FUNCTIONAL DIVERSITY OF PHYTOPLANKTON IN THE MEDITERRANEAN SEA: ENVIRONMENTAL FORCING ON CELL SIZE AND ECOPHYSIOLOGY

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Abstract
Size is a crucial biological trait that determines the metabolism and energy fluxes in cells through resources requirement and acquisition, as well as the "susceptibility" of cells to environmental changes. The aim of our contribution is to do a synthesis of the relations between size – pico *vs* nano+microphytoplankton – and environmental forcings that have been investigated in different trophic conditions of the Mediterranean sea as well as from laboratory experiments. Different time and space scales are analyzed, from the large basin scale to mixed layer or deep-chlorophyll maximum. A strong discrimination between picoplankton and the rest of the community is highlighted both at the level of the ecological pattern and on their ecophysiological behavior.
Keywords: Phytoplankton, Pigments, Physiology, Biodiversity, Primary Production

Phytoplankton size ranges between 0.3 and more than 100 µm, classified as picoplankton (<2-3µm), nanoplankton (3<20µm) and microplankton (>20µm). Body size is a key-parameter in community ecology and probably the most impacting functional trait for phytoplankton ecology. Both size and ecophysiological diversity could have their relevance in the paradox of plankton [1]. This adaptative character determines the efficiency of the algal community function - as photosynthesis [2] - and the food web structure. At a functional level, the broad range of sizes – resulting from adaptative evolution - determines a high diversity of behaviors and acclimative responses to environment forcing [3] and its variability over different scales. Tackling with the question of cell size community structure means to deal with the relation between ecosystem and cells at an energetic level [4]. The aim of our contribution is to investigate the relations between phytoplankton size community structure and environmental properties using a (photo-) physiological approach. The questions we address are: How does size affect the eco-photophysiological strategy developed by cells? and in which way does the size-related strategy fit with the environmental properties and variations? Data we are dealing with come from (i) experimental laboratory studies aiming to investigate the photoacclimation capacities relatively to light changes and the role of cell size on algal responses [3, 5] , and (ii) from the Mediterranean sea field. The data we are analyzing cover a broad range of trophic states and relevant scales for phytoplankton ecology, from the large basin scale to the vertical distribution over the water column with emphasis on mixed layer and deep-chlorophyll maximum. Data has been collected during a trans-Mediterranean cruise carried out in summer 2007, mesoscale studies performed in the NorthWestern Mediterranean sea (spring 2003), Northern Adriatic sea (June 2003) and Strait of Sicily (1996) as well as from a seasonally sampled fixed station in the South Tyrrhenian sea (2006-2009) and over a daily cycle sampling program. Analysis mainly regards size-fractionated pigments (pico *vs*. nano+microphytoplankton), primary productivity, hydrological and light environment and nutrient concentrations. Contribution of picoplankton varied along trophic gradients over all the investigated scales. Our results highlight significant differences of ecological behavior between the two algal size classes (pico and rest of the community). Picoplankton cells are no- or little limited by nutrient concentrations and these cells appear to be much more able to cope with infra-diel light variations than the greater cell size. That means that photosynthetic function is strongly related to light field in the picoplankton group relatively to the greater cell size. Ecological implications are that picoplankton distribution would be mainly influenced by light (quantity and variability) and that is able to occupy niches characterized by relatively high stressful conditions, in relation to strong adaptation to these niches.

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