

5UM25 – Marine MICROorganisms: MOLEcular approaches to their taxonomic and functional diversity (MICROMOL)

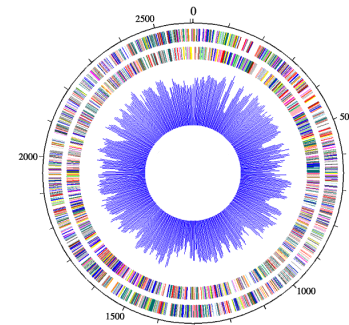
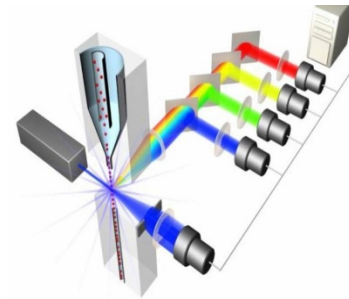
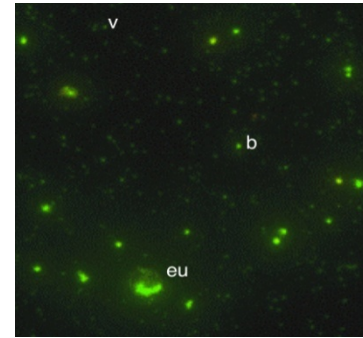
KEYWORDS : *Marine microorganisms*
Molecular tools
Phyto/bacterioplankton
Taxonomic diversity
Niche adaptation

Scientific context

The microorganisms inhabiting the oceans display a very large diversity that still remains poorly known. The eukaryotic organisms include a high number of groups of microalgae, fungi, ciliates and other heterotrophic organisms. The prokaryotes gather a variety of lineages of photosynthetic and (photo)heterotrophic bacteria as well as *Archaea*. At last, marine viruses, whose relevance has been pointed out only since the 90's, also constitute an extremely diversified biological compartment.

Most of the biological activity of the World Ocean originates in the microorganisms. Thus, to their taxonomic diversity is associated a remarkable functional diversity that has allowed them to colonize any marine ecological niche, and which gives them key-roles in most biogeochemical cycles of the Earth.

The study of microorganisms has been neglected for a long time, mostly because it was hindered by their microscopic size. However, the recent advances in molecular biology *sensu lato*, genomics and physiology have now placed the microorganism studies at the cutting-edge of the modern scientific research. These techniques have allowed opening the door to a still poorly known universe, unveiling a very rich taxonomic diversity, numerous types of interactions among organisms as well as amazing adaptation capacities that have been acquired during the evolution.



From top to bottom:

- Marine microorganisms visualised in epifluorescence (b : bacteria, eu : eukaryote, v : virus)
- Conceptual view of a flow cytometer
- Genome of the marine cyanobacterium *Synechococcus* sp. CC9311

Main topics

Diversity and interactions in the photosynthetic plankton

- Exploring phytoplankton diversity
- Which tools for which results : morphological & molecular diversities
- Symbiosis & parasitism in the oceans



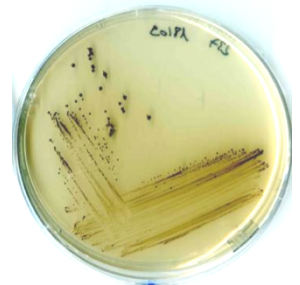
Niche adaptation in marine picocyanobacteria

- Evolution of photosynthesis in marine environments until nowadays
- Ecotypic differentiation: a key to adaptation
- Molecular and genomic adaptations



Dynamics and adaptation of heterotrophic prokaryotes

- Phylogenetic and functional diversities of bacteria and Archaea
- Niche adaptation: photoheterotrophy and *Quorum* sensing
- Dynamics and ecological relevance: role in the Earth biogeochemistry



Educational objective

- To understand how recent technologies allow unveiling the taxonomic diversity, interactions and niche adaptation processes in marine microorganisms.

From top to bottom:

- . The dinoflagellate *Ornithocercus quadratus* <http://planktonnet.awi.de/>
- . Cultures of marine picocyanobacteria in liquid medium
- . Culture de heterotrophic bacteria in solid medium

Skills & Knowledge

- **Concepts:** Microorganism biodiversity (eukaryotes, prokaryotes & viruses), Evolution & molecular adaptation, Interactions among microorganisms, Microbial loop, Biogeochemical cycles, *Quorum* sensing
- **Techniques:** Microorganism culture, Microscopy, Flow cytometry, Molecular tools, Phylogeny, Metagenomics, Comparative genomics, Photophysiology

References

- Falkowski P.G. et Knoll A.H. (2007). Evolution of primary producers in the sea. Elsevier Academic Press.
- Kirchman D.L. (2008) Microbial ecology of the oceans (2nd ed.) Ed. Wiley Liss, NY.
- Falkowski P.G. & Raven J. A. (2007). Aquatic Photosynthesis (Second Edition). Princeton University Press.



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