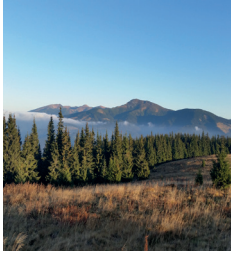


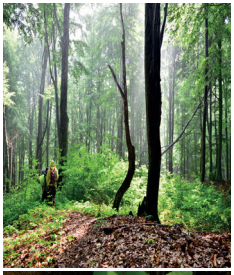

Temperate and boreal primeval forests in the face of global change

Conference

2-4 September 2019

Lviv, Ukraine

Program and Abstracts

КАРПАТСЬКИЙ БІОСФЕРНИЙ ЗАПОВІДНИК

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Swiss Federal Institute for Forest, Snow and Landscape Research WSL

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Conference Program

Monday, 02 Sept 2019

		Room A	Room B	Room C	Room D
08:00–09:00 am	Registration	Corridor outside Room A			
09:00–09:30 am		Welcome addresses			
09:30–10:30 am		Keynote by F.M. Sabatini			
10:30–11:00 am	Coffee break	Corridor outside Room A			
11:00–12:30 pm		Conser-vation I	Conser-vation III	Conser-vation V	
12:30–02:00 pm	Lunch	UNFU canteen			
02:00–03:00 pm		Keynote by Ch. Schenck			
03:00–04:30 pm		Struct & Dyn I	Conser-vation IV	Conser-vation II	
04:30–05:00 pm	Coffee break	Corridor outside Room A			
05:00–06:30 pm		Speed poster presentations			
06.30–07:00 pm	Shuttle to hotel				
from 07.00 pm	Individual dinner				

Tuesday, 03 Sep 2019

		Room A	Room B	Room C	Room D
8:00–09:30 am	Registration	Corridor outside Room A			
8:00 AM	Shuttle from hotels Eurohotel and Modern.Art to UNFU				
08:30–09:30 am		Keynote by D. Kulakowski			
09:30–11:00 am		Struct & Dyn II	Biodi-versity I	Struct & Dyn IV	
11:00–11:30 am	Coffee break	Corridor outside Room A			
11.30–12:30 am		Poster Session			
12:30–02:00 pm	Lunch	UNFU canteen			
2.00 pm		Keynote by N. Selva			
03:00–04:30 pm		Struct & Dyn III	Biodi-versity II	Glob Change effects I	Struct. & Dyn V
04:30–05:00 pm	Coffee break	Corridor outside Room A			
05:00–06:30 pm		Roundtable Permanent plot networks	Roundtable Biodiversity	Roundtable Capacity building	
06:30–07:00 pm	Shuttle from UNFU to hotels Eurohotel and Modern.Art				
07:30–10:00 pm	Conference dinner				

Wednesday, 04 Sept 2019

		Room A	Room B	Room C	Room D
08:00–09:30 am	Registration	Corridor outside Room A			
08:00 am	Shuttle from hotels Eurohotel and Modern.Art to UNFU				
08:30–09:30 am		Keynote by K. Woods			
09:30–10:00 am	Coffee break	Corridor outside Room A			
10:00–11:30 am		Research & Monitoring	Conser-vation VI	Glob Change effects II	
11:30–12:00 pm		Farewell adresses			
12:00–01:00 pm	Lunch	UNFU canteen			
1:00 pm	Departure of bus to post-conference excursion				

Session legend

Monday, 2 September

Conservation I:

Status and trends of primeval and unmanaged forests (part 1)	11:00am–12:30pm
Session Chair: Francesco Maria Sabatini, Peter Meyer	Room A

Conservation III:

Contribution of primeval and unmanaged forests to overall conservation targets, e.g. the European Habitats Directive or other national and trans-national programs (part 1)	11:00am–12:30pm
Session Chair: Veronika Braunisch, Thibault Lachat	Room B

Conservation V:

Pressures from emerging renewable energy markets on protected forests: focus fuel wood	11:00am–12:30pm
Session Chair: Astrid Björnsen Gurung	Room C

Structure & Dynamics I:

Disturbances and renewal in primeval and managed forests (part 1)	3:00pm–4:30pm
Session Chair: Lisa Hülsmann	Room A

Conservation IV:

Contribution of primeval and unmanaged forests to overall conservation targets, e.g. the European Habitats Directive or other national and trans-national programs (part 2)	3:00pm–4:30pm
Session Chair: Thibault Lachat, Veronika Braunisch	Room B

Conservation II:

Status and trends of primeval and unmanaged forests (part 2)	3:00pm–4:30pm
Session Chair: Peter Meyer, Francesco Maria Sabatini	Room C

Structure & Dynamics II:

Disturbances and renewal in primeval and managed forests (part 2)	9:30am–11:00am
Session Chair: Peter Brang	Room A

Tuesday, 3 September

Biodiversity I:

Primeval and unmanaged forests as refuge and source for populations of highly-demanding species: hotspots or coldspots? (part 1)	9:30am–11:00am
Session Chair: Martin Gossner, Vasyl Pokynchereda	Room B

Structure & Dynamics IV:

Growth, competition and density-dependent dynamics	9:30am–11:00am
Session Chair: Thomas A. Nagel	Room C

Structure & Dynamics III:

Disturbances and renewal in primeval and managed forests (part 3)	3:00pm–4:30pm
Session Chair: Peter Meyer	Room A

Biodiversity II:

Primeval and unmanaged forests as refuge and source for populations of highly-demanding species: hotspots or coldspots? (part 2)	3:00pm–4:30pm
Session Chair: Vasyl Pokynchereda, Martin Gossner	Room B

Global Change effects I:

Global change effects on the structure and dynamics of primeval and unmanaged forests	3:00pm–4:30pm
Session Chair: Peter Brang	Room C

Structure & Dynamics V:

Deadwood and other old-growth attributes	3:00pm–4:30pm
Session Chair: Tbd	Room D

Wednesday, 4 September

Research & Monitoring:

Long-term research and monitoring in primeval forests: experiences, benefits, prospects	10:00am–11:30am
Session Chair: Kerry Woods	Room A

Conservation VI:

Habitat continuity of primeval and unmanaged forests in a changing climate	10:00am–11:30am
Session Chair: Martina Hobi	Room B

Global Change effects II:

Effects of nitrogen emissions and land-use change	10:00am–11:30am
Session Chair: Peter Brang	Room C

Keynotes

Primeval forests and forest reserves in a changing world: status, trends and perspectives

Sabatini, Francesco Maria
Paper ID: 202

Primary forests continue to disappear, even in regions where forests are expanding. Their loss is worrisome since these forests are an irreplaceable part of our natural heritage, are critical for conserving biodiversity, and provide essential ecosystem services. Yet, many open questions remain on the distribution of primary forests in Europe, many of which remain undocumented. For which forest types is a 'sufficient' share of forest still primary? Are remaining primary forests adequately protected? Where should restoration efforts complement protection to reach long-term conservation targets?
After building a comprehensive database for Europe, which includes data for 1.4 Mha primary forest deriving from the literature, online questionnaires, and local to national datasets, we revealed a substantial bias in the distribution of these forests across and within biogeographical regions of Europe. Of the 54 forest types we considered, 16% have no primary forest at all, and two thirds have less than 1% of primary forest left. Only in five out of 54 types more than half of extant primary forests is strictly protected. This highlights major protection gaps. Much non-primary forests is protected in all forest types though, providing clear opportunities for restoration to increase primary forest extent in Europe.
Europe's primary forests are clearly in a perilous state: most forest types have close to no primary forest left, and most known primary forests are not strictly protected, small and fragmented. Changing this situation first and foremost requires increasing awareness of the irreplaceability of these forests by policy makers and relevant stakeholders, as well as a policy reform aimed at explicitly accounting for their unique nature. While protecting primary forests is a priority, protection alone is likely insufficient for meeting biodiversity targets. Especially in regions where the share of primary forest is very low, restoration is an inevitable complement to protection. The United Nations General Assembly designed 2021–2030 as the "decade of ecosystem restoration", which provides momentum to set ambitious restoration goals. Establishing a representative and functional network of primary forests in Europe will require ramping up protection and restoration efforts alike.

From knowledge to action: The role of primary forests in our global biodiversity crisis

Schenck, Christof
Paper ID: 201

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services IPBES highlighted in its Global Assessment Report the tight linkage between the climate and the biodiversity crisis. Loss of primary forests is leading to degradation of biodiversity and species extinction and is threatening local food and water security.
At the same time forest loss is supposed to contribute by 20 percent to the global anthropogenic carbon load responsible for fast increasing climate change. Artificial tree plantation is seen as a key tool to counteract climate change. Focusing on this bears the risk to miss the urgent need to stop primary forest loss and overlooks the multifunctional benefits and ecosystem services only primary forest can provide.

Three examples from around the globe will show threats to primary forests and their successful protection:

• In Eastern Germany ex-military training areas offer unique opportunities for re-wilding and the development of future old-growth forests. Human made forest fires, ammunition, off-road motor-biking and poaching are among the challenges.
• The Bale Mountain Nationalpark in Ethiopia with its unique Harenna Forests is the water tower for over 12 million people in the Ethiopian and Somalian lowlands. Its endemism rate is among the highest per area on global level. Primary forest loss is severe, will cause species extinction and mass migration of people as a result of droughts in the dry season.
• The Manu Nationalpark in Peru is home to indigenous tribes and holds world records on biodiversity. Alluvial gold mining and coca plantation are fast growing drivers in forest loss and land degradation in the surrounding of this outstanding protected area.

