Nationalparkverwaltung
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2ND INTERNATIONAL CONFERENCE ON FORESTS

26 – 29 APRIL 2017

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Temperate and Boreal Forest Conservation in a rapidly changing world
"New scientific findings and implications for future management"

Bavarian Forest National Park, Neuschönau, Germany

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Established in 1970, Bavarian Forest National Park is Germany's first and oldest national park. Through to the year 2027 nature is to be left to its own devices on 75 % of the park's territory and as such be free of human influence. Currently, this is the case for almost 60 % of the national park area.

This comprehensive protection of natural processes is the most important internationally recognised seal of quality for evaluating large protected areas.

Karl Friedrich Sinner (1946 – 2017)
A leading forest conservationist

This 2nd International Conference on Forests is dedicated to the memory of Karl Friedrich Sinner, who was Head of the Bavarian Forest National Park from 1998 to 2011.

Before Karl Friedrich Sinner's term at the national park, the research department was only responsible for basic monitoring and reporting of results in non-peer reviewed journals. His efforts finally convinced the Bavarian State Ministry of Environment to allow the establishment of scientific research in the park, consequently laying the foundation for evidence-based conservation management.

Under his direction, research in the park was given an international orientation at the university level. Research staff became qualified; two obtained their doctorate degrees and one received a Habilitation before then becoming an associate professor at the Technische Universität München.

Under his leadership, well-known projects were launched and successfully conducted, such as the BioKlim project, the project on predator–prey relationships between lynx and roe deer/red deer, and the project on the effects of management strategies on biodiversity after natural disturbance, e.g., windthrows. The research department started to obtain third-party funding from several sources, including the European Union programme Interreg and the German Federal Environmental Foundation (Deutsche Bundesstiftung Umwelt).

Further, he promoted the transfer of research results to practical management and environmental education and he excelled in the communication of research results to broad audiences. With time, the results of research conducted by the staff formed not only the basis for conservation management in the national park, but also influenced conservation concepts in European National Parks and European forestry.

Karl Friedrich Sinner gave research in the park room to unfold, allowing it to prosper under his leadership. Today, studies conducted in the Bavarian Forest National Park provide a blueprint for research in national parks throughout Central Europe and have attracted many international cooperation partners. The staff of the Bavarian Forest National Park are indebted to Karl Friedrich Sinner for his tremendous efforts in shaping our research department and for his contributions to forest conservation.

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Saturday, 29th April

9:30 - 17:00 **Excursions**

KEYNOTE:

Integrating principles for restoration forestry and forest biodiversity conservation within native forests subject to multiple interacting disturbances

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Forests globally are subject to increasing levels of natural disturbance, human disturbance and combinations of both (including salvage logging). This is having significant negative impacts on biodiversity and key ecosystem processes. This presentation briefly outlines some of the key effects of multiple, often interacting disturbances in forest ecosystems. As a result of these interacting disturbances, many natural forests are in urgent need of restoration. General principles for forest restoration must be multi-faceted and multi-scaled and should encompass strategies ranging from retaining existing key residual elements of original natural forest cover (e.g. remaining populations of target species, key structures, habitats, and patches) through to restoring patterns of forest cover and key ecosystem processes. Forest restoration principles intersect strongly with similarly multiscaled general principles for forest biodiversity conservation – in particular conserving populations of particular species and their habitats, maintaining stand structural complexity, maintaining patterns of landscape heterogeneity, and perpetuating key ecosystem processes. A framework integrating forest restoration principles with general principles for forest biodiversity conservation is illustrated using a detailed case study of the Mountain Ash (*Eucalyptus regnans*) forests of south-eastern Australia and the conservation of the Critically Endangered Leadbeater's Possum (*Gymnobelideus leadbeateri*).

Green ash and boxelder in European floodplain forests - a novel ecosystem approach

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Invasive species could support essential ecological functions in habitats irreversibly altered by them. Such habitats could be considered as 'novel ecosystems'. Their restoration could be so difficult, that it could even cause harm to ecosystem functions and neighbouring native ecosystems. Therefore it would be crucial, to preserve both the current ecosystem progresses and the native communities, with adaptive strategies. The presentation highlights the significance of this viewpoint in the case of green ash and boxelder in Europe. These North-American invasive species are widespread in the alluvial forests of Central Europe suppressing the regeneration of native tree species. According to the literature, the controlled riverbeds and the climate change are beneficial to them. Their control in younger stands has been practiced successfully, although in older, mixed-age stands it needs further considerations in nature conservation. Nowadays these invasive tree species support the essential mid- and overstorey layer in a great extent of their European range. The restoration of natural, meandering and flooding processes of such riverbeds would be one such novel, adaptive (yet utopian) strategy, so that, the native species could regenerate more successfully.

The effects of forestry treatments on microclimate, regeneration and biodiversity: first results of an experimental study

Bence Kovács, Flóra Tinya, Réka Aszalós, Gergely Boros, Zoltán Elek, Ferenc Samu, András Bidló, Péter Csépányi, Péter Ódor
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There is a paradigm shift in Central Europe from the traditional forestry systems towards continuous cover forestry providing diversification of management practices. The effects of different forestry treatments belonging to rotation system (preparation cutting, clear-cutting, retention tree group) and selection forestry (gap creation) were studied in a mature temperate sessile oak - hornbeam forest in Northern Hungary on microclimate, soil, regeneration and biodiversity of plants, ground beetles, spiders and enchytraeid worms. The experiment was established in 2014 following a complete block design with six replicates, and the short-term responses are summarized here. Air and soil temperature were highest in clear-cuts, but retention tree groups had very similar thermal pattern. The increase of soil moisture was the highest in gaps and it was also detectable in clear-cuts. The responses of different animal groups were strongly related to their mobility: for enchytraeid worms strong, for ground beetles intermediate, for spiders weak treatment effect was detected. In case of plants, the processes were relatively slow, in clear-cuts species richness, while in gaps cover increment was characteristic. Based on this short observation period we can conclude that gap creation or irregular thinning had only moderate effect on forest site that could maintain forest biodiversity.

Felling for biodiversity - the effect of canopy opening on communities of insects, vertebrates and plants in temperate oak-dominated forests

Pavel Sebek, Jiri Benes, Jiri Dolezal, Petr Kozel, Robert Stejskal, Martin Skorpik, Lukas Cizek
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Podyji National Park (South Moravia, Czech Republic) represents a protected area of mostly oak-dominated, historically open forests along the Thaya river canyon. Spontaneous succession in last 80 years has lead to actual threat for light-demanding specialists. Since 2011, a project studying the effect of artificial canopy opening on biodiversity in oak-dominated forests has been carried out in Podyji NP. Twelve small-size (0.16ha) clearings were created in closed-canopy forests in the lower part of the Dyje river canyon. For three years we observed the response of communities of butterflies, moths, epigeic, floricolous and saproxylic beetles, birds, reptiles, and plants to this intervention. The results of the experiment showed a positive effect of early stages of forest succession not only for the majority of studied groups, but also for many threatened species. Our results also demonstrated the great importance of open forest remnants for biodiversity. In protected forests at low and middle elevations, conservation management should attempt to maintain a mosaic of forest at different stages of succession. This can effectively be done by creating small or large clearings, preferably connected together in a network with other open habitats, or by restoring traditional silvicultural practices such as coppicing or wood pasture.

Targets and measures of nature conservation in German forests - a contemporary analysis of relevant strategies and concepts

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Setting operational targets is a major challenge for effective biodiversity conservation. Many problems in nature conservation are rooted in trade-offs between aims, imprecise definition and vague overall concepts. Furthermore, conservation measures are rarely deduced on a scientific evidence base and their implementation is hampered by formal or financial funding limitations and control deficits. These general constraints apply likewise to forest biodiversity conservation. Against this background we conducted a status quo analysis of forest conservation targets and measures relevant to Germany and reviewed their scientific rationale. As a reference framework we developed a general system of conservation targets and measures. The qualitative and quantitative investigation of 79 biodiversity and forest conservation strategies of different stakeholders on various spatial scales shows that the preservation of species and ecosystem diversity is the major conservation goal, with special emphasis on old-growth forests and species habitats. Contradicting, protection of genetic diversity and abiotic resources are considered of limited importance, which does not fully accord with a comprehensive approach of nature conservation. Furthermore, our results show that active and passive conservation measures to preserve old and dead wood and rare habitats are rated of primary importance, but often lack financial funding tools such as contract-based conservation.

Ground flora recovery in ancient woodland in Britain following removal of planted conifers

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Ancient woodland (sites believed to have been continuously wooded since c.1600AD) is a habitat conservation priority in the UK. Between 1935 and 1985 the native broadleaved tree cover in many of these was cleared and replaced by plantations dominated by non-native conifers particularly *Picea* spp., either as pure stands or in mixtures with oak (*Quercus* spp.). This reduced, in some cases eliminated, the ground flora cover. In 1985 a change of forestry policy encouraged the removal of conifers to restore native tree cover, but it was not known what the ground flora response would be. In 1982/3 surveys had been made of the ground flora under plantations at two sites in southern England, in 2014/5 these were revisited to determine how the flora had changed and whether it had recovered in stands that had been restored to native broadleaves. The vegetation was found to be broadly similar in 'restored' stands to remnants of the pre-plantation phase forest. There was no evidence that woodland specialist species were less abundant than woodland generalist species at these sites. This recovery may not happen in every case, but the work provides support for the continuing restoration of replanted ancient woodland sites.

Residence time of coarse woody debris in European mixed temperate forest

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Presence of dead wood plays an important role in protected forest areas. This study presents the results about dead wood residence time of European beech, Norway spruce and silver fir, the three major European temperate forest tree species. In this study, we analysed a dataset of 4260 European beech downed logs, 5365 Norway spruce logs and 2957 silver fir logs from four beech-dominated primeval and natural forest reserves (in total 113 ha), working with a time series of more than 40 years (1972-2015). With the help of Bayesian Survival Trajectory Analysis, we examined differences between residence times in the three macroclimatic regions in Czech Republic (cold-dry, warm-dry and warm-humid region) and in three DBH classes. Residence time of European beech and silver fir downed logs differ significantly between the three macroclimatic regions. The longest residence time was observed in cold-dry region: large-sized logs of European beech (DBH 55 cm) resides 53 years and silver fir logs (DBH 85 cm) resides 85 years. The shortest residence time was observed in warm-dry region: large-sized logs of European beech resides 43 years and silver fir 61 years. These results can be used in restoration management and retention forestry.

Economic analysis of deadwood management strategies with the forest optimization tool YAFO

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Deadwood is recognised as an important part of the forest ecosystem that provides ideal conditions for biodiversity. Mortality in forests is influenced by wind, fire, insects, diseases, suppression and competition. This multitude of calamities renews the pool of deadwood steadily whereas the decrease of deadwood is promoted by different ways of decomposition. Whereas there is a vast amount of research on the bio-physical mechanisms of deadwood, there are only few works about the management of deadwood. A decision support system that can optimise deadwood management by using economic objectives and considers risk aspects is missing so far. This presentation shows a possible solution for that by applying the forest optimisation tool YAFO in a case study (a private owned forest enterprise in East Bavaria) to different deadwood objectives deriving optimal strategies for those objectives. Results show that the economic performance of different strategies not only differ with species or size class restrictions but also heavily depends on the time horizon in which the objectives should be reached. The discussion about deadwood objectives and management approaches should not only focus on “where?” and “what?”, but also on “when?” to do it.

Structural complexity in managed and strictly protected mountain forests: Effects on habitat suitability for indicator bird species

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The designation of strictly protected forest reserves is a major goal of forest biodiversity conservation. However, the structural development in newly created forest reserves and its impact on forest species are controversially discussed. We evaluated the effect of forest management cessation on habitat characteristics of four bird species indicative for different seral stages: Capercaillie, Hazel grouse, Three-toed woodpecker and Pygmy owl. We analysed the forest structure in 39 forest reserves and 300 managed forest sites in four mountain regions in Switzerland and Southwestern Germany. We first modelled habitat use independent of management status and then compared habitat characteristics and suitability of reserves to managed forest with species presence or absence. For all model species, except Pygmy owl, habitat suitability in forest reserves was significantly higher than in managed forests with species' absence, but not than in those with species presence. No significant correlation between time since reserve designation and habitat suitability or key structural elements was found, however, there were consistently positive trends. Forest reserves provide suitable structures for indicator bird species, but these vary greatly in abundance and distribution. This variance was neither explained by the geographic region nor by the age of the reserve, suggesting that past management and site conditions may be crucial factors that need closer investigation.

Evaluation of an integrative strategy for biodiversity protection in forests

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To stop the ongoing loss of global biodiversity integrative conservation strategies can be a good complement to conservation in reserves. The forestry department Ebrach in Northern Bavaria has implemented an integrative nature conservation strategy since ten years. The key element of the conservation side of the strategy is the enrichment of deadwood during harvests. We investigated the success of the strategy, by addressing the following questions: (1) Does the implementation of the nature conservation strategy lead to an accumulation of deadwood in managed forests? (2) Does the implementation of the nature conservation strategy have an impact on biodiversity? We used inventories of structural and biodiversity data that were carried out before and after the implementation of the strategy. The structural data reveal a strong increase of deadwood amounts with a distinct enrichment of deadwood logs. Deadwood amounts increased in about 80% of the plots and the proportional increase was stronger in production forests. The models reveal a positive effect of deadwood enrichment on Multidiversity. Additionally, especially taxa with a high proportion of deadwood dependent organisms profited from the enrichment. In total we consider the strategy as successfully implemented.

Biomass turnover, deadwood structure and residence time - basic points for deadwood management

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Biomass turnover in temperate forests is still unknown because of lack of data. We analyzed 40-year time dataseries from 12 fully censused old-growth forests on the altitudinal gradient. The censuses were based on the stem position maps on the total area more than 250 ha. Deadwood/living wood ratio varies from 0,18 to 0,56 according to different sites, tree species and disturbance events. It is lower in the lowland than in mountain forests. Residence time of deadwood is shorter in the lowland forests than in mountain forests but the biomass turnover varies round 60 years for all localities. The DBH structure of CWD demonstrates the “wave dynamics” of selfthinning in natural forests - for European beech especially. After intensive selection of juvenile (between 4-5 cm) and young trees up to DBH 20 cm is possible to find the lack of snags with DBH 30-50 cm because of no selfthinning. According to the repeated censuses and knowledge of deadwood residence time we predict the lack of CWD for some tree species which will lead to the loss of biodiversity. Should we start the interventions in the old-growth forest reserves to support the biodiversity conservation? Is the potential intervention really the support of biodiversity?

Dead wood availability in managed Swedish forests - Policy outcomes and implications for biodiversity

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Dead wood is a critical resource for forest biodiversity. Based on data from the Swedish NFI we provide baseline information and trends in volume and distribution of dead wood in Swedish forests during 15 years. The data are based on ≈30,000 plots inventoried during 1994-1998, 2003-2007 and 2008-2012. Forest policy has since 1994 emphasized the need to increase the amount of dead wood. The average volume of dead wood in Sweden has increased by 25% (from 6.1 to 7.6 m^3 ha^{-1}) since the mid-1990s, but patterns differed among regions and tree species. The volume of conifer dead wood has increased in the southern part of the country, but remained stable or decreased in the northern part. Heterogeneity of dead wood types was low in terms of species, diameter and decay classes. We found only minor effects of the current forest policy since most of the increase can be attributed to storm events creating a pulse of hard dead wood. Implementation of established policy instruments need to be revisited. In addition to the retention of dead trees during forestry operations, policy makers should consider large-scale targeted creation of dead trees and management methods with longer rotation cycles.

