Flexible until it snaps: Dynamics of genes & traits, densities & diversity in communities challenged by environmental change

One of the main and crucial questions to be addressed within the SPP DynaTrait is whether diversity allows feedbacks within ecological communities, through trait dynamics, that in turn promotes the maintenance of diversity - specifically in response to environmental change. Changes in environmental conditions, such as pollutant exposure and water temperature increases interact with unknown additive, synergistic or antagonistic effects on biota. Community feedbacks spanning the dynamics of genes and traits, densities and diversity are presumably of key importance for buffering the community response to, for instance, environmental changes. Here we focus on model communities consisting of protist species that differ in major functional traits that are relevant at the ecosystem level (being autotrophs, mixotrophs or heterotrophs). The focus of the project lies on the dynamic responses to environmental stressors, specifically to ionic silver, and on the effect of such stressors to constrain the communities ability to dynamically respond to additional stressors such as heat waves. Shifts in selected morphological and physiological traits may not or may only indirectly be linked to the environmental cues under view. Past approaches relying mainly on morphological and physiological data alone may therefore miss some key aspects in the organisms and ecosystems response. A much broader approach considering many different potential reactions and feedbacks at a given time would be desireable or even essential to comprehensively address this issue. We consequently combine classical morphological and ecophysiological analyses with (meta-)transcriptome analyses based on high throughput sequencing technologies. In six consecutive working packages we (i) identify key responses of the target organisms and the dynamics of single species upon varying levels of stressors, (ii) identify the dynamics and feedbacks between genes and traits, densities and diversity of low and high diversity model communities, and (iii) identify the dynamics and feedbacks between genes and traits, densities and diversity at the community level in the presence of herbivore grazing pressure. The comprehensive character of the project requires expertise in protist ecology, ecotoxicology, bioinformatics and ecosystem modeling which is covered by the three applicants and the external cooperation partner. In brief, our hypotheses are (1) that constant and fluctuating environmental conditions have fundamentally different effects on the feedback between gene expression, traits, densities and eventual diversity and (2) that the magnitude of imposed stress and the interaction between different stressors determine when "the power of flexibility" breaks down.