Case solutions as well as general new initiatives in long-term funding and management for the protection of high value primary forest will be presented.

Changing drivers of the structure and dynamics of temperate mountain forests – a North American perspective

Kulakowski, Dominik
Paper ID: 203

Natural disturbances, including large and severe ones, have long shaped temperate mountain forests in North America. However, recent and ongoing climate change is increasing disturbances in these forests, with cascading effects on structure and dynamics. Interactions among disturbances are increasingly common and are sometimes counterintuitive, complicating management strategies. In some cases, interacting disturbances under extreme climatic conditions appear to overwhelm the resilience of forest ecosystems. In other cases, post-disturbance changes in forest composition may represent disturbance-mediated adaptive resilience. Anticipating the effects of climate change on temperate forests requires an understanding of long-term ecosystem dynamics and of climatic effects on disturbance regimes and post-disturbance regeneration.

Why remaining roadless matters for forests

Selva, Nuria
Paper ID: 205

With more than 100 million km of roads worldwide, the road network shapes the environment worldwide. Road impacts are numerous, very complex, time-lagged and extend far beyond the road itself. In most cases, they are irreversible. One of the most detrimental effects is the “contagious development” triggered by roads, i.e. roads provide access to previously remote areas, thus promoting more roads and developments, land-use changes, resource extraction and human disturbance. In forest ecosystems, roads are inevitably linked to deforestation, hunting, wildlife trade, biological invasions and fires. Roads are particularly harmful when cutting through primeval and natural forests. Case studies show that density of forest roads, both paved and unpaved, and their specific impacts, are much higher than previously thought. In this context, keeping roadless large unfragmented patches of natural forests is of crucial importance for biodiversity conservation. Roadless forests represent relatively undisturbed forest habitats and functioning ecosystems. They increase landscape connectivity, act as barrier against pests and invasions, contribute to the preservation of native biodiversity and of species with large spatial requirements and sensitive to human disturbance and provide important ecosystem services. Roadless forests get special relevance in the context of climate change because of their higher resilience and buffering capacity. Unnecessary and ecologically damaging forest roads should be reclaimed to enlarge roadless areas and restore landscape-level processes. Compensation policies of “no-net-loss” of unfragmented forest lands should be implemented. Forest roads should be seriously considered in forest management and conservation. By keeping forests road-free, we contribute to protect them de facto, at practically no financial cost. Avoiding the first cut in intact and primeval forests is the most cost-effective way to protect them.

Permanent plots and heritage data-sets offer our best insights into dynamics of primeval forests in the face of global change

Woods, Kerry
Paper ID: 200

Recognition of the importance of long-term data for understanding slow systems like forests is not new. Regulatory processes, particularly in late-succession, play out over decades to centuries. However, long-term studies pose logistical challenges; consequently, models informing forest management and conservation and used to forecast response to environmental change rely on short-term studies, assumption-laden proxies, and indirect methods. Recent initiatives promote establishment of long-term, permanent-plot studies, but new studies have decades-long ‚latency periods' before sufficient data are accumulated to understand inherently slow demographic processes or to capture impacts of rare events or environmental fluctuations, and few studies have been initiated in old-growth forests. Consequently, forest ecology struggles with a data ‚blind spot' at temporal and spatial scales most pertinent for old-growth forests. This is a critical shortcoming in a period of accelerating environmental change; newly-initiated studies can't provide baseline data for changes already under way. However, 'heritage' data-sets from permanent plots established in the early-mid-20th century, can provide retrospective baselines, and have already supported studies challenging conventional models of late succession in temperate forests. These studies tend to emphasize the importance of 'historicity' – long-persistent signatures of rare events and environmental change – in forest dynamics, as contrasted with traditional models suggesting that old-growth forests are typically maintained in quasi-equilibrium by gap-phase processes. If this view is correct, ‚baseline' states may be elusive, late-successional forests must be placed in historical context, and the effects of climate change will be filtered through such historical contingencies. Long-term, retrospective data-sets are essential for critical assessment and comparison of these models. I use examples from multi-decade, heritage permanent-plot networks in Europe and North America to illustrate this critical importance for testing and generating hypotheses about old-growth forests, anticipating response to climate change, and reshaping questions about forest conservation and management.
Status and trends of primeval and unmanaged forests

Status and trends of primeval and unmanaged forests

Quantifying the structural complexity of primeval forest ecosystems across biomes

Ehbrecht, Martin; Seidel, Dominik; Annighöfer, Peter; Willim, Katharina; Stiers, Melissa; Ammer, Christian
Paper ID: 137

Forest ecosystem functioning and the provisioning of ecosystem services is strongly depending on forest structure. So far, there is little empirical knowledge about spatial patterns of three-dimensional (3D) stand structure in primeval forests and the natural range of their complexity. Knowing the determinants that shape the 3D structure of primeval forests is crucial to understand responses of their functioning to global change. The main objective of this study was to identify the natural range and abiotic drivers of structural complexity in primeval forests in comparison with managed or formerly managed forests across biomes. Using 3D terrestrial laser scanning data and methods of fractal analysis, we quantified the structural complexity of boreal forests in the United States and Sweden, temperate broadleaved forests in Chile, Ukraine, Slovakia, and Georgia, temperate coniferous forests in the United States, dry deciduous forests in Namibia, Botswana and Chile, as well as tropical rainforests in Uganda, Fiji Islands, Guatemala, Honduras and Malaysia. Early results show how stand structural complexity is related to mean annual temperature and precipitation, which has strong implications for forest dynamics in the face of a changing climate. Based on 3D data, we could further identify how patterns of canopy space occupation and vertical structure differ between primeval and managed or formerly managed forests. On the one hand, our results provide a baseline for future studies to investigate long-term dynamics of 3D forest structure and how these dynamics will be affected by global change. On the other hand, information on 3D structure of primeval forests may serve as reference for close-to-nature silvicultural practices. During the presentation, we will show how newly developed measures of 3D forest structure and methods of fractal analysis may provide new insights into the ecology and dynamics of primeval forests.

Genetic diversity in beech populations from Iran, Ukraine and Germany

Fussi, Barbara; Kavaliauskas, Darius; Rahanjam, Saboura; Hrunyk, Nataliya; Yusypovych, Yurii; Lavnyy, Vasyl; Sagheb-Talebi, Khosro
Paper ID: 173

Natural disturbances and human activities affect diversity of forests on various levels: genetic, species and ecosystems. High genetic diversity of forest trees ensures that forests can grow, adapt and evolve under environmental change, but they may face threats when such change occurs faster than the species' adaptive and evolutionary mechanisms can handle. The comparison of genetic processes from primeval and managed forests can provide insights in the effects of global change. Forest genetic monitoring (FGM) was therefore implemented in *Fagus orientalis* (Iran), *Fagus sylvatica* (one plot in Ukraine and two plots in Germany).
Through an intensive selection procedure in each FGM plot we sampled 250 adult trees (DBH> 15 cm) and leaves from 200 saplings in four natural regeneration subplots 0 individuals in each). Subsequent genetic analyses were based on 16 nuclear microsatellite markers. Data regarding genetic variation and genetic differentiation among four FGM plots and among adult trees and natural regeneration within the plots will be presented.
The comparison of different ontogenetic stages will give a first hint to the intactness of the genetic system. First results indicate that genetic diversity was transmitted evenly from adults to natural regeneration. Genetic diversity within the Iranian Oriental beech population is slightly higher than in the Central European beech populations. The number of private alleles is highest in *Fagus orientalis*, and higher in *Fagus sylvatica* from Ukraine compared to Germany. Continuation of FGM will allow us to observe the status of the same ontogenetic stage over time and thereby draw conclusions about the population's evolutionary potential through comparison to the now assessed baseline data. In addition FGM includes phenology observations (flushing, flowering) and evaluation of reproduction capacities (fructification and presence/abundancy/ survival of natural regeneration).

Spatial structure and productivity of unevenaged old-growth forests of Skole Beskides

Korol, Mykola; Gusti, Mykola; Havryliuk, Serhii; Chaskovskyy, Oleh
Paper ID: 132

During 1950–1980 the Ukrainian forest management was based on clear-cuts and artificial regeneration of the forest (manual planting or sowing). This kind of forest management had led to the creation of the even-aged monocultural tree stands where spruce was the favored species. The forest of the national park "Skole Beskides" consists of both managed and protected parts. The managed areas are now recovering and present different stages of succession, while the old-growth parts show the mixed tree composition of beech-spruce-fir, beech-fir, spruce-fir species and uneven age structure.
We studied the process of succession and formation of the old-growth structure and change of species composition in the Skole Beskides forest. The research results might be implemented further for the efficient use of forest resources, and the improvement of approaches to balanced, sustainable management of forest areas in Ukraine.

