
Biogeography of mixotrophy in the global ocean: an ubiquitous traits sustained by a high diversity of differently distributed mixotrophic protists

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Abstract

Mixotrophy, or the ability to acquire resources from both auto- and heterotrophy, is an ecological trait that has been shown to be widespread in marine protists. In the last decade, the historic dichotomy between phyto- and zooplankton disappeared to give way to a new vision of continuity between a state of full heterotrophy and one of full autotrophy. Hence, mixotrophic organisms should always be considered when it comes to estimating primary production in the ocean, and their population dynamics should be included in marine ecosystems models. For that, we need to study the different types of mixotrophs to identify the biotic and abiotic factors that shape their distributions. Here, using a metabarcoding dataset of marine plankton from the global ocean, we identified a set of 140 taxonomic lineages classified into four mixotrophic functional types: constitutive mixotrophs, generalist non-constitutive mixotrophs, endo-symbiotic specialist non-constitutive mixotrophs, and plastidic specialist non-constitutive mixotrophs. We confirmed that mixotrophy is ubiquitous and we showed that constitutive and non-constitutive mixotrophs share similar global distributions, even though not always dominating in the same environmental conditions. Several lineages were evenly found in the samples. Yet, some of them displayed strongly opposed distributions, between mixotrophic types but also within types. Particularly, very divergent biogeographies were found within endo-symbiotic non-constitutive mixotrophs. We propose that the ability to form colonies, as well as the mode of symbiosis are traits playing an important role on the distribution of these mixotrophic organisms. We shown how metabarcoding can be used in a complementary way with morphological observations to study the biogeography of protists and to identify key drivers of their biogeography. This way, our study will facilitate the integration of under regarded groups and functional traits into ecological modeling studies.

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