Abstract

For long, microorganisms have been thought to have unlimited dispersal and therefore to follow fundamental different assembly rules than macroorganisms. This premise is slowly changing, and ecological structure of microbial communities could gain insights from the theoretical and methodological developments applied on macroorganisms. While scarcely used, functional and phylogenetic metrics represent complement facets of diversity that should add valuable information to understand microorganisms' diversity structuration.

We used freshwater phytobenthic algae desmids (Desmidiaceae, Streptophyta) as a model group. The main aim of this thesis was identification the processes creating distinct patterns of desmid diversity using functional and phylogenetical information. We sampled over a hundred communities within Europe, used a well-resolved phylogeny, and size-related functional traits. Moreover, we experimentally measured the population growth rate of desmids, to determine the link between functional traits and organism performance.

Desmid communities showed non-random patterns of size and phylogenetic distributions on both large and local scales, advocating for a strong influence of niche-based processes. At large scale, desmids were distributed into environmentally and geographically separated species pools. At the local scale, phylogenetic diversity was linked with a gradient of pH and functional diversity with climatic variation. The population growth rates were strongly related to the size of desmids while no signal was found with other morphological traits.

We show that large scale diversity of European desmids is driven by niche conservatism, large scale environmental filtering, dispersal limitations, and historical biogeography. Locally, functional and phylogenetic structuring in communities revealed the influence of environmental filtering and biotic interaction. Phylogeny and size-related traits apparently represented different ecological niche axes of desmids, as they responded to different environmental drivers. Size is strongly linked with organism performance and thus is a pivotal functional trait to infer desmids' community dynamics. The diversity of desmids communities is shaped by similar processes affecting macroorganismal communities.