Why the laws of the metabolic scaling theory do not drive demography and structure of European temperate old-growth forests

Kral, Kamil; Daněk, Pavel; Janík, David; Adam, Dušan
Paper ID: 172

Recently, one of the most influential theoretical concepts in biology and ecology has been the Metabolic Theory of Ecology developed by G.B. West, J.H. Brown and B.J. Enquist (WBE theory). This theory considers the metabolic rate of organisms as the fundamental biological rate that governs most observed patterns in ecology and was applied to variety of organisms and extended to many scaling laws (always power laws), including allometry of vascular plants and structure and dynamics of plant communities. Applied to forests the theory resulted in 'A general quantitative theory of forest structure and dynamics' (West et al., 2009, PNAS), also referred to as Metabolic Scaling Theory of Forests (MSTF).
We tested the main community scaling laws of MSTF related to growth rate, mortality rate and tree size distribution in three European old-growth forests in the Czech Republic. Opposed to the prediction, we consistently observed U-shaped pattern of mortality rate along tree size, which indicated that thinning is neither the only, nor the major driver of tree mortality and at least temporarily disturbances take the main role in mortality of large trees. We also observed enormous deviations from the predicted power-law relation in the tree size distribution and varying growth rates. Observed deviations nicely illustrate three significant features of European temperate forests that all violate the crucial assumptions of the MSTF: i) tree recruitment is temporally and/or spatially limited, which leads to underrepresentation of small trees compared to MSTF prediction; ii) by contrast, the cohort of canopy trees is usually dominant (overrepresented) while the frequency of largest trees declines more steeply than predicted, which is likely the effect of disturbances; iii) observed demographic processes are spatially patchy and temporally variable. Consequently, at least at the observed scale of tens of hectares the forests are not in demographic equilibrium.

Virgin and old growth forests in Romania – the Romanian national catalogue of virgin forests

Luick, Rainer; Schickhofer, Matthias; Fodor, Ecaterina
Paper ID: 124

The largest share of primary forest remains in the temperate zone within the EU is located in Romania (ca. 70%). However, these forests are under extreme threat. In 2012, the Romanian Government established the ”National Catalogue of Virgin Forests“ which allows experts to identify and map forest stands and to submit respective studies to authorities for protection. But the pace to populate the Catalogue is very slow, thus raising considerable concerns about the future of virgin and old growth forests in Romania. Based on previous studies like the so-called PinMatra survey from 2001 – 2005 we know that at least 200.000 hectares of virgin forest existed at that time. In 2008 a governmental Forest Code stated that all virgin and so called quasi-virgin forests were to be protected. However, many of these ecologically outstanding areas have been degraded or destroyed since and it is not clear exactly how much primary forest is left today.. And the destruction continues and we are facing one of the most serious losses of European natural heritage. The University of Rottenburg (HFR) / Germany with financial support provided by the German Environment Foundation (DBU) initiated a scientific project aiming to support the Romanian state with the identification and protection of important „virgin“ forests. The project is carried out by experienced Romanian forest scientist and practioneers and is with its first phase coming to an end in 2019. In our presentation we will highlight following topics: an analysis of the strategy and criteria of the catalogue project the role and position of the Romanian government and institutions, observations about the situation of virgin and old growth forest stands, the failure of European policy and) the urgent need to develop strategies to inform and to raise awareness.

Primeval and old forests of the Steppe Dnipro region: uniqueness, distribution, threats, protected status

Maniuk, Vadym
Paper ID: 163

There are unique old-growth forests in the steppe zone of the Dnipro river basin. Despite fragmentation and small size, these forests represent natural ecosystems without human management for the last 200 years. The most important steppe virgin forests belong to the basins of the Samara, Domotkan, and Samotkan rivers, and to the Dnieper Rapids region. The forests of Samara are of greatest value: they contain very old alder, oak and pine trees. In the ravines near the Dnieper Rapids and in the valleys of the Samotkan, Domotkan and Omelnik rivers, the primeval oak forests are preserved.
Unlike the mountain virgin forests of Ukraine, the steppe primeval forests are unknown for the scientific community. Their value is especially high as the model of the forests growing on the southern boundary of their range. Such old-growth remnants create relic habitats for the rare species of flora like *Matteuccia struthiopteris* (L.) Tod., *Aegonychon purpurea-coeruleum* Holub., Laser trilobum (L.) Borkh. and many others.
The main threats to steppe primeval forests are forest fires, land-use change, change of river level for hydropower stations, intensive farming and fragmentation. The first step to preserving them is the organization of the biosphere reserve “Prisamar’ya”, and establishment of national parks “Samarska Tovscha”, “Dniprovi Porogi”, “Sicheslavsky” where the old-growth forest parts should be delineated to strictly protected core zones of these parks.

Primary forest distribution in a Central European landscape

Mikoláš, Martin; Ujházy, Karol; Jasík, Marián; Wiezik, Michal; Gallay, Igor; Polák, Pavol; Vysoký, Juraj; Čiliak, Marek; Meigs, Garrett W.; Svoboda, Miroslav; Trotsiuk, Volodymyr; Keeton, William S.
Paper ID: 175

Most countries still lack data regarding primary forest distribution. Previous studies have tested remote sensing approaches as a promising tool for identifying primary forests. However, this has led to underestimation of primary forest abundance and distribution in the temperate zone of Europe. Field-based inventories of primary forests and methodologies to conduct these assessments are inconsistent, thereby increasing the vulnerability of primary forest systems to continued loss. We developed a comprehensive methodological approach for identifying primary forests, and from 2009 to 2015, we conducted a national-scale primary forest census covering the entire Slovak Republic. We analyzed primary forest distribution patterns and the representativeness of potential vegetation types within primary forest remnants. We further evaluated the conservation status and extent of primary forest loss. Remaining primary forests are small, fragmented, and often do not represent the potential natural vegetation. We identified 261 primary forest localities. However, they represent only 0.47% of the total forested area, which is 0.21% of the study landscape. The spatial pattern of primary forests was clustered. Primary forests tend to persist on sites with higher elevations, steeper slopes, rugged terrain, and greater distances from roads and settlements. Primary forest stands of montane and subalpine spruce forests are overrepresented compared to broadleaved forests. Alarmingly, several habitat types are completely missing in the landscape. More than 30% of the remaining primary forests are not strictly protected, and harvesting occurred at primary forest localities within the study period. The critical status of primary forest distribution in this part of Europe is evident. Effective primary forest conservation strategies are urgently needed to stop the rapid loss of the remaining primary forests.

Contribution of primeval and unmanaged forests to overall conservation targets, e.g. the European Habitats Directive or other national and trans-national programs

UNESCO MAB Reserves as a mechanism in conserving old-growth forest ecosystems: A comparative analysis of case studies in the Northern Forest Region (United States) and Transcarpathian region

Bihun, Yurij; McNulty, Stacy; Keeton, William; Dovciak, Martin
Paper ID: 135

The study of the ecology and silviculture of old-growth temperate forests as a science is a relatively new phenomenon. Its origins were mostly focused on remaining, intact old-growth forests until the last quarter of the 20thcentury, when this foundational research was adapted to the ecological framework of biologically diverse recovering forests as well as old-growth preserves worldwide. Estimates of old-growth are variable because of a range of reasons including criteria that define old-growth, anthropogenic influences and the continual change due to disturbance. Regardless, most old-growth stands have been protected in a variety of systems most notably as core reserves in the UNESCO Man and Biosphere (MAB) Programme.

Since its launch in 1971, MAB has promoted itself as “an intergovernmental program that aims to establish a scientific basis for improvement of relations between people and their environments.” The World Network of Biosphere Reserves has grown to be currently comprised of 686 sites in 122 countries including 20 transboundary sites.

A comparative analysis of two MAB mountain reserves with representative temperate old-growth forest ecosystems is presented: The Carpathian Biosphere Reserve (CBR) in the Transcarpathian region of Ukraine and The Champlain-Adirondack Biosphere Reserve (CABR) in the Northern Forest region of the US. The research employs a case-study model that relies on qualitative methods. The objectives are to examine whether the MAB designation in two disparate geographic regions with distinct physiographic conditions, forest types and land use history has resulted in different processes for protecting old-growth forests. By virtue of its design, the MAB system should provide an additional layer of protection and confer the highest category of recognition. From the onset of the program, however, the role of the MAB designation has been clouded with criticism; its inherent conservation value being questioned in terms of protecting ecosystems services and biological diversity as well as providing value-added to communities of place. The results identify research areas in the sustainable management and protection of old growth forests that are mutual beneficial to management of both biosphere reserves.

UNESCO world heritage site “ancient and primeval beech forests of the carpathians and other regions of europe” and its role in forest biodiversity conservation and providing sustainable development for adjacent territories

Hamor, Fedir
Paper ID: 105

On my initiative, Ukrainian primeval beech forest sites were enlisted into the UNESCO World Heritage List on June 28, 2007 as a part of the Ukrainian-Slovak nomination “Primeval Beech Forests of the Carpathians”, becoming the only natural World Heritage Site of Ukraine, thus starting up the European process of beech forests conservation.

And on July 7, 2017, at the 41st session of the UNESCO World Heritage Committee, in the Polish city of Krakow, a Trans-European World Heritage Site “Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe” was formed out of it.

It is composed of the least disturbed forest ecosystems in Albania, Austria, Belgium, Bulgaria, Croatia, Italy, Germany, Romania, Slovenia, Slovakia, Spain and Ukraine.