Resilience of understory vegetation after variable retention felling in boreal Norway spruce forests - a ten-year perspective

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We studied the response of understory vegetation and lichens in mature boreal Norway spruce forests to five felling treatments in southern Finland. The stand level treatments were: clear felling (CF), retention felling (RF) (7 % of stand volume retained), gap felling with site preparation (GFs) (50 % retained), gap felling (GF) (50 % retained), and selection felling (SF) (67 % retained). The dynamics of vascular plants depended on the felling intensity. The dynamics of non-vascular species depended both on the felling intensity and site preparation. Local extinctions of mosses and liverworts were caused especially by CF and RF. However, even with 67 % retention, 18 bryophyte species were lost during the study period. Loss of bryophyte species was higher after SF than after GF treatments, suggesting that aggregated retention is better for maintaining bryophyte species in felling areas. The resilience of understory vegetation increased in the order CF< RF < GFs < GF < SF. The abundance of mosses, liverworts and dwarf shrubs had not recovered ten years after treatments. We conclude that in intensively managed forest landscapes, GF and SF can be recommended as alternatives to CF to better maintain understory diversity on the stand level.

Changes in the tree species composition of forest stands in the Białowieża National Park

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The aim of our study was to predict changes in the tree species composition of forest stands located in the oldest part of the Białowieża National Park over the period of 40 years. A size−class growth model was developed for this purpose. The empirical material was taken from the permanent (160) measured in 2000, 2002, 2004 and 2011, used to determine, separately for each species, the relationship between the most important features. The temporary sample plots (460) were measured in 1995 and 2005, and the data were used to validate our model and predict timber volume in the period 1995−2005. The results of the validation indicate significant changes in standing volume for the majority of tree species in the period 2005−2045. The volume increment in the period 2005−2045 will remain at almost the same level, the volume of tree loss will decrease and the volume of ingrowth will slightly increase, beginning from 2015. Only five taxa will have a significant share in the ingrowth throughout the period 2005−2045, of which approx. 85% will be hornbeam in the period 2035−2045. Anticipating changes in the structure of forest stands may be useful in planning the protection of forests.

Could tree-related microhabitats be relevant forest biodiversity indicators?

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Over the last decades, the conservation of forest taxa has been increasingly tackled by the development of biodiversity-friendly forestry practices. Such practices may focus on the retention of key structures such as microhabitat-bearing trees. Tree-related microhabitats (TreMs), such as cavities or wood-decaying fungi are widely recognized as key features for associated specialist taxa which require their particular substrate or microclimatic conditions. At the stand scale, TreMs contribute to increase the structural heterogeneity which is in turn expected to favor biodiversity. TreMs have therefore been suggested as indirect biodiversity indicators or conservation targets. From the compilation of available results, we infer that the relationship between TreMs and local biodiversity is strongly influenced by the forest context, the target taxon or the stand openness. Only a few studies have provided practical benchmarks, such as the minimum density of TreM-bearing trees to be retained by forest managers in production forests. We also point out that the strength of the biodiversity-TreMs relationship is affected by the identity of the response (i.e. overall diversity vs diversity of TreM-associated taxa) or the predictive variable (i.e. TreM density vs diversity), and also by both the TreM and taxon sampling methods.

To manage or not to manage : conservation and restoration strategies in forests with a long management history in Flanders, Belgium.

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Forests in Flanders have been intensively managed for many centuries. This management has profoundly altered their species composition and structural characteristics. There is quite some controversy among conservationists what management options are to be preferred when such forests are included in conservation areas. The choice is often between non-intervention and continuation and restoration of traditional management systems such as coppice-with-standards. We present some illustrative examples indicating that developments are not always as expected, making certain developments less predictive, but all the more captivating and management choices less straightforward, but all the more challenging. Topics covered include spontaneous development of very old beech stands, development of tree layer composition and ground vegetation in unmanaged forests, and species richness of plants, mosses and beetles in unmanaged vs. restored coppice-with-standard management.

Slovenia's extreme case of integrative forest management and implications for biodiversity conservation

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Integrative forest management attempts to simultaneously fulfill both wood production and biodiversity conservation in a given forest region, and presumably supplants the need for unmanaged forest reserves. This is the dominant management paradigm in the temperate zone of Europe, yet few studies have examined the validity of this approach. We used Slovenia as a test bed to examine how the long-term practice of integrative forest management has influenced coarse woody debris and large living trees. Data were compiled from national forest inventory plots, coupled with separate surveys in 51 forest reserves. The mean volume of CWD and density of large beech trees across managed forests in Slovenia was 15 m^3ha^{-1} and 6 ha^{-1}, respectively, these values were more than an order of magnitude greater in old-growth reserves. CWD was primarily comprised of small diameter pieces in managed forest, whereas large diameter pieces in multiple stages of decay represented most of the volume in reserves. These results suggest that integrative management practiced over a large scale may be insufficient for maintaining biodiversity dependent on mature forest conditions at current levels of wood extraction. These findings are further supported by survey data of the White-backed Woodpecker, a species indicative of mature forest structures in beech-dominated forests.

KEYNOTE:

Conservation of Natural Disturbance-Recovery Processes

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Disturbance regimes do not get the attention in conservation biology they deserve. Although the importance of apex predators and trophic cascades is now well accepted among conservation biologists and environmentalists, relatively few recognize the role of natural disturbances in generating and maintaining biodiversity. The rewilding paradigm, for example, focuses on reintroduction of apex predators and other megafauna but usually does not include the equally important need to restore natural disturbance-recovery processes, or to mimic natural disturbance regimes through management. I review the role of natural disturbance regimes in biodiversity conservation, with an emphasis on temperate and boreal forests and woodlands in North America. I suggest ways that an explicit consideration of disturbance-recovery dynamics can contribute to the design of protected areas networks and to the restoration and management of natural and semi-natural landscapes. Especially critical is allowing natural disturbance and recovery processes to operate within a range of variability that species experienced during their evolutionary histories. Species adapt to specific disturbance regimes, not to disturbance per se. The role of natural recovery from disturbance in maintaining biodiversity is as important as disturbance in generating biodiversity. Extreme departures from natural disturbance-recovery processes, for example through clear-felling and salvage logging, will usually result in reduced biodiversity.

Disturbances mitigate climate change effects on biodiversity

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Rising temperatures and altered precipitation patterns are threatening forest biodiversity. Also intensifying disturbance regimes have the potential to modify environmental conditions for plants and animals in the future. In this study, we (i) investigated the long-term effect of climate change on forest biodiversity, (ii) assessed the effects of disturbance frequencies, severities and sizes, and (iii) identified climate- and disturbance-driven changes in biodiversity hotspots in a forest landscape. We used the individual-based forest landscape and disturbance model (iLand) to dynamically simulate the tree vegetation of the Kalkalpen National Park in Austria, taking into account 36 unique combinations of different disturbance and climate scenarios. Subsequently, we used the projected trajectories of tree vegetation in conjunction with empirically derived response functions to predict changes in the diversity of nine different taxonomic groups. We found diverging responses of biodiversity indicators to climate change. Disturbance frequency and severity had a positive effect on biodiversity, while an increase in disturbance size reduced this effect. Spatial hotspots of biodiversity were situated in low- to mid-elevation areas under baseline climate, but shifted and shrank considerably under changing climate conditions. Our findings reveal that increasing disturbance regimes can partly offset negative impacts of climate change on biodiversity.

Historical disturbance patterns in the European mountain spruce forests

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Disturbance patterns drive forest structure and dynamics, the species' environment, and understanding disturbance patterns is necessary for understanding the population dynamics of many species. The potential effects of climate change on forests will be strongly modulated by disturbance patterns. Here we compiled dendrochronological disturbance reconstructions from natural mountain spruce forest landscapes spanning five central and eastern European countries to analyse the temporal and spatial patterns of disturbances. We found significant temporal changes in disturbance extent at all spatial scales suggesting the non-equilibrium nature of mountain spruce forest dynamics. Disturbances peaked in the studied landscapes between 1825 and 1925 with the following reduction in disturbance extent leading recently to region-wide increase in forest age and sensitivity to wind and bark beetle disturbances irrespective of the climate change. The severity of disturbance events was spatially variable and included also high-severity disturbance events. This partially synchronized pattern of disturbances led to patchy nature of forest dynamics suggesting the dynamic nature of the species' environment.

Consequences of scynchronized age-structure for Norway spruce disturbance patterns

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Observable changes in forest cover imply disturbance regimes are shifting towards higher severity events synchronized across broad spatial domains. Quantitative treatments of forest age structure are critical for determining whether contemporary disturbance patterns are due to global change factors or changes in stand-age associated susceptibility. A compilation of 12 000 tree ring cores collected from 560 plots from landscapes spanning five central and eastern European counties was used to reconstruct disturbance histories for Old-growth Norway spruce landscapes. Mean disturbance rates differed significantly among the 5 landscapes and among decades. Large-scale synchronization is implied by the region-wide occurrence of a sustained period of elevated disturbance severity between 1825 and 1925, with the following reduction in disturbance leading to region-wide increases in forest age. Approximately 75% of the current canopy area is now more than 100 years in age. Time-since disturbance and the severity of the last event accurately explain more than 50% of variation in contemporary disturbance patterns. Age-structure effects on forest disturbance rates at sub-continental scales are potentially large, effects of global change on forest disturbance estimated independently of age-structure data are likely inaccurate.

Forest Change after the Kyrill windstorm in Šumava NP

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Mountain forests in Central Europe are disturbed by windstorms and insect outbreaks. Šumava NP was affected by the Kyrill windstorm in 2007. Thanks to land cover data we can analyse forest changes from 2006 to 2012. We recorded spatial-temporal changes in large scale by so-called land cover flows. The land cover flows detect changes among land cover types within complex spatial-temporal framework. The results show small direct effect of the Kyrill, windfalls subsequently increased their proportion by 4.73 km2 (0.69% of Šumava NP) mainly at the expense of the extent of already damaged forest. Coniferous forest area diminished from 56.55% to 48.27% of NP area between 2008 and 2011. The new clear-cuts, clear-cuts with left dead wood and so-called dead-standing forest were formed as well in this period. In intervention zone area of clear-cuts and clear-cuts with dead wood increased, on the contrary in non-intervention zone coniferous forest was transformed in dead-standing forest. This pattern was spatially stable and temporally it was the most intensive between 2008 and 2011. Most of the changes took place in higher altitudes and wet stands. During the last period (2011-2012) those processes slowed down and it may constitute the new beginning of large-scale regeneration.

Natural regeneration of wind-disturbed lowland forest stands

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Natural regeneration was studied in 111 plots in a formerly managed forest which had been set aside for research purposes after large hurricane in 2002. Tree mortality after the hurricane was 49% by tree number and 48% by basal area. The average densities of regeneration in the year 2015 were: 2534 individuals per 1 ha for seedlings, 859 for short saplings and 1146 for tall saplings. The composition of regeneration was more mixed than of mature stand before the hurricane. *Pinus sylvestris* used to be a dominant species (49% by tree number) in 2002, in 2015 it also dominated also among seedlings (46%), and short saplings (31%), but had only 19% of tall saplings. Silver birch, a minor admixture in mature stands in 2002 (7.5%) had a share of 12% in seedlings, 19% in short saplings and 41 % in tall saplings. *Quercus robur* which used to be sporadic among of canopy trees (0.3%), was the second numerous species in seedlings (17%) and fourth in short saplings (12%). The other species which had played minor role in tree stand but were abundant in regeneration were: *Sorbus aucuparia* (12% of seedlings) and *Padus avium* (12-13% of both short and tall saplings).

Life and death of spruce forest: ecological processes in the first 12 years after bark-beetle outbreak

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Bark-beetle outbreaks cause apparently dramatic changes in forest. Detailed insight in regeneration processes reveals striking ability of the spruce forest to recover directly after disturbance. We emphasize the role of seedlings established during the bark-beetle outbreak, which together with advanced regeneration form fundamental part of the future stand. Detailed monitoring of individual saplings helped us to understand the role of microsite and height-dependent mortality in formation of spatially clustered patterns of tree regeneration. Analogously, despite rapid growth of grasses (*Calamagrostis villosa*) we found relatively stable species composition in the herb layer.

Short-term forest fire history and the regional distribution of beetles favoured by fire

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The amount and size of forest fires in northern Europe have been reduced dramatically and several pyrophilic species are now threatened. Efforts are put into control burns in forests Sweden, but the actual benefit of a an individual fire remains unclear, and there is room for optimizing both temporal and spatial occurrence of such conservation burns. We sampled insects attracted to smoke generated as an attractant at 21 sites in a forested region of SE Sweden. The catch was compared against recent (<15 yrs) forest fire statistics with the aim to relate the occurrence of species to temporal and spatial history of fires. Huge numbers of Microsania (Diptera) were attracted, but the catch was unrelated to fire history. Of eleven pyrophilic beetles, seven were positively correlated with recent forest fires, mostly at the smaller spatial scales (100-5000 m). The abundance of 17 beetles with unknown fire-dependency was also associated with recent forest fires. As the autecology of many of these species is not known, it is possible that they too might be favoured by substrates created by fires. Conclusion: Conservation burns that are strategically placed, both temporally and spatially, can help to increase the conservation benefit of forest fires to conserve both fire-dependent and fire-favoured insects.

Białowieża Forest conflict: science vs. politics

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Outbreaks of *Ips typographus* are natural, cyclic phenomena shaping forest ecosystems with Norway spruce. For a century, such outbreaks have caused conflicts over management priorities in Białowieża Forest. The recent outbreak which started in 2012 overlapped with a reduction in logging rate and ban on timber extraction from old-growth stands due to the expansion of the World Heritage Site. Despite the UNESCO Site management rules, intensive salvage logging was applied "to avoid the risk that the forest will succumb to the bark beetle". The decadal logging limit for the Białowieża forest district was subsequently tripled by the Minister for Environment. Scientific evidence, that outbreaks are natural phenomena leading to the regeneration of biodiversity, structure and functions typical of natural forest, was neglected. This caused nationwide protests and instigated visits to the forest by UNESCO and the European Commission. In response, the Minister and foresters, supported by some forest scientists, started to deny the natural origins of the Białowieża Forest. A socio-political campaign was launched and a monitoring programme worth 3 million Euros was funded by State Forests, the aim of which is to prove that Białowieża Forest was created by local people and will collapse if not cut and replanted.

Harmful biodiversity effects of forest clear-cutting can be reduced by post-harvest burning and retention trees: the case of rare and threatened flat-bugs

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Fire suppression and reduced volumes of dead wood have led to a major decline in pyrophilous and saproxylic insects in Fennoscandian boreal forests. As a consequence, several species are currently seriously threatened. We explored in a large-scale field experiment whether specific conservation measures - prescribed burning and retention forestry - can facilitate the survival of flat bugs (an insect genus that includes several pyrophilous and threatened species) in managed forests. The data included 1224 individuals of 12 species, sampled over a 4-year period. Burning increased the species richness and abundance of flat bugs, especially the pyrophilous species, including two Red-Listed and very rare pyrophilous species, *Aradus angularis* (VU) and *A. laeviusculus* (NT). Non-pyrophilous flat bugs disappeared after burning but recolonized the stands quickly. Logging increased the abundance of flat bugs only when retention forestry was applied. This study shows that pyrophilous flat bugs are quickly able to locate recently burned forests and that these forests are important for their survival. However, the effect of fire is transient at the stand level and pyrophilous species disappear almost completely quickly after fire. To maintain these species, recently burned forests with a sufficient volume of retention trees should be available continuously at the landscape level.

