Biodiversity Change in Central Europe since 1950 – BioChange

Central Europe has seen unprecedented losses of biodiversity in its cultural landscapes during the past 50 years. Population sizes and species numbers of plants and animals have decreased in many ecosystems accompanied by population fragmentation and genetic isolation, while other species have profited from changes. No comprehensive synthesis is available on quantitative biodiversity losses in Central Europe's main ecosystem types during the past 50 years. Since this information is of high relevance, e.g. in

policy-making, BioChange-Germany aims at compiling data on changes in flora and fauna with a special focus on the major ecosystems of northern Germany's agricultural landscapes. Data on species frequency and abundance are combined with GIS analyses of land cover change in order to estimate changes in species numbers but also population sizes during the past 5 decades.

Intraspecific genetic diversity along plant species diversity gradients

A better understanding of the interplay between evolutionary and ecological processes is crucial for the appreciation of the functional importance of intraspecific diversity. We intend to study interactions between genes and genetic variation within a species and populations of other species in a community. Our research aims to contribute to functional biodiversity research by focusing on intraspecific diversity of an important group of forest organisms (oaks) and investigating the interactions of (oak) genetic diversity with the diversity of associated communities. The functional importance of intraspecific diversity and these interactions will be investigated against the background of changing environmental conditions.

Ecosystem Modelling

The dynamic behaviour of ecosystems emerges from interactions at multiple spatial and temporal scales. By understanding pattern formation at different hierarchical levels, one may disentangle how local effects translate into global behaviour of complex ecological systems and vice versa. Simulation models are an ideal means for such an integration of ecological knowledge across scales and disciplines. The Ecosystem Modelling group develops and analyses ecological simulation models with an emphasis on spatial ecology and biodiversity. In close collaboration with field experts from biology, forestry, agriculture, and socioeconomics an integrated understanding of ecosystem behaviour is generated.

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GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Functional Biodiversity
Cluster of Excellence

Cluster of Excellence – Rationale

Man has dramatically increased plant and animal extinction rates on earth. Since processes such as productivity, water purification, pollination, and natural pest control are influenced by biodiversity, genetic erosion may threaten ecosystem functioning and can impair ecosystem services used by man.

Scientists from three faculties, biology, agriculture, and forestry, at the University of Göttingen established an interdisciplinary platform to conduct collaborative research on functional biodiversity and to attract and promote excellent junior scientists in this field. The scientific concept includes new innovative diversity manipulation experiments in grasslands, in soil, and with tree species to investigate the functional role of intra- and interspecific genetic diversity for ecosystem processes and services.

The goal of scientists collaborating in the Cluster of Excellence »Functional Biodiversity Research« is to address four key questions which relate to the core of the biodiversity – ecosystem functioning debate:

(1) Are the numerous existing species needed in order to maintain the expected ecosystem functions?
(2) In case not all species are needed, which are redundant without loosing ecosystem functions?
(3) Which diversity of genetic resources must be maintained in order to survive in a changing world?
(4) Which proportion of the ecosystem services can be used by mankind without affecting the sustainability and the biodiversity of the system?

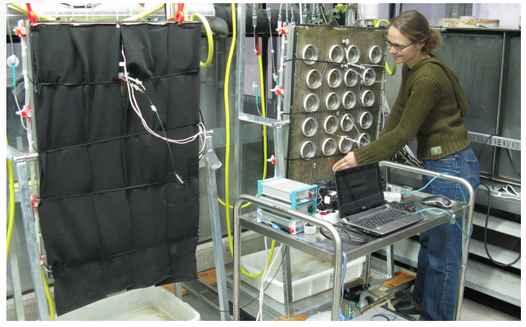
Grassland Management Experiment – GrassMan

Linkages between management factors, grassland diversity and related soil processes and functions are investigated in a long-term field experiment on a semi-natural, moderately species-rich agricultural grassland in the Solling uplands.

Sward diversity has been manipulated by reduction of the abundance of either monocot or dicot species by herbicide application. Management intensity is modulated by the frequency of mowing and by different amounts of fertilizer application. Since the management intensity gradient also results in a gradient of species richness, a matrix of plots with differential species richness has been generated. Plant productivity, plant-herbivore-predator, and plant-pollinator interactions as well as soil processes and sward-soil interactions are studied.

Results show distinct effects of grassland management measures on ecosystem functions while sward diversity and composition are of minor importance. This demonstrates the need to lay increased emphasis on permanent grassland systems in addition to experimental grasslands to improve the knowledge on the relationship between sward diversity and ecosystem functioning.

Biodiversity Manipulation in Rhizosphere and Soil – MicroRhizo



In terrestrial systems plant roots, soil microorganisms, and soil animals interact intricately thereby affecting plant nutrition and plant performance. Due to their complexity and the opaqueness of the system, these interactions are little understood until today and this applies in particular to the rhizosphere of trees. In a complementary approach in the laboratory and in the field species composition and their functions in the rhizosphere of trees are investigated.

A double split-root rhizotron system was developed for high-resolution analyses of rhizosphere processes, addressing in particular the interaction between mycorrhiza, bacteria and soil animals, and associated nutrient transfer processes. The system allows investigating spatial and temporal dynamics of physicochemical processes in the rhizosphere of trees exposed to intra- and interspecific competition. It provides unique opportunities for manipulating the composition of rhizosphere biota and the availability of resources, such as litter material labelled with stable isotopes, allowing to gain insight into the role of detritivore species for rhizosphere processes, plant nutrient capture, and plant growth.

The Göttingen Poplar Diversity Experiment – PopDiv

While there is increasing evidence that species diversity affects ecosystem functioning, it is not sufficiently known whether decreasing abundance of a given species also affects genetic diversity within the species and whether there is a requirement for high within-species diversity for the maintenance of ecosystem functions.

To test the hypothesis that reduced intraspecific genetic diversity has negative effects on ecosystem functions and services, ecosystems have been constructed that differ in intra-specific diversity using poplar as a model species. To vary intraspecific genetic diversity, *Populus tremula* clones and openly pollinated progenies from different locations from a south-north gradient across Europe were planted in different combinations. The dependence of productivity, biogeochemical fluxes, and trophic interactions on intraspecific diversity is studied.