As for the Ukrainian part of the Site, it consists of the component parts protected by the Carpathian Biosphere Reserve, nature reserves “Gorgany” and “Roztochchia”, national nature parks “Uzhanskyi”, “Synevyr”, “Zacharovanyi Krai” and “Podilski Tovtry”.

The area of the core zone of the Heritage Site amounts to 91232,81 hectares, 23% of which are protected in the territory of the Carpathian Biosphere Reserve. Thanks to this, Ukraine takes the first place by area within the Heritage Site (26985.98 hectares). The second place belongs to Romania (23982.77 hectares), and the third – to Bulgaria (10988.91 hectares).

Out of 77 component parts in 12 European countries, the largest site in terms of area is the Uholka-Shyrokyi Luh primeval forest site protected at the Carpathian Biosphere Reserve (11860 ha).

The serial Site “Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe” contains an invaluable gene pool of beech and of about 10.000 other species that are bound to and dependent on these forest habitats, and it greatly contributes to sustainable development of the region where it is located.

Reference, refuge and source: the role of primeval forests for biodiversity conservation

Lachat, Thibault; Müller, Joerg; Blaser, Stefan; Gossner, Martin; Wermelinger, Beat
Paper ID: 177

Based on many studies conducted in unmanaged and primeval forests, we could identify forest characteristics representing the backbone for the conservation of saproxylic species, namely absence of habitat fragmentation, habitat continuity, recurring natural disturbance, high amount and quality of dead wood, high density of habitat trees and natural tree species composition. Such habitat characteristics can serve as references for close-to-nature management and nature conservation. However, few studies focusing on biodiversity were made to establish references at the species and community level.
In this talk, we will make a plea to intensify biodiversity studies in primeval forests using standardized methods and sampling designs. This should be of prime concern, especially since primeval forests also represent refuges and even source for saproxylic species which cannot survive in managed forests due to their high ecological requirements. In that sense, we will present the results from different case studies conducted in beech forests in Ukraine and Switzerland focusing on saproxylic beetles and fungi. Such an approach enables to (i) compare results from different case studies, (ii) set references for biodiversity and (iii) estimate which species could be expected under natural conditions. Our results show strong differences between regions dominated by primeval forest and regions with century-long intensive forest management. Consequently, we strongly recommend intensifying studies in primeval forests. This will provide more reference data for integrating primeval forest characteristics into forest landscapes with managed forests and hence stimulate sustainable forest management.

Extension of the UNESCO World Heritage Site in Ukraine – main results

Pokynchereda, Vasyl; Prots, Bohdan; Berkela, Yuriy
Paper ID: 141

The Ukrainian primeval beech forests of the Carpathian mountains were the basis for the creation of the UNESCO World Heritage Sites (WHS) in 2007. However, they are not the only ones in Ukraine. Here we presented the additional four Beech Forest Regions (BFR): Carpathian, Polonic-Podolic-Moldovan, Euxinic, and Pannonian. The selection of the most valuable plots resulted in 11 stands already protected within seven forest reserves. Two Crimean plots of the primeval beech forests were not considered because of the annexed Crimea by Russia In 2014. Thus, the nomination portfolio included nine clusters of the unique beech forests in Carpathian and Polonic-Podolic-Moldovan BFRs, totaling 5473.47 hectares.
The 41st session of the UNESCO World Heritage Committee (Poland) decided to extend the existing WHS. As a result, 63 new components of the beech primeval and ancient forests from ten European countries together with the existing parts created the Transnational Serial Site “Ancient and primeval beech forests of the Carpathians and other regions of Europe”. Up to date, Ukraine is represented by 15 forest clusters covering an area of 26453.98 hectares that constitutes 28.75% of the total area of the Transnational Serial Site.

Priority areas for strict forest reserves: reaching political targets while identifying hot spots with high conservation value

Seebach, Lucia Maria; Braunisch, Veronika
Paper ID: 107

One ratified goal of the German National Biodiversity Strategy is to increase the proportion of strict forest reserves to five percent of the total and ten percent of the state's forest area, respectively. Formerly, these reserves have frequently been designated in areas unviable for forestry, which are not necessarily of high conservation value.
To optimize future reserve selection and to meet the political area-target we used a systematic conservation planning framework to spatially identify a coherent and representative network of forest patches of high conservation value within the state's forest of Baden-Württemberg.
We applied an optimization algorithm (MARXAN) to ensure high conservation impact whilst minimizing costs. This requires the definition of quantitative conservation targets for specific selection criteria, which in our case were representativeness (regarding e.g. forest type) or high conservation value (e.g. naturalness). As conservation targets are difficult to define, a sensitivity analysis was carried out to evaluate target-selection effects on the variability of the resulting area network. Different scenarios were modelled, in which target values were gradually increased and outcomes subsequently assessed by a range of metrics (representativeness, irreplaceability, total area, connectivity). Also, the effect of minimizing different cost types (area versus stand value) was tested.
In general, MARXAN is an appropriate tool for an objective cost-efficient selection of potential forest reserves with high conservation value. Yet, the use of different costs schemes heavily altered the distribution of selected areas, only top conservation hotspots showed a high persistence across these scenarios. Furthermore, reserve selection is rather driven by meeting the conservation targets than complying with area targets, which often resulted in reserve networks surpassing the political target area.
Our approach allows decision-makers to choose one preferred among a portfolio of different scenarios of forest reserve networks, all optimizing conservation values under different, politically defined cost and area constraints.

Old-Growth and Virgin Forests as an integral part of Green Infrastructure in Ukrainian Carpathians

Smaliychuk, Anatoliy
Paper ID: 194

Identification and protection of the natural and especially virgin forests (VF) are defined as the specific measures to be undertaken by countries of the Carpathian Convention (CC). Recently, we finished the identification of the virgin and old-growth forests (OGF) in the Ukrainian Carpathians (UC) using a comprehensive methodology developed in line with CC criteria for the virgin forests.
According to the last findings, UC possesses about 94,000 ha of VF and OGF (ca. 8900 forest plots). For every such forest, we created a geo-database with information on past forest management, protection status, area, age, species composition, forest type, the volume of deadwood, forest regeneration status and decay, presence and type of anthropogenic impact. The beech (*Fagus sylvatica*) dominated natural forests comprise over 55 %, followed by spruce (*Picea abies*) with a share of 21%, dwarf pine (*Pinus mugo*) - 5% and fir (*Abies alba*) - 3%. The species composition of VF and OGF differs considerably depending on elevation and aspects of mountain ridges.
We consider the protection of structural diverse VF and OGF of the Ukrainian Carpathians is a key element for the preservation of habitats for many endangered and regionally important animal and plant species. In this respect, such forests have to be incorporated in a wider ecological network, e.g. Natura 2000/Emerald network, in order to ensure migratory routes across the entire Carpathian ecoregion. At present, only 60% of the natural Ukrainian Carpathian forests are included in Emerald network but are often defragmented.

‘The woods are lovely, dark and deep’: unmanaged forests as microclimate ‘coldspot’ refuges for late-successional species?

Vandekerkhove, Kris; Thomaes, Arno; De Keersmaeker, Luc; Leyman, Anja; Van de Kerckhove, Peter; Verheyen, Kris
Paper ID: 106

Formerly managed forests that are left for free development give opportunities for recovery and development of late-successional species depending on old-growth elements and structures. On the other hand, these forests switch to lower frequencies of disturbance and may go through a prolonged phase of closed canopy cover, that may lead to temporal or permanent loss of light-demanding and thermophilous species.
We analysed the development of ground vegetation in four formerly managed lowland forests on fertile soils, and indeed registered a distinct decline in species richness. However, developments were strongly differing between different plant life strategies. Ruderal species, with strong links to anthropogenic disturbances and typical light-demanding species of gap disturbances significantly declined, while stress-tolerant species sustained. Vernal geophytes and hemicryptophytes (ferns) significantly even expanded in frequency and cover. Gap species that declined typically have good dispersal abilities or long-lived seed banks and are therefore not necessarily lost from the species pool.
We combine these conclusions with results for other species groups such as fungi and saproxylic beetles, and come up with a spatial configuration concept that caters for both thermophilous and microclimate-associated late-successional species.

Global change effects on the structure and dynamics of primeval and unmanaged forests

Scale-dependent changes in the structure of naturally dynamic old-growth boreal forests on two continents

Kulha, Niko; Pasanen, Leena; Holmström, Lasse; Kuuluvainen, Timo; De Grandpré, Louis; Gauthier, Sylvie; Aakala, Tuomas
Paper ID: 122

Global change has altered boreal forest dynamics and structure. While changes in forest dynamics are well-studied, neglecting the scale-dependency in how forest structure changes hampers the understanding of forest development. We studied scale-dependent changes in the structure of three 4 km² boreal forest landscapes in Finland and two landscapes in Quebec, Canada. We visually interpreted canopy cover in each landscape at three time points between the years 1959 and 2011, using aerial photographs and a grid of 0.1-ha cells. We calibrated the interpretation and developed posterior distribution for the interpretation error using field- and tree-ring measurements. We quantified and mapped annual canopy cover changes between the time points, identified spatial scales at which changes occurred, and analyzed the credibility of changes at these scales.
We identified canopy cover changes at three to four spatial scales, the number of scales depending on the studied landscape and time period. At large scales (15.4–321.7 ha), predominantly positive changes occurred in Finland, independent of the studied time period. In Quebec, the direction of the large-scale change varied between the studied time periods. At large scales, 36–100 % of the landscape area changed credibly, considering all landscapes and time periods. At small scales, changes occurred at 1.3–5.0 ha, and at 0.1 ha scales. At these scales, both positive and negative changes occurred in all landscapes and time periods. The landscape area that changed credibly ranged between 12–35 % at 1.3–5.0 ha scale, and between 3–12 % at 0.1 ha scale.
That forest structure changed at different hierarchical scales, and that the change direction and magnitude varied between spatial scales indicates that this scale-dependency should be considered in forest change analysis. The eminent large-scale change suggests that currently top-down factors, not gap dynamics, change the structure of the studied old-growth boreal forests.

