1.

Aboveground net primary production response to chronic nitrogen addition in a tropical montane forest

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Nitrogen (N) deposition in tropical areas is projected to increase rapidly in the next decades and little is known on how tropical forest productivity will respond to increase in N availability. We used an N-addition experiment to achieve an N-enriched condition in an old-growth forest growing in an Aluandic Andosol soil at 1200-1300-m elevation in Fortuna Forest Reserve, Panama. Control and N-addition treatments (starting in 2006 at a rate of 125 kg urea-N ha^{-1} yr^{-1}, split in four applications) were laid out in paired-plots design with four replicate plots (40mx40m each, separated by ≥40-m distance). Here, we report the changes in various components of above-ground net primary production (ANPP) after 4 years of N addition: stem diameter growth (separated by diameter at breast height (DBH) classes of 10-30 cm, 30-50 cm, and >50 cm), woody biomass production (WBP), and fine litterfall. No significant differences were observed between 3-4-yr N addition and the control in stem diameter growth of any DBH classes or all classes combined, in WBP, in total fine litterfall, and in ANPP. There is a rapid, initial response to N addition in the first 2 years in leaf litterfall, WBP, and ANPP which suggests that this montane forest is partly N limited. Our results also showed interannual variation of ANPP response.

2.

Trophic cascades in model communities

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Trophic cascades, the positive indirect effect of one species on the species two feeding links below, have been in the focus of researchers for several decades. Analytical solutions have been developed to assess the strength of trophic cascades

and to predict their strength in the field. These analytical solutions are based on simplifying assumptions, such as equilibrium dynamics, type II functional responses and isolation from the food-web environment (i.e. simple food chains), that do not effect the variety of species interactions in natural food webs. Using dynamic computer simulations we show that disregarding these assumptions radically alters the predicted strength of the cascades as well as the number and identity of explanatory parameters. The analytical solution, with the body-mass of the intermediate species as the only influencing parameter, generally over-estimates the strength of the cascades found in the numerical solution. There, omnivory largely explains the sign of the cascades, whereas their strength is driven by the top species' body-mass and abundance paired with the vulnerability of the intermediate species' trophic level.

3.

Mechanistic modelling of transpiration to improve simulations of the water budgets of mixed forests

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The estimation of root water uptake and water flow in plants is crucial to quantify transpiration and hence the water exchange between land surface and atmosphere.
We extended and further developed an individual-based functional-structural model of the water usage of trees.
The finite element tree hydrodynamics model is based on the porous media equation of water flow and includes the explicit three-dimensional architecture of the canopy and the root system.
The effect of species specific hydraulic traits and the stand structure on the water cycle could be revealed and quantified.
In this way, the model can estimate the water budgets of single trees and mixed forests.

4.

Identifying effects of tree diversity and tree identity on nematode community composition

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Understanding processes influenced by biodiversity is one of the great challenges of current ecological research. We examined the impact of tree diversity and tree identity on nematode community structure in deciduous forests of different tree diversity. Clusters of three trees were identified differing in the composition of tree species. Target tree species were beech (*Fagus sylvatica*) and ash (*Fraxinus excelsior*) differing strongly in physiology, litter quality and mycorrhizal type, as well as lime (*Tilia cordata* and *T. platyphyllum*). Diversity had no significant effect on total nematode density, but in trend the density was at a maximum in the most diverse clusters. Ash beneficially affected bacterial feeding nematodes, whereas fungal feeding nematodes were suppressed. The opposite pattern was true for beech by beneficially affecting fungal feeders and detrimentally affecting bacterial feeders in the clusters dominated by beech. Lime in general negatively impacted nematode density, but did not affect nematode trophic structure. Plant feeders, predators and omnivores, were not affected by tree diversity or tree species identity. Generally, beech and ash strongly impacted the trophic structure of nematode communities suggesting that tree identity may result in major shifts in the channelling of energy through decomposer food webs.

5.

Fungal Diversity in a Transgenic Poplar Plantation

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One issue of the European Union is to replace 20% of fossil fuels by renewable sources until 2020. Poplars are fast growing trees and already used in short rotation coppice. Thus they are interesting candidates for biomass production. But due to the high energy demand of the breakdown of lignin only poplars with low lignin contents are desirable biofuel sources. However, the impacts of these genetically modified trees on symbionts like ectomycorrhizas are unknown. The aim of this study was to determine if the modification in the lignin biosynthesis pathway of the poplars affected the ectomycorrhizal fungi diversity.

For this purpose seven transgenic and one wild-type clone of *P. alba x tremula* (= grey poplar) were planted on an experimental field in June 2008. Soil core were taken in October 2009 and 2010. Diversity analysis of ectomycorrhizal fungi was conducted by combined morphotyping/ITS-sequencing approach. Additionally, in 2009 soil and roots of two transgenic clones and the WT were analyzed by 454-sequencing.

Our results indicate that the transgenic modification has no impact on the diversity of ectomycorrhizal fungi associated with the roots of these poplars. One transgenic clone showed significant lower diversity indices than the others. However this clone was retarded in biomass production pointing to a link between plant productivity and fungal diversity.

We are grateful to the EU for funding this project via ENERGYPOPLAR.

6.

Habitat usage and Behaviour of Exmoor ponies (*Equus ferus*) during the winter on Langeland (DK)

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Habitat usage and behaviour of Exmoor ponies in a grazing project under conditions close to nature were examined during February and March 2009 on Langeland (DK). Major aspects were the spatial use of the animals' area and the temporal percentages of the shown behaviours and if both is affected by different weather conditions.

The results show preferences for several areas whereas other pastures have rarely been frequented, influenced by the food availability of the different pastures, wind-exposure and other climatic conditions as well as thickness of snow cover.

Environmental conditions also impaired the ponies' behaviour. The time spent on feeding and resting increased during sunny weather, whereas rainy weather increased the time spent in the forest.

Varying temperatures did not have apparent effects on the animals' behaviour. With rising wind, the time spent on feeding decreased in favour of time spent in the forest, while the resting behaviour remained unchanged.

Occurrence of a minor snow covering did not have an impact on the behaviour. Thicker snow covering increased resting periods and the animals avoided the forest.

Unlike in summer the Ponies remained more individual in their behaviour during the winter season, although each animal kept its own, individual daily rhythm.

7.

Towards an improved understanding of trophic connectivities in belowground microbial food webs

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The flow of carbon and energy through natural systems is largely controlled by organisms engaged in complex trophic interactions. Although such food webs have been intensively studied for higher organisms, involved microbes are mostly treated as a black box. In the frame of the DFG FOR-918 ("Carbon flow in belowground food webs assessed by isotope tracers"), we aim to open this black box and uncover the interactions between bacteria and other trophic levels of a soil food web depending on plant carbon inputs and channeling carbon into deeper unsaturated and saturated zones. To trace this organismic food web from its origins, a model community of microbial plant exudate consumers was enriched from an agricultural soil at our field sampling site (a maize field in Göttingen) with an artificial mixture of 13C-labelled root exudates as substrate. Subsequently, labeled indigenous bacterial biomass was added to mesocosms with the same soil and secondary microbial consumers were traced by rRNA-SIP.

