FACULTY OF SCIENCES

DEPARTEMENT OF BIOLOGY

Research Unit in Environmental and Evolutionary Biology

Thesis defence by Adrien Latli

PLANCTONIC RESOURCES DECREASE, AND HABITAT ALTERATIONS, WHICH CONSEQUENCES FOR THE FUNCTIONING OF COMMUNITIES?

An overview through the ecological niches of macroinvertebrates and fish communities of the Belgian and French River Meuse

Mussels invading the river Meuse

Friday, 21st of September 2018
14:00-16:00 – Amphithéâtre L12, Rue Grafé, 5000 Namur

Many large European rivers have undergone multiple pressures that have strongly impaired ecosystem functioning at different spatial and temporal scales. Global warming and human activities have favoured the invasion of exotic species, deeply modifying the structure of aquatic communities in large rivers. In many rivers, exogenous species alter trophic interactions within assemblages by increasing the predation risk for potential prey species and limiting the dynamics of others via the limitation of resource availabilities. Effects of these alterations according to the degree of river channelization have been poorly investigated so far. Rivers laid out for navigation could be more sensitive to trophic perturbations due to a lower diversity of available resources and a stronger trophic redundancy within communities.

The main objective of this thesis was to evaluate the influence of planktonic resource decrease on the functioning of macroinvertebrates and fish communities in relation to the degree of hydromorphological anthropization of the River Meuse.

In the first part, we studied long-term combined effects of global warming, trophic resource decrease, predation risk, and water quality variations on the trait-based structure of macroinvertebrate and fish assemblages over 26 years and 427 km stretch of the River Meuse. The study of temporal variations in biological, physiological, and ecological traits of macroinvertebrates and fish allowed identifying community trends and distinguishing impacts of environmental perturbations from those induced by biological alterations. We provide evidence, for this large European river, of an increase in water temperature (close to 1 ° C) and a decrease in phytoplankton biomass (-85%), as well as independent effects of these changes on both invertebrate and fish communities. The reduction of trophic resources in the water column by invasive molluscs has dramatically affected the density of omnivorous fish in favour of invertebrate feeders, while scrapers became the major feeding guild among invertebrates. Macroinvertebrate and fish communities have shifted from large-sized organisms with low fecundity to prolific, small-sized organisms, with early maturity, as a response to increased predation pressure.

Chub (*Squalius cephalus*)

In the second part, we investigated the trophic niches of macroinvertebrate and fish communities from two differentially regulated reaches of the River Meuse, both affected by reduced water column resources. We hypothesized that the impact of the planktonic decrease should have been lower in the less regulated reach, regarding community indices. Firstly, based on a trait-based approaches, we provide evidence that the potential trophic niches of the communities were affected at both sites by the phytoplankton decrease with a greater impact on the most altered site. In the less regulated reach, the functional equitability and the specialization increased in the trophic niches of the macroinvertebrate communities during the decrease of the planktonic resources while the indices stayed constant in the channelized reach. Secondly, based on stable isotope approaches, we highlighted that (i) the trophic niche was slightly smaller in the channelized sector, with a significant contribution of allochthonous detritus and bryophytes at both sites; and (ii) taxa in the most disturbed site had a lower trophic niche overlap between sympatric consumers.

In the third part, we quantified the trophic niches of three cyprinid species (common bleak *Alburnus alburnus*, chub *Squalius cephalus*, and roach *Rutilus rutilus*) and one percid species (European perch, *Perca fluviatilis*) at various stages of development, in order to compare intra- and interspecific competition between sites differing in their degree of channelization. Using stable isotope analysis in two reaches of the River Meuse differing by their degree of regulation, we hypothesized that habitat heterogeneity increased the

trophic specialization at different life stages by offering more alternative resources which reduce food competition, notably during the early period of life. We provided evidence that, in the context of low planktonic biomass, most young-of-the-year relied on benthic food sources. Furthermore, the River Meuse flow and depth regulation significantly impacted the abundance and species richness of young-of-the-year. In the heavily channelized reach, between-stages competition and low resource diversity increased the diet partition between cyprinid larvae and forced a part of individuals to consume non-optimal energetic food sources such as aquatic vegetation. On the other hand, in the less channelized reach, larvae displayed a generalist feeding habit focusing on energetic prey such as different taxa of macroinvertebrates, suggesting that the diversity of habitat reduces the food competition within and between stages and the predation risk.

This research took place within a multi-stressor context where it is complex and difficult to statistically explain the variation of a single dependent metric by a specific independent variable because of potential confounding effects. Nevertheless, the study highlighted (i) the importance of trophic relationships in community dynamics, (ii) the potential role of new exotic taxa in the trophic functioning of rivers, and (iii) the potential influence of channelization that can unbalance the trophic functioning, reducing the fish community diversity and magnifying trophic disturbances.

*Adrien will present the results of his PhD thesis he conducted in the **Research Unit of Environmental and Evolutionary Biology** (URBE) under the supervision of **Patrick Kestemont** and **Jean-Pierre Descy** (Co-promotor). (The presentation will be in French)*