Public and governmental perceptions towards bark beetle outbreaks and their management in El Salvador

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Decision making after natural disturbances is commonly influenced by multiple stakeholders. Consequently, the management of naturally disturbed forests is a consensus of various interests. Despite the increasing number of naturally disturbances around the world, human perceptions, which lead to different decisions, are poorly understood, particularly in developing countries. This talk presents the results of a standardized questionnaire survey distributed to forest owners and employers of the governmental forest sector in El Salvador, Central America. Around 250 persons (~80% of all persons working in the governmental forest sector of El Salvador) were asked about their attitude towards bark beetles, control strategies and general ecological perspectives. I compared these attributes between local forest owners (sampled in different regions) and governmental employers controlled by demographic parameters. Compared to previous studies conducted in Canada and Europe, my results particularly highlight differences in attitudes between industrial nations and developing countries.

The impact of salvage logging after bark beetle outbreak on the herb layer composition and forest natural values. A Białowieża Forest case

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Spruce bark beetle outbreak is a natural process of forest dynamics in Europe. In Białowieża Forest (N-E Poland), where Norway spruce is a natural tree component outbreaks took place several times during the 20th century. The current outbreak led to great conflicts between those who claim that sanitary logging and tree planting is the only way to overcome it and those insisting on the scenario of no after-disturbance management, to guarantee an increase of structural and biological diversity of such forests. We investigated the consequences of the already implemented clearcuts on the diversity of their forest floor. We assessed: (i.) whether clearcuts lead to an increase in diversity of the understory species, (ii.) plant species compositional dissimilarities between clearcuts and adjacent forests occupying the same habitat type, (iii) whether observed dissimilarities may indicate a direction of the succession towards mixed broadleaved forests. Diversity of vascular plants was significantly higher on clearcuts, due to presence of species associated with deciduous forests, and of open-habitat, early-successional species. On older clearcuts understory homogenization was observed, mainly due to increase in abundance of non-forest graminoids reducing the cover of forest species. Human intervention inhibits post-disturbance succession. It stops natural processes of stand replacement and herb layer recovery.

Incorporating ecosystem services into post-disturbance management: Economic valuation of seed dispersal

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Post-disturbance logging is often implemented to recover ("salvage") some of the remaining economic value of the forest. However, this approach neglects the value of the numerous ecosystem services that are affected by salvage logging. On the other hand, ecologists have pointed out many detrimental ecological consequences of this practice, yet seldom appealing to human wellbeing. To fill this gap, we used the ecosystem services framework to assess the value of a non-timber service. We assessed the value of the natural regeneration of the Holm oak in a burnt pine stand of the Sierra Nevada Natural Park (Southern Spain) under three management options that included nonintervention and salvage logging. The cost of replacing the ecosystem service (i.e. natural regeneration) by a human action (i.e. reforestation) was twice as great in nonintervention plots than in salvage logged plots. Although the magnitude of this difference was small (tens of € per ha), we suggest that the value of this and other ecosystem services should be added to traditional cost/benefit analyses to obtain the true benefits (or losses) of salvage logging. We also call for ecologists to frame their work under the ecosystem services paradigm to provide direct input to decision-makers after disturbances.

KEYNOTE:

Wolves return to Yellowstone: evaluating the influence of predation risk on elk nutrition, demography and browsing intensity

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The return of large carnivores to habitats where they have been previously extirpated has prompted interest in understanding how new sources of predation risk alter prey behavior. Behaviorally mediated trophic cascades (BMTCs) can occur when the fear of predation among herbivores enhances plant productivity. Similarly, predators can cause non consumptive effects (NCEs) when behavioral responses of prey negatively influences their growth or fitness. The reintroduction of wolves (*Canis lupus*) to Yellowstone National Park in 1995 provided researchers a means to evaluate these hypotheses. Early studies post-introduction suggested that the presence of wolves was leading to a recovery of trembling aspen (*Populus tremuloides*) by causing elk (*Cervus elaphus*) to avoid foraging in risky areas. Other studies suggested that the predation risk caused by wolves was strong enough to alter elk nutrition and pregnancy. Although these broad risk effects had been generally accepted and highly popularized, both phenomena have suffered from adequate testing. In an experimental test of the BMTC hypothesis we found that the impacts of elk browsing on aspen demography were not diminished in sites where elk are at higher risk of predation by wolves. And in a separate study, despite high variation in the rate of encounter between wolves and elk, the frequency of wolf encounters for individual elk was not associated with reduced body fat or pregnancy. These results suggest that wolves generate risk cues too diffuse, and antipredator behaviors too weak, to significantly influence prey nutrition and reproduction. Top predators play an important role in ecosystems, but the lesson from our work in Yellowstone is that their influence is more likely to be transmitted through direct consumption of prey abundance, as opposed to non-consumptive effects caused by alteration of prey behavior.

Native ungulates, plant assemblages and ecosystem functioning

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Successive ecological filtering processes include dispersal limitation, environmental filtering and biotic interactions among plants and across trophic levels. These filters act upon the regional species pool to form dynamic and transient plant assemblages. Herbivorous ungulates regularly disperse seeds over long distances, create local chemical and physical heterogeneity, selectively consume plants and modify plant-plant interactions, whereby they shape plant assemblages. They also make plant communities more prone to invasion by native colonizers or exotic invaders. We demonstrate how endozoochory, hair- and hoof-epizoochory differentially filter the regional species pool. We further highlight how complementary zoochorous processes by different ungulates affect the composition and spatial distribution patterns of plant assemblages. The interactions among dispersal vector, seed and plant traits affect the seed dispersal cycle and its effectiveness. Ungulates occupy an in-between position as primary consumers somewhere between predators and plants, they may compete for resources with phytophagous insects and thus trigger cascading effects on birds. Through the many interactions ungulates are involved in, we have to consider their global role as dynamic actors in ecosystem functioning and potential tools to rehabilitate degraded habitats via seed dispersal and associated engineering effects. Large ungulates are very likely to affect plant responses to major current changes.

Large mammals and their importance for dung beetle conservation

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Dung provided by large mammals is inhabited by a diverse invertebrate community in which dung beetles (Geotrupidae, Scarabaidae, Aphodiidae) play a crucial role for ecosystem functioning by assisting in or directly removing the dung. I will give an overview of species richness patterns and on functional groups of dung beetles and how they contribute differently to selected ecosystem functions. The role of large mammals is crucial for dung beetle survival in both managed and unmanaged landscapes. Although most European dung beetle species prefer open and semi-open habitats, large strictly protected forest reserves such as the Black Forest National Park or the Bavarian Forest National Park may play an important role for dung beetles if free roaming of wild large mammals is allowed. Present knowledge on the individual role of European bison, wild horse and red deer for dung beetle conservation is presented and knowledge gaps are identified. I finally present a new database on morphometric, life-history, and ecological traits of Central European dung beetles and discuss some possible future research directions.

Interactions between ungulates and vegetation in a strictly protected area

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Ungulates at high population density and in the absence of large predators have long been at the centre of human-wildlife conflict in forestry and beyond. With the protection of natural processes as its principal guideline, the Swiss National Park takes no measures to reduce its large red deer population that migrates naturally between the park and surrounding areas. This absence of population management and lack of human disturbance within the park boundaries, together with long-term vegetation monitoring, has provided some unexpected insights into the relationship between ungulates and the landscape. This includes new results on the relative importance of factors responsible for forest rejuvenation and positive effects of red deer on plant species diversity both in the forest and on meadows, even at high population densities. At the same time, competitive interactions between ungulate species are modulated by local habitat preferences of red deer, which are correlated with nutrient distribution on meadows at different altitudes. The study of ecological relationships involving large ungulates in a natural system thus provides an important knowledge base to predict possible alterations in these interactions with climate change, the return of large mammalian predators or land use changes.

The impact of (red) deer on their environment - A review

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The red deer (*Cervus elaphus*) is a common and widespread species and one of the largest herbivores in Europe. Discussions about red deer often revolve on how to deal with the damages caused by the species. In an ecological context we can't refer to bark stripping and browsing as a damage, but instead as a disturbance in vegetation society. In general it is evident that herbivores play a decisive role shaping heterogeneity in the landscape, which is the basis for biodiversity. In a literature study we summarized the current state of research dealing with the complex field of ecological relationships between deer, especially red deer and its environment. The feeding behaviour is thereby not alone having an impact on its environment by affecting individual plants as well as the strucutre of vegetation communities. Behavioural characteristics such as movement and droppings take also effect on e.g. seed dispersal and coprophage communities. So far the studies showed that we are still far from understanding the full extent of interactions and the role of herbivores in our latitudes and that in future more research should be done.

Do our forests stay the same after European bison has gone?

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The European bison *Bison bonasus* is the largest terrestrial animal native to Europe. Its past range covered temperate Europe approximately from Spain to the Urals. By the Middle Ages, the bison had become extinct in most of that area. Today the largest population of European bison lives in Białowieża Forest. Due to the early shrinkage of its range, European bison became a focus of scientific interest from the 18th century. Studies were intensified after it became extinct in the wild and then released back into Białowieża Forest in 1952. There is a wide range of scientific publications showing that the bison is essential for several ecosystem functions. It shapes ecosystems not only by eating plant biomass but also as one of the most effective seed dispersers. Bison faeces are a substrate for the development of several groups of organisms: coprophagous insects and coprophilous moss and fungi. Even the impact of a bison carcass on ecosystem functioning is outstanding due to its size: carcasses serve as a food source for several dozen scavenger species, lasting for several months. Furthermore this can later be traced in the concentration of soil nutrients. Do our forests function properly without one of their key elements?

How does tree sapling diversity influence browsing intensity by deer across spatial scales?

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Browsing of tree saplings by deer often hampers regeneration in mixed forests across Europe and North America. It is well known that tree species are differentially affected by deer browsing, but it is still unclear, whether foraging selectivity of deer is also influenced by different facets of sapling diversity, such as species richness, species identity, and composition, and how their influence varies across spatial scales. We used forest inventory data from the Hainich National Park and applied a hierarchical model approach, mimicking browsing decisions across scales. We found that, at the regional scale, deer mainly selected patches according to species composition, whereas at the patch scale, the proportion of individual saplings browsed was largely determined by the species' identity, providing a "palatability ranking" of the 11 species under study. Interestingly, species-rich patches were more often selected, but less saplings were browsed per patch, indicating that deer's nutritional needs are satisfied faster with higher species richness. By indicating which regeneration patches and individual saplings are (least) prone to browsing, our study advances the understanding of mammalian herbivore - plant interactions across scales. It also shows the importance of different facets of diversity for the prediction and management of browsing intensity and regeneration dynamics.

Beaver altered processes in the riverine corridors

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Eurasian Beavers (*Castor fiber*, L. 1758) continue to recover large parts of their former range. This key-stone species has an extraordinary impact on river corridors. Effects caused on forests and landscape dynamics are more akin to larger herbivores, while beavers are only rodents. The impact on riverine ecosystems stems from foraging of woody vegetation and dam building. Although beavers are choosy opportunists, the consumption comprises a lot of species. Several long-term studies have confirmed shifts in food intake from highly preferred trees to alternative and less palatable species. Although heavy harvesting by beavers has a massive impact on woody vegetation, the ultimate range is up to 100 metres from the shore line. Different speeds of foraging and regeneration of woody species overturn the succession stage of vegetation, allowing colonisation by highly competitive woody species. Damming of a riparian zone raises the water table, destroying the vegetation, and affects the availability of nutrients and light conditions. After abandonment of the site by beavers, a dam system tends to collapse, returning the succession phase to the beginning of the process. The spatio-temporal context has to be considered in understanding the dynamics of boreal and temperate forests under beaver pressure.

Objectives and practices of wildlife management in European national parks differ strongly between regions

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The impact of wildlife and their cascading effects at lower trophic levels has led to much discussion regarding proper wildlife management practices within national parks. While the protection of natural processes and minimal human influence are emphasized, prioritization is occasionally necessary resulting in complex interactions between national park objectives and management practices. In this study we evaluated the naturalness of current wildlife management practices across European national parks using the results from a large-scale survey. For each national park, a naturalness score was calculated for three different categories; management objectives, species composition and human intervention. Subsequently, naturalness scores were compared between different parts of Europe and we assessed which factors influence the naturalness of wildlife management practices within European national parks. Our study showed that naturalness scores differed between European countries. Furthermore, damages by wildlife and stakeholder attitudes were highlighted as influential for the naturalness of wildlife management objectives and practices. Overall, the variability in the naturalness of wildlife management practices reflects the differences in management across European countries and the complexity of achieving the parks objectives.

Leopards (Panthera pardus) kill many livestock in Iranian forests in spite of protection by shepherds and dogs

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Little is understood about the role of husbandry practices in human-carnivore conflicts over livestock depredation. We evaluated the performance of shepherds and dogs by studying 39 attacks of leopards (*Panthera pardus*) on sheep and goats in 17 villages of the Hyrcanian forest zone near Golestan National Park and three neighboring protected areas, Iran. We found that 92.5% of losses occurred when sheep and goats were accompanied by shepherds and 77.6% when dogs were present. Leopards killed more sheep and goats per attack (surplus killing) when dogs were absent in villages distant from protected areas, but still inflicted most losses when dogs were present, mainly in villages near protected areas. As a result, local husbandry practices are ineffectual. Shepherds witnessed leopard attacks, but could not deter them while dogs did not exhibit guarding behavior and were sometimes killed by leopards. We suggest that dogs are raised to create a strong social bond with livestock, shepherds use only best available dogs, small flocks are aggregated into larger ones and available shepherds herd these larger flocks together. Use of deterrents and avoidance of areas close to Golestan and in central, core areas of neighboring protected areas is also essential to keep losses down.

Hunt prey at night, hide during day: prey availability and predation risk drive habitat choice by Eurasian lynx (Lynx lynx)

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The greatest threat to Eurasian lynx (*Lynx lynx*) in Central Europe is human-induced mortality. As prey availability is often highest in areas with high human activity, lynx have to trade off successful prey hunting against the risk of being killed by humans. We hypothesized that lynx minimize this risk by adjusting habitat choices to the phases of the day and over seasons. We predicted that lynx range use is higher at night, prey availability drives lynx habitat selection at night while safety factors drive habitat selection during the day, and habitat selection also differs between seasons, with altitude being a dominant factor in winter. We analysed telemetry data of ten lynx in the Bohemian Forest Ecosystem between 2005 and 2013 using generalized additive mixed models and considering various predictor variables. Night ranges exceeded day ranges by more than 10%. At night, lynx selected potentially riskier open habitats associated with high ungulate abundance. By contrast, during the day, lynx preferred dense cover and rugged terrain away from human infrastructure. In summer, land-cover type greatly shaped lynx habitats, whereas in winter, lynx selected lower altitudes. These findings provide concrete recommendations for future management and conservation of Eurasian lynx in Central Europe.