Already after one day of the inoculation, T-RFLP fingerprints of 'heavy' rRNA revealed secondary microbial consumers of the added biomass to be active. Over time, 13C-labelled microbial subpopulations varied and indicated a complex and dynamic food web to be active within the bacteria. For identification of labeled OTUs, selected rRNA fractions are analyzed by massively paralleled 454-pyrotag sequencing. We use bidirectional sequencing of bacterial rRNA amplicons, which allows for assembly, T-RF prediction and phylogenetic placement of dominating amplicon contigs. Furthermore, pyrotag data from the SIP experiment are compared to respective field community data to link the identified trophic connectivities to C-turnover in the field. As next step (in progress), links to other members of the belowground food web (Fungi, Protozoa) will be elaborated together with our partners within FOR-918.

8.

Structure of forest soil food webs on a land-use gradient

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Since soil food webs provide many important ecosystem functions for aboveground communities knowledge about soil food-web parameters and their scaling is important. However, good documented terrestrial soil food webs are scarce. We assembled a set of 48 forest soil food webs with high taxonomic resolution across a forest land-use gradient and analyzed food web structure and network properties to (I) compare them with 75 food webs from other ecosystems and (II) test the effect of forest land-use intensity on food web structure. In forest soil food webs we found no differences in scaling laws (e.g. complexity, diversity) compared to food webs of other ecosystems but higher rates of omnivory, cannibalism, loops and clustering. We found no effect of forest land-use intensity on the structure of soil food webs.

9.

Influence of livestock co-grazing on the abundance of the endophytic fungus *Neotyphodium* – Does plant diversity matter?

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The specialized endophytic fungus *Neotyphodium* is common in many temperate grass species. It is known to enhance the resistance of its host against biotic stress like herbivorous insects and mammals by producing toxic alkaloids and can therefore be detrimental to livestock.
Here, we test the hypotheses that grazing by different types of livestock at varying plant diversities influences the abundance of *Neotyphodium* in the common pasture grass *Festuca pratensis*. We conducted a field experiment with six treatments and

three replications. The treatments were: Grazing by sheep, cattle or co-grazing by sheep and cattle with two plant diversity levels; a herbicide-treated low diversity sward and an untreated control sward. After five years grass samples were taken from all plots and analyzed with an ELISA-based test kit for the presence of *Neotyphodium*. We detected a significantly higher level of infestation with *Neotyphodium* in the co-grazed low diversity plots compared to the plots grazed by sheep. In contrast, in the control plots the different grazing regimes had no influence on the rate of endophytic infection. Therefore, we conclude that biodiversity has an impact on the abundance of *Neotyphodium* and that co-grazed low diversity pastures could cause a higher risk of toxicoses.

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10.

The influence of tree diversity on the soil fauna of a deciduous forest

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The Hainich National Park is the greatest cohesive forest area in Germany (Thuringia) and a typical European deciduous forest dominated by beech (*Fagus sylvatica*) with other deciduous tree species interspersed including ash (*Fraxinus*

excelsior), lime (*Tilia cordata* and *T. platyphyllos*), hornbeam (*Carpinus betulus*) and maple (*Acer pseudoplatanus*). We investigated the effect of five different deciduous tree species and species mixtures on the density and diversity of the soil fauna. The effect of tree diversity was investigated using clusters of three tree species of different diversity. In these clusters soil and litter samples of 20 and 5 cm diameter were taken in May 2008 and soil fauna was extracted by heat and assorted to group level. For clusters including beech, lime or ash oribatid mites (Oribatida) were determined to species level.

Tree diversity and identity strongly impacted the density of major groups of soil fauna such as Lumbricidae. The presence of beech facilitated major mesofauna-groups such as oribatid mites and Gamasida, but abundance of saprophagous macrofauna groups decreased. Interestingly, maple and hornbeam opposingly affected soil arthropods. In oribatid mites small species (Oppiidae, Suctobelbidae) benefited from the presence of beech, presumably because beech favoured the formation of humus layers. In contraststpecies of Suctobelbidae and Oppiidae, comprising mainly of big Individuals, were favoured by ash and lime, having a high qualitative litter layer.

11.

Molluscs respond to biodiversity and grassland management in a functional group removal experiment

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Little is known about the effects of grassland management on mollusc populations in temperate regions. Therefore this study has been performed within a large scale Grassland Management experiment (GRASSMAN) in the Solling Mountains in Lower-Saxony.

We collected grassland molluscs using a simple, standardized technique to investigate the influence of plant diversity, cutting frequency and fertilization on mollusc diversity and abundance.

Our results show a strong effect of plant composition, plant height and cutting frequency.

12.

Does the scale of sampling affect the relationship between biodiversity and productivity of temperate grasslands?

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This study was conducted on the experimental field in the Solling Uplands, Germany in the framework of the GrassMan project. The site is an old permanent semi-natural grassland with no history of arable farming. The three-factorial latin square design of the experiment includes sward type (control, monocot-reduced and dicot-reduced), mowing frequency (1 and 3 cuttings per year) and fertilization intensity (no fertilization and 180-30-100 kg/ha of N-P-K) as main factors and block and row effects as spatial factors. We investigated the effects of sampling area size on the relationship between diversity and productivity. The data on the number of species and productivity was collected at four different spatial scales: 0.16 m², 1 m², 9 m², and 225 m². Several biodiversity experiments with sown grasslands (Jena, BIODEPTH) reported a positive relationship between species number and productivity. First results of our study show no such relationship. At the small scale plots (0,16 m²) productivity even tended to decrease with species number. Reasons for this scale effect are analysed and discussed in the contribution.

13.

Linné's floral clock is slow without pollinators – flower closure and plant-pollinator interaction webs

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Temporal patterns of flower opening and closure within a day are known as Linné's floral clock. Time of flower closure has been explained mainly by light in the traditional botanical literature. We show with a set of experiments that Asteraceae flower heads can close within three hours after pollination, whereas unpollinated

flower heads stay open until the late afternoon. This suggests that closing time strongly depends on pollinators. Using plant-pollinator interaction webs we further demonstrate that the daily pattern of flower opening and the rapid response to pollination can impose strong temporal dynamics on interspecific interactions within a single day. We observed pollinator species turnover and changes in facilitation vs. competition among plants. Our results show for the first time that pollination induces rapid flower closure on the community level. This causes imprecision in Linné's floral clock with far-reaching consequences for plant-pollinator interactions.

14.

Soil amoebae (*Acanthamoeba castellanii*) and mycophagous bacteria (*Collimonas sp*.) change the competition of two competing plant species

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Plant growth in natural environments depends on microbial mineralization rates and recycling of nutrients from organic matter. Both are affected by microbial predators, because grazing 1) intensity controls the flux of nutrients from microbial biomass and 2) selectivity controls the identity of microbial decomposers.

We investigated interactions between a bacterivorous protist (*Acanthamoeba castellanii*) and fungivorous bacteria (*Collimonas* spec.), and their consequences on the competition between mycorrhizal (*Plantago lanceolata*) and non-mycorrhizal (*Rumex acetosella*) plants in a full factorial design.

Despite low densities of *Collimonas*, *A. castellanii* and *Collimonas* mutually enhanced another. Both microbial groups had independent and interactive effects on the remaining microbial community and plant competition.

Acanthamoebae increased total plant biomass, but *Plantago* benefited stronger than *Rumex*, Effects of amoebae on root growth depended on *Collimonas*. For example, root biomass of *Plantago* compared to *Rumex* was enhanced in presence of either Acanthamoebae or *Collimonas*, but root length of *Rumex* almost doubled with both.
Our results confirm an important functional role of bacterivorous amoebae in affecting plant competition. Mutual positive interaction of *A. castellanii* with low numbers of *Collimonas* shows that single microbial species may shift competition at the plant community level.

15.

