Master research project : PHENOTYPIC DIVERSITY WITHIN CLONAL PHYTOPLANKTON CULTURES USING SINGLE CELL APPROACH.

1. Host Lab :

This project will be performed on two sites, one in France (Sorbonne Université), one in the UK (Exeter university).

Host Lab 1 (project part 1) GENOPHY Lab, Banyuls sur mer, France
http://biom.obs-banyuls.fr/fr/equipe-genophy.html -Contact : gwenael.piganeau@obs-banyuls.fr
Host Lab 2 (project part 2) : PAGLIARA Lab, Living Systems Institute, University of Exeter, UK-Contact : s.pagliara@exeter.ac.uk

2. Research Project :

Picophytoplankton include the smallest photosynthetic eukaryotes that sustain the marine ecosystems worldwide. With cell diameters smaller than 2 µm, a simple cellular organisation and compact haploid genomes, picoalgae from the *Ostreococcus* genus are ideal model organisms to study evolution and adaptation in phytoplankton [1] [2]. In these picoalgae, phenotypic traits like division rate, fluorescence, viral resistance or susceptibility over cultures, have yet been estimated from whole cultures, which typically contain millions of individual cells [3][4]. Recent results suggest a high level of phenotypic plasticity within microorganisms [5] and the main objective of this project is to provide the first evidence and estimations of phenotypic plasticity within clonal cultures:

1. Is there variation in division rate between individual cells in a clonal culture ?
2. Can we detect phenotypic plasticity to virus resistance in a clonal culture ?
3. Is the microalgal division rate affected by the presence/absence of the bacterial partner ?

Implementation:

Ostreococcus cultures will be monitored at Host 1 in the first part of the project to estimate division rate and resistance to viruses at the culture level.
After this preliminary stage, the cultures would be analyzed in host lab 2 in microfluidic devices that will allow studying phenotypic diversity. Host Lab 2 has developed a microfluidics-microscopy approach that allows investigating single-cell responses to environmental changes over time [6]. By using this approach, individual microalgae will be confined in separate chambers of a microfluidic device and their division rate measured via time-lapse epifluorescence microscopy. In order to investigate phenotypic plasticity to virus resistance, *Ostreococcus* viruses will be introduced in this microfluidic device and individual microalgae lysis recorded. In order to determine whether the bacteria present in *Ostreococcus* cultures have a beneficial effect on microalgal growth, bacteria will be selectively added to only some chambers containing microalgae. Division rate will then be measured and compared between microalgae growing in presence or absence of bacteria.

References

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6. Bamford, R. , Smith, A. , Metz, J. , Glover, G. , Titball, R. W., Pagliara, S. (2017). Investigating the physiology of viable but non-culturable bacteria by microfluidics and time-lapse microscopy. BMC Biology *15*, *15*, 121.