Macroecological patterns of movement in terrestrial land mammals

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Animal movements are key for ecosystem functioning and species survival. Yet, macroecological studies understanding their underlying drivers are rare. We built global databases of migrations and of tracking data in land mammals. We related these movement databases to extrinsic factors such as resources and anthropogenic land change, and intrinsic factors such as body mass and diet type to explain the underlying drivers that determine mammalian movements. For mammalian migrations we found that resource availability, spatial scale of resource variability and body size all affected migration distance. Resource availability had a strong negative effect and we predicted a tenfold difference in migration distances between low- and high-resource areas, explaining 23% of the variation in migration distances. While studies have shown that resource-poor environments increase the size of mammalian home ranges, we here demonstrate that also migratory animals that live in resource-poor environments have to travel farther to fulfill their resource needs.

Migration plasticity in ungulates: facts and consequences in a changing European landscape.

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Migration is an important component of ungulate behavioural tactics, that is tightly linked both to population distribution and to the function ungulates exert in ecosystems, and forest in particular. The fraction of migrants in a partially migratory ungulate population, however, can vary widely across populations. By analysing movement data from the Euroungulates consortium (individual trajectories of roe and red deer from > 10 populations for this study), we analysed the effects of intrinsic factors (sex) and extrinsic conditions (e.g. topography, seasonality, canopy closure, plant productivity/NDVI, snow layer) on seasonal distribution of individuals and parameters describing migration plasticity. Although variation in plant phenology affected migration probability in both species, we found a stronger disconnect between plant productivity and migration for roe deer than for red deer, especially in spring. In a fine-scale analysis at the local scale, we also observed a strong relation between the snow layer (i.e., snow depth) and the winter distribution of roe deer, in presence of supplemental feeding. Our results suggest that climatic and landscape changes may affect future ungulate migrations and seasonal distribution of populations. However, there is urgent need to quantitatively evaluate how this change will feedback on forest productivity, biodiversity, and related ecosystem services.

Spatio-temporal activity patterns of forest wildlife measured with camera traps

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How intensely forest ungulates and other wildlife use certain areas, and when, is of major relevance to conservation, forestry, and disease control. The spatio-temporal patterns of activity that underlie habitat use are often measured by following individual animals as they move across habitat patches, which requires animal capture and tagging. We explored a Eulerian alternative to tracking: quantifying the intensity and timing of habitat use by wildlife with camera traps that monitor activity at random points. We applied this approach in Hoge Veluwe National Park, The Netherlands, where we ran a network of 48 permanent camera-trap stations at random points across six major habitat types for multiple years. Subsets of the millions of images that we collected were processed using the semi-automated camera-trap image processing and archiving system 'Agouti'. The camera traps effectively captured patterns of habitat use and diel activity patterns, as well as changes across seasons. These patterns, however, were partially driven by variability in wildlife detectability with species, habitat, season and temperature. We find that randomly placed camera traps can in principle be used to assess spatio-temporal activity patterns and even abundance of wildlife if this variability is accounted for.

KEYNOTE:

Forest national parks as refuges for pristine streams

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Currently 90% of all streams and rivers in Germany do not reach a good ecological status as demanded by the EU Water Framework Directive. The few remaining pristine streams can almost exclusively be found in protected (low mountain) forests. Although partly affected by past acidic rain events and former monoculture spruce forests, the Bavarian Forest National Park still harbors some reference streams that can be considered true biodiversity hotspots. In a recently started long-term monitoring program, 10 streams are investigated to detect potential effects of climate change, but also recovery from forest dieback, decreasing acidification and stream restoration measures.

Responses of benthic macroinvertebrate communities to restoration of boreal stream habitat

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The use of streams as waterways for timber floating was common in northern Sweden from the mid-1800s to the 1970s. For that, many streams were channelized by removing boulders, reinforcing banks and closing side channels, and flow dynamics was impacted in tributaries by splash dam operations. This reduced the physical complexity as well as the longitudinal and lateral connectivity, which strongly affected aquatic and riparian biota. We studied ten boreal streams within the Vindel River catchment where restoration measures have been undertaken to enhance physical and biotic diversity after timber floating. At each restored stream we selected two reaches, differing in restoration intensity. Both reaches were initially subjected to basic restoration (channelized banks were broken up and small–medium sized boulders returned to the main channel) and one of them was subsequently subjected to enhanced restoration, consisting in increasing the addition of large wood, large boulders and gravel beds. Benthic macroinvertebrates were surveyed four times between 2010 and 2015, with the aim to evaluate the role of restoration intensity and time since restoration on biotic recovery. Our results indicate that enhanced restoration prompted recovery dynamics of benthic macroinvertebrates, which become fully apparent five years after the enhanced restoration was undertaken.

Insect adaptation to stream intermittency: molecular and physiological perspectives

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Intermittent rivers and ephemeral streams (IRES) are environmentally challenging habitats. While IRES are a natural feature of the landscape, anthropogenic impacts (e.g., climate change, water abstraction) are altering hydrological regimes thereby leading to an increase in frequency and decrease in predictability of droughts. IRES are well-studied in Mediterranean regions, but less is known about their central European counterparts. Limnephilid caddisflies are abundant in central European IRES and adapted to the loss of surface water. Yet molecular and physiological mechanisms underlying this adaptation are unknown. We present two studies from IRES of the Beech Forests of the Hessian Spessart. First, we study physiological responses of *Stenophylax permistus* larvae during the sudden transition from an aquatic to terrestrial environment with transcriptomics. Second, we investigate growth and metabolic energy reserves (glycogen, triglyceride) through larval developmental of Micropterna lateralis. Transcriptional profiling indicates energy and water saving mechanisms are critical to overcome drought. Final instars show higher levels of glycogen than triglyceride energy reserves. This is unusual in insects and potentially significance for the species to exploit intermittent habitats. Overall, our results show that adaptation to life in IRES is complex and involves different life stages.

From genes to ecosystems: Assessing stressor effects on freshwater macroinvertebrates with genomic approaches

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As a consequence of anthropogenic action, freshwater ecosystems have been drastically degraded over the past centuries with severe consequences for biodiversity and ecosystem function. To counteract degradation, many restoration efforts from small and local to large international catchment-spanning activities have been launched. Here, macroinvertebrates are central indicators to quantify the loss of biodiversity in response to anthropogenic stressors and its subsequent recovery. Unfortunately, determination of macroinvertebrates with morphological methods, specifically of their juvenile stages, is difficult and frequently leads to incorrect results. In addition, the level of genetic variation is not included in the contemporary approaches. Therefore, current assessments are limited in their power to gain deeper process understanding. In my talk I will outline how genetic and genomic tools can be routinely applied to study responses of macroinvertebrates to stressors. Using case studies from Europe and New Zealand, we outline how the impact of stressors on populations can be studied using genetic and genome-wide polymorphism data. The data show that critically important responses of biodiversity are overlooked when only relying on morphological data. Second, I will show how DNA-metabarcoding can be routinely integrated into present-day biodiversity assessment to improve biodiversity - ecosystem function responses to environmental stressors.

Epiphyte response diversity differs among tree taxa

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In a changing world it is important to know how communities respond to the various environmental drivers they face. We use an extended version of response diversity to study the often neglected, but specious, organism group of epiphytic lichens. Our study covers lichen species occurrences on 2400 trees in four regions of Sweden, focusing on the possibilities of retention tree forestry to sustain populations through forest succession. We model 144 species individually and conclude that the response diversity of epiphytic lichens in relation to logging differ depending on their main tree host taxon. Lichen species associated with early successional tree taxa had higher probability of occurrence on trees in logged areas than in intact forest. Lichen species associated with a late successional tree taxon, on the other hand, had a higher probability of occurrence on trees in intact forest. At the same time there were time-lags in colonizations but not in extinctions. Our results are novel in terms of epiphytic lichens, but also represent an example of complexity in species responses to forest management actions.

Projecting responses of dead-wood inhabiting bryophytes with different traits to forest management and climate change for the coming 100 years

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Habitat loss and fragmentation, exacerbated by climate change, constitute major threats to forest biodiversity. Dead wood-inhabiting bryophytes are tied to a rare and declining habitat, and sensitive indicators of climate change. Species vary in reproductive strategies, and many are dispersal limited. We applied a suite of species distribution models fitted to records of 23 epixylic bryophytes, available from the Swedish Life Watch project (www.svenska-lifewatch.se), to 1) identify factors shaping the distributions of species with varying traits, and 2) to project species trends under different forestry and climate change scenarios in Sweden. Our results suggested that species' geographic range sizes are mainly regulated by macroclimatic conditions, and that dispersal limitation, low reproductive rates and microclimatic habitat requirements are major causes for species rarity within these ranges. Forecasts of future species trends under different scenarios indicated that species with a southern distribution will benefit from climate change. Central-eastern and wide-spread species were predicted to be negatively affected by climate change, but for species with high dispersal capacities and abundances these negative effects may be compensated by increased conservation activities. For rare species of this group, and species with a northern distribution, this may not be sufficient, and negative population trends seem unavoidable.

Effect of management on the biodiversity of bryophytes in temperate and boreal forests

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Bryophytes are related to the available substrates within the forest as open soil, rock outcrops, trunks and dead wood. As poikilohydric organisms, they are very sensitive to air humidity conditions. In deciduous forest litter layer inhibit the establishment of a bryophyte layer, terricolous species are related to micro-disturbances. Epilithic bryophytes are sensitive to air humidity and dead wood accumulation beside rock surface availability. Epiphytic communities are determined mainly by tree species composition and presence of large trees. Dead wood inhabiting assemblages deteriorated in managed forest landscape because of limiting substrate (dead wood) availability. They show a clear succession during decay resulting that the continuity of dead wood of different decay stages and presence of large logs are necessary for their maintenance. Many dispersal limited epiphyte and epixylic species are influenced by forest connectivity and the temporal continuity of the appropriate substrate on landscape scale. They are very sensitive to microclimate determining structural elements like presence of secondary canopy and shrub layer and wetlands within the forests. Because of their substrate and microclimate limitation, forest management that maintain a continuous forest cover, presence and diversity of dead wood as well as veteran trees can provide their long term sustainability.

Succession of lichen assemblages after forest fire: impacts of harvest and stand structure

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Fire is one of the most important natural factors influencing the structure and function of boreal forests. Still, very little is known about the post-fire succession of lichens and the value of post-fire stands as lichen habitats. To examine these questions, we surveyed lichen assemblages (including tree- and ground-dwelling species) in 18 burned forest stands in Finland and Estonia (middle- and hemiboreal regions). The stands had burned 9-20 years ago and included both mature forests and stand harvested directly before or after the fire. The lichen assemblages had recovered rapidly after fire: we found 187 lichen species, of which 15 red-listed in either Finland or Estonia. Harvest of burned stands did not affect species richness, but changed assemblage composition: harvested sites were inhabited mainly by generalist lichens, while forested sites hosted more middle- and late-successional species and species of conservation concern. Volume of dead wood had a positive effect on species richness in forested sites. These patterns were consistent between the two studied regions, but varied among lichen groups. Thus, we conclude that post-fire stands can host diverse lichen assemblages, but a prerequisite for this is that a sufficient amount of suitable substrates, such as dead wood, is retained.

Contrasting response of insect and lichen richness to three environmental elements in one of the smallest and isolated mountain ridges in Europe

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Isolated mountain ecosystems help us much to understand effects of fragmentation and climate change. Many mountain ridges in Europe are quite isolated from the others, which is also the case of Krkonoše in the Czech Republic and Poland. Broadleaved trees often constitute isolated forest islands within the naturally and artificially created coniferous mountain forests. This study was focused on three taxa: (i) lichens, (ii) beetles and (iii) aculeate hymenopterans within sixteen beech islands (*Fagus sylvatica*) in the area of the oldest Czech national park Krkonoše (385 km^2). The studied environmental elements were: (i) two tree, (ii) three patch and (iii) one topography variables. The results for lichens and insect were contrasting. Lichens were favored by rising elevation (especially, altitudes above 800 m), which could jeopardize them due to the future climate scenario. Insect was affected by the rising elevation and was mainly influenced by the patch parameters - dead wood amounts, canopy openness and spruce contamination. Thus, insect would be mainly threatened in the future by forest land use changes reflected by relatively surprising interconnection of microclimate and dead wood. Nevertheless, no effect of host tree was observed.

KEYNOTE:

A fungal perspective on forest conservation

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Fungi are crucial components of forest ecosystems. They provide food for other organisms, regulate carbon cycling and are highly sensitive to environmental change and forestry. Yet they have traditionally been neglected in forest conservation and management, because of their hidden lifestyle, lack of scientific knowledge and overwhelming diversity. The last decades have however seen a rapid development of research tools that enable a deeper insight in fungal biodiversity and ecosystem functioning, and time is ripe for a fungal perspective in forest planning. Here, I review the roles fungi play in forest ecosystems as mycorrhizal partners, decomposers and pathogens. I discuss fungi as providers of ecosystem services and their role in securing, and disrupting healthy, productive ecosystems. Finally, I give concrete examples on how fungi can be used as indicators in the selection of conservation sites, and in the monitoring of environmental conditions in forests.

What drives the species diversity and community structure of wood-inhabiting fungi on large beech (Fagus sylvatica) trunks in unmanaged forests?

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A total of 134 large beech trunks (with DBH from 72 to 140 cm) in various stages of decomposition (on 5-grade scale) were selected in 4 forest reserves in the Czech Republic with long non-intervention management history (80 to 177 years). In 2015, we monitored occurrence of fruit bodies of all major groups of macromycetes (incl. Corticiaceae s.l.) during four visits. Besides the species inventory and detailed description of surveyed trunks, we also collected precise substrate information about each fungal record in order to understand microhabitat demands of individual species. Repeated tree-inventory in studied localities in the past three decades enabled us to evaluate the effects of spatial and temporal dynamics of dead wood on lignicolous fungal community structure and diversity. Despite the extremely dry weather during the research season we registered 7190 fruit body occurrences and documented over 430 fungal species (207 to 264 per locality, 10 to 63 per trunk). The effects of selected environmental factors including the variables describing the coarse woody debris amount and dynamics on selected trunk-inhabiting fungi will be discussed as well as revealed microhabitat preferences of species with an indicator and/or conservation value.

Fungi associated with log wood and bark in an old-growth mesic boreal forest

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We examined the resource requirements and diversity of wood-inhabiting fungal communities in a chronosequence of decaying logs using a repeated survey of fruit bodies. Bark mycobiota was studied also with the 454 pyrosequencing. Old conifer, especially pine logs, and large aspen logs with branches represented the most important substrates for the red-listed and indicator species. Mean specialization index of substrates decreased in the order: log species identity > decay class > bark cover > time since tree death > stem part > diameter. Time since tree death explained most of the variation in the mean species number for all species, polyporoid and corticoid saprotrophs. The greatest diversity was recorded on 6 to 25 and more than 46 years old logs. In bark of all tree species, the phylum Ascomycota predominated upon the phylum Basidiomycota (64.3 vs. 25.6 %). We identified a small amount of fungi from phylum Zygomycota (0.1 %) and Chytridiomycota (0.1 %). The mycobiota of spruce, pine and aspen bark samples in the initial decomposition stage was different from that in the advanced stages. In birch bark, fungal succession was not revealed. The composition of fungal communities depended on all studied log attributes.