SPLIDRHEX -Species Litter Identity and Diversity effect on the Rhizosphere of trees Experiment

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Although biodiversity is currently a main topic in politics and science, mechanisms that control and sustain belowground biodiversity are still debated. Moreover, previous biodiversity experiments often lack information on the importance and contribution of above- versus belowground biodiversity for ecosystem functioning (e.g. nutrient cycling and primary production) and key ecosystem processes (e.g. herbivory and decomposition).

For the first time SPLIDRHEX allows to partition effects of below- and aboveground plant diversity and will allow exploring their interactions in a factorial design. Five institutes from different fields of ecology participate in this interdisciplinary project.
In spring 2011 SPLIDRHEX was set up in a 150 year old mountain oak forest in the vicinity of Göttingen (Rheinhäuser Wald). Seedlings of four different deciduous tree species (*Fraxinus excelsior*, *Fagus sylvatica*, *Tilia cordata* and *Acer pseudoplatanus*) differing in litter decomposability (fast *vs* slow) and mycorrhizal associations (arbuscular mycorrhiza *vs* ectomycorrhiza) were planted. Plant and litter species richness (0, 1, 2, 4) were manipulated independently and replicated four times on the functional level. A total of 304 plots (180 x 210 cm) each containing 30 tree individuals were established in four blocks.
Plant parameters to be measured include stem height and increment, root growth and development and photosynthetic activity. Litter parameters to be analysed include weight loss, changes in carbon and nutrient concentrations, microbial biomass and respiration. Focusing on soil biota the density of mesofauna species and community composition will be investigated as well as microbial biomass and community composition. The analysis of natural stable isotopes will help to disentangle the relative role of above- and belowground resources of different quality for soil food web structure and interrelationships.

16.

Intraspecific diversity of leaf and root morphological traits of trembling aspen (*Populus tremula*)

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Leaf and root morphology are known to represent important functional plant traits. While significant intraspecific variation in leaf morphological traits has been frequently reported so far, almost nothing is known about intraspecific variation in root morphological properties.

Within the “Goettingen Poplar Diversity Experiment” (POPDIV), located in the Solling uplands (Germany, 51°44'56'' N, 9°32'28'' E, 485 m a.s.l.), we sampled in total 160 individuals of eight aspen demes (*Populus tremula* L. and *Populus tremuloides* L.), in order to investigate intra- and interspecific variability of root morphological traits and to relate variation in root morphology to leaf morphological properties.
Our data demonstrate significant intra- and interspecific variability in fine root morphological traits (e.g. SRA, SRL, root tip frequency), and differences in leaf - versus root morphological strategies across the different aspen demes.
In conclusion, the findings point to genetically driven differences to adapt to environmental conditions of different origins, resulting in variations not only on aboveground but also on belowground traits.

Keywords: Leaf morphology, root morphology, intraspecific variation, *Populus tremula*, *Populus tremuloides*

17.

Nitrogen response efficiency of a managed and phytodiverse temperate semi-natural grassland

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Nitrogen response efficiency (NRE) is a measure of ecosystem functioning, that ingrates productivity and nitrogen (N) availability. Here, we present results of NRE of the GRASSMAN-experiment from naturally species-rich (controls), monocot-reduced and dicot-reduced grassland. Additionally, two contrasting N fertilization treatments and two mowing frequencies were set up.
In 2009, NRE ranged from 10 to 488. Fertilization ($P = 0.000$) and mowing frequency ($P = 0.047$) were the factors influencing NRE with higher efficiency on the non-fertilized compared to the fertilized plots and on plots cut three times compared to plots cut one time. Fertilized plots were dominated by N application and showed a

priming effect. In 2010, NRE slightly decreased to a range of 5 and 162. Fertilization ($P = 0.000$), mowing frequency ($P = 0.000$) and sward composition ($P = 0.034$) affected NRE. Non-fertilized plots were characterized by higher ratios than fertilized plots and plots cut three times showed higher NRE than plots cut one time. The control had higher NRE compared to dicot-reduced and monocot-reduced plots.
We can conclude that fertilization led to a reduction of NRE and a higher mowing frequency increased NRE. The presence of monocots was important to achieve high NRE ratios which were due to more efficient nutrient uptake.

18.

Effects of protozoa – microbe interactions on carbon fluxes in the detritusphere

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Decomposition of organic matter is crucial for ecosystem function. Microorganisms, responsible for the mineralization and recycling of nutrients required by plants, are usually treated as a homogeneous functional guild. However, there is strong evidence that microbes differ in mineralization capacity. In addition, a significant part of the microbial community is top-down controlled by microbial grazers, such as protozoa. Since protozoan grazing is highly selective and selectivity differs among species, we hypothesised that protozoa specifically affect microbial decomposer diversity and function. We tested the effects of different protozoa on mineralization rate of maize litter in arable field soil by using two species from each of the following functional groups: flagellates, ciliates and amoeba. The effects of protozoan diversity, composition of functional groups within the community and the effects of specific species are discussed with respect to CO_2-production over time (as an indicator for the microbial mineralization process). These effects are also investigated in relation to grazing induced changes in microbial biomass and community composition (measured by Phospholipid fatty acids analyses). During microbial decomposition, different protozoan grazers gain influence for different time intervals. Effects of

protozoan grazers on microbial respiration turned out to be species specific. Even within the same functional group of protozoa, effects were not consistent.

19.

Diversity of protozoa in soil: Functional redundancy or complementarity?

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We manipulated the diversity of protozoa in soil planted with ryegrass and hypothesized additive effects of different protozoan species and functional groups on bacterial diversity and function in the plant rhizosphere; and that these effects should propagate up to the plant level.

We determined protozoan effects on microbial biomass and activity (measured via substrate induced respiration, SIR), on microbial community composition (measured via phospho lipid fatty acids, PLFA), and microbial functional diversity (measured as community level physiological profiles, CLPP), and determined subsequent effects on plant performance and root architecture.

We found that a linear increase of protozoan species numbers up to eight species still had complementary effects on microbial sum parameters and on plant growth, indicating a clear “diversity” effect. Most parameters measured showed a positive linear response with increasing species diversity of protozoa, despite specific protozoan species could exert partly contrary effects. Functional group effects occurred to a lesser extend, showing that amoebae and flagellates - independent of species numbers - had complementary functions when acting together compared to treatments with only one functional group. Plants did benefit from enhanced protozoan diversity, because they invested fewer resources in root growth to gain maximum shoot growth.

20.

Biodiversity effects *vs.* species-specific effects on the fine root system in a mature broad-leaved forest differing in tree species composition

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Tree species diversity can affect the functioning of forest ecosystems (e.g. complementary resource use). Most studies have addressed the biodiversity-function relationship of forest above-ground compartments, but studies of diversity effects on below-ground processes are still rare. We analyzed the effect of tree species composition on the fine root system in a temperate mixed forest in Central Germany. In order to investigate effects of tree species diversity and identity on fine roots, we recorded living and dead fine root mass in 100 study plots built by three canopy tree individuals each. The plots consisted of one, two or three different tree species representing all possible combinations of the five prevailing tree species in the forest. Fine root biomass in the upper 20 cm of the soil was not affected by tree species diversity; whereas fine root necromass was lower in more diverse plots. The relative over- or under-representation of a tree species in terms of fine root biomass revealed differences among species. Ash produced more fine roots in mixed than in its monospecific plots, in contrast this over-representation was less pronounced for lime, beech, hornbeam and maple. The results show clear differences in intra- *vs*. interspecific competition effects between the species.

21.

