13:30 Jan Wunder

On the development of more realistic tree mortality routines for forest succession models – recent progress and challenges

Tree mortality is a key process of forest dynamics. In most forest succession models, tree mortality is modelled using a surprisingly simple routine based on 'data-free' assumptions about stress thresholds. In many situations, such unrealistic tree mortality routines may bias succession modelling results, e.g. the projected future forest structure and composition in a warmer world.
In my talk, I will show you the recent development of more realistic mortality routines for Swiss forest species using several hundred unmanaged forests of the Swiss National Forest Inventory (NFI/LFI). In the near future, these promising new mortality routines may contribute to more reliable projections of forest succession models.

13:45 Ché Elkin

Evaluating the resilience of mountain forest ecosystem services to climate change.

Mountain forest ecosystems, and the ecosystem services (ES) that are derived from them, are predicted to be strongly influenced by climate change. However, the timing and magnitude of climate impacts on forests will likely differ depending on: 1) regional differences in climate and environmental conditions, 2) the specific forest ecosystem services that are being examined, and 3) the intensity of climate change that is realized. Using three mechanistic forest models we examined how forest ecosystem are projected to be influenced by climate change, specifically focusing on if and when a range of important forest ES are projected to decrease below critical threshold levels. We tested three climate realizations such that we could evaluate the likelihood of the ES thresholds being exceeded, and when this may occur, under the different climate scenarios. Our results suggest that even under moderate climate change scenarios (e.g. a plus 2 degree global increase in temperature) some mountain forest ES will be considerably impacted. Conversely, other forest ES, which are less influenced by specific forest composition, are projected to be more resilient to climate change and may not deviate beyond historic boundaries even under extreme climate change scenarios.

14:00 Kerstin Hockmann

Mobility of antimony in soils under changing redox conditions

Antimony (Sb) is a rather rare element in the earth's crust, but in the recent past, human activities have led to highly elevated Sb concentrations in soils and sediments at many locations and, as a consequence, to increased exposure of biota to this toxic element. In Switzerland, soil contamination by Sb has recently become an urgent issue in particular on shooting ranges. Knowledge about the risks of Sb leaching from such soils is, however, very limited.
A key factor regarding the mobility of Sb in soils is the water regime. Changes in redox potential have a strong influence on the entirety of soil chemical and biological conditions affecting the transport behavior of a solute. This holds all the more for elements that are sensitive to changes in their oxidation state under environmental conditions such as Sb. Under aerobic conditions, Sb is stable as the pentavalent Sb(OH)6- in soil solution. Under reducing conditions, the trivalent Sb(OH)3 becomes dominant. Both species strongly differ in their affinity to iron (Fe) and manganese (Mn) (hydr)oxides. The interplay of Sb redox transformations, differential sorption and reductive dissolution of Mn and Fe (hydr)oxides during water-logging and its effect on Sb mobility has received little attention though.
In this project, we investigate the influence of water-logging on Sb leaching from contaminated soil

using incubation batch, column and lysimeter experiments. Our results indicate that water logging conditions at first led to the immobilization of Sb by the reduction of Sb(V) to Sb(III), since the latter has a higher binding affinity to metal hydroxides. When reducing conditions continued, the previously bound Sb(III) was released into the solution again due to reductive dissolution of the (hydr)oxides, resulting in increased mobility and thus posing a risk to environmental systems.
The results are relevant beyond providing a scientific basis for the risk assessment of Sb leaching from contaminated soil, as they also further the mechanistic understanding of how water-logging affects the transport of redox-sensitive solutes in soils in general.

14:15 Anja Gramlich

Availability of organo-Zn-complexes to wheat plants – Does uptake of entire complexes play a role?

Organic ligands in soil solutions affect the availability of micronutrients such as Zn to plants. Various factors influence the extent to which metal-ligand complexes contribute to metal uptake, as e.g. the stability constant, the charge of the complex or the physiological role of the metal and ligand in plants. In this study, the effects of two ligands involved in physiological Zn transport (citrate and L-histidine) on Zn uptake by wheat were investigated under hydroponic conditions. In a first part, we compared their effect on Zn uptake (65Zn labelled) to the effect of the control ligand EDTA at equal free Zn concentration (50 nM). In the presence of citrate, forming only negatively charged complexes, Zn root uptake was enhanced ~ 3 times and in the presence of L-histidine, forming neutral and positively charged complexes, by a factor of ~ 9 compared to the EDTA treatments (50 ± 3 nmol g-1 DW h-1). In a second step, Zn and ligand uptake were studied from doubly labelled simplified nutrient solutions containing ligands only and two levels of Zn-ligand complexes (20 and 99 µM Zn-ligand complexes). Citrate uptake was slightly reduced in the presence of Zn and the total influx was not high enough to explain the enhanced Zn uptake relative to the EDTA treatments entirely, suggesting that complex dissociation at the root surface explains the major part of the enhanced Zn uptake. L-histidine uptake was much higher than citrate uptake and not influenced by the presence of Zn. Since L-histidine forms stronger complexes with Zn and Zn uptake was enhanced ~ 3 times more than in the presence of citrate, it is probable that Zn-L-histidine complexes contributed directly to the Zn uptake; either by the formation of ternary complexes at the root surface or by the uptake of entire complexes.