Conservation strategy for Phellinidium pouzarii, a rare fungus of the Bavarian Forest National Park

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Silviculture management lead demonstrably to a major decrease of old growth forests across Europe. Accompanied by this is a great loss of deadwood associated fungal diversity. *Phellinidium pouzarii* is a rare fungus living on decaying logs of *Abies alba* in the Bavarian Forest National Park. To beware this species from extinction it is necessary to isolate and cultivate it. We were able to isolate this fungus from fruitbodies and to maintain it in our laboratory. The inoculation of three different wood substrates (*Abies alba*, *Picea abies* and *Fagus sylvatica*) was successful, but the fungus is rather slow growing. Furthermore, we were able to assemble a draft genome using next generation sequencing techniques, which helps us to infer the potential ecology and enables us to design probes for environmental detection of this species. We measured important degradative extracellular enzymes, which are involved in nutrient cycling and wood decomposition, in our laboratory cultures. Hereby ligninolytic oxidoreductases showed low activities whereas (hemi)cellulolytic hydrolases were higher. In 2016, a fresh cutted *Abies alba* log was inoculated with *P. pouzarii* to get first insights in manifestation of this species. In future, we plan to extent this kind of experiments.

How can conservation of dead-wood dependent insects become more efficient?

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Most of the forests in Europe have lost up to 90% of their naturally occurring dead-wood stocks. This has caused massive negative effects on species communities depending on dead wood which comprise at least 30% of all forest species. National and international conservation strategies thus aim at increasing dead-wood amounts by retaining wood from logging operations, active habitat restoration and set-aside of forest stands. To make such conservation strategies more efficient, we conducted an experiment in the Bavarian Forest National Park which evaluates the relative importance of dead-wood amount, dead-wood diversity, canopy openness and spatial configuration of dead wood for biodiversity. Our results indicate that both saproxylic and non-saproxylic taxa benefit from dead-wood addition. Canopy openness and habitat heterogeneity were major drivers of arthropod community composition and diversity, while the spatial arrangement of dead wood had no effect on species numbers of saproxylic beetles. We recommend that conservation strategies for saproxylic insects should focus on increasing the overall amount and diversity of dead wood wherever possible. Managers who must deal with strong economic restrictions, should focus on providing a high diversity of dead wood while aiming at the lower boundaries of proposed dead-wood amount thresholds.

Saproxylic beetles assemblages in Caspian hyrcanian forest: conservation and recommendations for sustainable forest management

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The Iranian forest (1.8 million ha) in south of the Caspian Sea, represents a remarkably intact temperate forests ecosystem with numerous old-growth features and unique species assemblages of hyrcanian forest. In spite of great importance of this forest, its faunistic studies is inadequate and its identified insect fauna is still incomplete. In this forest, saproxylic beetles (SD), as a largest taxa contributing to biodiversity, are highly diverse but quite poorly understood. Totally, 118 species belong to three SD families, Cerambycidae, Buprestidae and Elateridae, have already been reported by Barimani Varandi et al. during 2009-2011, with six new species for science. In a recent study analysis of dead wood features, tree species and stand characteristics, the amount of dead wood and the host species *Fagus orientalis* revealed as important drivers for a high alpha diversity. Among tree species, *Quercus castanifolia* contributed the highest beta diversity. Now, more than 350 SD and true bugs (Aradidae) underpin the importance to terminate the current practice of logging damaged and old large trees. If this is not done, the Hyrcanian forest will soon experience a decline in biodiversity as experienced by European forests centuries ago.

What factors shape the biodiversity of saproxylic beetles and birds in commercial forests?

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One of the factor indicated as crucial for forest biodiversity, is the amount and quality of the dead wood. Although this fact has been known for a long time, still there is few empirical data describing such dependencies of managed forests in Central Europe. That is why, in 12 forest complexes in Poland, we analysed the structure of the forest stand, amount and quality of dead wood as well as the biodiversity of saproxylic beetles and birds. Our results showed, that beetle diversity was not related with the amount of dead wood nor its quality. Moreover, the structure of forest stands and species of the dead wood were not affected the observed number of beetle species. Only, the tree species in the stand had an impact on species richness of beetles. Similarly, biodiversity of forest birds was not connected with dead wood amount or dead wood quality. However, the forest structure played an important role in avian biodiversity, bigger tree basal area affected higher birds diversity. Surprisingly, no evidence of positive role of dead wood was found in this study. But we believe, that presented results demonstrate fact how complex is the relationship between biodiversity and environmental factors in forests.

Systematic dead wood enrichment in beech forests removes a historical land-use gradient mirrored by saproxylic beetle assemblages within one decade only

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In temperate forests restoration of habitats may be used as a conservation tool, because most of these forests have lost their natural structure due to centuries of intensive management. Hence, systematic dead wood enrichment could be one effective way to restore habitats of many species. We asked to which extent large-scale deadwood restoration by active management is able to reverse historical gradients of land-use intensity. We sampled saproxylic beetles on 69 plots in three categories of historical management intensity in a forest, before and after ten years of a systematic dead wood enrichment. We compared the three management intensity classes using ordination methods and sample-size-based rarefaction- and extrapolation curves. Results show that a clear management gradient from intensively managed to strictly protected areas was removed ten years after deadwood enrichment started. Diversities of intensively managed areas were enhanced by dead wood accumulation, leading to nearly equal diversity as in strictly protected areas. Species of conservation concern reflected best the former management gradient before dead wood enrichment, which became significantly less pronounced ten years later. Our results support the view that active enrichment of dead wood in temperate production forests is a valuable tool to restore ecologically degraded beech forests.

Abundance of parasitoid Hymenoptera decreases along a gradient of phylogenetic diversity of saproxylic beetle communities

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Parasitoids are adapted to a certain range of host species. This specialization increases efficiency of foraging but also decreases the ability to acquire new resources. Therefore, changing hosts is only possible among closely related hosts, which share morphological and physiological similarities. However, empirical tests of this hypothesis on a community level are lacking. Here, we used data from stem-emergence traps mounted on experimentally felled spruces to test the effect of abundance, species richness and evolutionary proximity communities of saproxylic beetles (hosts) on abundance and species density of parasitoid Hymenoptera. We revealed, that abundance of parasitoid Hymenoptera decreases with decreasing evolutionary proximity of saproxylic beetle species, whereas their species density was not affected. However, species density of parasitoid Hymenoptera was positively correlating through their abundance. Hence, our findings indicate that a higher evolutionary proximity within host communities supports host switching.

Innovative monitoring techniques: A way forward to get forgotten species into policy

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Conservation policies often use lists with priority or indicator species. However, it has often been argued that species selected for monitoring or conservation are biased towards the more familiar taxa, while groups such as beetles and fungi are often underrepresented. For forests, this is of great concern as these two groups represent the main biodiversity associated with natural and unmanaged forests and contain good indicators for habitat qualities that are not covered by other species groups. Several national and international examples are given of these forgotten and even ignored species. To counter this, we have focused on experimenting with innovative monitoring techniques (such as e-DNA, pheromone trapping, detection dogs, …) to get these species groups accepted into conservation policy. Using these innovative techniques, we could demonstrate that many of these indicator and umbrella species can also be monitored cost efficiently, an argument often used to not include these species. Furthermore, these techniques can generate better insights in the rarity of these species and the pressures involved. Finally, these techniques make these groups more prominent, both for the broader public and policy stakeholders, which may help to incorporate them in practice and policy.

Measuring biodiversity in dead wood - is the use of a surrogate advisable?

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It is widely known that the biodiversity within forests depends on and increases with the amount and size of dead wood. Dead wood acts as a habitat for a wide range and variety of different species from different kingdoms. Many of them are involved in the degradation of wood and depend at least in parts of their lifecycle on dead wood as a substrate. Yet, many species are threatened, due to the removal of dead wood in managed forests. In recent years, methods addressing biodiversity using molecular methods like next-generation sequencing (NGS) became more operational and provide together with classical methods new opportunities for the assessment of biodiversity across multi taxonomic scales, which has not been carried out for dead-wood as a habitat. We compared the alpha and beta diversity within dead wood considering insects, fungi and bacteria using classical (e.g. sporocarp inventory) as well as molecular methods (NGS) and including different species concepts for NGS results (based on OTUs only, based on taxonomic nomenclature). Based on first results, which show relatively weak correlations between taxa and methods, we suggest that the usage of a surrogate taxon or method to assess the overall biodiversity in dead wood is not advisable.

Functional- and Phylogenetic Diversity Patterns of Decomposer in European Beech Forests across Europe

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European beech forests define temperate forests in Central Europa in a way that is globally unique. The UNESCO honoured European beech forests as a world natural heritage for their outstanding character and as source of natural biodiversity. The dominance of beech forest developed in the still on going post-glacial re-colonisation of Europe to the North and took place parallel to settlement of land by humans. In this study we investigated how the biogeographic history and land use intensity shape the pattern of phylogenetic and functional diversity across Europe. We combined two datasets on the main taxa involved in the decomposition of wood in beech forests, records of 532,496 saproxylic beetles of 791 species and records of 8,630 of 249 wood inhibiting fungi species across Europe with species traits and phylogenetic relatedness for the analyses. Functional diversity (FD) response to our predictors of both groups was highly congruent, despite totally different lifestyles. FD was higher in the east of Europe and decreases at the same time to the north. For fungi the pattern of phylogenetic diversity (PD) follow the FD, while for beetles PD and FD show contrary patterns. These results support the idea of a functionally degraded community from east to west and a reduced functionally diversity in the most recently established beech forests in Northern Europe. Overall this supports the idea that current biodiversity of European beech forests is shaped by anthropogenic and biogeographical patterns.

Rethinking the importance of habitat connectivity for dead wood organisms

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The relative importance of habitat area vs. connectivity in species conservation has been debated. One reason is that empirical studies of species occupancy patterns in real landscapes have been unable to disentangle the relative importance of habitat area and connectivity, due to constraints in study designs. Here we contribute to the habitat area vs. connectivity dispute by reviewing the empirical evidence on dispersal ability of dead wood dependent species. We focus on direct studies (e.g. mark-recapture, radio telemetry), field experiments and genetic analyses. Our review revealed two somewhat opposite things: based on direct methods dispersal is common but seems to be limited within a few kilometers, whereas genetic studies generally find no genetic structure over tens of kilometers, indicating frequent long-distance dispersal. Direct dispersal studies, however, suffered from a small study extent and thus could not have detected long-distance dispersal. Although there seem to be systematic and species-specific differences in dispersal ability, fungi being better dispersers than insects, there is surprisingly little direct evidence for the limited dispersal ability of saproxylic species at management-relevant scales. Thus, managers should focus on retaining high quality dead wood habitat, rather than conserving habitat connectivity.

Connectivity-dependence in wood-inhabiting fungi: combining data on the different life stages

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The exact mechanisms of fungal species declines in fragmented forest landscapes are not fully understood. We studied how decreased connectivity affects dead-wood dependent fungal species occurrence as fruit bodies, mycelia and spores at different spatial scales, to gain a better understanding of the underlying processes behind the occurrence patterns. The fungal communities were different in well-connected and isolated forest sites, especially in the most human-influenced areas where the landscape context becomes critical. Old-forest connectivity had generally a positive effect on the red-listed species except for in sites with relatively low amounts of dead wood. Non-red-listed species usually slightly benefitted from connectivity but not in sites with high amounts of dead wood, suggesting competition pressure. There were several indications of dispersal limitation. Total spore production in red-listed species was higher in northern, more connected forest landscapes than in southern, fragmented landscapes while the opposite was true for non-red-listed species. Spores turned out to lose their viability relatively quickly when exposed to UV light during dispersal. We found evidence for reduced spore germination in isolated habitat fragments or in regions with a long history of extensive forest fragmentation. Increasing the connectivity between dead-wood rich forests would be necessary for reducing species declines.

Epiphyte establishment and future metapopulation size in landscapes with different spatiotemporal properties

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Understanding the relative importance of different ecological processes on the metapopulation dynamics of species is the basis for accurately forecasting metapopulation size in fragmented, dynamic landscapes. We investigate which factors determine the future metapopulation size of the epiphytic lichen species *Lobaria pulmonaria* in a managed forest landscape. First, we test the importance of dispersal and local conditions on the colonization-extinction dynamics of the species using Bayesian state-space modelling of a large-scale dataset over a ten year period. Second, we test the importance of dispersal and establishment limitation in explaining establishment probability based on an experiment. Third, we test how future metapopulation size is affected by different metapopulation and spatiotemporal landscape dynamics, using simulations with the metapopulation models fitted. The colonization probability increased with tree inclination and connectivity, with a mean dispersal distance of 97 m. Local extinctions were mainly deterministic set by tree mortality, but also by tree cutting. No experimental establishments took place on clearcuts, and in closed forest the establishment probability was higher on trees growing on moist than on dry-mesic soils. The simulations showed that the restricted dispersal range, and the tree rotation length, and the spatial pattern of trees had large effects on future metapopulation size.

Increasing landscape effects on saproxylic beetle fauna during 10 years of succession

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A previous study of one and three year old high stumps found only weak relationships between saproxylic beetle fauna and landscape parameters. A potential explanation to this was that the wood was too young, and we expected a stronger relationship in older wood as beetles should be less mobile later in the succession, due to a higher predictability of the habitat. To test this, we made a third sampling of the saproxylic beetle fauna on the same 80 high stumps after ten years. Beetles were sampled with window traps and we found 51,390 individuals belonging to 445 saproxylic species. In accordance with our expectations, the landscape variables explained more of the species composition of the saproxylic beetles later in the succession than early. Also the similarity of the fauna between the clear-cuts decreased over time. Apparently early colonising species have a more homogenous fauna over south Sweden than species later in the succession. This suggests that also for species living in trivial dead wood, nature conservation measures should be concentrated to the richest regions. However, creation of high stumps is a cheap measure that can be made in all forests to support biodiversity also on the most impoverished lands.

Large-scale patterns of diversity of arthropods inhabiting sporocarps of Fomes fomentarius.

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Saproxylic species make up for a considerable part of forest biodiversity, many of which depend directly on wood-decaying fungi in order to utilize their fruiting bodies. In this study we investigate the species richness and community composition of arthropod communities inhabiting the bracket fungi *Fomes fomentarius* on forest sites at the whole extent of the distribution of the European beech *Fagus sylvatica*. The study aims to investigate potential patterns in species richness and species composition of the fungus-dwelling arthropod species, due to habitat availability, climate and spatial variation. Saproxylic arthropod communities were sampled by rearing of 560 fruiting bodies of different decay stages at 56 sites. Species richness of *F. fomentarius* inhabiting arthropods shows no large-scale gradient reflecting climate or geography. Species richness was best explained by host biomass, which could not be accounted for by passive sampling alone. Variation in species turnover displayed a weak longitudinal gradient, while climate, space and sporocarp biomass were only poor predictor for community composition. We conclude that diversity of fungus-dwelling arthropod communities in general is not structured on a continental scale and conservation effort should take place at as many forest sites as possible.

Dispersal ability of the protected saproxylic beetle: first insight into the radio-tracking of the Great Capricorn beetle (Cerambyx cerdo)

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To better understand the dispersal ability of saproxylic beetles, different methods have been proposed. Out of them, mark-recapture (MR) and telemetry are probably the most straightforward providing the direct measures of field dispersal. Unlike MR, telemetry studies, however, are restricted by the size of the studied species and thus their employment in saproxylic beetles is highly limited. So far, only *Osmoderma eremita* and *Lucanus cervus* were studied in Europe. To fill this gap we investigated the potential of radio-tracking for measuring the movement of *Cerambyx cerdo*, an endangered veteran tree specialist. Totally, we equipped 26 individuals (15 males and 11 females) with the transmitter and tracked them for 4 to 17 days (median 14). We observed no disturbance of movements neither flight problems due to the transmitter weight. The daily probability of movement of an individual was 64% and the longest covered distance in one day included 1498 m for males and 1566 m for females. For 15% of all individuals, the lifetime distance was >2200 m. Our results indicate the high probability of movement as well as the high dispersal ability of *Cerambyx cerdo* adults. Such findings are in contrast to previous results obtained from a MR study.

