

## PhD project - Unité Evo-Eco-Paléo –starting date October 2019

**University:** University of Lille

**Doctoral school:** ED104 Sciences de la matière, du rayonnement et de l'environnement (SMRE)

**Doctoral program:** Géosciences Ecologie Paléontologie Océanographie

**Thesis title:**

**Assessment of plant-pollinator networks via metabarcoding approaches: evaluation, comparison with classic approaches and optimization to propose a next-generation biomonitoring protocol**

**Advisors:** François MASSOL (advisor),  
Nina HAUTEKEETE (co-advisor)  
and Céline POUX (co-advisor)

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**Lab:** Unité Evolution, Ecologie et Paléontologie, UMR CNRS 8198

**Scientific program:** ANR NGB

**Funding:** 50% ANR NGB (acquired) + 50% Univ Lille (requested)

### PHD PROJECT

In a recently published opinion (Bohan *et al.*, 2017, *Trends in Ecology & Evolution*, 32, 477-487), the implementation of next-generation biological monitoring approaches has been proposed as a cost-effective tool to detect ecosystem changes accurately and generically at a global scale in the next decade. With such an approach, Next-Generation Sequencing (NGS) of DNA would provide the relative abundances of operational taxonomic units or ecological functions in the various environments of the planet Earth. Machine-learning methods would then be used to reconstruct ecological networks of interactions from these raw data from NGSs and relate them to different environmental parameters in order to detect and predict changes in ecosystems. As part of the ANR project "Next Generation Biomonitoring of change in ecosystems structure and function" (ANR NGB, principal investigator: David Bohan, INRA Dijon; coordinator for the University of Lille: François Massol), we seek to develop and test protocols based on NGS approaches to predict the structure of ecological interaction networks and hence the quality of the functioning of ecosystems and the services that depend on them.

The thesis proposed aims more particularly at developing inferential approaches on plant-pollinator networks, in continuation of studies conducted at the Evo-Eco-Paléo laboratory (ANR ARSENIC 2014-2018 and Climibio project on plant-pollinator networks in the Lille metropolis). The student's work will consist in

- (i) analyzing metabarcoding data obtained on pollen carried by previously captured insects (two capture methods were used: active capture using insect nets and passive capture using attractive pan traps),
- (ii) developing learning methods for reconstructing interaction networks using machine learning from molecular data,
- (iii) evaluating their efficiency compared to conventional methods, by comparing the networks obtained using conventional vs. NGS approaches,
- (iv) using the data thus obtained to assess structural differences between urban and semi-rural plant-pollinator networks, as well as the exploitation of native and non-native floral resources by pollinators in urban areas,
- (v) issuing recommendations for management and monitoring structures of natural

areas concerning the use of such protocols to qualify the proper functioning of terrestrial ecosystems.

The traditional capture data (hand nets and pan traps) have already been collected, and the NGS data on the sites of the Lille metropolitan area will be obtained in 2019, around the beginning of the thesis.

The work of the PhD student will be fully integrated into the dynamics of the NGB project, which will naturally lead him to collaborate with the different partners of the project, both for the development of methodological and statistical aspects (UMR MIA, AgroParisTech-INRA Paris and Imperial College, London) or the reflection on molecular techniques and bioinformatics (UMR BioGeCo, INRA Bordeaux), but also in the framework of regular meetings allowing the other three PhD students of the project (Dijon, Paris, Rennes) to discuss their respective topics and share their experience learning molecular data networks.

**Key words:** bioinformatics; machine learning; network reconstruction and analysis; next-generation sequencing

**Other local collaborators:**

Anne Duputié, MCF University of Lille, UMR8198 EEP, Lille

Yves Piquot, MCF University of Lille, UMR8198 EEP, Lille

Anne-Catherine Holl, Technician University of Lille, UMR8198 EEP, Lille

Cécile Godé, Assistant engineer CNRS, UMR8198 EEP, Lille

Sophie Gallina, Research engineer CNRS, UMR8198 EEP, Lille

**Profile:** We are looking for a highly motivated candidate having a primary interest in applied statistics and ecology. The ideal candidate will also have good capacities for bioinformatics and/or experience in ecological/evolutionary data analyses, especially dealing ecological networks. Prior experience with molecular ecology techniques (metabarcoding in particular) will be appreciated. Finally, the candidate should have obtained good marks and ranking at the master's degree.

Because of the project's interdisciplinary nature, we are open to applicants from ecology/evolution, statistics, computer science and related areas.

Interested applicants should have a look at <http://next-genbiomonitoring.org/> and <http://eep.univ-lille.fr/> for information about the project and the laboratory.

**Contact:** Please send your application to François Massol ([francois.massol@univ-lille.fr](mailto:francois.massol@univ-lille.fr)) and Céline Poux ([celine.poux@univ-lille.fr](mailto:celine.poux@univ-lille.fr)). This should include (1) a detailed CV, (2) a cover letter putting forward relevant training, (3) a copy of grades and rank for both the master degree (first and second-year marks), (4) name and contact information of two reference persons. We recommend that you send your application as soon as possible and by **no later than May 1st 2019**. Review of applications will begin immediately and continue until the position has been filled.

**Starting date:** October 2019 (36 months)