Interplay between trait variation, food web dynamics and maintenance of biodiversity

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What this subproject is about

Inherent trait variation of individuals, populations and communities allows them to adjust to altering environmental conditions. We postulate that (1) the available trait variation (functional diversity) influences biomass and trait dynamics and (2) this, in turn, influences the maintenance of trait variation in concert with the trade-off(s) among traits. We consider the qualitative and quantitative dynamic properties which are highly relevant for ecosystem functions and services.

Objectives

In the first funding period of the project we have made great advances in understanding how these feedbacks impact dynamics and the maintenance of functional diversity in simple predator-prey models. **During the second period 2018-2024, we are to synthesizing this newly gained body of results, and to build on our existing theory to investigate more complex scenarios; e.g. accounting for multiple co-evolving traits on a single trophic level, and extending predator-prey modules to tri-trophic systems, intra-guild predation and more complex food webs modules based on comprehensive field observations from Lake Constance.**

More generally, we want to contribute to a unifying theory how standing trait variation and associated trait changes in general impact the structure, function and dynamics of food webs due to multiple feedbacks between biomass and trait dynamics. We aim at understanding not only eco-evolutionary dynamics but also the effects of trait changes resulting from mechanisms other than evolution – such as species sorting and phenotypic plasticity – that occur simultaneously in natural systems.

Approach

We use four complementary model approaches: multispecies or multiclonal sorting models, full trait distribution models, aggregate models approximating full models by explicitly describing the dynamics of the mean and variance of the underlying trait distribution, and hybrid models considering intra- and interspecific trait variation simultaneously by combining a multispecies model with an aggregate approach. This enables us to investigate the intertwined ecological and evolutionary processes, and to test the robustness of our results against model assumptions.

Our latest key publications [downloads at our Working Group homepage possible]:

Flöder S., J. Yong, T. Klauschies, U. Gaedke, T. Brinkhoff, T. Poprick & S. Moorthi (2021) Intraspecific Trait Variation Alters the Outcome of Competition in Freshwater Ciliates. Ecol. Evol.11: 10225–10243.

Ceulemans, R., C. Guill, and U. Gaedke (2021) Top predators govern multitrophic diversity effects in tritrophic food webs. Ecology

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Ehrlich, E., N. Kath & U. Gaedke (2020) The shape of a defense-growth trade-off governs seasonal trait dynamics in natural phytoplankton. The ISME Journal 14: 1451-1462.

Blasius, B., L. Rudolf, G. Weithoff, U. Gaedke & G. Fussmann (2020). Long-term cyclic persistence in an experimental predator-prey system. Nature 577: 226-230.

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Ehrlich, E. & U. Gaedke (2018) Not attackable or not crackable - How pre- and post-attack defences with different competition costs affect prey coexistence and population dynamics. Ecology and Evolution 8: 6625–6637.

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Seiler, C., E. v. Velzen, T. Neu, U. Gaedke, T. Berendonk & M. Weitere (2017). Grazing resistance of bacterial biofilms: A matter of predators' feeding trait. FEMS Microbiology Ecology 93 (9), doi: 10.1093/femsec/fix112

Weithoff, G. & U. Gaedke (2017) Mean functional traits of lake phytoplankton reflect seasonal and inter-annual changes in nutrients, climate and herbivory. J. Plankton Res. 39: 509-517.

Gaedke U, Klauschies T (2017). Analysing the shape of observed trait distributions enables a data-based moment closure of aggregate models. Limnology and Oceanography: Methods. doi: 10.1002/lom3.10218.

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