Trait-based biodiversity and multitrophic dynamics under external forcing: a combined planktotron and modelling approach (PlanktoTrait)

Understanding and quantifying the drivers and consequences of diversity in food webs is a main topic in ecology, especially in the context of environmental change. The (overwhelming) consensus is that differences among traits underlie all mechanistic explanations why diversity, in particular species richness, should matter for ecosystem functioning.

The current project aims at a mechanistic understanding of ecosystem functioning and the dynamics of trophic interactions as mediated by trait-based diversity at various trophic levels. We will set up two experiments in custom-built planktotrons, highly controlled and large indoor mesocosms for long-term plankton studies, with a near-natural planktonic food web comprising both the direct phytoplankton-zooplankton grazing link and the indirect link via the microbial loop. We will manipulate diversity at the base (phytoplankton) and top (zooplankton) of this food web, and study effects on trophic transfer, food web dynamics and ecosystem functioning. We will explicitly include stoichiometry and fatty acid composition of the key trophic levels as potentially important qualitative controls, as well as trait-based assessments of bacterial metabolic capabilities and of the complex organic resources fueling the microbial loop. Here, bridging biogeochemistry and ecology, we will employ novel high-resolution mass spectrometry in the context of a reduced ecological experiment to describe chemical diversity of dissolved organic matter (DOM) as derived from biota differing in diversity and to uncover its potential effects along the microbial loop. Further, we will expose our food webs to a pulse of colored, terrigeneous DOM as external forcing with disturbance-character, and study its effect on food web dynamics (i.e. the grazing link as well as the microbial loop). Our experimental approach will be accompanied by modeling of the relatively complex planktotron setups to generate improved insight into underlying mechanistic relationships.

We expect our project to provide evidence for functional, trait-based diversity to matter more for ecosystem functioning in a food web context than taxonomical diversity. We expect phyto- and zooplankton diversity to affect trophic transfer, zooplankton growth and dynamics, and the trophic linkage intensity as assessed by the dynamics of both trophic levels. We also anticipate phytoplankton diversity to increase the chemical diversity of dissolved organic matter, and thereby affect bacterial resource use, and long-term functional diversity and biomass of bacterioplankton. Comparing energy flow between the grazing food chain and the microbial loop, we expect phyto- and zooplankton diversity to preferentially benefit the grazing food chain. Last, we expect the experimental DOM pulse, introduced as external forcing, to induce a shift of carbon flow through these two pathways of the planktonic food web, and postulate this shift to be related to phyto- and zooplankton diversity.