Dissecting the three-way interaction between ectomycorrhizal fungus, herbivorous insect and their host plant: a ubiquitous interaction in terrestrial ecosystems

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Ectomycorrhizal fungi (EMF) form intimate association with tree roots, a mutualism characterized by the establishment of a dual organ to facilitate nutrient exchange. However, the significance of this belowground interaction goes far beyond a simple exchange of nutrients as these fungal symbionts provide several other benefits to their host trees; for instance the ectomycorrhizal basidiomycete *Paxillus involutus* primed poplar for increased tolerance to abiotic stress (Luo *et al.,* 2009). In the present study we asked if *P. involutus* can also modify the defense of poplar against a generalist leaf herbivore (*Helicoverpa armigera*).

Larval weight gain data from standardized feeding assays revealed that treatment of black poplar (*Populus nigra*) with *P. involutus* helps the plant to limit feeding success of the leaf chewing pest.

Moreover, a negative correlation was found between the weight gain of *H. armigera* larvae fed on leaf disks and the foliar concentrations of phenolic substances. FT-ICR-MS (Fourier Transform Ion Cyclotron Resonance Mass Spectrometry) analysis of the leaf samples from plants treated and untreated with *P. involutus* suggest that *P. involutus* re-programs the aboveground leaf metabolism of the host plant and thus confers systemic resistance against the leaf chewer. It will be of interest to identify putative roles of fungal effectors that might be involved in such regulatory processes.

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Acknowledgements: We are grateful to the Ministry of Science and Culture of Lower Saxony and the cluster of excellence “Functional Biodiversity Research” for the funding of this project.

22.

Daily stem growth patterns in five temperate broad-leaved tree species: Air humidity vs. soil moisture control

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High-resolution measurements of stem radial variation provide insights into diurnal cycles of stem water relations and they may allow studying the weather response of stem growth. This study uses electronic point dendrometers to examine the influence of environmental variables on the daily radial growth rate of five broad-leaved tree species in the Hainich National Park in Germany. We focused on the effect of air humidity (RH) on radial growth because soil moisture is generally assumed to be the key determinant of the plant’s water balance neglecting that water flows along the soil-to-atmosphere potential gradient with flux controlled by edaphic and atmospheric water status. Daily stem growth was extracted from diurnal cycles of stem radius changes as the difference between two subsequent daily maxima of stem radii. Daily growth increased linearly with RH and RH was identified as the most important factor influencing daily stem growth in all species. We assume that RH changes during a

day and between consecutive days influence tree water status on a daily time scale, while rainfall and resulting soil moisture variation exhibit a more coarse-grained event structure which often is of only secondary importance for the actual tree water status and thus for cambial activity.

23.

Effects of environmental warming on trophic interactions

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How does climate change affect ecosystems, communities and complex food webs? Over the next 100 years the mean annual temperature might increase by 1 to 6 °C with weather extremes such as heat waves or heavy precipitation becoming more frequent. Ecosystems are highly complex, and for predicting the consequences of global warming knowledge of the strength of species interactions is required. The trophic interactions between consumers and their resources build the energetic backbone of natural communities and are mainly driven by feeding and assimilation.
We conducted functional response experiments to investigate temperature effects on interference competition showing complex responses in predator behaviour depending on the predators' metabolic rates. Subsequently, we established an assimilation efficiency database which we analyzed for feeding habit and temperature dependence showing that assimilation efficiency depends on the feeding habit but is temperature independent. Together, these findings can contribute substantially to systematic predictions on the effects of climate change on ecosystems and population dynamics.

24.

The addition of ash in beech dominated forests on loess over limestone positively affects the soil chemical properties

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The influence of the distribution of different broadleaved tree species on soil chemical properties was analyzed in a mature deciduous forest in Central Germany. Triangles of three neighboring trees (tree clusters) that consisted of either one or two species of European beech (*Fagus sylvatica* L.), European ash (*Fraxinus excelsior* L.) or lime (*Tilia cordata* Mill. or *Tilia platyphyllos* Scop.) were selected and analyzed for their litter chemistry and chemical properties of the mineral soil (0 10 cm and 10 20 cm). The pH value and the stock of exchangeable Mg^{2+} (0 10 cm) were highest under ash and lowest under beech. The stock of exchangeable Mg^{2+} correlated positively with the annual input of the respective nutrient from leaf litter. Ash litter contained highest amounts of Mg. Stocks of exchangeable Mg^{2+} correlated positively with increasing ash litter input. Our results indicate that the abundance of ash in beech dominated forests on loess over limestone had a positive effect on soil chemical properties and reduced soil acidification. The intermixture and distribution of ash in beech-dominated stands resulted in an increase of the horizontal and vertical diversity of the soil habitat.

Keywords: Nutrient stocks in the forest soil / nutrient recycling with the leaf litter / effect of Fraxinus excelsior on soil properties

25.

Plant diversity improves protection against soil-borne pathogens by fostering anatgonistic bacterial communities

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Fluorescent pseudomonads are able to increase soil suppressiveness by producing antifungal exometabolites, such as 2,4-diacetylphloroglucinol (DAPG) and pyrrolnitrin (PRN). Consequently, they have been proposed as biocontrol agents of plant diseases, but their use has had limited success due to the various factors affecting microbial communities in the rhizosphere. Increased plant diversity results in a higher soil microbial biomass and activity and likely affects various functions of soil microbial communities, such as protection against pathogens. Additionally, increasing plant diversity has been shown to enhance plant productivity, and we hypothesized that this may in part rely on the positive impact of plant-protective bacteria.

26.

The impact of grassland management on the invertebrate soil fauna and their trophic interactions

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Meadow and pasture management in Central Europe have drastically changed since the 1950s, which was mainly due to agricultural intensification. This development has resulted in a decline of species diversity in permanent grassland. While much research focused on the impact of land-use change on aboveground organisms little is known on organisms below the ground, though soils are among the most species-rich habitats of terrestrial ecosystems.

Our study focuses on the diversity and functionality of the belowground fauna along a gradient in management intensity. The composition of animals, especially the macro- and mesofauna are analysed, but also microorganisms are considered. We implemented a three-factorial grassland management experiment in the Solling (Lower Saxony, Germany) including two cutting frequencies (one and three cuts per year), two fertilization treatments (non-fertilized and NPK fertilized) and three diversity levels of the sward.

For investigating the structure of food webs in the soil and disentangling trophic interactions natural abundances of stable isotopes (^{15}N) in invertebrates will be analysed. In addition, a labelling experiment with ^{13}C is planned, aiming to differentiate between roots and leaf litter as sources of carbon for the soil food web.

27.

Measuring the Chemodiversity of Poplar Volatiles

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Poplars are of great interest for a lot of different insects. To investigate why some poplars are more interesting than others we have a look at the chemodiversity of the volatile organic compounds (VOC) emitted by the poplar leaves. These compounds are crucially involved in processes like finding food, host trees or locating prey insects. The chemosystematic of poplars uses patterns of secondary metabolites for systematic classification. Because some of these compounds are volatile, we expect that insects can differentiate poplars on different systematic levels by the pattern of the VOC. Therefore, we currently investigate VOC-patterns released by different poplar species from 3 sections (Aigeiros, Tacamahaca and Populus) growing under defined conditions in the greenhouse.

Because insects often select their host plants on the basis of an array of volatile compounds, we set out for a holistic approach and used diversity indexes to discuss the impact of chemodiversity of poplars on trophic interactions with insects.

28.

From biodiversity down to species identity – where do we find effects on yield in grassland of different species composition?