14:30 Jochen Breschan

Forest characterization based on LiDAR data

A forest can be represented as a network where the network nodes capture tree locations and edges capture the neighborhoods of trees. Tree locations are processed as points from LiDAR data. The neighborhoods then result from applying the Delaunay Triangulation to these points. This novel representation of a forest enables to automatically derive forest characteristics like forest stands, horizontal structure and stand density. Here, we present results obtained from a case study carried out in an Alpine forest in the Canton of Grisons.

14:45 Leo Bont

Spatially explicit optimization of forest harvest and transportation systems layout under steep slope conditions

Cable-based technologies are a backbone when designing forest harvesting systems for steep slopes. However, layout and placement of the cableways is challenging. To guarantee that wood harvesting costs are minimized and that the process has the least environmental impact on the remaining forest, one must carefully locate both cable towers and cableways. We developed an approach of mixed integer linear programming for planning an optimal harvesting and cableway layout. The model delivered for terrain units up to 35 ha results within a reasonable timeframe.

15:30 Sascha Ismail

Fragmentation genetics and reproductive success of Dysoxylum malabaricum (Meliaceae) in a complex agro-forest landscape in South India

We investigate effects of habitat fragmentation on pollen and seed dispersal and reproductive success in *Dysoxylum malabaricum (Meliaceae)*, a rare timber tree endemic to the Western Ghats, in India. The research area is an agro-forest landscape situated in Kodagu district, Karnataka containing a high density of small 'sacred grove' forests within a matrix of paddy and coffee plantations.
We sampled all 235 adult trees within this landscape (216 km2). Using eleven nuclear microsatellite markers, we applied paternity and parentage analysis to 1054 progeny to assess contemporary pollen and seed dispersal. With field observations on recruitment success and a nursery experiment we evaluate genetic and reproductive consequences of fragmentation.
Our results demonstrate that pollen dispersal in *Dysoxylum malabaricum* can occur over long distances (up to 24 km), connecting trees among different sacred groves. Recruitment rate of seedlings to saplings is three times lower in patches with low local adult tree density than in patches with greater densities. Recruitment of saplings is linked to the frequency of short distance mating events among more re-lated individuals, indicating possible signs of inbreeding depression. Single isolated trees, in contrast, frequently receive heterogeneous pollen from distances exceeding five kilometres, demonstrating their potential as variable genetic resource.

15:40 Esther Frei

Responses of low and high elevation plant populations to climate change

Mountain ecosystems are suggested to be particularly vulnerable to climate change. The local persistence of plant species under climate change is largely mediated by adaptation and/or phenotypic plasticity, i.e. the individual capacity of a genotype to respond differently in its phenotype to differing environments. In species with a wide altitudinal range, plant responses are likely to differ at contrasting elevations. In common gardens at 600m, 1200m and 1800m a.s.l we studied plant responses of low (1200m a.s.l.) and high (1800m a.s.l.) elevation populations of three grassland species (*Ranunculus bulbosus, Trifolium montanum* and *Briza media*). Phenology of all three species was advanced under elevated temperature conditions independent of the altitude of population origin. In R. bulbosus, genetic differentiation between the altitudes of origin was observed in growth and reproduction. Plants from low elevation performed better than plants from high elevation. Furthermore, growth decreased while reproduction increased in the gardens at higher elevation (in plants of both altitudes of origin). Besides the plastic phenological response, *Trifolium montanum* and *Briza media* plants showed hardly any reactions to the experimental treatments, nor genetic

differentiation between the altitudes of origin.
Our conclusion is that the plant species under study might be buffered by phenotypic plasticity in a warmer world. That we found no indications for local adaptation to altitude might be explained by high gene flow among populations which is counteracting potential selection pressures. Indeed, parallel molecular studies showed low genetic structuring among populations and high contemporary pollen dispersal along an altitudinal gradient in *Ranunculus bulbous* and *Trifolium montanum*.

15:50 Andrea Pluess

Micro-evolutionary potential of European beech

Species distribution models suggest that European beech (*Fagus sylvatica*) in the Swiss lowlands might disappear in a warmer climate with longer dry periods. While European beech prefers mesic sites, this species also occurs on shallow soils with low water retention capacities. I therefore wondered if European beech might be adapted to the water availability and thereby harbor 'preadaptive' genes for the anticipated longer dry periods. Indeed, a genetic study revealed divergent selection on dry and mesic sites in close vicinity. The general genetic similarity among sites suggests that 'preadaptive' genes can easily spread across the landscape. Yet, due to the long live span of trees, fostering saplings originating from dry sites and grown within mesic sites might increase resistance of beech forests in the face of climate change.