Tracking changes in tree species composition over the past half-century in natural forest reserves

Mathys, Amanda; Stillhard, Jonas; Hobi, Martina; Bugmann, Harald; Brang, Peter
Paper ID: 171

Primeval forests provide an opportunity to track natural forest dynamics over time without human intervention. The natural forest reserve network in Switzerland has been monitoring demographic forest processes and stand structure over the past 60 years on long-term permanent plots distributed in different forest types across the country. Climate change may influence existing species distribution patterns leading to changes in forest composition, which in turn affect forest ecosystem processes and functions. This study aimed to assess changes in species composition over the past half-century within the Swiss forest reserve network. The occurrence and abundance of tree species was compared between the first and last inventory and also along an altitudinal gradient to determine where species shifts have been most abundant. Species gains and losses were determined in relation to stem diameter to analyse demographic trends in species composition. New tree species emerged in 32% of the permanent plots with 13% experiencing a loss in tree species and 55% no change. The greatest changes occurred at lower elevations particularly in the colline, submontane, and lower montane zones. This indicates that species richness is increasing in lower elevation forest reserves across Switzerland.

Influence of climate and competition on growth sensitivity and trends of *Fagus sylvatica* in the largest primeval beech forest of Europe

Muhmenthaler, Julian; Lévesque, Mathieu
Paper ID: 170

Understanding the processes that drive growth of European beech (*Fagus sylvatica* L.) is critical to predict dynamics of natural beech forests under climate change. Here, we analyzed the effect of climate and competition on radial growth of beech in the Uholka-Shyrokyi Luh massif in southwestern Ukraine, the largest primeval beech forest of Europe. Yearly radial growth time series from 249 trees and forest inventory data were combined with high-resolution climatic data to assess the climate sensitivity of beech trees. To test for an effect of competition on growth and climate sensitivity we calculated a spatially-explicit competition index. Linear mixed-effects models were used to model basal area increment as a function of tree size, climate and competition. Our results indicate that growth of beech was only slightly sensitive to climate. Among the climatic variables, winter temperature had the strongest positive effect on growth. Moreover, trees benefitted from elevated summer temperatures and reduced summer climatic water balance, suggesting that drought is not an important factor limiting the growth of beech in the study area. Trees experiencing low levels of competition were slightly more sensitive to summer water deficits than trees suffering high levels of competition. Overall, 62 % of the sampled trees exhibited a significant positive growth-trend over the period 1901-2009 that matched the increase in temperature, suggesting that warming may have enhanced tree growth in this primeval forest.

Disturbances and renewal in primeval and managed forests

Impact of forest development phases on soil C and N stocks: insufficient and controversial data

Bedernichek, Tymur; Bundzyak, Yosyp; Dziuba, Oksana; Kolotilov, Sergey; Volochnyuk, Dmitriy; Zaimenko, Natalia
Paper ID: 187

Soil organic matter is one of the biggest carbon stocks on the planet. The stability of soil organic matter depends on many factors, but one of the most important is the availability of nitrogen. Therefore it is recommended to study C and N stocks simultaneously. There is still insufficient data about the distribution of soil organic matter and belowground biomass in forests. In this study, we evaluated the content of total organic carbon and total nitrogen in Dystric Cambisols of Uholka-Shyrokyi Luh primeval beech forest for each forest development phase (FDP). The classification approach and protocol of Zenner et al. (2016) were used to identify FPDs. All the studies were conducted in three replicates – three separate locations for each FDP. We analyzed the content of carbon and nitrogen in the topsoil (0 – 10 cm) with CHN analyzer. The hypothesis was that FDP affects soil properties and in particular content of C and N. We thought that content of these elements in the soil would depend on the FDP and thus may be used as an additional criterion for the identification of the phase. Unfortunately, the dispersion of C and N contents in the group (different sites under the one type of development phase) was almost the same as between the groups (different development phases). Our results contradict with previously published data (Henyk, 2011) that showed significant differences in C content in soils under different FDPs. We conclude that i) content of C and N in the studied soils was not a sensitive indicator of the FDP; ii) this may be explained by statistical noise and other inaccuracies, caused by significant spatial heterogeneity of soil properties iii) in future studies should be more replicates and Kalman filtering or equivalent should be applied to the raw data.

Trait-based mechanisms of fine-scale species persistence and patterns of functional diversity in the understory of the Bialowieza Forest under different management regimes

Cacciatori, Cecilia; Chelli, Stefano; Simonetti, Enrico; Tordoni, Enrico; Klub, Piotr; Campetella, Giandiego; Canullo, Roberto; Bobiec, Andrzej
Paper ID: 183

Plant strategies to survive and disperse are at the base of forest ecosystem functioning. The understanding of trait-based mechanisms of species persistence and functional diversity patterns of understory communities can provide the key to predict future shifts in species composition and functional relationships likely to occur as a result of climate changes and management activities.
This study aims at highlighting spatial variations in functional diversity in the understory of different Tilio-Carpinteum stands of the Białowieża Forest (Poland) and exploring which functional traits are correlated with fine-scale species persistence along a timespan of twenty years. Vegetation surveys were performed both in and outside the Białowieża National Park, in ten 20x10-m plots representing two stages of stand development: old growth (over 100 years) and middle aged. The sampled stands were subject to four surveys over the period 1997–2019. Each plot was divided into 200 subplots 1x1m, for each of which abundance of vascular plant species, pH of the uppermost soil layer and the Canopy Influence Index were calculated.
We selected a set of above- and belowground traits (e.g. specific leaf area, seed mass, clonal traits) reflecting different plant functions and we assigned to each species the relative attributes. Conditional inference trees were used to evaluate if specific traits are correlated with patterns of species persistence at a fine scale and if such correlations change across different site conditions depending on the degree of management. Patterns of functional patterns and their ecological meaning were further assessed comparing managed and old-growth stands.
The results of this study will help us assess the effects of forest structure and of different management regimes on functional diversity of different forest stands and trait-based mechanisms of species persistence in the understory layer.

Natural dynamics of the temperate mountain beech dominated primary forests in the Western Carpathians

Frankovič, Michal; Čada, Vojtěch Čada; Janda, Pavel Janda; Kozák, Daniel Kozák; Dušátko, Martin Dušátko; Kameniar, Ondrej Kameniar; Svoboda, Miroslav Svoboda
Paper ID: 128

Primary forests plays a key role in providing habitat for many rare species and other important ecosystem functions and services. Natural disturbances are a key factor in forming forest ecosystem structure. Using dendrochronological analysis, we reconstructed the overall regional canopy disturbance history of primary forests dominated by European beech (*Fagus sylvatica*, L.) and Silver fir (*Abies alba*, M.) in Western Carpathians, Slovakia. We established 42 circular permanent study plots of 1000 m^2 across three forest stands within two mountain ranges. On each plot we cored 25 trees and measured their canopy area. Using tree-ring width analysis we conducted disturbance history reconstruction based on two patterns of radial growth: abrupt, sustained increases in growth (release – indicating mortality of a former canopy tree) rapid early growth rates (gap recruitment - indicating recruitment in a former canopy gap). All detected events were converted to the percentage of the canopy area disturbed in each plot. For access stand-level disturbance events, we compiled plot-level disturbance chronologies and segregated events with severity more than 10% of canopy area removed. To obtain patterns in synchronicity of disturbance events, timing and evaluating of maximum severity disturbances were grouped into ten 20-years long time periods. We observed periods of temporal gradation within study region and within study stands. We recorded occurrence of whole spectrum of disturbance events severities. Low and moderate severity plot-level disturbance events were the most common, but occurrence of high and extreme high severity events were observed. Their ratio in study periods fluctuates and in some periods were formed by very high severity events more, some intervals less. It suggests coarse-grained structure formed by occurrence of canopy gaps, patches and their events synchronicity within the stand suggests occurrence of stand-level near-stand replacing disturbances.

Structure and diversity of a beech-dominated virgin forest

Hanzu, Mihail; Luick, Rainer
Paper ID: 162

In this study we are quantifying the spatial micro-structure of a virgin forest ecosystem stand in the Romanian Carpathian Mountains, dominated by European beech (*Fagus sylvatica* L.). Parameters are the location of each single tree, number of trees, height, diameter, age, growth performance using a rectangular coordinate system. Based on these measured data, we used nearest neighbour statistics (NNS) for quantifying the forest spatial structure and diversity in terms of aggregation, species mingling and size differentiation. The results from this beech-dominated virgin forest plot might represent a reference for continuous cover forestry, applied under similar conditions.