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The biodiversity-productivity relationship has been in focus of ecosystem research for several decades now. Mainly focussing on artificial grasslands, only few studies have concentrated on semi-natural systems such as managed permanent grasslands. In the Grassland Management Experiment (GRASSMAN) we examined such grassland manipulated by application of herbicides resulting in monocot and dicot reduced swards on top of untreated control swards. These swards are subject to different management intensities, regulated by cutting regime and nutrient supply.

We examined the effect of biodiversity, functional diversity and species identity on yield. Neither the sward types nor biodiversity measured as richness, Shannon and Simpson index or evenness had any effects on single yields or the total yield 2009. Likewise the functional diversity in terms of proportions of grasses, forbs and legumes. A finer classification with functional groups subdivided into small and tall grasses, fobs and legumes revealed a significant positive correlation between yield and the amount of tall grasses (only in fertilized plots) and the amount of tall and small forbs (the latter only in fertilized plots). Higher amounts of small grasses in fertilized plots decreased the yield significantly. We found no significant identity effects of single species common on all plots.

29.

Influence of beech participation in stands composition on the tree and herb layer diversity

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The development of mixed and near-natural/close-to-nature stands/forests is highly recommended under the circumstances of future growth conditions that are changeable as a consequence of the climate change (Lüpke 2009), as well as for ecological and economical reasons. Since under natural conditions in Central and Eastern European countries, European beech (*Fagus sylvatica*) represents the most important tree species (Bohn et al. 2004), it is crucial to know how the beech participation in stands composition influences the stands diversity and productivity.

On 34 plots (1,000 m^2 each) located in natural mixed beech-sessile oak stands in "Runcu-Grosi" Natural Reserve (Western Romania), with various beech participation rate (as per cent from total stand volume), diversity and productivity of tree layer and herb layer species richness were investigated.

A lower beech proportion implied an increasing of canopy layer species richness, Shannon-Wiener Index and Eveness whereas it didn't affect the stand volume. The species richness of herb layer was related to both beech proportion ($r = - 0.38$) and number of canopy layer species ($r = 0.38$).

The contagion index W (Gadow et al. 1998) with values of 0.48-0.58 indicated a randomly tree distribution and was independent to beech participation. In beech-dominated plots, the mingling index (M) had the lowest values (<0.1) whereas in plots rich in canopy layer species reached higher values (ca. 0.7).

Our study showed that beech had a strong and negative influence on the tree and herb layer diversity but not affected the stand volume.

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30.

Tree species effects on the composition and activity of soil bacterial communities

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Mankind increased plant and animal extinction rates dramatically by altering natural environments and transforming landscapes. In this study, we analyzed the effects of tree species and tree species diversity on soil microbial community composition. For this purpose, we established artificial soil habitats and planted *Acer pseudoplatanus*, *Fagus sylvatica*, *Fraxinus excelsior*, *Carpinus betulus*, *Tilia cordata*, a mixture of three and of all five tree species. As a control, a treatment without trees was established. Additionally all 17 variants were grown with and without a litter overlay. To assess soil microbial community compositions, soil samples were taken in October 2008 and June 2009 and analyzed.
We applied denaturing gradient gel electrophoresis as well as the 454 pyrosequencing of partial 16S rRNA gene sequences. To assess the prokaryotic community composition and active community members we used DNA-based and RNA-based analysis of 16S rRNA gene sequences, respectively. The recovered data

showed differences in community composition with respect to employ DNA or rRNA as starting materials. The achieved DGGE patterns revealed a high bacterial diversity but no correlation between tree diversity and community structure was observed. Nevertheless, the cluster analysis indicated differences in community composition in response to seasonal changes and litter overlay.

31.

Dawn of death: species and food web extinction risk

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How ecological communities react to species extinctions is a long-standing and current question in ecology. The species that constitute the basic units of the ecosystems interact with each other forming complex networks of trophic relationships. The characteristics of these networks are likely highly important for the consequences species extinction will have. Here we take a holistic approach analysing a broad range of network characteristics and their role in food web susceptibility to extinction risk. While we focus on species extinction-risk additionally to food web extinction-risk with empirical food webs we explore for niche model food webs the food web extinction-risk only.

The results were obtained by calculating the average number of secondary extinctions to get a measure of food web extinction-risk. Our results show there are multiple factors from all three groups of food web characteristics are affecting food web vulnerability. However, we find the most striking effect for empirical and niche model food webs was related to the body mass, which points to the importance of body mass relationships for food web stability.

32.

Long-term change of ant communities in cacao agroforestry in Indonesia

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Land-use change and agricultural intensification can strongly affect biodiversity in agricultural habitats. While most studies use either space-for-time substitution approach or short-term experiments to investigate management impacts, data on the long-term change of species communities in agroecosystems is scarce. Here we investigate the long-term change of ant communities in cacao agroforestry systems in Central Sulawesi, Indonesia and attempt to disentangle the driving factors of this change. A decrease in shade tree cover, increase in the pesticide use frequency and the spread of invasive species were expected to cause a significant decrease in species richness and a strong change in community composition. In 2009, we resampled ant communities from sites for which previous surveys had been conducted either in 2001 (Palolo region) or 2003 (Kulawi region) using insecticide fogging. We correlated data on management change with the change in ant communites. The change in ant communities differed between regions. While plot and tree-scale species richness decreased in Palolo, plot-scale richness remained constant while tree-scale species richness increased in Kulawi. While these regions differed in the background level of intensification, plot-level management change explained but little of the change in ant community, with a weak trend towards a decrease in species richness under frequent pesticide application from the observational data. Change in ant communities in managed systems over time may be more difficult to predict than expected. This highlights the importance of repeating such long-term studies to improve our understanding of the processes underlying the patterns, while our findings suggest that larger scale changes in land-use may play a more important role than local management.

Keywords: ant, species richness, land-use change, agriculture intensification

33.

Short-term succession buffers local management effects on insect guilds in grasslands

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1. As all species are linked in networks of mutualistic and antagonistic interactions, diversity and abundance patterns of interacting insect taxa are important factors influencing ecosystem services and stability. Agricultural intensification by means of grazing, fertilization and mowing practices could reduce biodiversity and associated ecosystem functions, even though trophic guilds are differentially affected and often contradictory effects were found in different regions. The aim of this study was to measure the effects of land use intensification on the community of insect functional groups (predators and herbivores) in agricultural grasslands of three regions located along a north-south gradient in Germany. Additionally we investigated the compensatory potential of short-term established succession areas to buffer local management effects.
2. True bugs (Heteroptera) and beetles (Coleoptera) were chosen as indicators because both groups include phyto- and zoophagous species, are highly mobile and have been reported to be sensitive to environmental changes. A succession area of 4x7m was excluded from any agricultural management during a one year period. Shannon diversity was calculated to measure guild diversity with respect to local abundance. For further characterization of communities we used guild abundance relative to total insect abundance. To quantify agricultural intensification effects we evaluated farmers' questionnaires and tested management components either combined to an overall land use index and as separate management practices.
3. We found a direct negative effect of overall land use intensification on diversity and relative abundance of the herbivore community, consistently at the three study regions. In particular mowing frequency, affecting vegetation height and local plant species richness, excelled as a key driver of herbivore diversity decline.

