Title: **Impact of nutrients availability on resources allocation and photosynthesis of the dinoflagellate *Alexandrium minutum* in view of climate changes** (SSD BIO/01)

Research project:
Il seguente progetto è Finanziato dall'Unione Europea - NextGenerationEU a valere sul Piano Nazionale di Ripresa e Resilienza (PNRR) – Missione 4 Istruzione e ricerca – Componente 2 Dalla ricerca all'impresa - Investimento 1.1, Avviso Prin 2022 indetto con DD N. 104 del 2/2/2022, dal titolo "**Impact of nutrients availability on resources allocation and photosynthesis of marine microalgae in view of climate changes (INPHOMARE)"**, codice proposta 2022KT9X3S_002 - CUP J53D23006610001"

This specific project is primarily aimed at deciphering the molecular mechanisms that regulate nutrient assimilation, photosynthesis, and the adaptations that have occurred during the evolution of diverse groups of algae. In INPHOMARE, three research units from Università Politecnica delle Marche (UNIVPM), Università di Bologna (UNIBO), and Università di Padova (UNIPD) will cooperate to deepen our understanding of the physiological and molecular mechanisms of nutrient uptake, assimilation, and resource allocation in marine microalgae.

Activity plan:

The candidate will work within the Algal Biology research group (AlgoLab) of the Department of Biological, Geological and Environmental Sciences (BiGeA), in the Ravenna campus, under the supervision of Prof. Laura Pezzolesi.
The objective of this research grant is to contribute to the study of the dinoflagellate *Alexandrium minutum*, unraveling how species-specific adaptations in resource assimilation and allocation contribute to shaping dominant phytoplankton communities and the development of *A. minutum* blooms as a function of environmental variations.
Microalgae are responsible for approximately half of global carbon fixation and comprise an exceptionally diverse group of species, characterized by both phylogenetic and metabolic diversity, which is a valuable source of biodiversity for both ecophysiological studies and biotechnological applications.
Microalgae growth and productivity are continuously challenged by perturbations in the physicochemical parameters of their habitat, such as light intensity, nutrient chemical form and concentration, and temperature. Thus, changes in microalgae distribution and abundance have also been predicted due to climate change. Particularly in coastal ecosystems, a general increase in algal bloom frequency and intensity has been attributed to eutrophication, and further increases have been predicted due to climate change. Optimal growth conditions (i.e., temperature, salinity, light) may vary among bloom-forming algal species. Intensive blooms of nontoxic microalgae often result in bottom-water hypoxia, which can be potentially fatal to sessile macrofauna. Conversely, toxins produced by some harmful dinoflagellates may be detrimental to marine species, including fish, birds, marine mammals, and even humans.
As for nutrients, proteins are the major sink for cellular N and also harbor the S-containing aminoacids Cys and Met. Cell N content positively affects photosynthesis, which is partly related to N signalling and N partitioning in photosynthetic enzymes, pigment biosynthesis, and the size, number, and composition of photosynthetic membranes. Similarly, S plays multiple structural and functional roles

in the cell, including photosynthesis. S-containing metabolites in marine microalgal cells also include dimethylsulfoniopropionate (DMSP). DMSP contributes to about half of the natural flux of S into the atmosphere through its breakdown product dimethylsulfide (DMS). In the atmosphere, DMS oxidation creates aerosols acting as cloud condensation nuclei, which in turn increases sunlight reflection due to cloud albedo, decreasing temperature on Earth. Dinoflagellates are among the major DMSP producers in the oceans, with a concentration of up to 3.4M. Dissecting how environmental variations and occurring/forecasted climate changes affect microalgal DMSP production is of utmost relevance in the context of global warming. Further, DMSP could act as an osmolyte in algal cells, while DMS is an important infochemical involved in microbial predator–prey interactions either as an algal chemical defense or as an eat-me signal for grazers, raising questions regarding its role in trophic dynamics of dominant bloom-forming dinoflagellates.
The Candidate will focus on Nitrogen and Sulfur assimilation metabolism and on the characterization of photosynthesis, the primary energy source for photosynthetic cells, by challenging selected microalgae with nutrient limitation, and various light intensities and by mimicking temperature variations due to climate change.
The Candidate, in particular, will: i) evaluate how future global warming, together with nutrient availability, may affect the dinoflagellate bloom dynamic; ii) study the photosynthetic response; iii) investigate the effect on sulfur metabolism, considering the influence on DMS and DMSP production, which can act as cloud condensation nuclei, during algal growth; iv) highlight the implications of DMS/P production in sulfur cell metabolism.

The project will consist of:

- Cultivation of microalgal, in particular the bloom-forming dinoflagellate *A. minutum*, under different nutrient (i.e., N, S) and temperature conditions to understand how future global warming, together with nutrient availability, may affect dinoflagellate bloom dynamic
- Investigation of the effect of temperature increase on sulfur metabolism, highlighting the implications of DMS/P production in sulfur cell metabolism
- Activities of dissemination and communication related to the project
- Final report

Required Skills:

Applicants should:

- Proven experience in the field of microalgal and/or cyanobacterial cultivation
- Proven experience in microalgal or cyanobacterial strains' isolation, nutrient analysis, monoalgal culture preparation
- Proven experience in the extraction and characterization of algal biomass through spectrophotometric or chemical analyses (e.g. CHN, Ion Chromatography, GC/MS, LC/MS)
- Proven experience in DNA extraction and PCR analysis
- Proven experience in writing scientific reports or articles
- Good knowledge of spoken and written English