Habitat suitability, loss and connectivity of capercaillie populations in the Carpathians

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The Carpathians, constitute one of the largest continuous forest ecosystems in Europe, harbor most of Europe's remaining temperate primary forests, and are therefore of outstanding conservation value. We studied habitat of an increasingly threatened umbrella species capercaillie (*Tetrao urogallus*) at different spatial scales using three methodological approaches including dendroecology, population monitoring, and species distribution modeling. The highest habitat suitability values were obtained in primary spruce forests, where suitable habitat structures, such as standing dead wood, lower tree densities, higher ground vegetation cover, gaps, are created by natural disturbances. However, the capercaillie densities at the landscape level were best explained by forest clearcuts with a strong negative effect on capercaillie numbers. In total, 1109 km^2 of suitable habitats were lost since 1985 due to intensive harvesting, with highest values in Romania (565 km^2), Slovakia (324 km^2) and Ukraine (180 km^2), independently on the status of protection. The functional connectivity of capercaillie habitats decreased significantly by 33 %, which seriously threatens the population viability. Network of large protected forest reserves is crucial for the long-term persistence of biodiversity hotspots, such as the Carpathians, where allowing natural events and natural disturbance processes across multiple scales is the most effective way for capercaillie conservation.

KEYNOTE:

Forty years of bias in habitat fragmentation research

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The idea that habitat fragmentation seriously threatens biodiversity is so widespread that it might be considered a "conservation biology principle". However, effects attributed to habitat fragmentation are usually confounded with effects of habitat loss. Recently, I reviewed the effects of habitat fragmentation per se (effects independent of habitat loss). Most effects are weak and non-significant. Seventy-six percent of the 381 significant effects of fragmentation per se are positive, and I found no situations where most significant effects are negative. I then evaluated potential biases that may contribute to the common misrepresentation of fragmentation per se as a major threat to biodiversity. Most strikingly, I found that only 40% of authors finding only positive fragmentation effects actually discuss these in their abstracts. Thus, authors themselves have reinforced the misrepresentation of the fragmentation literature. I speculate that this derives from authors' fears that their results could be incorrectly used to justify habitat destruction.

How forest seral stages translate into biodiversity in montane temperate forests

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The temporal dynamic of montane temperate forest patches from gaps, to maturation and to decay is the backbone of resource-variability in forests landscapes. This dynamic serves as the baseline for future biodiversity predictions. However, overall biodiversity across trophic levels has never been quantified along the complete range of seral stages. The present results demonstrate the high power of seral stages as predictors for biodiversity patterns in forests, but demonstrated considerable differences among functional groups. Controlled for elevation and soil conditions, our models supported U-shaped patterns for primary producers and their direct consumers. In contrast, saprotrophic groups such as beetles and fungi demonstrated a bell-shaped response. Predators tended to follow the diversity of their main prey. Most of the patterns could be explained by the more-individual hypothesis, but for plants, phytophageous beetles, true bugs, xylobiont beetles and saprotrophic fungi support for the habitat heterogeneity hypothesis was also found. The link between stages quantified by Remote Sensing data and biodiversity across taxa and trophic levels opens the avenue for implementing biodiversity in forest growth models and for upscaling diversity investigation to whole biomes, such as montane temperate forests, on a continental scale.

LiDAR remote sensing of 3D forest structure improves alpha and beta diversity predictions of plants, butterflies and birds

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3D forest structure is an important predictor of biodiversity and is increasingly mapped at a high level of detail using Light Detection and Ranging (LiDAR) remote sensing. However, the relative effect strength of forest structure compared to other principal biodiversity predictors, such as climate and site conditions, remains poorly investigated. Here, we used occurrence data of 1765 vascular plant, 185 butterfly, and 144 bird species to analyse the predictive power of LiDAR-derived forest structure for alpha and beta diversity across an environmentally heterogeneous mountain region in Central Europe, i.e. Switzerland. Disentangling the relative effects of forest structure, climate and edaphic features on alpha and beta diversity revealed a considerable independent effect of forest structure. This held across all taxonomic groups, but was particularly evident for butterflies and birds. Thus, the growing availability of high-fidelity maps of forest structure across large regions furthers our understanding of niche-based community assembly and diversity. Including data on 3D habitat structure will be important to improve the predictions of global change effects on biodiversity, particularly once multi temporal LiDAR datasets will be available.

Building up a national forest reserve network: the role of research

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The Estonian forest reserve network has expanded from one 13-ha reserve in 1924 to 11% of all forest strictly protected in 2017. Bio/ecologists have made critical contributions to this process, but their contributions have involved diverse motivations and irregular political 'windows of opportunity'. Supported by personal experience from the last 20 years, I review the features of scientific arguments and political moments that have enabled to advance the network. It appears that the effects are not necessarily related to scientific rigor: e.g., island biogeography or metapopulation theory have never been directly applied for reserve selection in Estonia. Rather, multiple debatable concepts, such as protection of 'typical' or 'extraordinary' sites, habitat thresholds, and surrogate species have been iteratively applied during the history. Wild animal populations have been better communication tools than "diversity". These experiences suggest that long-term effectiveness of research depends on acknowledging and sustaining conservation as a cultural process on a national scale. We should promote a diversity of analytical approaches to be filtered through the cultural process, consider time to implementation as a part of effectiveness, re-establish the importance of field surveys, and involve decision-makers in research projects to support trust in the scientific method.

Landscape analyses of spatial and temporal dynamics of tree cover loss and FSC-certification in the boreal forests of the Arkhangelsk Region in the Russian Federation

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The Forest Stewardship Council (FSC) is a worldwide forest certification system with national standards, which has been established with the aim of safeguarding sustainable forest management. Systematic assessments on the ecological effectiveness are still missing. As a case study, we investigate the Russian National Forest Stewardship Standard. Amongst others, its theoretical framework stipulates smaller size of clear-cuttings. We analyse the temporal and spatial dynamics of tree cover loss in the taiga of the Arkhangelsk Region according to different size classes and patterns for distinguishing logging, fire, and small-scale tree cover loss including dieback. The study area comprises 41 FSC-certified companies covering more than 9 million ha and almost 20 million ha of non-certified land. The geospatial analyses are based on available data on annual tree cover loss between 2000 und 2014. A comparison between non-certified and FSC-certified areas shows that in each year mean tree cover loss was lowest in non-certified areas. Except for 2012, the highest mean tree cover loss occurred after companies had been FSC-certified. In general, the small-scale tree cover loss (< 1 ha) is more frequent than larger patches. Further inquiry goes into the spatial correlation of small and large-scale tree cover loss.

Identifying old-growth biodiversity hotspots as priority areas for forest nature conservation

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Systematic conservation planning approaches provide the basis for a structured discussion of forest nature conservation goals and their cost-efficient implementation. Spatial prioritization is a relatively well-established method in conservation planning. In forest management and conservation, however, there seem to be only few examples of application. In order to identify priority areas with high relevance for protection, we used spatial explicit information on groups of old-growth indicator species and relevant eco-geographical variables. The applied habitat modeling method ENFA is based on presence-only data. Therefore it is applicable for many existing data collections on indicator species. Within a study area of 54,000 ha, consisting of the state forest of Germany's federal state Schleswig-Holstein, we identified about 1,800 ha of potential old-growth biodiversity hotspots. In our models, the most important variables where the maximum age of native deciduous trees, the proportion of ancient woodland and the proportion of deciduous trees. A validation in the field verified the quality of the results. Both the available data and the results suggest that the method is suitable for supporting decision making in forest management. The results can be integrated into further systematic planning processes.

Cost-efficient strategies to preserve dead wood-dependent species in a managed forest landscape

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Negative consequences of forestry on biodiversity are often mitigated by setting aside old forest, but alternative strategies have been suggested. We have compared with simulations the consequences of two of these alternatives – setting aside young forests or extending rotation periods – to that of current practice in managed boreal forest. In all scenarios we applied a constant conservation budget and predicted forest development over 200 years. As a proxy for biodiversity conservation, we projected the extinction risk of a dead wood-dependent beetle, *Diacanthous undulatus*, in a 50 km^2 landscape in Sweden. During the first century, setting aside young stands rather than old stands increased extinction risk. However, the strategy allowed a larger set-aside area, resulting in lower extinction risk and harvested timber volumes in the second century. Prolonging rotations also decreased the extinction risk. The most cost-effective strategy in the long term (200 years) was to set aside a mixture of old and young forest. However, setting aside young stands rather than prolonging rotations or setting aside old stands delays both the benefits (lower extinction risk) and costs (lost harvest volumes), so the optimal strategy depends on the assumed societal values and hence discount rates.

Mitigating forest biodiversity and ecosystem service losses in the era of bio-based economy

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Forests play a crucial role in the transition towards a bioeconomy by providing biomass to substitute for fossil-based materials and energy. Increasing forest harvest levels to meet the needs of the bioeconomy may conflict with biodiversity protection and ecosystem services provided by forests. Through an optimization framework, we examined trade-offs between increasing the extraction of timber resources, and the impacts on biodiversity and non-wood ecosystem services, and investigated possibilities to reconcile trade-off with changes in forest management in 17 landscapes in boreal forests. A diverse range of alternative forest management regimes were used varying from set aside to continuous cover forestry and the current management recommendations. Increasing forest harvest level to the maximum economically sustainable harvest had a negative effect on the habitat suitability index, bilberry yield, dead wood diversity and carbon storage. It resulted in a loss in variation among landscapes in their conservation capacity and in their ability to provide ecosystem services. Multi-objective optimization results showed that combining different forest management regimes alleviated the negative effects of increasing harvest levels to biodiversity and non-wood ecosystem services. The results indicate that careful landscape level forest management planning is crucial to minimize the ecological costs of increasing harvest levels.

Predicting ecosystem functions across forest types using relationships with forest structures

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Humans rely on ecosystem services for their well-being. However, our ability to estimate ecosystem services at large scales is limited by the resources needed to undertake such assessment (i.e. time, money, human resources). Land-use-land-cover maps are the most common proxy for estimating ecosystem services supply on large scales. Those maps normally consist of a coarse set of land-use classes which are assigned levels of ecosystem services. Such land-use classes do however not reflect the variability within land-use classes. This is an especially strong caveat for forests, which are often only categorized by their main tree species or protection status. An alternative approach to using land-use classes for ecosystem service estimation relies on the relationships between forest structural parameters and ecosystem functions. We used a set of 15 ecosystem functions measured on 150 forest plots from three regions and across a range of forest types to define “forest structure-ecosystem function relationships”. The forest structures were selected to be available from standardized forest inventories, such as the German National Forest Inventory. We show whether our chosen forest structures can explain the variability in ecosystem functions and how our modeled relationships can be used to estimate ecosystem functions on different scales.

POSTER PRESENTATIONS

1: Structure and composition enhancement in a homogenous oak forest stand, Hungary

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Conservation oriented management was started by the Bükk National Park Directorate to enhance the structure and composition of a 34 ha oak dominated, structurally and compositionally homogeneous forest stand in 2014. Our aim was to monitor the effect of the management with a network survey on the short- and long-run. In all the net points the survey was carried out in a defined-sized circular plot before (2014) and after (2016) the management action. Following variables were measured in each circle: species, diameter, social position and health status of the tree individuals (diameter ≥ 5 cm), species and number of the shrub layer individuals, diameter and length of the lying deadwood (3x20 meter transects). The original amount (12 m^3/ha) of deadwood was tripled with the treatment. Significant decrease in case of the number and amount (m^2/ha) of sessile oak and significant increase of all deadwood indicators was detected. However, the diameter classes did not show a more natural distribution after the management. Our further monitoring targets to investigate the long-term effect of the treatments on stand structure and composition, deadwood decomposition, herb layer and on selected organism groups, as birds, carabids, saproxylic insects and fungi.

2: Nature conservation criteria of wood selection in Natura 2000 forests

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The naturalness condition of Natura 2000 forests and the conservation status of the species of plants and animals of community significance, connected to forest habitats are mostly defined by the sylvicultural activities carried out therein, and more specifically by the various uses of wood. Accordingly, we can state that the extent of woodfelling and the fact which tree comes out of a forest and which remains there make the most significant impact on forest habitats within a short period of time. Trees to be cut are chosen by marking with paint prior to woodfelling, during the process of “marking”. The nature conservation criteria of “marking” work cannot be simply separated from each other in respect of the marking Natura 2000 forest habitats including individual zonal forest associations. Consequently, the nature conservation criteriawere set out systematically in this poster, in accordance with the use of wood in forestry practice, separately emphasizing the methods of forest management which secures continuous forest cover. The poster is based on the publication with the same title, which has been prepared by Bükk National Park Directorate from the budget of LIFEinFORESTS project.

3: Impact of horse logging in Hungarian nature conservation areas

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Nowadays there is a deficiency about animal-powered logging in literature and it seems to be like an extinct tradition in Hungary. The aim of the research is to compare the skidding carried out by horses and machines depending on many aspects. 30 out of 116 Hungarian forestries employ contractors who use horses for skidding on nature conservation areas. The advantage of the animal power is that it is harmless for the topsoil, the wood stand and the saplings. Harmful fuel is not presented and the contractors can produce the forage. The disadvantage is that the output capacity of horse logging is less than that of the machines, the daily logging capacity of a single draft horse ranges from 4.5 m^3 to 30 m^3. To quantify these attributes the degree of soil compaction is necessary to investigate throughout the penetration resistance and soil moisture with a cone penetrometer, furthermore to determine the depth of the compacted layer with a hand probe is also important. The vegetation survey defines the Braun-Blanquet (1951) cover-abundance scale, Ecology Indicators, Social Behaviour Types, Raunkiaer (1943) and Pignatti (2005) life-forms. The sample areas are assigned considering the wood stand, the type of soil, the relief and the weather conditions.

4: Stand-scale forest management systems using nature as a template: enhancing biodiversity in production forests

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The practice of sustainable forest management that integrates ecological, social, and economic objectives has become increasingly important as our society's demands for forest resources have grown. The efforts to enhance and maintain biodiversity in managed forests have been particularly pronounced in the past few decades. Such changes have occurred simultaneously with increasing interests in forest management practices that use natural processes and patterns as a basis to increase biodiversity in production forests. Although various forms of such management approaches have been applied, the extent of their practice in certain parts of Europe is still rather limited. This study aims to review stand-scale forest management systems adopting some form of natural pattern and process. Some of the practical applications of these methods are addressed, however, a particular focus is made on stand level biodiversity and how it can be enhanced or maintained by using specific 'nature-based' management practices. The emphasis is made on biodiversity not only because of its innate conservation value, but also because of the increasing recognition of the role that biodiversity plays in ecosystem function. Forest management paradigms and systems using nature as a template that were developed in Europe and North America are addressed.

