# MICROALGAE AND PLANKTON FOOD-WEBS: EFFECTS OF A CHANGING ENVIRONMENT AT THE MICROSCALE

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Planktonic microalgae, or phytoplankton, are at the basis of aquatic food webs and encompass a huge biological diversity, expressed in terms of individual dimensions, morphology, physiological as well as genetic features and trophic behaviour (photoautotrophic, mixotrophic, heterotrophic). A myriad of ecological niches can be occupied by planktonic microalgae whose abundance sweeps reciprocally across time and space scales, such sweeps are driven by both environmental factors, which modulate species metabolic and reproduction rates, and biological interactions, such as predator-prey relationships with their consumers.

As a consequence, planktonic microalgae are at the centre of complex ecological networks (i.e. networks of biological interactions) that include multifaceted pathways of matter circulation and allow an effective "cross-feeding" within the plankton community. These properties may be also at the basis of the apparent resilience of plankton to anthropogenic environmental changes that act at different time-scales, from the sudden transitions between eutrophic and oligotrophic conditions occurring in coastal zones and potentially related to heat waves, and the long-term and progressive warming of Ocean temperature. However, the level of robustness of the ecological networks sustained by the microalgae is still under debate: indeed, the complexity of these networks opens to the possibility that even the smallest perturbations at the lowest trophic level can propagate and magnify across the food web, with uncertain and potentially detrimental ecological implications, as environmental changes can exert both direct (e.g. modification of reproduction rates) and indirect effects (i.e. modification in the intensity of trophic links) at community level.

This PhD project aims at studying and describing the fine-scale structural modifications occurring in plankton communities under environmental changes. This aim will be pursued by building time-series of plankton networks based on conceptual and numerical models. These latter will employ an 'Ecopath' approach fed by: i) abundance and biomass data of plankton organisms, ii) metabarcoding data used to infer the relative abundances of photo-, mixotrophic, and heterotrophic plankton; iii) expert knowledge deriving from previous research, to define physiological properties and trophic links between plankton species. Data will be provided by the Long-Term Ecological Research programme MareChiara (environmental data, plankton biomass and abundance from 2000 and metabarcoding data from 2010) and BATS, the Bermuda Atlantic Time-series Study (environmental data, plankton biomass and and metabolic rates from 1995), thanks to collaborations with the Stazione Zoologica Anton Dohrn (Naples, Italy) and the Bigelow Laboratory of Ocean Sciences (USA).