Insights on the disturbance regime of the Uholka-Shyrokyi Luh forest in western Ukraine on different scales gained from remote sensing

Hobi, Martina Lena; Rehush, Nataliia; Ginzler, Christian
Paper ID: 166

Natural disturbances are an integral component of forest dynamics and lead to changes in the structure of a forest. In the primeval beech forest of Uholka-Shyrokyi Luh (Ukraine), covering an area of around 10'000 ha, wind is known to be the most important disturbance agent. With remote sensing approaches based on airborne laser scanning (ALS) and stereo aerial images, we are characterizing recent windthrow events in this forest. Both 3D data sets are used for the calculation of digital elevation models in form of canopy surface models and the ALS data additionally to model the terrain of the forest floor. Through subtraction of the terrain from the surface model the height of the canopy is calculated and a vegetation height model (VHM) generated which is providing the basis for mapping canopy gaps. The differences of the two approaches from ALS and stereo images will be discussed. Additionally the findings can be compared with results based on 2D spectral information from image data alone. The main characteristics of this forest such as the dominance by the highly shade-tolerant beech, the uneven-aged canopy structure, the high abundance of old trees and the homogeneity of forest characteristics at larger scales suggests that small-scale disturbance events are shaping the structure of this forest. In contrast to a mosaic of canopy gaps typically ≤ 200 m^2 found in a previous study in 2010, several canopy gaps > 10'000 m^2 created in the context of two storm events in autumn of the year 2017. In combination with data from field assessments, these results deliver interesting insights into the disturbance regime of this forest.

Drivers of basal area variation: the lesson from primary late-successional *Picea abies* forests along the Carpathian mountain range

Janda, Pavel; Tepley, Alan, J.; Schurman, Jonathan, S.; Brabec, Marek; Nagel, Thomas, A.; Mikoláš, Martin; Trotsiuk, Volodymyr; Bače, Radek; Chaskovskyy, Oleh; Teodosiu, Marius; Svoboda, Miroslav
Paper ID: 131

Understanding the processes driving spatial variation in forest biomass is key to understanding the contribution of forests to carbon sequestration and many other ecosystem services. At coarse scales, forest biomass is likely to vary along major climatic and physiographic gradients. Within those broad biophysical gradients, disturbances may either amplify or dampen spatial heterogeneity in forest biomass, depending on the spatial extent of disturbances and their synchrony in time. The aim of this study is to compare the roles of coarse-scale biophysical gradients and local disturbances in driving spatial variability in the basal area of late-successional spruce forests at region, stand, and plot scales throughout the Carpathian Mountains of central Europe. We evaluated 30 late-successional stands distributed throughout a 1,000-km section of the Carpathians. Each stand included an average of 16 0.1-ha plots (472 plots), in which forest composition and structure were sampled and tree-ring data were sampled to assess disturbance history. We used linear mixed-effects models to evaluate the effect of disturbance regimes and site conditions on stand basal area at three spatial scales. The basal area of late-successional spruce forests varied across the regional climatic gradient, with the highest values (48–68 m^2 ha–1) in the warmer southern Carpathians, and lower basal area (averaging 37–52 m^2 ha–1) in cooler areas of the eastern and western Carpathians. The natural disturbance regime of windstorms and bark beetles causing tree mortality at varying spatial extents and patterns drove substantial within-stand heterogeneity in the basal area. Over broad spatial scales, however, there was much lower variability in forest basal area, and this variability was largely as expected along the major regional climatic gradients. Our findings suggest that warming could increase the basal area of northern sites, but potential increasing disturbances could disrupt these environmental responses.

Natural disturbances in spruce primary forest have short-term impact on bird community composition, while diversity and abundance remain stable

Kameniar, Ondrej; Baláž, Michal; Svitok, Marek; Reif, Jiří; Mikoláš, Martin; Morelli, Federico; Vostarek, Ondřej; Langbehn, Thomas; Frankovič, Michal; Janda, Pavel; Kozák, Daniel; Čada, Vojtěch; Dušátko, Mar
Paper ID: 123

High vertical and horizontal diversity of primary forest structure is a result of natural dynamics, mostly represented by natural disturbances of different severity, spatial extent, frequency and timing. Due to difficulties to obtain detailed information on disturbance histories, studies focused on forest biodiversity in temperate Europe mainly analysed immediate or short-term impacts of natural disturbances on biodiversity, while studies relating disturbance history to biodiversity are rare.
To address this important knowledge gap, we used a dendroecological approach to link natural disturbance history of 250 years (1750-2000) to structural habitat elements and, in turn, to breeding bird communities in 58 permanent study plots within 10 primary spruce forest stands across the Western Carpathians. Birds were counted during the breeding seasons 2017 and 2018, three times per season. Environmental variables, describing forest density, tree diameter distribution (DBH), height, tree microhabitats, deadwood quantity and quality, regeneration, were measured in 2017.
Although we did not found a direct relationship of disturbance history variables and bird community, we proved significant indirect influence of disturbance history (time since last disturbance, severity of the last disturbance and disturbance frequency) through forest structure (number of trees with bark loss, density of the large dead trees, basal area of dead trees, volume of standing dead trees, overall amount of deadwood and canopy openness) on bird community composition. Group of early successional, more open habitat demanding species like Dunnock (Prunella modularis) was positively influenced by disturbance-related structure, while other species responded neutrally or even negatively. As a consequence, overall abundance and diversity of birds remained unchanged. Our results support the view of primary spruce forest as a highly dynamic ecosystem. Within this ecosystem, particular species show adaptations to different phases of its complex dynamics resulting in remarkable stability of diversity and abundance at the community level.

Environmental and host factors affecting bark beetle spatio-temporal dynamics in the forests of the High Tatra Mts (Central Europe)

Mezei, Pavel; Jakuš, Rastislav
Paper ID: 174

Environmental and host factors affecting bark beetle spatio-temporal dynamics in the forests of the High Tatra Mts.(Central Europe)
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Forests cover 41 % (2 milion ha) of land cover in Slovakia. Nearly 60 % of forests of Slovakia are located in protected areas, ranging from landscape protective areas to strict nature reserves. Approx. 3% of forests (1.5 % of land area) are strictly protected. Primeval forests cover 0.46 % (10 000 ha) but only 69 % of these forests are under strict protection. Strictly protected areas usually consist of near natural forests without any human intervention in the past 20 years. Most of the nature reserves in Slovakia are located in mountainous areas of the Carpathians. They have undergone significant changes in recent decades, mostly caused by windthrown events and bark beetle outbreaks. The dominant ecological tree species in high-elevation forests of Central Europe is the Norway spruce (*Picea abies* Karst.) which is a native host for the spruce bark beetle (Ips typographus). Our research is focusing on insect population dynamics in these forests.
We used species distribution modelling (landscape level analysis of environmental factors and logistic regression) for the analysis of factors affecting (the spatio-temporal spread of bark beetles in these near natural forests without human intervention. Potential solar radiation affected the infestation of trees mainly during epidemic stage of insect outbreak. Thus, forests on exposed sites are affected earlier by bark beetles than unexposed sites. From the analysis of single windthrown trees in generalized additive models, the main factors are radiation under the canopy, zenith of the trunk, tree length and time span from the last windthrown event.
Analysis of the spatiotemporal pattern of bark beetle outbreaks can reveal new insights into the drivers of dynamics of near-natural forests of the Carpathians.

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Patterns and drivers of forest disturbances in global protected forests

Senf, Cornelius; Honkaniemi, Juha; Seidl, Rupert
Paper ID: 181

Protected forests serve as natural laboratories for studying forest disturbance dynamics. However, comparing forest disturbance dynamics across protected areas is challenging.
We tackle this challenge by consistently analyzing remote sensing data jointly with local expert knowledge to identify patterns and drivers of forest disturbances across 103 strictly protected landscapes in the temperate and boreal zone. The landscapes cover more than 10 Mill. ha of forest area across the Americas, Europe, Russia and Oceania. Following an in-depth spatial pattern analysis, we find that forest disturbances can be grouped into three distinct groups, ranging from low-disturbance activity to high disturbance activity landscapes. Clusters are consistent among the temperate and boreal biome and can be well explained by forest types and disturbance agents. While low disturbance activity landscapes are linked to wind and biotic disturbances, high disturbances activity clusters are strongly driven by fire. We further find a strong link between dry and hot conditions and high disturbance activity, which again was consistent across the temperate and boreal biome. As such, we highlight the sensitivity of global forests to climate variability and thus recent climate change. Our study provides unique insights into the patterns and drivers of natural forest disturbances, which will serve as an important baseline for comparing the impacts of humans on natural forests, as well as to assess potential changes in natural forest disturbances under climate change.

Primeval and unmanaged forests as refuge and source for populations of highly-demanding species: hotspots or coldspots?