5: Faunistic Indicators for structural diversity in temperate forests: a systematic niche-based approach

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Given the accelerating decline of biodiversity paralleled by limited resources, methods for systematically prioritizing conservation efforts are unavoidable. Surrogate species have thus been proposed in a variety of conceptual approaches, but these often suffer from methodological issues such as solely expert-based selection procedures. We used an objective niche-based selection algorithm to identify a set of faunal focal species representing forest structural diversity in temperate forests, using Baden-Württemberg as example region. Based on a coarse categorization of species' resource requirements we identified species sets that covered all predefined forest structures and types with the most sensitive species at different spatial scales. We examined the effect of variance in expert scoring on the stability of set composition. Candidate species were defined for mammals (N=24), birds (27), amphibians reptiles (17), lepidoptera (36) and saproxylic beetles (37). The resulting sets consisted of six (amphibians and reptiles) up to thirteen (lepidoptera) species. Differences in expert scoring had a major effect on set composition, but dissimilarity between sets decreased with an increasing number of included experts. Niche-based selection algorithms proved valuable for systematically selecting surrogate species for promoting structural complexity in forest ecosystems as they require a clear definition of the conservation-targets to be covered.

6: Forests and climate change in the Czech Republic: an appeal to responsibility

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The ongoing climate changes requires global responsibility in the approach to the management of supporting sustainable production and the consumption of forest products. In the face of related changes in forest disturbance regimes, risk-oriented management became a key concept. Unstable monocultural forests need to be transformed into stable, uneven-aged and diverse forests, which are able to ensure the provision of the required functions. These procedures can reduce the risk of sudden destruction of large forested areas and also promote the desired asynchronous dynamics and ecological stability of forests. In regards to the needs of a multifunctional management, especially one that supports biodiversity, water retention in the landscape, the accumulation of carbon, etc., it is necessary to create a framework for the implementation on a wider spectrum of management alternatives supporting these functions. The Platform for Sustainable Landscape Management (www.nasekrajina.eu) was set up to share information, assistance in developing strategic advice and education for sustainable landscape use. We collaborate with the Czech Ministry of the Environment on the National Action Plan for Climate Change Adaptation in the Czech Republic in formulating adaptation measures concerning the way forests are managed.

7: Initial response of the understory to experimental silvicultural treatments in a temperate deciduous forest in Hungary

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Forest management highly influences forest biodiversity by altering the stand structure and species composition of the overstory layer, and hereby changing forest site (e.g. light and soil) conditions. Understory vegetation is very sensitive to disturbances caused by management practices. We compared the effects of different forestry treatments - belonging to rotation and selection forestry systems - on understory. Experimental clear-cuttings, retention tree groups, uniform preparation cuttings and gap-cuttings were established in a sessile oak - hornbeam forest stand in Hungary. Two years after the implementation, due to the increased light and soil moisture, understory cover and species richness grew substantially in clear-cuttings and gaps. In clear-cuttings, extreme light conditions caused the establishment of many non-forest species, so composition changed also considerably. Compositional changes in gaps were smaller and were driven mainly by the increased soil moisture. In preparation cuttings and retention tree groups changes in site conditions were moderate, so understory altered also modestly. Gap-cutting and preparation cutting are able to preserve the forest characteristics of the understory better than clear-cutting. Retention tree groups within clear-cuttings can mitigate the effects of the harvest. To determine the long-term effects of the treatments further samplings are planned for the further years.

8: How to protect the Tatra's forests - a socio-economical perspective

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The Tatra National Park is the most popular tourist destination in Poland. In 2014, after a great windfall and during intensive salvage logging carried in the Park, we conducted a survey on public preferences regarding socially optimal protection regime of the Tatra's forests. The survey was carried out on a representative sample of 800 citizens. Respondents were asked direct questions regarding passive/active protection. In addition they were shown 5 pairs of photos depicting different forests under passive/active protection and were asked to choose the preferred one. There were two treatments in our survey. Half of the respondents faced the questions regarding passive/active protection in the beginning of the survey, whereas the other half answered these questions after the information on the natural disturbances and natural processes was delivered. The results of our study indicate a very high polarization regarding passive protection. In the first treatment there was almost an equal split between supporters and opponents of passive protection. However, the share of respondents who supported passive protection was significantly higher in the second treatment, in which almost 75% of respondents supported this regime. Our study shows a great importance of informational and educational measures for the perception of passive protection.

9: Similarities and differences in forest disturbance patterns across the European temperate forest biome

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Forest disturbance in the European temperate forest biome have increased over the past decades, likely driven by changes in forest forest land use and global climate change. Yet, there is anecdotal evidence of differences in the spatial and temporal patterns of forest disturbances between sites within the same forest type. Those differences, however, are poorly understood, hampering a deeper understanding of the landscape- to regional-scale patterns and drivers of forest disturbances in Europe. To overcome this knowledge gap, we utilized Landsat time series and landscape pattern analysis to map and characterize the spatial and temporal pattern of forest disturbances across five strictly protected forest sites in Central Europe (Bavarian Forest National Park [GER], Berchtesgaden National park [GER], Harz National Park [GER], Kalkalpen National Park [AUT], and High Tatra Nationalpark [SK]), where disturbances were allowed to progress without human intervention. Preliminary results suggest that patch size was highly variable across sites, with larger disturbance patches found in sites with gentler topography. Temporal development, however, was more similar across sites, suggesting that regional to continental scale drivers such as climate synchronized forest disturbances across the temperate forest biome. In particular, we found strong evidence for windfall-triggered bark beetle outbreaks in all sites, highlighting the complex interaction between varying disturbance agents.

10: Regeneration after ice storm and salvage logging - a case study

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Ice is a frequent disturbance agent in forests of Slovenia. An ice storm that occurred in February 2014 was exceptional in terms of its severity and scale. In such events, forest stands are severely damaged with little regard to previous silvicultural treatment aimed at increasing resistance, such that forest resilience becomes increasingly important for recovery. The level of resilience is dependent on the presence of regeneration. Within a network of plots in areas severely damaged by the ice storm, tree species composition, damage rates, and densities of regeneration were measured. In addition, coverage of coarse woody debris and vegetation was estimated. Measurements were performed after the storm, as well as after salvage logging in the same year and one year after logging. There was a moderate increase in damage rates and a moderate decrease in total regeneration density and vegetation coverage after the salvage logging. One year after the logging regeneration density decreased more severely, mainly due to increase in Rubus coverage. The only species capable of competing with Rubus were chestnut and Robinia due to intensive vegetative growth, and beech saplings present as advance regeneration before the storm. Our results suggest a relatively small negative impact of salvage logging on regeneration below 50 cm in height and a very important role of fast growing species and advanced regeneration in forest recovery.

11: Species composition, elevation, and former management type affect the browsing pressure in montane and subalpine forests of the Tatra National Park.

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Population of herbivorous animals in the forests of the temperate zone is steadily increasing for a long time. Because in many forests only shoots of young trees are available, the browsing pressure on seedlings became a serious problem for forestry. Information on pressure of ungulates on the renewal of trees are insufficient. They are collected using a variety of methods, which to a large extent rely on subjective evaluation. The chances of objectifying data on that issue are a permanent sampling plots. In this study we summarise data collected on 430 sampling plots established in 2016 in the Tatra National Park, southern Poland. Newly established grid is covering montane and subalpine zone (900-1600 m asl). It consist of 214 plots in strictly protected area, 115 in actively protected area, and 101 in managed forest. On every plot we collected data regarding damages made by ungulates on young trees in three categories: saplings (up to 50 cm), low seedlings (up to 1,3 m high) and high seedlings (up to 7 cm dbh). The average level of browsing pressure ranged from less than 10% for the saplings to more than 20% for high seedlings.

12: Lynx predation on deer prey in the protected areas and multi-use landscapes of the Bohemian Forest Ecosystem

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In Central Europe, large carnivores cannot survive only within (relatively small) protected areas, and in unprotected areas they are persecuted due to competition with game hunters. Thus, understanding how predation intensity varies spatio-temporally across protected and unprotected areas is fundamental. In the Bohemian Forest, based on roe (*Capreolus capreolus*) and red deer (*Cervus elaphus*) killed by GPS-collared Eurasian lynx (*Lynx lynx*), we calculated annual kill rates and tested for effects of season and lynx "status". Because deer concentrate in unprotected lowlands during winter, we modeled kill spatial distribution separately for summer and winter, calculating the -probability of a deer killed by lynx and -expected number of kills for protected and unprotected areas. Lynx killed more roe than red deer, and more deer in winter than in summer. Lynx families had higher annual kill rates than single lynx. In winter the probability of a deer killed and the expected number of kills were higher in unprotected than in protected areas, in summer, the expected number of kills was slightly larger in protected than in unprotected areas. This likely leads to local increase of perceived predation impact in winter in unprotected areas. Mitigation of conflicts in these areas should be a priority.

13: The Lynx Effect: Behaviour of Roe Deer Under Predation of Lynx

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The responses of roe deer under predation of lynx were investigated in the Bohemian Forest using data from GPS and accelerometer collared lynx and roe. A spatiotemporal analysis revealed no avoidance of roe to lynx locations. Generalised Additive Models of accelerometer and location metrics suggest the dominance of habitat in roe behaviour in all but the closest lynx encounters. In general, cover density was the most important explanatory variable for roe activity level, with lower activity in areas of highest visibility, and vice versa. The specific case of closest encounters (within 24 hours and 1km) at night, lynx's most active time, activity level of roe was elevated compared to less proximate individuals. A suggestion that roe closer to lynx move further than otherwise was found. Furthermore, roe selected lower predation risk areas when closest to lynx (within 24 hours and 1km) during winter nights and consistently inhabited lower predation risk habitats during summer compared to winter. Furthermore, it was shown that activity level was lower in high predation risk habitats. Under the predation risk of an ambush hunter, lynx, it is believed roe have a "business as usual" strategy, with anti-predator behaviour limited to scenarios of imminent risk.

14: Red deer in the Southern Black Forest: luxury or necessity

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The commercial production of wood is a primary objective of European forestry. This led to an increasing amount of coniferous species throughout areas, where broadleaved species would naturally dominate which created a forest with a higher sensitivity for ungulate browsing. Large ungulates were not only perceived as evolutionary luxury but also as pest. In Southern Germany red deer (*Cervus elaphus*), one of the largest European ungulates is forced to live in predefined red deer management areas. The Southern Black Forest (SBF) is one out of five isolated management areas (size of 17.500 ha) in the federal state of Baden-Württemberg. The elevation of the SBF ranges between 690 and 1410 meter above sea level and correspond to rather rough environmental conditions. From an ethical point of view a successful red deer management in the SBF is not a luxury but a necessity. In this study we present population development tendencies of red deer in the SFB between 2006 and 2016. Several indicators of red deer abundance pointed to a decrease in population size since 2007. Winter population size (2015/2016) was estimated by a non-invasive capture-mark-recapture approach.

15: Assessing the impact of browsing and grazing on forest development in the Black Forest National Park

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The effects of ungulate browsing and grazing on forest development in the absence of predators is continuingly under discussion. In recently established protected areas there is an urgent need for these effects to be documented reliably. But to achieve this raises issues that need to be dealt with first. The most pressing is that neighboring forest owners want to be kept updated concerning the latest developments. This requires data that is both transparent and comparable with past assessments and methodologies including those done inside and outside the National Park. However the methods being used rarely meet scientific standards. Therefore, a second approach is needed, one which documents browsing and grazing effects consistently in the long-term. To quantify these effects on natural forest development and vegetation composition we want to do integrated assessments on long-term monitoring plots which will allow us to analyze the interactions between forest structure, ungulate feeding and other processes. Last, but not least, it would be of interest to compare these effects between the different national parks. Therefore this conference is a great opportunity to discuss these issues.

16: Response of leaf functional traits and species composition of savanna herbaceous vegetation to livestock grazing and rainfall treatment

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The combined effects of grazing and rainfall variability on semi-arid savanna herbaceous vegetation are not well understood. Taking into account that savanna herbaceous communities are under threats of climate change and overgrazing a better understanding how plants will respond to the threats is a major challenge. We tested the theory that certain functional traits can explain vegetation changes along grazing and soil moisture in response to land use- and climate change. We conducted intensive field measurement during the dry season in August and September. Our experiments were designed into two main blocks (grazed and ungrazed), and the rainfall was manipulated into three climate regimes (50% rainfall removal, 100% rainfall control and 50% rainfall additional). We analysed the response of above ground biomass, species composition, abundance and an additional five function traits (specific leaf area (SLA), leaf dry matter content (LDMC), leaf nitrogen content (LNC), leaf C: N ratio and leaf stomata density). We found significant higher above ground biomass in grazing exclusion and along the water availability. There was no significant shift in species composition, but we found that C4 species were more tolerant to grazing and drought compared to C3 species. Grazing enhanced SLA and LNC, but diminished C: N and LDMC. However rainfall removal (drought) enhanced LDMC and LSD but diminished SLA in both plots. Our study suggests that rainfall is the most important factor in shaping the savanna herbaceous community in semi-arid and arid regions. Fires and herbivore are mainly secondary modifiers determinants.

17: Foraging activity of wood ants depends on forest stand age

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Wood ants are endangered species and also play a crucial role in many ecological functions of the forest. They influence soil qualities, occurrence of other invertebrates and vegetation growth. Within our study we compared foraging activity of *Formica polyctena* ants in clearings and in mature forests. We selected fifteen nests located on borderline of two said forest stands and used food baits for ants activity monitoring. Workers activity was higher in spring and summer than in autumn. The observation of daily forage activity regime show highest activity in the morning. Noticeably more workers were recorded in the mature forest. The results confirm the dependence of wood ants on a permanent food sources and suitable temperature. Important food sources are found mainly in mature forests. Also temperature does not reach unsuitable high values in these habitats. Although wood ants build their mounds rather at the clearings edges, where they have sufficient amount of morning sun radiation, they forage mainly in mature forest. This confirms our earlier findings that mosaic of different age stands is important for long-term occurrence of ants in forests.

18: Inner values matter: substrate related factors are more important than environmental heterogeneity on fungal species diversity

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1. Dead wood within forest ecosystems is a spatially and temporarily delimitated and ephemeral habitat and harbors enormous organismal diversity. Yet, it is unclear whether environmental heterogeneity (extrinsic) or dead-wood heterogeneity (intrinsic) explains the diversity pattern of wood-inhabiting fungi. 2. To address this question, we set up a large field experiment with random block design and manipulated intrinsic (host species: angiosperm vs. gymnosperm, size: coarse woody debris vs. fine woody debris) and extrinsic factors of dead wood (microclimate: canopy openness; dead-wood amount; dead-wood diversity). The experiment comprised 180 plots of different combinations of intrinsic and extrinsic factors. We exposed a total of 7.397 dead-wood objects and sampled fungal fruit bodies of 715 objects of the first four years of succession. We used number of fruit bodies as alpha density measure and community composition as a beta diversity measure. 3. We found evidence that species diversity of wood-inhabiting fungi is overwhelmingly determined by intrinsic factors. We found no significant relationship between fungal diversity and local dead-wood amount, nor diversity. Canopy openness showed an independent effect on the community composition. Moreover, a deeper analysis revealed fundamentally different successional pattern between angio- and gymnosperm host species dependent on canopy openness and size of the dead-wood object. 4. Synthesis: We conclude that one reason for high fungal diversity in dead wood is host related niche partitioning rather than heterogeneity in the surrounding environment. Our results finally indicate that wood-inhabiting fungi are not dispersal limited on a landscape scale.