4. Predators appeared to be bottom-up controlled via herbivore availability and not directly influenced by management practices. Short-term succession enhanced herbivore diversity on frequently mown grasslands.
5. *Synthesis and applications.* Our results indicate that even small and easy achievable succession plots serve as refuges islands and promote desirable levels of ecosystem services. Succession established on intensive used plots enhanced local insect communities considerable and guild diversity and abundance were, with slight shifts in species composition, equal to extensively managed grasslands in the surrounding agricultural landscape.

34.

Tropical tree species assemblages in topographic habitats for different life stages

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Habitat-driven species assemblages and species distribution patterns in recruits, juveniles (< 1cm dbh), and adults (≥1 cm) were examined for 219 species in the 25-ha Dipterocarp forest in *Sinharaja (Sri Lanka)*. Habitat types[1] were determined with *Multivariate Regression Trees* that grouped areas with similar species composition (i.e., species assemblages) according to the topographic variables *elevation*, *slope*, *altitude above channel*, *topographic wetness index (TWI), convexity* and *curvature.* The variance explained by topographic variables for different life stages ranged between 13 and 24%*. Elevation* explains most of the species variance (10-13%), and *convexity* and *slope* were least important for the habitat classification*.* However, in contrast to earlier studies in the Sinharaja forest, aspect playeds an important role in our habitat classification. We found that the species assemblages emerging for the juvenile stage were the same as for the adult stage and similar to that for recruits. Habitat change due to temporal variation was negligible in all life stages. In *Sinharaja,* the indicator species for the juvenile stage were also indicators in the adult

stage. Most species in the juvenile stage were associated with steep spurs but less steep spurs hosted more species for adults; which is similar to results from the *Gutian Plot (China)*. *Unconstrained K- means cluster analysis* explained approximately 41-62% of species variance in the different life stages. This additional variance occurs due to important unobservable variables.

[1]. Steep spurs, S-W less steep spurs, S-W of the valley, N-E less steep spurs with low altitude above channel, N-E less steep spurs with high altitude above channel

35.

European beech seedlings are much more responsive to shade and drought in biomass partitioning than Norway spruce

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We investigated the effect of light availability and soil moisture on growth and biomass partitioning of Norway spruce and European beech seedlings in a 3 (light) x 2 (soil moisture) factorial greenhouse experiment. In both tree species, growth and biomass allocation to above and belowground plant components were affected by light availability. A significant response to drought in all aboveground components and fine root biomass of European beech, and in stem and branch biomass of Norway spruce was found. The shoot/root ratio of both species increased significantly with reduced light availability. European beech proved to be more plastic and less stressed by reduced light availability. Overall, European beech seedlings appear better able to adjust biomass partitioning to resource availability. The slow response of Norway spruce may result in severe stress if resource availability suddenly decreases further. Our results indicate that biomass partitioning is not only driven by ontogeny, and thus tree size, but is environmentally determined to a substantial degree. A possible explanation for this divergence from other results on the role of ontogeny in biomass partitioning may be that seedling plasticity in response to limited

resources declines with increasing age and/or time of exposure to the limited resources.

36.

Effect of Biodiversity on Dissolved Organic Matter Export - HPLC-IRMS Evaluation for Online Isotope Measurements of DOM

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Sources and fate of dissolved organic matter (DOM) in soils are still under discussion. Additional chemical and isotopic analyses of DOM are needed to improve our knowledge. Here, we evaluated high performance liquid chromatography online coupled to isotope ratio mass spectrometry (HPLC-IRMS) to determine the amount and isotopic signature of DOM in natural samples.

The conversion efficiency of the wet chemical combustion and mean recovery of 99.3 % carbon for standards proved the excellent performance of the method. An evaluation against reference methods showed excellent correlations of $R^2 > 0.99$ for DOM concentrations and isotopic signatures. Accordingly, quantitative and isotopic measurements of DOM using HPLC-IRMS are possible.

The new method was used to investigate the effect of litter quality and diversity on DOM export. Soil water samples were collected in 5 cm depth during a labelled litter exchange experiment (different labeled litter of *Fagus sylvatica* and *Fraxinus excelsior*) in the National Park Hainich (Germany). Unexpectedly the contribution of litter ^{13}C into the dissolved carbon pool was very low. A higher percentage (up to 6 %) of ash litter derived ^{13}C in DOM of soil water indicates a positive effect of both litter quality and diversity on decomposition.

37.

Carbon flow in the belowground food web of an agricultural field site assessed by isotope tracers: a pulse-labeling experiment

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The flow of carbon from plants to the soil food web is one of the most important transfers of organic material into the soil system, but still many details remain unclear.

In a pulse-labeling experiment on an agricultural field site planted with maize I investigated the incorporation of ^{13}C and ^{15}N into the soil animal food web. Soil meso- and macrofauna were extracted 25 days after labeling, identified and analyzed for concentrations of ^{13}C and ^{15}N.

After 25 days all animals were highly enriched in ^{13}C and ^{15}N. However, incorporation clearly differed between trophic guilds and was significantly higher in predators compared to decomposers. My results suggest that soil invertebrates predominantly rely on recently fixed carbon and nitrogen, whereas old soil organic matter pools are only of minor importance. Moreover, variations across trophic guilds point to different reliance of predators and decomposers on recently fixed carbon and nitrogen resources in arable ecosystems.

38.

Feedback between plants and soil biota in invaded ruderal plant communities

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Investigations of plant interactions with soil biota play an important role for understanding the mechanisms behind the successful spreading of invasive plant species. Plant-soil feedbacks occur when plants change soil community composition with positive or negative feedback effects on their own performance. Here we

examine whether the successful invader *Solidago canadensis* negatively influences plant growth and susceptibility to leaf herbivores of two coexisting native plant species (*Tanacetum vulgare*, *Melilotus albus*) mediated by changes in soil community composition. We collected soil beneath the three target species in the field and used it as inocula for an experimental greenhouse study. We transplanted seedlings of our target plant species either into their own soil (home soil) or into soil derived from the competitive invasive or native plant species (foreign soil). Our results show that *T. vulgare* has increased shoot growth in foreign soil derived from *S. canadensis* compared with its own soil suggesting a negative soil feedback or a growth promotion by the soil community of *S. canadensis*. This effect differed in soils from urban or forest sites. We analyzed the community structure of soil inhabiting nematodes to see whether nematodes could play an important role in achieving positive or negative soil feedbacks.

39.

Effects from beech and ash to the CO_2-, N_2O- and CH_4-fluxes of a Luvisol

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Plants have largely unknown influence on greenhouse gas fluxes from soils by changing conditions in the topsoil. Changes are (a) of physical nature soil by influencing soil structure which has considerable impact on gas diffusion into and out of the soil and (b) of chemical nature by changing biogeochemical condition in the rhizosphere which represents the interface between plant, soil and atmosphere. Biogeochemical changes influence the microbial production and consumption from CO_2, N_2O and CH_4 in soils. Plant impulses are manifold and may be repressive or supporting for the net balance of greenhouse gas fluxes from soil. Here we tested if ash and beech differ in their influence and the immediate response of photosynthesis activity on rhizosphere net GHG fluxes.The experiment has 4 treatments and each was 5 times replicated. Each of the 20 soil columns was filled with 5 kg soil from a Luvisol (topsoil from Hainch forest National Park). The treatments included two young trees of (a) ash (b) beech (c) ash and beech and (d) soil as control. Own experiments

showed that ash has nearly double methane (CH_4) uptake than the other treatments and less nitrous oxide output and more CO_2 -output. Photosynthesis had, besides the expectable CO_2 effect, significant effect on the uptake of CH_4 which were higher than without photosynthesis.

Keywords: Soil, Greenhouse gas, Photosynthesis-Effect, Ash, Beech

40.

