PhD position / Sujet de thèse

Assessing the combined effects of multiple stressors (agricultural run-off and climate change) on aquatic communities

Évaluer les effets combinés de multiples facteurs de stress (ruissellement agricole et changement climatique) sur les communautés aquatiques

Specialty: Ecotoxicology, Biodiversity, Ecosystems

Graduate school: RP2E (Ressources Procédés Produits Environnement; → "SIReNa" 9/2018)

Disciplines: Aquatic ecology; ecotoxicology; ecophysiology; environmental sciences

Background: Shallow freshwater habitats provide vital ecosystem functions but are threatened by multiple stressors acting at different spatial and temporal scales. While a response to global climate change might be gradual, abrupt changes are possible when critical thresholds by additional effects of local stressors are exceeded. The difficulty in analysing effects of multiple stressors is to account for complexity, as stressors may act additive, synergistic or antagonistic. The project CLIMSHIFT aims for a mechanistic understanding of stressor interactions acting on shallow aquatic systems, which are especially vulnerable to climate warming and agricultural run-off due to their high surface to water ratios, large riparian interface and groundwater connectivity. Complex interactions between different functional groups of benthic and pelagic primary producers and associated consumers result in alternative stable regimes. Multiple stressors may trigger non-linear shifts between those regimes, with far-reaching effects on crucial ecosystem processes and functions. Our main hypothesis is that increased temperature will enhance negative effects of agricultural run-off, containing nitrates, pesticides and copper. Submerged plants, periphyton and phytoplankton as primary producers will be combined with the second trophic level, consumers, composed of the snail *Lymnaea*, consuming periphyton and plants, and benthic and pelagic phytoplankton filter-feeders, *Dreissena and Daphnia*. We will apply exposure scenarios at two different spatial scales to understand effects at the individual, community and ecosystem level. Investigations in microcosms at laboratory scale will be upscaled to larger, outdoor mesocosms. We will use an integrative dynamical model approach to simulate potential outcomes and critical thresholds, and predict stressor interactions. Model development will be conducted in close collaboration with all work packages to identify the most appropriate modelling approach, integrate empirical results, link different spatial and temporal scales, generalize and extrapolate results, and develop and test hypotheses. We expect that combined stressors will lead to sudden shifts in community structure in highly coupled systems. Macrophytes are expected to be replaced by phytoplankton or benthic algae, with major consequences for important ecosystem functions. The strength of our proposal is that common ecotoxicological stress indicators such as growth and biomarkers of the different organisms will be combined with functional community/ecosystem approaches looking at ecosystem metabolism and dynamics. 5 laboratories with complementary expertise and all necessary facilities will ensure the project

feasibility. The outcome of our project will support de definition of “safe operating spaces” for a sustainable agriculture and management of shallow aquatic systems in a changing world.

Position: A 3 year doctoral position will be available starting from October (September) 2018. The PhD student will be responsible for setting up and running the microcosm experiments at LIEC and participating in the mesocosms experiments scheduled at the LMU Munich and LIEC. You will take over partial responsibility for the analyses taken during and at the end of the experiments, such as growth performance and defined biomarkers for the different organism groups. Refinement and development of certain methods might be required. Assistance will be provided by master students, a post doc and other persons involved in the project. We look for candidates expressing scientific curiosity, professional conscience, ability for team work and high motivation to work on a complex, concurrent topic within an international team.

Your ideal profile would be:

- Master’s degree in hydrobiology, ecotoxicology, environmental science or related subjects
- Strong interest in aquatic ecology and the impact of multiple stressors including chemicals, nutrients and climate change
- Experience in handling aquatic organisms (primary producers, invertebrates)
- Knowledge in running micro/mesocosm experiments under chemical stress
- Good communication skills within the local and wider research team
- Experience in data handling and multivariate statistics
- Proficiency in English (B2 level)

The PhD-project is embedded in the joint French-German ANR-DFG project ‘CLIMSHIFT’: Regime shifts in freshwater ecosystems exposed to multiple stressors by increasing temperature, fertilizers and pesticides (Funding 2018-2021).

Laboratory: LIEC (Laboratoire Interdisciplinaire des Environnements Continentaux) UMR 7360 CNRS - Université de Lorraine. Extended research stays at one or several of the following partner institutions (ECOLAB Toulouse; LMU Munich; IGB Berlin; UFZ Leipzig) scheduled.

Supervisors: Elisabeth M. Gross, PRU; gross5@univ-lorraine.fr
Martin Laviale, MCU; martin.laviale@univ-lorraine.fr

Please send your CV + letter of motivation to both supervisors until May 9, 2018. Later applications will be considered if position has not been filled.