marie Curie Action-PARAWARM was to address the interaction between parasitism and pollution in the context of climate change using parasites in freshwater fish as a model early warning system for altered environmental conditions. The main objectives were (i) precise identification and quantification of all metazoan parasites in order to elucidate the compositional patterns of local parasite communities in the model freshwater fish species; (ii) comparative evaluation of the effect of small-scale temperature differences using 'matched pairs' control-impact design on parasite richness and abundance and parasite community composition and structure in model fish species in order to identify possible indicators based on abundance and structure patterns in parasite species; (iii) comparative assessment of the spatio-temporal patterns in parasite and macrozoobenthos community structure in relation to different ambient temperatures; (iv) evaluation of the variations of accumulation rates of heavy metals in tissues of selected parasites at different water temperatures and statistical assessment of the relationship to variations in ambient (water and sediments) and host tissue metal concentration levels.
Identification of temporal and spatial patterns of abundance and community structure at different thermal regimes is the key to forecast the impacts of climate change on parasite communities in fish in European freshwater ecosystems. Further, linking ecological data to pollutant metabolism is expected to provide novel insights into the response of parasite communities to environmental change which may help predict possible outcomes of host-parasite interaction and forecast minimum index values to detect pollution in the context of the effect of global warming.

The main milestones envisaged for the first year of the project have been achieved. Sampling of fish, macrozoobenthos, water and sediments was performed in the eight selected impact and reference sites (four at River Lenne, two at River Ruhr and two at River Lippe). Standardized sampling protocol for freshwater parasites was established. The parasite fauna of the model fish species, *Salmo trutta fario* and *Perca fluviatilis* has been delineated and a pilot analysis of the data on the composition of parasite and macrozoobenthic communities in the localities under study has been carried out. Moreover, some preliminary analyses planned for the second year of the project were performed namely, a comparative assessment of the spatio-temporal patterns in parasite and macrozoobenthic community structure in relation to different ambient temperatures; a preliminary evaluation of the variations of accumulation rates of heavy metals in trout tissue and the acanthocephalan parasite *Echinorhynchus truttae* at different water temperatures.

Macrozoobenthic invertebrate communities showed variable patterns of general degradation depending on the river sampled. However, no drastic changes were detected in relation to different water temperature regimes and multivariate community analyses did not indicate a clear separation between macrozoobenthic communities sampled at

impact and reference sites. In contrast, parasite infracommunity composition and structure exhibited significant differentiation between impact cold and reference cold sampling sites at both Ruhr and Lenne rivers. This suggests that parasite communities in *S. trutta fario* may have reflected an effect of the cold water input on communities of free living animals acting as intermediate hosts for parasites at these two rivers. This could be related to differential occurrence and abundance of the intermediate hosts of a few species which we identified as key discriminating species. Thus, parasite communities revealed patterns that are not detectable at the community level of the macroinvertebrate system.

Sediment samples analyzed from the three rivers indicate that a generally high background pollution (considerable contamination to high contamination) occurred in Ruhr and Lenne rivers compared to a lower degree of pollution in sediment of Lippe River. This indicates that sampling sites at the former two rivers represent good model locations to study the combined effects of pollution and temperature. Preliminary analyses carried out on metal accumulation by the acanthocephalan *E. truttae* and in its fish host, *S. trutta fario*, indicate that this parasite is as good or even better indicator of aquatic metal pollution than its host.

Considerable efforts were made to disseminate the results of PARWARM to the appropriate scientific communities during the 10 month period covered by this report. Identification and examination of the samples collected during the execution of the project are in an advanced stage and analyses will be finalized and the results published in 2011.

The wealth of data that has been gathered at different hierarchical community levels within the framework of the temporal scaling in combination with determination of metal accumulation rates, holds promise for generalisations of heuristic value towards how on-going and future climate change may alter risks from chemical pollution in the freshwater environment. The quantification of the response to increased ambient temperature of the targeted model organism groups relates not solely to issues fundamental to assessment of climate-mediated community level alterations and host-parasite interactions but to wider conceptual and applied domains such as synergism and/or antagonism among multiple stressors and metal pollution risk analysis using model indicator systems, respectively.

The EU especially raised awareness of the global warming (http://ec.europa.eu/environment/ climat /home_en.htm) it is said: '*Climate change is already happening and represents one of the greatest environmental, social and economic threats facing the planet. The European Union is committed to working constructively for a global agreement to control climate change, and is leading the way by taking ambitious action of its own*'. PARAWARM project has been and will be beneficial to the EU by contributing to the enhancement of European research on forecasting the effect of climate change in the freshwater ecosystems. Furthermore, this project leads to advancement of both research and monitoring tools in European freshwater ecosystems.