‘Trophic whales’ as biotic ecosytem buffers against external stressors

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Human activities compromise biodiversity by species loss and by inducing unstable dynamics. However, some ecosystems maintain high complexity levels despite experiencing continuing disturbances suggesting that intrinsic properties prevent resulting extinctions. In this vein, **weak interactions** are suggested stabilizing elements of complex systems but experimental test are lacking. Here, we present a concept for an **a-priori identification** of stabilizing species based on allometric theory, which is rigorously tested in an experiment. Our results indicate that large basal-feeding species buffer ecosystems against enrichment-induced unstable dynamics. Similar to chemical or mechanical buffers, these species serve as **'biotic buffers'** that take up stressor effects and preserve systems from instabilities. We refer to these species as **'trophic whales'** as they share important characteristics with baleen whales: (1) high body masses and thus low per unit biomass feeding rates, (2) consumption of basal resources, and (3) invulnerablity to predation. In an experiment, we found: (i) enrichment increases biomasses in a food chain potentially causing feedback loops, and (ii) addition of earthworms, as trophic whales, impedes this effect and dampens population oscillations. We discuss trophic whales as common entities in ecosystems. Considering increasing stressor effects, the conservation of network-intrinsic biotic buffers helps maintaining stability of ecosystems.

41.

N-oxide fluxes and (de)nitrification contributions from tropical forests after chronic N addition

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N deposition is projected to increase in tropical region and emissions of climate-relevant N-oxide (NO and N_2O) gases are expected to rise. However, few studies quantify long-term impact of increased N availability on these gases and on the processes responsible for their production. We used N addition experiments to achieve N-enriched conditions in contrasting montane (3-4-yr N addition) and lowland (11-12-yr N addition) forests in Panama. Control and N-addition (receiving 125 kg urea-N ha^{-1} yr^{-1}) treatments were represented by four (40 m x 40 m) replicate plots each. Between the montane forest soil (3-4 yr N addition) and lowland forest soil (11-12 yr n addition), we wanted to 1) compare the N-oxide flux and soil-N-cycling responses and 2) quantify the changes in the contributions of nitrification and denitrification to soil-surface N_2O emissions. With N addition, a significant increase in N-oxide fluxes was observed from the montane forest soil but not for the lowland forest. In terms of the magnitude, the montane forest soil has comparable responses to that of the lowland forest. Both nitrification and denitrification contributes equally to N_2O production in the montane forest and in the lowland forest during dry season. However, with N addition denitrification was favored in the lowland forest during the wet season.

42.

Ectomycorrhiza: a link between above- and belowground ecosystem?

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Trophic relationships between soil fauna, plants and mycorrhizal fungi are fundamental to ecosystem functioning. Ectomycorrhizal fungi (EMF) play an important role as regulator of the flux of carbon and nutrients. However, little is known on trophic relationships between EMF species and soil animals and the role of these interactions for carbon cycling and plant nutrient uptake.

The flux of carbon from *Fagus sylvatica* into soil biota was investigated in a greenhouse experiment by labeling tree seedlings with $^{13}CO_2$. In parallel, nitrogen uptake of the trees from $^{15}NO_3$$^{15}NH_4$ was studied. The tree seedlings were collected in the Hainich National Park (Thuringia, Germany) and incubated with intact rhizosphere soil in the greenhouse for five months. Thereafter, EMF and soil arthropods were identified to species. The flux of plant C into soil arthropods and the uptake of N by the plants were investigated by analyzing stable isotope ratios of meso- and macrofauna species, mycorrhizal root tips and fine roots.

A total of 32 EMF and 55 soil animal species were investigated. The results highlight species specific differences in C allocation and N uptake by EMF. Stable isotope ratios demonstrate that EMF functions as control point of plant nitrogen uptake which is mediated by plant carbon. The results further indicate trophic links between EMF, fungivorous soil arthropods and soil arthropod predators.

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43.

Effects of tree and herb layer diversity on richness and abundance of flies (Diptera) in Germany's largest connected deciduous forest

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Plant diversity can strongly influence the diversity of associated insect communities. However, little is known about this relationship in forest ecosystems.

Here we investigate how Dipteran family richness and abundance change along a tree and herb diversity gradient in the Hainich National Park (Thuringia, Germany), one of the largest continuous stretches of deciduous forest in Central Europe. We combined pan trap catches and suction sampling.

We found that both tree and herb diversity influenced Dipteran abundance, with herb layer diversity having a stronger effect. However, the direction of the relationship depended on the dominant tree species: In forest stands dominated by *Tilia* spp., tree and herb layer diversity had a positive effect on Dipteran abundance, whereas the effect was negative in stands dominated by *Fagus sylvatica*. In contrast, Dipteran

richness did not respond to tree or herb layer diversity. Herb cover had a consistently positive effect on both Dipteran richness and abundance.
Our results indicate that plant diversity, particularly of the herb layer, does influence abundance patterns of Diptera; however, plant cover plays a much greater role in driving Dipteran richness and abundance. Also, species identity of dominant tree species appears to modify relationships between plant diversity and insect communities in forests.

44.

Relationship of intraspecific diversity and biomass production in a poplar model ecosystem

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Anthropogenic activities narrow the genetic reservoir for flora and fauna. It is unknown how changes in intraspecific diversity affect the functionality and productivity of ecosystems. Here we are using poplar as a model tree to investigate the influence of increasing intraspecific diversity for ecosystem functions. Our working hypothesis is that increasing intraspecific diversity of poplars increase biomass production above that of poplar mixtures with low intraspecific diversity.
To test this hypothesis 8 different poplar demes (*Populus tremula, P. tremuloides*) were planted in mixtures of 1, 2, 4 or 8 demes. The demes which are used in this experimental design originate from a north-south and an east-west transect: 7 from Europe (German (3x), Swedish, Polish, Swiss and Austria) and one from the USA.
First results show significant growth differences of the different demes. Stem heights of the USA and the Austrian demes were about the average. Growth in terms of height shows a biodiversity effect suggesting facilitation between co-occurrence of 2 demes and competition in the presence of higher deme numbers.

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Key publications:
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45.

Influence of grassland management intensity on the endophyte diversity in different grass species

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Most grass species are colonized by high numbers of microorganisms. The most interesting ones are endophytic species. Contrary to plant pathogens, they do not cause visible symptoms when living in plants. Endophytes do change the plant metabolism and strengthen the plant resistance to herbivores or pathogens. Despite the knowledge of the interaction between grasses and endophytes, the influence of grassland management intensity on the bacterial and fungal endophyte diversity is still unknown.

This study is focused on assessing and exploiting the endophytic diversity in different grass species with regard to grassland management regimes. For that purpose, samples from a semi-natural, moderately species-rich grassland site near Silberborn (Solling) were analysed in two different ways. On the one hand, non-specialised

endophytes were isolated from the plants and classified by rDNA analysis. On the other hand, total DNA was extracted directly from the samples and studied by DGGE. To gain insights into the endophyte diversity, interesting bands were sequenced and further analysed.
Evaluating the endophyte diversity in different grass species will allow us to determine the influence of grassland management intensity on the endophyte diversity.

46.