Structural complexity in managed and unmanaged mountain forests: effects on the habitat suitability for indicator bird species

Braunisch, Veronika; Roder, Stephanie; Coppes, Joy; Bollmann, Kurt
Paper ID: 108

Increasing the proportion of unmanaged forests in multi-functional forest landscapes is a primary goal of conservation strategies. However, the development of structural features and associated habitat suitability for forest species after management cessation is unknown. We evaluated these effects on key habitat characteristics of four mountain forest bird species indicative of different structural components: Capercaillie (Tetrao urogallus), Hazel grouse (Bonasa bonasia), Three-toed woodpecker (Picoides tridactylus) and Pygmy owl (Glaucidium passerinum) across four mountain regions in Central Europe. Habitat suitability was modelled based on 300 forest sites selected independently of their management status, and predicted to an independent dataset of 42 strictly protected forests. We compared forest reserves to managed forests with species presence or absence with regard to habitat suitability and key habitat structures and related both to the time since reserve designation. For all species, except Pygmy owl, habitat suitability in reserves was significantly higher than in managed forests with species' absence, but not different from managed forests with species presence. For the species associated with open forest structures (Capercaillie, Hazel grouse, Pygmy owl) habitat suitability decreased significantly in the first three decades after reserve designation, when the relatively young forests grew dense, and increased afterwards. No such correlation was found for the Three-toed woodpecker associated with deadwood and bark-beetle infestations following temporally unpredictable disturbance events. Structural characteristics varied greatly in abundance and distribution, but only open structures were related to the "reserve age". We therefore recommend focusing on mature, near-natural and structurally diverse forests when designating new reserves.

Saproxylic beetles and fungi in primeval and managed beech forests: a case study from the Carpathian Biosphere Reserve, Ukraine

Diedus, Valeriia; Varyvoda, Mariia; Chumak, Maksym; Chumak, Vasyl; Hrynchuk, Yevheniia; Gleb, Ruslan; Blaser, Stefan; Gossner, Martin; Lachat, Thibault 3,4
Paper ID: 127

Besides their role as refuges for saproxylic species, primeval forests such as the beech forest of Uholka-Shyrokyi Luh might also represent biodiversity-references for managed forests. For this, it is crucial to understand their biodiversity and its drivers.
The aim of our study was to assess the influence of management on species diversity in a landscape dominated by primeval forests. In 2017 and 2018, 8 respectively 11 study plots were installed in each, primeval and managed beech forests in the Uholka division of Carpathian Biosphere Reserve. Saproxylic beetles and fungi were studied using standardized methods. On each plot, 2 flight interception traps (polytraps) were sampling insects from May to September and 4 pieces of dead wood were inspected for fungi at spring and autumn. Additionally, insects and fungi were sampled on 1000 m^2 around the center of the plot following standardized protocols. Parallelly, forest structures such as dead wood amount and habitat trees were assessed on each plot. This enabled us to identify forest structural properties that are influencing the sampled communities and which are affected by management type (primeval vs. managed).
During the first year of sampling, we collected more than 20’000 individuals of saproxylic beetles representing more than 300 species. For the saproxylic fungi, we identified more than 260 species. We will present the results of the first year of our study and discuss the importance of the primeval forests for the conservation of saproxylic species.

Occupancy dynamics and habitat selection of an old-growth forest specialist: implications for forest management

Ettwein, Antonia; Korner, Pius; Lanz, Michael; Lachat, Thibault; Kokko, Hanna; Pasinelli, Gilberto
Paper ID: 184

Old-growth forest specialists are among the species most affected by commercial forestry. However, it is often unclear whether such species can persist and what their habitat needs are in managed forests. We investigated occupancy dynamics and habitat selection of one such old-growth forest specialist, the white-backed woodpecker (Dendrocopos leucotos), a species highly dependent on dead wood and typically found in primeval forests. Our aim was to understand factors affecting occupancy probabilities in managed forests in Central Europe, based on presence/absence data in 62 squares of 1 km^2 in 2015 and 2016. We used dynamic site-occupancy models to compare a priori expectations about the relationships between habitat characteristics and occupancy while accounting for imperfect detection and to address changes in occupancy of the squares between the years. Occupancy probability was best explained by forest structure: it increased with the average diameter at breast height of live trees, the number of live trees with dead branches, the proportion of deciduous trees, and the area covered with forest within the squares. Colonization probability increased with our estimate of food availability (saproxylic beetle emergence holes) in lying dead wood, but appeared to decrease with beetle abundance in snags. Local extinction probability was not explained by any of the factors analyzed, while detection probability decreased with time of day. We found occupancy to be better explained by habitat characteristics in patches with high amounts of dead wood than at the 1 km2 scale. Therefore, patches with old deciduous forests should be retained or created as these appear to improve habitat quality for this species in managed forests.

Effect of habitat availability on small scale distribution of diversity and processes in tree-related microhabitats in primeval and managed beech-dominated forests

Gossner, Martin Maximilian; Yaremchuk, Mykola Y.; Varyvoda, Mariia; Larrieu, Laurent; Goulard, Michel; Courbaud, Benoit; Stillhard, Jonas); Chumak, Vasil O.; Lachat, Thibault
Paper ID: 176

Habitat availability is assumed to be a major driver of organismic diversity and related ecosystem processes. This is why conservation measures widely focus on increasing the habitat amount for species depending on tree-related microhabitats (TreMs) by promoting habitat trees. Communities associated with TreMs are predicted to be organised in metacommunities. However, it is not well understood if small scale differences in habitat availability affect the diversity and composition of these specialised communities and related processes in TreMs due to e.g. dispersal limitations within metacommunities. Moreover, it is not clear if management affect these relationships.
To address these questions we mapped all rot holes as well as water-filled tree holes on a 10 ha plot in the primeval beech forest of Uholka, Ukraine, and a managed beech-dominated forest nearby. We assessed the communities during two consecutive years in 58 rot holes in primeval forest and 27 natural water-filled tree holes each in primeval and managed forest. Additionally, we installed 27 artificial water-filled containers on a regular grid in both forest to assess the spatial distribution of diversity and community composition of the organisms associated with this TreMs. Additionally we measured the spatial distribution of leaf decomposition rates in the artificial containers. We did a spatial correlation analyses to test whether communities and processes in these TreMs are affected by the spatial distribution in habitat availability.
We found substantial small-scale variability in habitat availability in the primeval as well as managed forest. The response of communities and processes to these small-scale differences were variable but be found strong indication for habitat availability being a strong driver of the small scale distribution of TreM associated communities, at least for particular functional guilds. This suggest that dispersal limitations might affect the colonization of habitats within metacommunities already at a very small scale.

Variation in home range size of the white-backed woodpecker

Lanz, Michael; Pasinelli, Gilberto; Ettwein, Antonia
Paper ID: 189

Knowing a species' area requirements and the mechanisms affecting them is of great importance for developing effective conservation measures. The endangered white-backed woodpecker Dendrocopos leucotos typically occurs in forests with little or no forest management. Although this species is of high conservation concern and has already been used as a target species in conservation projects, knowledge gaps exist regarding its ecology, particularly in Central European forests, as well as its area requirements and space use patterns. We studied variation in home range size of white-backed woodpeckers occurring in managed forests in Western Austria, Eastern Switzerland and Liechtenstein in relation to sex, season and habitat. We also tested whether reproductive success (number of fledglings) was related to home range size during the breeding season. Fifty individuals were fitted with radio transmitters in 2017 and 2018, and data collected throughout each year. The nestlings of each tagged woodpecker were counted shortly before fledging. We used 95% fixed kernel density estimation to estimate home range sizes. Home range size significantly differed between the seasons and was 47±19 ha (n = 13) during the pre-breeding season, 21±14 ha (n = 23) during the breeding season and 94±36 ha (n = 25) in summer. Nine individuals tracked during winter had home range sizes of 84 ha. Home range size did not differ between the sexes, and reproductive success was not related to home range size. The relationships between home range size, habitat structure and forest management intensity and the implications for forest management will be discussed.

Functional diversity of ground invertebrates of primeval and managed forests of Gorgany range (Ukrainian Carpathians)

Slobodian, Olena
Paper ID: 111

The natural forest ecosystems are unique by composition and possess resilience against disturbances and changes. Species diversity depends on forest type, density, amount of dead and decaying wood, a ground cover of woody debris, plants, and level of human impact. Species richness, species abundance, and diversity indices are continuously used to monitor the anthropogenic impact on natural communities of insects.
The taxonomic and functional diversity of ground invertebrates were described in the spruce-fir-beech primeval forest of the Gorgany range, Ukraine. Ten monitoring plots were laid within the altitude of 700 - 1500 m. Data were collected on the permanent plots using pitfall traps. In total, 4450 specimens of invertebrates were collected. Comparison analyses of permanent plots of invertebrates by functional groups richness showed that predatory, saprophagous and coprophagous were the most numerous groups of invertebrates. Furthermore, a high diversity of species from the families Staphylinidae, Silphidae, Carabidae, Geotrupidae, Cholevidae, and Curculionidae (783 individuals) was found at the altitude of 1010 m asl. Species diversity and abundance of invertebrates was lower and included 666 individuals at the altitude of 1470 m asl. 194 individuals of ground invertebrates were found in the Swiss-pine – spruce forest that reached 1470 m asl.
Species and functional diversity have significant relationships with anthropogenic pressure and altitude. Invertebrates of the Gorgany range are sensitive to the influence of anthropogenic pressure such as forest management and fire. The occurrence of ground invertebrates was limited by fire and forest management in the permanent plot located in the state-managed forest compared with the nature reserve. Only 65 individuals were found in the plot in the managed forest. Species and functional diversity as the indicators of stability of the natural forest ecosystem might be the base for further studies and conservation efforts.

