



PhD proposal (2017-2020) : Microbial Interactions in the Oceans: Integrating metabolomics and transcriptomics to explore associations between *Emiliana huxleyi* and bacteria (INTIMIO)

Host laboratory : Adaptation et Diversité en Milieu Marin, UMR7144, CNRS-UPMC, Station Biologique de Roscoff (www.sb-roscoff.fr)

Scientific context:

Marine bacteria and microalgae are key players in the functioning of ocean ecosystems and their contribution to major biogeochemical cycles is widely recognized. The association of phytoplankton with bacteria is ubiquitous in the oceans. The immediate environment of phytoplankton cells (or phycosphere = surface of the algae and its immediate environment) is considered physically and chemically distinct from the surrounding water promoting specific associations. These relationships could thus create dynamics of interactions whose functioning could explain the complexity of marine food webs. In this context, the study of the role of the interactions between bacteria and microalgae which form the basis of these networks is therefore critical.

Main representative of the class of coccolithophores, the unicellular alga *Emiliana huxleyi* colonized most of the world's oceans. This model has been selected because these algae are ubiquitous in the marine environment and easily cultivated making them available in culture collections.

The general objective of the thesis will be to determine the different types of interactions exerted by bacterial taxa associated with *E. huxleyi* and to identify the physiological bases that explain their robustness and stability.

A first objective of this PhD will therefore be to study the degree of specificity and nature of the interactions between *E. huxleyi* and its associated bacteria. This work will be carried out using two complementary approaches. The first approach will investigate the molecular diversity of bacteria associated with a representative number of *E. huxleyi* cultures obtained from a variety of marine environments. We will have access to these cultures via the Roscoff Culture Collection (RCC) which maintains more than 1000 *E. huxleyi* strains. Bacterial diversity will be analyzed by high-throughput sequencing of 16S rRNAs. In addition, we will detect in the marine environment the interactions between *E. huxleyi* and bacteria by investigating co-occurrence patterns using the metabarcoding data obtained during the Tara Oceans expedition. These data, obtained from the exploration of the surface of the world ocean (154 stations along a 150,000 km cruise), will enable us to determine the importance of these associations in the different ocean regions.

The second objective of the PhD will be to understand the nature of these associations and the capacity of partners to interact (and thus co-evolve) in the oceans. We will therefore look at strong metabolic changes related to the interactions existing between two partners. This axis will be based on the study of co-cultures of axenic *E. huxleyi* strains (free of their associated microflora) with some of their associated bacteria. The transcriptomes and metabolomes of algal strains cultured with their

bacteria will be analyzed and compared with those of algal cultures and individual bacteria in order to demonstrate respectively the differential expression of genes and the exchange of molecules / signals mediated by Interactions between partners.

The complementarity of approaches combining microbial ecology, bioinformatics and chemistry promises a significant advance in the understanding of the structure, dynamics and evolution of planktonic microbial interactions.

Skills :

- Master's degree in microbiology, molecular microbial ecology
- Experience in basic molecular biology methods (DNA/RNA extraction-purification, PCR, qPCR, sequencing).
- A background in bioinformatics and biostatistics. Knowledge on NGS data analysis and on microbial ecology.
- Excellent interpersonal skills to work effectively and closely with team members and different partners.
- A good knowledge of spoken and written English is required.

PhD funding:

Half of the PhD grant already obtained from the Région Bretagne. The second half to be obtained by the selected candidate through the ED227 Call (Ecole Doctorale 227 UPMC-MNHN – « Sciences de la nature et de l'homme : évolution et écologie »).

More information on the project:

<https://apps.mnhn.fr/DepotSujetThese/sujetcandidature.xhtml?tk=19>

Online application until May 21st, 2017:

<http://enseignementsuperieur.mnhn.fr/fr/enseignement-superieur/doctorat/concours-ed227>

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