19: Forest structural target values for photophilous species - a case study on the Aspic viper (Vipera aspis)

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The trend towards “close to nature forestry” with selective cutting causes increasingly dense forests in Central Europe, which calls for targeted habitat management for photophilous species. The Aspic viper (*Vipera aspis*) is a typical indicator species of dry, open forests on rocky, sun-exposed slopes in mountainous regions. Its only occurrence in Germany is located in southern Baden-Württemberg as the north-eastern edge of its distribution. The population is geographically isolated and considered as critically endangered. To derive threshold values for Aspic viper occurrence as target values for habitat management we compared habitat characteristics of stone runs with extant viper occurrence to those without any sightings throughout the past five years. Stone runs with and without viper occurrence did not differ in inclination, altitude, dead wood structures, ground vegetation and shrub cover. However, presence sites showed a significantly higher sunshine exposure before noon (threshold: > 2 hours), a lower cover of conifers (< 17%) and hazelnut trees (< 1%) and a more southerly exposition (between 135° to 225°, compared to 100° to 225° in absence sites). To maintain suitable habitat for the Aspic viper we recommend reducing tree cover on southerly exposed stone runs to ensure a high amount of solar radiation.

20: Wood-inhabiting bryophyte communities are influenced by different management intensities in the past

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Many studies have underlined the fact that once forest continuity is broken, communities of wood-inhabiting organisms may never be restored to their original status. However, only few studies have presented results from sites that have current old-growth structure, and where the history of disturbances is known. We compared species richness, nestedness, beta diversity, and composition of bryophytes from living trunks and dead logs of beech (*Fagus sylvatica*) in seven forest stands in the Czech Republic with old-growth structure and various histories of past human impact. Our analysis showed that these communities are nested and their beta diversity is lower than random. There was a significant proportion of shared species, and rare species were present only on the most heterogeneous habitats. Bryophyte communities of forests with more intensive past management were significantly impoverished in terms of both species richness and composition. Beta diversity was not related to management history and reflected only current habitat heterogeneity. The effect of decay stage on species richness and beta diversity was stronger than the site effect. The protection of current natural beech-dominated forests and improvements to their connectivity in fragmented landscapes are crucial for the survival and restoration of the diversity of wood-inhabiting bryophytes.

21: Effect of dead wood volume on saproxylic beetle assemblages of montane beech-fir forests

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Beetles are among the most abundant and ecologically important invertebrates inhabiting dead wood. The level of forest management intensity, resulting in differing abundance of old trees and dead wood, is known to be critical for their conservation. We studied saproxylic beetles in 12 montane beech-fir stands in Central Europe, using 72 flight interception traps placed at sites characterized by three levels of dead wood volume. In total, 8,255 individuals of 298 species (considered saproxylic) belonging to 42 families were collected. Species richness and total abundance of beetles were surprisingly similar in all three categories of forest stands. Bray-Curtis Dissimilarity between all stand categories was about 30% and was caused mainly by the replacement of some species by others, less so by changing abundances of the very same species. 45 species were found to present indicator species (in the sense of Dufrêne and Legendre, 1997) for a particular stand category: half of them for forests of low dead wood volume, but only 10 species for forests with a large dead wood volume. Analysing the 42 recorded red-listed species separately, insignificantly higher abundance and species richness were found in stands of medium dead wood volume than in the other stand types.

22: Impact of canopy openness on epigeal spider communities with implications on conservation management of forest biodiversity

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In this study, we investigated the impact of canopy openness on epigeic spiders in abandoned coppice forests in order to develop conservation recommendations for forest management in lowland woodlands. In particular, we studied the effect of canopy openness gradient on species richness, abundance, functional diversity, community composition, conservation value, and degree of rareness of spiders. We established transects reflecting the canopy openness in each forest stand. We recorded 90 spider species, including high proportions of xeric specialist and red-listed threatened species. The peaks of conservation indicators, as well as spider community abundance, were shifted toward more open canopies. On the other hand, functional diversity peaked at more closed canopies followed by a rapid decrease with increasing canopy openness. Species richness was highest in the middle of the canopy openness gradient. Ordinations revealed that species of conservation concern tended to be associated with sparse canopy. We show that the various components of biodiversity peaked at different levels of canopy openness. Therefore, the restoration and suitable forest management of such conditions will retain important diversification of habitats in lowland oak forests.
The study was financially supported by the Specific University Research Fund of the FFWT Mendel University in Brno (Reg. No. LDF_PSV_2017004).

23: Epigeal arthropod communities during succession development and different silviculture practices of a commercial lowland forest - preliminary results

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In this preliminary study, species richness and abundances of arthropods were studied across succession development of forest plantations. Moreover, we compared the latest successional stages of the managed plantations with protected native forests and forest clearings with extensive and intensive management. Sampling were conducted in differently aged forests: clearfell stage, early age class, middle age class, old age class. The two control places - undisturbed native forest and forest clearing without mechanical site preparation were situated along the studied region. We found that mechanical site preparation of forest clearings had significantly negative effect on all of the studied groups of organisms. Surprisingly, the overall diversity and abundance of arthropods in managed forests was slightly higher or similar in comparison to control plots of native forests. The presence and abundance of forest associated species increased with increasing plantation age, with a corresponding decrease in open habitat associated species. Nevertheless, to investigate the exact diversity patterns along succession development of lowland forests, it will be necessary to investigate effects of particular environmental variables affecting the biodiversity in studied locations. The study was financially supported by the Specific University Research Fund of the FFWT Mendel University in Brno (Reg. Numbers: LDF_PSV_2017004 and LDF_VP_2017023).

24: Habitat-specific focal species - a tool for species management of forest plants and fungi

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Applied nature conservation operates at three scales: species, biotopes and processes. For conservation of biotopes and processes, adequately-implemented instruments exist for public forests. In contrast, the focus on threatened species (except of species of the Habitats Directive) depends on the interest and knowledge of local forest managers. In order to take account of those threatened species being influenced by forest management, habitat-specific focal species were selected to be considered within forest management for the state forest of Baden-Württemberg (Germany). Habitat-specifity refers to the reliance of these species on a specific forest community and/or structure. Based on the dataset of the forest biotope mapping (5.822 biotopes), an indicator species selection of vascular plants was performed for 46 forest communities, integrating all recorded red list species (342 species). Sixteen focal species were selected from the identified indicator species, either due to their high statistical significance for a specific habitat or due to their high risk of local extinction. Due to deficient data, focal species of lichens and fungi (21 and 15 species) were selected by species experts. Detailed information on the spatial distribution of focal species and species-specific management recommendations will be integrated in the geographic information system of the forest administration.

25: Wood-inhabiting bryophyte communities are influenced by different management intensities in the past.

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Many studies have underlined the fact that once forest continuity is broken, communities of wood-inhabiting organisms may never be restored to their original status. However, only a few studies have actually presented results from sites that have current old-growth structure, and where the history of disturbances is known. In this study we compared the species richness, nestedness, beta diversity, and composition of bryophytes from living trunks and dead logs of beech (*Fagus sylvatica*) in seven forest stands in the Czech Republic with old-growth structure and various histories of past human impact. Our analysis showed that these communities are nested and that their beta diversity is lower than random. There was a significant proportion of shared species, and rare species were present only on the most heterogeneous habitats. We found that bryophyte communities of forests with more intensive past management were significantly impoverished in terms of both species richness and composition. Beta diversity was not related to management history and reflected only current habitat heterogeneity. The effect of decay stage on species richness and beta diversity was stronger than the site effect. Our results demonstrate that the protection of current natural beech-dominated forests and improvements to their connectivity in fragmented landscapes are crucial for the survival and restoration of the diversity of wood-inhabiting bryophytes.

26: Plant diversity patterns at the park scale assessed by probabilistic survey

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In protected areas, plant community data are often available as phytosociological relevés collected by different authors, in different periods and with different purposes. Consequently they include different sources of bias. For management and monitoring purposes, it is fundamental to improve data collection based on probabilistic methods. We tested a method for sampling forest biodiversity within the Foreste Casentinesi National Park, Italy, to get an unbiased picture of plant diversity. The sampling design was stratified according to elevational belts and sampling year. During the first year of sampling 30 plots were sampled and used to analyze species diversity patterns, with special attention to forest specialist species. 247 species were recorded, among which 73 were classified as true forest species. Although beta diversity among the classified vegetation types is highly related to tree species, most of the species diversity was due to the diversity of the herb layer. In addition, the NMDS of the herb layer demonstrated a high overlap of species composition among forest types. The richness of generalist species decreases with elevation, probably due to landscape structure, but the richness of true forest species did not show any pattern with elevation.

27: ConFoBi - Conservation of Forest Biodiversity in Multiple-Use landscapes of Central Europe

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Protected areas such as National Parks are an important part of biodiversity conservation. However, most protected areas remain small islands surrounded by multi-use landscapes and additional measures are needed to effectively secure biodiversity. Therefore, integrative conservation measures are currently being implemented. In production forests, retention forestry is considered one suitable approach to integrate forestry and biodiversity conservation goals. The aim of retention forestry is to preserve and create structures which are normally characteristic features of old unused forests and support a high biodiversity.In this context the graduate school and research programme ConFoBi ("Conservation of Forest Biodiversity in Multiple-Use landscapes of Central Europe") formulated two lead questions: (1) What is the contribution of the landscape context to the effectiveness of retention for conserving biodiversity in multi-functional forests? The research is aligned along two gradients: fragmentation of the landscape around the study plots and structural richness inside them. (2) What is the role of the socio-economic context for the integration of such measures in forest management? To achieve that ConFoBi employs a multidisciplinary and translational research approach incorporating a variety of different disciplines. The southern parts of the Black Forest consist of temperate montane forests and are an ideal model system for our purposes.

28: A spatially explicit decision support model for assessment of tree stump harvest using biodiversity and economic criteria

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Clearcutting has been identified as a main threat to forest biodiversity. Today alternatives are being adopted worldwide and numerous studies have reported on the positive effects for biodiversity of retention forestry where living and dead trees are retained after harvest. At the same time as forces are acting towards increased efforts for conserving biodiversity new arguments for intensifying forestry has arisen. With a changing climate both forestry and biodiversity are facing new challenges and today forestry needs not only to balance production goals with nature conservation goals, but also goals concerning climate change mitigation and adaptation. In my presentation I will give examples of recent studies on how to balance these goals using multiple decision criteria analysis. We have developed a spatially explicit decision support model for stump harvest at stand level incorporating biodiversity, production and other environmental goals and this model will be demonstrated.

EXCURSIONS

Please register for the excursions using the lists present in the conference office at the Hans-Eisenmann-Haus.

For each excursion a designated bus will drive you to the destination.
You will receive packed lunch before departure.

DEPARTURE:
Saturday, April 29th at 9:30 a.m.
from P1 at Nationalparkzentrum Lusen

RETURN:
Saturday, April 29th at 17:00 p.m.
at P1 at Nationalparkzentrum Lusen

Management strategies and ecological outcome (Bavarian Forest National Park)

During the 1990s several bark beetle outbreaks completely transformed the majority of spruce-dominated forest of the Bavarian Forest National Park. Not without resistance in politics and especially from the local population, a benign neglect strategy for the affected areas was implemented. This entailed the possibility to study and observe for the first time such dynamic processes of large scale nature disturbance in Central Europe.

However, the National Park as a mainly former managed forest does not harbor sufficient old-growth structures for all species. To promote especially dead wood dependent species, speed up the process of an establishment of old-growth structures and investigate for example the influence of habitat heterogeneity and amount on species assemblages and spatial arrangement of different dead wood structures in forest ecosystems restoration experiments were designed

A prominent and ecosystem shaping species in the Bavarian forest National park is the red-deer. Due to fragmentation, political hunting regulations the natural annual movement down to lower elevations in winter season is restrained. Hence, red-deer enclosures are the current management strategy for nourishment of red-deer during winter season.

During the excursion, you will get an overview on how the natural regeneration transformed the landscape during the last 20 years of benign neglect and get the possibility to discuss management effort and ecological implication of the visited experiments and the red deer enclosure.

Forest management and revitalisation of water sites in Šumava National Park

The excursion aims at introducing the participants to Šumava National Park. In its southern part, we will have a closer look at the forest management and at the revitalisation of streams and peat bogs.
At the first excursion site, the focus will be on the history of the area, forest management in intervention zones and natural development in non-intervention zones. We will start near the village České Žleby and visit the area of Radvanovický hřbet with a beautiful example of mixed mountain forest (combination of herb-rich and acidophilous beech forests).
The second part of the excursion will be about the restoration of water sites. The Hučina stream was regulated in the 19th and 20th century for traditional wood logging. The regulated stream was heavily deepened and adjacent mires were drained by various surface channels. The restoration project, implemented in 2006 and 2013, included the reconstruction of the historical stream course and the restoration of the natural stream bed morphology. The valley raised bog Soumarský Most is a part of a large mire complex in the basin of the Upper Vltava river. The original peat bog (about 80 ha) was covered by typical bog pine (*Pinus rotundata*) forest. It was severely damaged by drainage and industrial peat extraction on an area of 75 ha. In the course of restoration (1999-2004), drainage ditches were blocked, Sphagnum mosses reintroduced and the bare peat surface covered by straw mulch. A monitoring of the site provides interesting implementations for peatland restoration.

Xerothermic forests and reptile conservation Jochenstein, Restoration in managed forests of the diocese Passau

The first destination of the excursion will be the managed forests of the diocese Passau, near Thurmansbang. Here, we will receive an impression of how measures for the restoration of forests can be implemented in private forests.
The second destination will be the xerothermic forests at the hillsides of the Danube valley near Jochenstein. The area is under protection since 1986 under German law and part of the NATURA 2000-framework especially because of the rich diversity of thermophile species, like the Aesculapian snake (*Zamenis longissimus*) or the European green lizard (*Lacerta viridis*). Under the guidance of local managers of the area we will learn about the history of the area and projects aiming for the conservation of reptiles.
The aim of the excursion is to encourage discussions among the participants on how the goals of forest conservation can be achieved in managed forest and how public and private stakeholders can be involved in the process.

River restoration and pasture management in the Bavarian Forest National Park

The Bavarian Forest National Park hosts > 800 km of flowing waters. Many of these streams have been modified from the 19th century onwards for the floating of logs. The result was an increase in flow speed and a decrease in structural and organismal diversity. We will visit two sites to show and discuss renaturation of flowing waters in the National Park. Last year, bank fixation and planted spruce (*Picea abies*) were removed along the stream 'Sagwasser' within an ongoing LIFE+ project, but its course was not changed. In contrast, the renaturation of the stream 'Kolbersbach' between 2000 and 2008 involved an approval procedure of the requirements of water law and a complete rebuilding of the supposed ancient stream course.

The management of open landscape habitat is a controversial topic. Whereas peat bogs and block fields are natural open landscapes, the conservation of anthropogenic meadows and pastures is a controversial topic in the National Park. One example are the 'Schachten', medieval cattle pastures that have developed into diverse matgrass (*Nardus stricta*) communities and are subject to forest succession since the abandonment of grazing in the 1960ies. We will visit the 'Ruckowitzschachten', where an innovative experiment in the scope of the LIFE+ project combines the conservation of the matgrass communities with the conservation of an endangered cattle breed, the 'Rotes Höhenvieh'.

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Bayerischer Wald

THE BAVARIAN FOREST NATIONALPARK IS

A holder of the European Diploma (awarded 1986);

A certified transboundary park (awarded 2009);

An important contribution to the european Natura 2000 network;

A member of EUROPARC Deutschland, the umbrellea organisation for Germany‘s large protected areas „National Natural Landscapes“.