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ORIGINAL ARTICLE

The green–blue swing: plasticity of plankton food-webs in response to coastal oceanographic dynamics

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Abstract

The internal organization of plankton communities plays a key role in biogeochemical cycles and in the functioning of aquatic ecosystems. In this study, the structure of a marine plankton community (including both unicellular and multicellular organisms) was inferred by applying an ecological network approach to species abundances observed weekly at the long-term ecological research station MareChiara (LTER-MC) in the Gulf of Naples (Tyrrhenian Sea, Mediterranean Sea) in the summers of 2002–2009. Two distinct conditions, characterized by different combination of salinity and chlorophyll values, alternated at the site: one influenced by coastal waters, herein named 'green', and the other reflecting more offshore conditions, named 'blue'. The green and blue 'phases' showed different keystone biological elements: namely, large diatoms and small-sized flagellates, respectively. Several correlations amongst species belonging to different trophic groups were found in both phases (connectance ~0.30). In the green phase, several links between phytoplankton and mesozooplankton and within the latter were detected, suggesting matter flow from microbes up to carnivorous zooplankton. A microbial-loop-like subweb, including mixo- and heterotrophic dinoflagellates and ciliates, was present in the green phase, but it was relatively more important in the blue phase. The latter observation suggests a more intense cycling of matter at the microbial trophic level in the blue phase. These results show that different modes of ecological organization can emerge from relatively small changes in the composition of aquatic communities coping with environmental variability. This highlights a significant plasticity in the internal structure of plankton webs, which should be taken into account in predictions of the potential effects of climatic oscillations on aquatic ecosystems and biogeochemical cycles therein.

Introduction

Understanding the structure and functioning of plankton communities is a crucial step in tracking biogeochemical cycles and predicting future responses of aquatic ecosystems to environmental changes at different times and spatial scales (de Senerpont Domis *et al.* 2013; Behrenfeld & Boss 2014).

The flux of matter, energy and information in the oceans largely depends on the structure of plankton communities, which are, in turn, characterized by the species present, their abundance and functional roles, and their possible biological inter-connections (Sommer *et al.* 2012). The clear-cut, paradigmatic formalization of a planktonic trophic chain ruled by phytoplankton production and zooplankton grazing – dating back to G. A. Riley's work (Anderson & Gentleman 2012) – and applied to any planktonic system, has been progressively questioned by the increasing levels of awareness of the fine-tuned mechanisms at the base of plankton ecology (Tett & Wilson 2000;