CSC-RUB PhD Project Proposal

Title: The consequences of biodiversity feedback for ecological restoration. Or: How to prevent and reverse cascading extinctions?

Sector of research: Biodiversity Research, Community Ecology, Restoration Ecology

Degree awarded: PhD, Dr.rer.nat.

Keywords: Biology, biodiversity, coexistence, conservation biology, community ecology, community reassembly, competition, competitive exclusion, diversity, ecological modeling, ecological modelling, ecological restoration, ecosystem function, ecosystem services, environmental change, extinction, extinctions, extreme events, food chain, food web, food webs, food web dynamics, food web interactions, food web model, freshwater ecology, persistence, population dynamics, predation, predator, prey, priority effect, priority effects, resilience, restoration ecology, species richness, stability, stress, stressor succession.

Supervisor of PhD project: Prof. Dr. Matthijs Vos, Theoretical and Applied Biodiversity Research, Ruhr University Bochum, e-mail: Matthijs.Vos@rub.de

Research focus of supervisor: The current estimate is that a million species are on a trajectory of accelerated extinction. It is a major question what the consequences will be of this expected biodiversity loss. Will it lead to further cascades of extinction that also affect the millions of species that presently still seem unthreatened? Do high levels of diversity help to maintain diversity? And does that capacity break down when extinctions start to cascade? We use experiments and ecological modelling to explain how low versus high levels of diversity affect the trajectories of both decline and recovery. We have theoretical expertise in analyzing the positive and negative feedbacks of diversity on itself, under different environmental conditions. We also have lots of experience running replicated community dynamics experiments at different levels of diversity. This allows us to study the mechanisms governing collapse and recovery of simple and more complex ecological communities.

Publications: In the last 5 years: 9 papers that were cited 96 times. Selected papers:

Second Supervisor of PhD project: Prof. Dr. Ralph Tollrian, Department of Animal Ecology, Evolution and Biodiversity, Ruhr University Bochum.

Summary of research plan:

**Background:** High levels of biodiversity can positively or negatively affect species persistence in food webs. This is mediated by positive and negative feedbacks of diversity on itself. The key modulating mechanism is that interaction strengths between predators and prey are weakened in more diverse food webs. This can *increase* deterministic extinctions (by changing conditions for predator existence) but, conversely, *decrease* stochastic extinctions (by changing boom-bust dynamics), depending on environmental conditions.

**Study objective:** We hypothesize that diversity negatively affects maintenance of diversity at low ecological carrying capacities but positively affects maintenance of diversity at high carrying capacities. The theoretical work will generate quantitative predictions for decline and recovery that are subsequently tested using experimental communities, at different levels of diversity and at different carrying capacities of basal species in the food web.

**Expected Results:** The project can lead to three publications (1 theoretical and 2 experimental papers) and to international conference presentations as output.

**Methods:** We theoretically study alternative ecological model scenarios using bifurcation analysis of ordinary differential equations and numerical simulations in Matlab. In the lab we perform community decline/recovery experiments using algae, ciliates and rotifers in Multitron incubator shakers. Counts of the different sampled species are made by microscopy and/or use of a Flowcam.

**Candidate Requirements:** An MSc degree in Ecology, Community Ecology, Theoretical Ecology, Restoration Ecology or a related discipline is requested. The candidate preferably has practical experience in experimental plankton ecology / community dynamics and/or in ecological modelling. Strong conceptual thinking is a requirement. We are an international group and request team player attributes! Excellent English language skills are mandatory.

**Motivation for CSC application:** In our group you have the unique chance to combine experimental and theoretical research approaches. The research will generate insight that helps to manage, prevent and repair biodiversity loss in natural and man-used ecosystems. We offer training in the study of replicated experimental communities and in the use of Matlab for ecological modeling. You will be integrated in our International Graduate School of Biosciences (IGB) and have the opportunity to attend international courses and conferences to enhance your career development.