PhD Project

Valve behaviour in *Dreissena polymorpha*: a useful tool for assessing the quality of aquatic environments.

Keywords : valvometry, proteomics, immunity, biosensor, biomonitoring

Aquatic environments represent a final outlet for many contaminants resulting from human activity. These environments are generally contaminated by numerous families of chemicals (trace metals, pesticides, polycyclic aromatic hydrocarbons, etc.), as well as microorganisms that may or may not be pathogenic to humans (*Escherichia coli*, *Cryptosporidium* spp, Adenovirus, etc.).

In this context, the UMR-I 02 SEBIO laboratory has been developing research work for over 15 years into the use of a freshwater bivalve mollusc, *Dreissena polymorpha*, as a biological probe for assessing and monitoring environmental quality. This work has enabled not only to define the conditions for a genuine *in situ* bioassay based on an active approach involving the transplantation of organisms that are as standardized as possible, but also to highlight the added value of this approach with regard to chemical contamination (Hani et al., 2021), microbiological contamination (Capizzi-Banas et al., 2021) and the assessment of toxicity (i.e. immunotoxicity, genotoxicity, energy metabolism, Catteau et al., 2022) in water bodies. This set of responses (bioaccumulation, biomarkers) already provides an interesting assessment of the quality of water bodies. However, considering the biology of our model organism, a behaviour of closing the valves of individuals in response to the quality of the environment (chemical, microbiological, physical) cannot be excluded during the exposure by caging. This could i) represent a factor affecting the exposure of individuals and, consequently, the biological responses measured as biomarkers, but also ii) represent a marker of toxicity if a relationship between the modulation of this behaviour and markers of early effects (i.e. at the molecular level) can be established. Valve-closing behaviour isolates the soft body of bivalves, protecting them from any external threats, and can be modulated by a number of parameters (toxic algae, nocturnal lighting, circadian rhythm, etc.; Tran et al., 2020; Durier et al., 2022; Botté et al., 2023). More specifically, various studies have highlighted changes in valve behaviour in different species of bivalves in response to the presence of parasites (Chambon et al 2007; Basti et al 2009), or chemical contaminants (Chen et al., 2012; Shen and Nugegoda., 2022). In laboratory conditions, changes in behaviour have been observed as a function of the dose (Liu et al., 2016) or time of exposure (Tran et al., 2003) to the contaminant. Behaviour monitoring the of bivalve molluscs (Andrade et al 2016; Vereycken and Aldridge 2023) to detect environmental changes, particularly in mussels, are now being proposed as Biological Early Warning Systems (BEWS) using the Musselmonitor as an example.

The aim of the doctoral project is to study the relationships between responses measured at the individual level (valve behaviour) and molecular markers of disturbances to different physiological functions. To this end, the project will simultaneously study responses at the molecular and individual levels (accumulation, behaviour) in mussels exposed under controlled laboratory conditions to a concentration gradient of different stresses (chemical/biological). The original data thus obtained will improve our knowledge of the behaviour of our biological model and establish relationships between molecular and behavioural responses. Ultimately, this knowledge will make it possible to define whether behavioural metrics can be considered as markers of toxicity (and not just of a change in the quality of the environment) and/or should be taken into account when interpreting biological measurements (accumulation, molecular markers).

For this project, the PhD student will rely on the system set up within the SEBIO laboratory in Reims to monitor the valve behaviour of the mussels (video and image processing approach) and on the expertise of the INRAE in Lyon for the application of a targeted proteomics approach in the mussels for proteins measured in different organs that are a priori involved in carrying out different functions (osmoregulation, immunity and detoxification).

Host laboratory and collaboration :

UMR-I 02 SEBIO, Stress Environnementaux et Biosurveillance des milieux aquatiques, Université de Reims

INRAE, Unité de recherches RiverLy, Ecotox team Centre de Lyon-Grenoble Auvergne-Rhône-Alpes

Doctoral School: Agriculture, Alimentation, Biologie, Environnement, Santé (ABIES –Reims)

Thesis supervisors: Dr Melissa Palos Ladeiro (Université Reims Champagne Ardenne, UMR-I 02 SEBIO) and Dr Davide Degli Esposti (INRAE, Unité de recherches RiverLy, Ecotox team Centre de Lyon-Grenoble Auvergne-Rhône-Alpes)

Scientific supervision: Supervisors and Pr Alain Geffard (Université Reims Champagne Ardenne, UMR-I 02 SEBIO)

Desired profile - Candidates must have a master's degree in animal biology, (eco)toxicology or physiology/molecular biology. Desired skills (but not compulsory): Ecology of organisms - Experiments with model organisms in the laboratory or in the field, study of stress responses. - Good level of statistics, notions of bioinformatics.

- Good level of English - Ability to communicate and work in a team - Willingness to disseminate science at specialist events (conferences) and to the general public.

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i) motivation letter, ii) a document of no more than 4 pages on how you intend to develop the subject, iii) letters of recommendation (with contact details of referees), iv) transcript of Master's grades.

Références :

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