16:00 Stan Schymanski

Stomatal control and leaf thermal and hydraulic capacitances under rapid environmental fluctuations

Leaves within a canopy may experience rapid and extreme fluctuations in ambient conditions. A shaded leaf, for example, may become exposed to an order of magnitude increase in solar radiation within a few seconds, due to sunflecks or canopy motions. Considering typical time scales for stomatal adjustments, (2 to 60 minutes), we asked whether leaves rely on their hydraulic and thermal capacitances for passive protection from hydraulic failure or over-heating until stomata have adjusted. We employed a physically based model to systematically study effects of short-term fluctuations in irradiance on leaf temperatures and transpiration rates. The results suggest that common leaf heat capacities are not sufficient to protect a non-transpiring leaf from over-heating during sunflecks of several minutes duration whereas transpirative cooling provides effective protection. To avoid over-heating on hot summer days, stomata must be already open before arrival of a sunfleck. Our results also suggest that typical leaf water contents could sustain several minutes of evaporative cooling during a sunfleck without increasing the xylem water supply and thus risking embolism. We thus submit that shaded leaves rely on hydraulic capacitance and evaporative cooling to avoid over-heating and hydraulic failure during exposure to typical sunflecks, whereas thermal capacitance provides limited protection for very short sunflecks (tens of seconds).

16:15 Dani Or

Evaporation dynamics from drying porous surfaces – lessons for water loss from plant leaves

Evaporation dynamics from porous media reflect interactions between internal liquid and vapor transport, energy input, and mass transfer across air boundary layer. We focus on nonlinear interactions between drying porous surfaces and air boundary layer responsible for the constant evaporation rate (stage 1) that is maintained despite loss of evaporation sites (drying surface) and receding drying front. The increased spacing between active pores during drying of a soil surface under

low atmospheric demand (low air speed and thick boundary layer) results in significant increase in evaporative flux per pore that may fully compensate for the reduced evaporative surface area thereby sustaining a constant surface evaporation rate. Such compensation is less efficient under high atmospheric demand associated with thin boundary layer resulting continually decreasing evaporation with surface drying irrespective of internal supply capacity. Despite evidence for similar non-linear interactions between neighboring stomata based on diffusion theory and measurements, and the rich fossil record of co-evolution of leaf stomatal density and aperture size, most plant gaseous exchange models estimate diffusive resistance as a simple product of single pore resistance by stomatal density. The incorporation of stomatal interactions into leaf gaseous diffusion resistance models is relatively simple and could shed new light on the impact of stomata size and density coevolution on plant water use efficiency during plant evolution (Phanerozoic).

16:30 Maëlle Delay

Why do they do that? Understanding farmers strategies through an online RPG.

The loss of biodiversity and associated ecosystem services in the coffee-based agroforestry system (CAFS) of Kodagu is driven by the replacement of the native trees forming the canopy by the exotic Silver Oak. To understand the drivers of this transition, a research team had adopted the ComMod participatory approach. It led to the development of a role-playing game (RPG) used to explore the CAFS management strategies of the farmers. But the RPG has limits that restrict its capacity to explore the impact of different scenarios. The present project had been conducted to turn the RPG onto a multi-agent system. The use of an agile approach combined to an agent-based model and simulation development methodology led to the development of a computerized model with stupid agents and an online computer Role-Playing game (CRPG) using the NetLogo platform. The CRPG will be used to collect information on the farmers' strategies, explore possible futures and serve as a communication and learning tool.

16:45 Janice Lee and Sinan Abood

The Impact of smallholders vs Large-scale companies in oil palm plantation expansion in Sumatra utilizing the 2000 & 2010 Land cover maps of insular Southeast Asia

Oil palm expansion in the Indonesian island of Sumatra had a significant impact on land use/cover change and received considerable attention by researchers to estimate the spatial extent of land conversion and the impact of such land use/cover change on biodiversity and ecosystem services. Between 2000 and 2009, the area of smallholder oil palm plantation has risen rapidly by 11.1% compared to 5.5% from private enterprise (IPOC 2010). The area of oil palm cultivation currently under smallholder production is estimated at 3 million hectares, approximately 40% of total oil palm cultivated area in Indonesia. Given that 1) little is known about the environmental impacts of oil palm development by smallholders and 2) the role of smallholders in Indonesia is expected to increase, we decided to investigate the environmental impact of oil palm smallholders by assessing their role in land use change activities, in particular, the extent of land cover and forest conversion into oil palm plantations. In this paper we focus on the land use/cover change in the island of Sumatra due to both smallholders and large scale activities utilizing the 2000 & 2010 land cover maps of insular Southeast Asia and the GIS ownership layers provided by the Center for Planning and Regional Developments (IPB, Indonesia). The result of this paper is a change detection analysis for the island of Sumatra highlighting the overall expansion of plantation/regrowth class caused by smallholders and large scale activities and the impact of land use/cover on different land cover classes.