Genetic diversity of poplar communities in a diversity experiment (POPDIV)

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Poplar is a preferred model tree species for ecosystem function studies. We used *Populus tremula* and *Populus tremuloides* as model tree species to study the effect of different numbers of demes on the total genetic diversity in a diversity experiment (POPDIV). The material used in this experiment was composed of seven *P. tremula* demes from Geismar (Germany), Holstein (Germany), Switzerland, Sweden, Austria, Poland in Europe and one *P. tremuloides* deme from the USA propagated from seeds or seedlings. Eight microsatellite- and two AFLP- markers (amplified fragment length polymorphism) were used in order to analyse the genetic diversity within demes and the genetic differentiation among different demes and to model the genetic diversity of different mixtures of demes. The results of both markers showed that the eight demes in the monoplanting plots had different levels of genetic diversity. The highest genetic diversity was observed in the USA deme and the lowest was found in the Geismar 8 deme. Although AFLP markers showed lower gene diversity than microsatellites, both markers were highly positively correlated. The highest genetic diversity was found within demes but not in the plots with eight demes. Many plots mixed with the USA deme showed a high genetic diversity especially the two deme plots composed of the USA and Sweden deme. However,

the mean genetic diversity increased with the number-of-deme combinations in the plots. In conclusion, the number of the demes within a plot is a poor predictor of its genetic diversity. So the genetic diversity depends not only on the number of demes mixed in the plots, but also on the genetic composition of the deme.

47.

Soil water uptake in single and mixed species tree groups of a temperate deciduous Forest

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The objectives of this study were to identify possible effects of tree species identity and mixture on soil the water balance and vertical distribution of water uptake by trees in a temperate deciduous forest. For this purpose 16 tree clusters were selected in the Hainich National Park, Germany, each consisting of three co-dominant trees and their surrounding neighbours. Observed species were beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*) and lime (*Tilia cordata*) combined in single- and three-species groups (n=4). Volumetric soil water content was measured with FDR sensors (at 0.1 - 0.7 m soil depth) in 0.1 m intervals and throughfall with four collectors per cluster. A soil water budgeting was conducted to estimate the daily soil water uptake of the tree species during a desiccation period. Furthermore we carried out a stable isotope analysis to assess the natural abundance of 2H and investigate on the soil water uptake depth of the different species. Hence, soil samples were taken from the soil profile on each cluster in 0-0.1, 0.1-0.2, 0.2-0.3, 0.3-0.5 and 0.5-0.7 m depth in addition with stem samples from the cluster trees. The water budgeting didn’t reveal any significant effect of tree species identity nor species mixture on the daily volume of soil water uptake during the desiccation period. Soil water isotopic signatures of δ2H (ranging between -30 and -80 δ‰) declined with depth in the soil profile from the topsoil to 0.5 m levelling off at 0.5 to 0.7 meters.

Direct inference comparison of tree and soil isotopic signatures showed similar depth of soil water uptake for all observed species and the mixture at 0.3-0.5 and 0.5-0.7 meters. However a linear isotope mixing model showed that the fraction to which trees utilized these depths for water uptake differed between the single and mixed clusters. This hints to a diversity effect with regard to complementarity between the species.

48.

Pollen diversity along an altitudinal gradient in the northern tropical Andes hotspot

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The region of the south Ecuadorian Andes has been world-renowned for its species richness since Humboldt first visited the country. Here, numerous ecosystems on an altitudinal gradient of more than 3000 m create a unique landscape pattern and enable an outstanding variety of vascular plant species to grow in this area. In the frame of the RU 816 of the Deutsche Forschungsgemeinschaft, vegetation, fire and land-use history have been studied in the Podocarpus National Park and its surroundings since 2003. However, until today only little is known about the relationship between pollen rain and vegetation patterns. Yet this knowledge is crucial for the better interpretation of palynological datasets that deal with the reconstruction of past environments. We obtained pollen rain data from 72 pollen traps that collected pollen for one year along an altitudinal gradient from the premontane to the lower, as well as upper montane rainforest of the Podocarpus National Park region in South Ecuador. First results show a clearly distinguishable pollen rain pattern along the altitudinal gradient, despite of the constraints of pollen taxa identification. Furthermore, our results indicate that a mid-domain effect is clearly visible in the pollen data.

49.

Effects of ash and beech saplings on gas exchange and chemical soil properties of a temperate deciduous forest soil

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Tree roots are main drivers of the carbon and nitrogen exchange of forest soils with the atmosphere. However, the mechanisms behind these processes are largely unknown. Therefore, we investigated the effects of two of the most important European tree species in a double split-root rhizotron approach. We studied the influences of beech and ash saplings on internal soil properties and consequently greenhouse gas fluxes of CO_2, N_2O and CH_4 between soil and atmosphere. Two saplings in each of 16 rhizotrons were hold under controlled climate conditions for 475 days. Gas fluxes were measured biweekly using the closed chamber technique, whereas NO_3^-, NH_4^+, N_{total}, C_{org} and the pH were investigated at the end of the experiment. We showed that especially the fast growing ash saplings affected soil properties and gas fluxes. CH_4 uptake was strongly enhanced and N_2O emissions were lowered by ash roots. For beech saplings, we found only low impact on gas exchange. Changes in soil properties by tree roots are less pronounced. Consequently, we assume that gas fluxes are highly sensitive indicators of changes in the carbon and nitrogen cycling of soil.

50.

Diversity of wood traits of five endangered Dipterocarpaceae of the Philippines: a biodiversity hotspot

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Most tropical forests of Southeast Asia are dominated by the species rich family Dipterocarpaceae which comprises the most important tropical timbers for trading (Whitemore, 1984). Stem samples of five dipterocarp species, (*Dipterocarpus kerrii* King Damar, *Hopea plagata* (Blanco) S. Vidal, *Parashorea malaanoman* (Blanco) Merr, *Shorea almon* Foxw and *Shorea contorta* Vidal) were collected from a plantation within the forest reserve of the Leyte State University Leyte, Philippines. These species varied in height, density, usability and durability. To find out the reasons of these variations, functional anatomy and chemical properties of wood and lignin were studied with FTIR (Rana et al., 2009, 2010). Quantitative analysis showed that *D. kerrii* and *H. Plagata* had three-to four times thicker fibre walls than the other species. High lignin and extractive concentrations per volume reflected the better durability of these two species than Parashorea and Shorea species (Rana et al., 2009). Besides, wood and lignin of these two species was easily separable from the rest. The lowest C/N ratio in *D. kerrii* in both wood and lignin is probably an indication of its unsuitability to be used in outdoor purposes inspite its high density (Rana et al., 2010) Higher predicted conductivity of *D. kerrii* and *S. contorta* perhaps indicates their higher water requirements than the rest of the species-those would be more resistant to dry periods (Rana et al., 2009).

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51.

Influence of drought and soil properties on ectomycorrhizal community composition

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Ectomycorrhizal fungi serve mutual nutrient exchange between host plant and fungus and improve host protection from environmental cues such as low water availability. In different regions in Germany ectomycorrhizal communities colonizing beech (*Fagus sylvatica*) roots differ strongly. It is unknown whether these differences reflect adaptation to edaphic or climatic factors.

To investigate this question, a soil transplantation experiment was conducted. Soil from three well characterized regions (Hainich, Schorfheide-Chorin, Schwäbisch Alb) was transferred to Hainich and beech roots were allowed to colonized the soil cores. After one year, half of the soil cores were covered by an experimental roof to induce drought stress. Drought-exposed and non-roofed soil cores were harvested and used for the analyses of EM (ITS and morphotyping), root biomass, nutrient content and architecture as well as for analyses of soil properties (pH, N, C,). First results of this experiment show that the EM community converges to the original Hainich EM community although soil properties of the other sites show strong differences. The results of drought stress will be discussed in the context of global changes.

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