PhD position

Multitaxonomic functional diversity and interaction network in French lakes

A 3-year PhD position is available at the ECOVEA team (EABX lab) in the National Research Institute of Science and Technology for Environment and Agriculture (Irstea) in Bordeaux, France. We are seeking a highly motivated PhD student to tackle questions related to lacustrine communities and assembly rules.

Context and objectives

Aquatic ecosystems support a high diversity of plants and animals. These ecosystems biodiversity and functioning are however largely impacted by human activities. In this context, the protection and restauration of the functioning of aquatic ecosystems is a priority, as evidenced by numerous European environmental policies. To reach these objectives, it is crucial to have a good understanding of the ecosystems' functioning broadly recognize to be strongly related to biodiversity (Hooper et al. 2005; Reiss et al. 2009).

Biodiversity has long been apprehended on different taxonomic structures generally considered in independent analyses through the single environmental filter effect. Functional approaches allow to investigate new and/or complementary processes (Tilman et al. 1997), and move to new insights for the understanding of ecosystems functioning (Mouillot et al. 2013a; Abonyi et al. 2018). However, functional diversity is most of the time defined on a single type of organisms whereas the interest for a multidimensional approach of biodiversity was clearly demonstrated (Naeem et al, 2016).

On another hand, considering ecosystem functioning, the recent literature (Heino, 2013) highlights the need for integrating biotic relationships in the analysis of community structure, as they have long been recognized to pattern local species assemblages (Paine 1966; Tilman 1994; Michalet et al. 2006). Nevertheless, the weight to be attributed to these interaction processes in the determinism and evolution of local communities in different bio-geographical environments is still an open question that will be addressed by the project.

The functional and biotic interactions approaches are intrinsically linked, as more rich functional communities are expected to exhibit higher interactions in the network. Consequently, major current challenges of international research in community ecology are to investigate simultaneously distinct taxonomic and functional groups and to integrate biotic relationships in the initial biodiversity/abiotic environment model. Lakes ecosystems represent ideal ecosystems for studying these scientific questions as they represent discrete units in the landscape and gathered all the impacts of human activities of the watershed.

In addition, in France, lots of biotic indicators have been developed for aquatic ecosystems during the last decades, encompassing various type of organisms (Haury et al. 2006; Laplace-Treyture and Feret, 2016; Mondy et al. 2012; Argillier et al. 2013). However, even if some of these indicators include functional metrics, they only offer a restricted overview of the ecosystem functioning; each biotic group respond to different environmental factors and a global approach of the whole biodiversity response to anthropogenic disturbance is still missing.

The project aims to improve our understanding of lake ecosystems functioning by:
- Studying, at the national scale, the response of multitaxonomic (i.e. phytoplancton, macrophytes, macroinvertebrates and fish) functional diversity to environmental factors,
- Integrating biotic interactions in the study of multitaxonomic species assemblages and testing the relative importance of these interactions face to environmental drivers,
- Based on these results, the development of new ecosystem vulnerability tools based on multitaxonomic functional diversity and interaction networks properties will be explored.

Requirements
- A MSc or equivalent in biology, ecology or bioinformatics
- Strong skills in quantitative methods and ecological modelling, or motivation to acquire them rapidly
- Good writing skills (English); Written and spoken French are an asset
- Rigor in scientific reasoning
- Solid background in ecological theory
- Experience in R or other common programming languages (Python, Matlab, C++)
- Previous experience in fish community ecology is an asset
- Experience with large-datasets (SQL) is an asset
- The candidate is expected to publish his/her results in peer-reviewed journals

Additional Information
Starting date: September 2019 - Duration: 3 years
Location: Irstea Bordeaux (http://www.irstea.fr/en/institute/centers/bordeaux)
Salary: ~1500 € net per month

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References

Abonyi, A., Horváth, Z., & Ptacnik, R. (2018). Functional richness outperforms taxonomic richness in predicting ecosystem functioning in natural phytoplankton communities. Freshwater Biology, 63(2), 178-186. **Argillier**, C., Caussé, S., Gevrey, M., Pédron, S., Bortoli, J. D., Brucet, S., … Holmgren, K. (2013). Development of a fish-based index to assess the eutrophication status of European lakes. Hydrobiologia, 704(1), 193-211. **Haury**, J., Peltre, M.-C., Trémolières, M., Barbe, J., Thiébaut, G., Bernez, I., … Lambert-Servien, E. (2006). A new method to assess water trophy and organic pollution — the Macrophyte Biological Index for Rivers (IBMR): its application to different types of river and pollution. In J. M. Caffrey, A. *Dutartre, J. Haury, K. J. Murphy, & P. M. Wade (Eds.), Macrophytes in Aquatic Ecosystems: From Biology to Management (pp. 153-158). Springer Netherlands. **Heino**, J. (2013). The importance of metacommunity ecology for environmental assessment research in the freshwater realm. Biological Reviews, 88(1), 166-178. **Hooper**, D. U., Chapin, F. S., Ewel, J. J., Hector, A., Inchausti, P., Lavorel, S., … Wardle, D. A. (2005). Effects of Biodiversity on Ecosystem Functioning: A Consensus of Current Knowledge. Ecological Monographs, 75(1), 3-35. **Laplace-Treyture**, C., & Feret, T. (2016). Performance of the Phytoplankton Index for Lakes (IPLAC): A multimetric phytoplankton index to assess the ecological status of water bodies in France. Ecological Indicators, 69, 686-698. **Michalet**, R., Brooker, R. W., Cavieres, L. A., Kikvidze, Z., Lortie, C. J., Pugnaire, F. I., … Callaway, R. M. (2006). Do biotic interactions shape both sides of the humped-back model of species richness in plant communities? Ecology Letters, 9(7), 767-773. **Mondy**, C. P., Villeneuve, B., Archaimbault, V., & Usseglio-Polatera, P. (2012). A new macroinvertebrate-based multimetric index (I2M2) to evaluate ecological quality of French wadeable streams fulfilling the WFD demands: A taxonomical and trait approach. Ecological Indicators, 18, 452-467. **Mouillot**, D., Graham, N. A. J., Villéger, S., Mason, N. W. H., & Bellwood, D. R. (2013a). A functional approach reveals community responses to disturbances. Trends in Ecology & Evolution, 28(3), 167-177. **Naeem**, S., Prager, C., Weeks, B., Varga, A., Flynn, D. F. B., Griffin, K., … Schuster, W. (2016). Biodiversity as a multidimensional construct: a review, framework and case study of herbivory's impact on plant biodiversity. Proc. R. Soc. B, 283(1844), 20153005. **Paine**, R. T. (1966). Food Web Complexity and Species Diversity. The American Naturalist, 100(910), 65-75. **Reiss**, J., Bridle, J. R., Montoya, J. M., & Woodward, G. (2009). Emerging horizons in biodiversity and ecosystem functioning research. Trends in Ecology and Evolution, 24(9), 505-514. **Tilman**, D. (1994). Competition and biodiversity in spatially structured habitats. Ecology, 75(1), 2-16. **Tilman**, D., Knops, J., Wedin, D., Reich, P., Ritchie, M., & Siemann, E. (1997). The Influence of Functional Diversity and Composition on Ecosystem Processes. Science, 277(5330), 1300-1302.