Universitat Pompeu Fabra Barcelona

Master in Bioinformatics for Health Sciences

Master project 2024-2025

Personal Information

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Project

Computational genomics

Project Title:

Defining the ecological niches of the “most wanted” marine protists

Keywords:

protists, microbiome, niche space, marine environment, reactive websites

Summary:

Protists – single-celled microeukaryotes – are one of the most abundant groups of organisms in the ocean, competing even with animals. These microorganisms sustain the marine trophic web through photosynthetic growth (phytoplankton) or through bacterial predation (heterotrophic flagellates). Despite their key importance, their microscopic scale coupled with the huge diversity of protist species has impeded their study enormously. In our group, the Biology and Ecology of Abundant Protists lab, we couple high-throughput sequencing and classical culture approaches to understand protist ecology. Our main focus are the most abundant protists across the global oceans, given that a majority of them remain uncultured and therefore uncharacterized. To be able to culture a microorganism, it is necessary to mimic its niche conditions. The niche of a species is the set of capabilities that enables its persistence in the ecosystem and that defines its impact and relationship with it. An intuitive definition, described by Hutchinson, is an ‘n-dimensional hypervolume’, where the dimensions are the set of abiotic conditions defining the requirements of the species to persist, modulated by the biotic factors (the relationships with other species). For species recently discovered through high-throughput sequencing, not much is known, and the information out there is scattered and fragmented, complicating its use to ease the culturability of these organisms. The objective of this project will be to characterize the hypervolumes of the top 100 uncultured marine protist species. Through the EukBank database, we will collect information from hundreds of samples to characterize the ranges of environmental variation for each species, and finally obtain a representation of these hypervolumes in an interactive interface such as Shiny. The student will characterize its niche with novel multivariate techniques and it will create a virtual open resource for microbiologists to obtain information for these key species.

References:

Global biomass of the ocean: https://doi.org/10.1016/j.cell.2019.11.018 Microbial niche: https://doi.org/10.1016/j.tree.2023.04.015 Mapping niches for species: https://www.nature.com/articles/s41467-020-18695-z EukBank database: https://doi.org/10.5281/zenodo.7804945

Expected skills:

Linux command line, R or python, interest in multivariate statistics and Shiny

Possibility of funding:

No

Possible continuity with PhD:

No