Water-filled microhabitats in primeval and managed beech forests in the Uholka, Ukraine: Spatial variation in communities and related decomposition process

Yaremchuk, Mykola; Chumak, Vasyl; Sukhomlin, Kateryna; Lachat, Thibault; Gossner, Martin
Paper ID: 151

Among the diversity of tree-related microhabitats, water-filled tree-holes (dentrotelms) are common in beech forests. They are inhabited by a specialized insect community that is driving an important ecosystem process, i.e. leaf litter decomposition. The communities in these microcosms are simple enough to allow studying the whole system, but sufficiently complex to derive results. We asked whether insect communities and litter decomposition differ (1) between natural and artificial holes, (2) between managed and unmanaged forests, and (3) between understorey and canopy.
We studied the insect larval communities and related leaf litter composition in 58 natural and 85 artificial tree holes on the 10-ha permanent plot in the beech primeval forests of the Ugolsky-Shirokoluzhny massif of the Carpathian Biosphere Reserve (Ukraine) and in the managed forest nearby. We found the larval stages of 24 species of which eight species were obligate inhabitants of dendrotelms: *Prionocyphon serricornis*, *Elodes marginata*, *Cyphon coarctatus* (all Coleoptera: Scirtidae); *Anopheles claviger, Anopheles plumbeus, Aedes geniculatus* (all Diptera: Culicidae); *Dasyhelea flavifrons* (all Diptera: Ceratopogonidae); *Metriocnemus cavicola* (all Diptera: Chironomidae). The communities were dominated by Metriocnemus cavicola (45%), *Prionocyphon serricornis* (28%), *Elodes marginata* (12%) and *Dasyhelea flavifrons* (8%). Overall, 23 species were found in natural reservoirs (3.1 per dendrotelm) and 15 species (2.7) in artificial ones.
For artificial dendrotelms, the number of species and larvae was higher in the primeval forests (species: 2.9, individuals: 64.8) compared to the managed forest (species: 2.6, individuals: 36.4). In the canopy (10 m) the number of individuals per dendrotelm was higher (205.6 vs 58.0), but the number of species lower (total 3.1 vs 3.5) than in the understorey (1.5 m). Decomposition was similar in the understorey and canopy (0.83) of both managed (0.86g consumed per 10 weeks and dendrotelm) and in the primeval forests (0.85).

Too much deadwood? Unmanaged forests enable detecting an adverse effect of very high deadwood amounts on occurrence of Three-toed woodpecker

Zielewska-Büttner, Katarzyna; Heurich, Marco; Müller, Jörg; Braunisch, Veronika
Paper ID: 109

Defining species-specific thresholds for key habitat characteristics is crucial for conservation planning and management, yet this requires investigating the full gradient of possible conditions. In the European context protected and unmanaged forests are therefore of special importance for both assessing and providing suitable habitat for species depending on the structural attributes typical of natural or primeval forests, which are lacking in managed forests. The three-toed woodpecker (Picoides tridactylus) (TTW) is an important keystone species of temperate and boreal natural spruce dominated forests. Globally represented with a stable population, it is regionally and locally endangered or threatened with extinction. Studies from central Europe report prevalent occurrence of this species specialized on dying trees and deadwood rich in bark beetles (the main food) mainly in protected or unmanaged forests.
We used TTW observations and remote sensing data from the Bavarian Forest National Park (Germany) to derive species specific habitat thresholds and tested for effects of substrate quality. In complementation to the well-known positive relationship between the birds' presence and the amount of deadwood as a limiting resource, we hypothesized an adverse effect of very high deadwood amounts.
Based on 104 woodpecker presence or absence locations, we modelled habitat selection at four spatial scales reflecting different home range sizes. The abundance of standing dead trees was the most important predictor and the importance of fresh deadwood was indicated by a positive relationship with the deadwood crown size. As hypothesized, we also observed the probability of TTW occurrence increasing with deadwood amounts up to a threshold of 40–55 dead trees per hectare but decreasing afterwards. .
The detection of this trend was possible due to the no intervention policy in the core zone of the National Park and the very high deadwood amounts resulting from severe storm and bark beetle infestation events, underlining the importance of strictly protected forests for deriving reliable habitat thresholds for conservation management. Our results also show that targeted group wise retention of deadwood in early stages of decay is needed to protect the TTW.

Growth, competition and density-dependent dynamics

Does tree mortality reveal a latitudinal gradient in conspecific negative density dependence?

Hülsmann, Lisa; Chisholm, Ryan; Comita, Liza; Hartig, Florian
Paper ID: 154

Strong Janzen-Connell effects caused by specialized natural enemies that prevent species from becoming highly abundant are one of the most famous explanations for high tropical tree diversity. Together with intraspecific resource competition, the effect of specialized pathogens has jointly become known as conspecific negative density dependence (CNDD), and numerous local studies have found CNDD in tropical and temperate tree communities, yet at varying frequency and strength. Recent studies have assessed CNDD at larger spatial scales and claimed signatures of a latitudinal CNDD gradient in static forest structure. These analyses, however, have been criticized for severe statistical and conceptual problems, and dynamic analyses have been suggested as a robust, but globally not well explored alternative. Consequently, empirical evidence for a latitudinal gradient in CNDD under natural conditions and its contribution to diversity remains inconclusive. We therefore conduct a global analysis of conspecific neighborhood effects on demographic rates using repeated surveys from the Forest Global Earth Observatory (ForestGEO) network to test the hypothesis of a latitudinal gradient in CNDD. We focus primarily on CNDD in mortality, because this process is ultimately causing the spatial segregation of conspecific recruits and adults, a prerequisite for stabilization. Because quantifying and comparing CNDD is anything but straightforward, particularly across biomes, we pay special attention to an unbiased and comparable indicator of CNDD that is unaffected by potential problems such as rare species bias, habitat suitability, and non-linearity in effect sizes. In the suggested presentation, we will explain how to develop an appropriate indicator for CNDD and present novel insights into global patterns of CNDD that provide a more thorough test to understand the role of CNDD for one of the most fundamental ecological patterns, i.e. the latitudinal diversity gradient.

Can we ask a tree about its neighbors? Patch mosaics from a tree‘s-eye view in natural *Fagus sylvatica* L. and *Picea abies* (l.) Karst. forests

Janík, David; Král, Kamil; Vrška, Tomáš; Adam, Dušan; Hort, Libor; Unar, Pavel
Paper ID: 126

Spatial interactions among trees change over their life span. This has been well-documented by many studies, in which authors have categorised the diameter classes or height-social classes arbitrarily. The main goal of this study was to focus on *Fagus sylvatica* (beech) and *Picea abies* (spruce) patch structure from the tree's-eye view. For a particular tree, we asked which others could be its neighbours in a patch.
The study was conducted in old-growth forests in Czech Republic. We analysed the stem maps of trees with diameter at breast height (DBH) ≥ 1cm. Various types of the pair correlation function were applied to the data to describe the tree density variability.
The general trend of intraspecific interactions is similar in beech and spruce. Positive associations are most intense among trees with similar DBH, and recede towards trees with larger and smaller DBH. As the positive associations gradually decline, they turn into negative associations with some DBH intervals. Spruce is spatially tolerant towards nearby individuals with more dissimilar DBH. Trees within the 1–8 cm DBH interval demonstrate negative associations with trees from 22–34 cm DBH. Beech individuals in the 1–2 cm DBH class already show negative relations with individuals in the 12–14 cm DBH class. Beech individuals in smaller DBH classes are spatially structured in a finer manner than in the case of spruce.
The knowledge of the species-specific spatial structure of population provides an opportunity to model forest dynamics from the tree's-eye view, based on the neighbourhood interactions.

Longevity and lifetime growth patterns of dominant tree species in old growth temperate forests of the Carpathian arch and Balkan peninsula

Pavlin, Jakob; Nagel, Thomas Andrew; Janda, Pavel; Svoboda, Miroslav
Paper ID: 136

Knowledge of interspecific differences in tree life history traits may yield valuable insight into forest dynamics and subsequently provide fundamental guidelines for practitioners. They are also key for understanding how forests respond to changing disturbance regimes under climate change. We use dendroecological data from old-growth forests to provide insight into several key traits, including longevity, growth rates, and shade tolerance. The tree-ring dataset covers a large environmental gradient across the Balkan and Carpathian region allowing a comprehensive overview of trait variation. Various growth patterns were quantified, including maximum and minimum growth rates, maximum durations of sequential fast and slow growth, canopy accession patterns, and longevity, for dominant tree species (*Abies alba*, Acer pseudoplatanus, *Fagus sylvatica*, and *Picea abies*). Preliminary results show notable differences among species for various growth metrics. Mean minimum growth rates are notably faster for P. abies and A. pseudoplatanus compared to F. sylvatica and A. alba. *Abies alba* generally has longer periods of consecutive slow growth (e.g. suppression), indicative of higher shade tolerance. Finally, F. sylvatica trees reached markedly higher ages then other three species in the analysis. Median age of the oldest F. sylvatica trees on 19 Romanian localities exceeded 430 years, whilst median for P. abies trees was 315 years and A. alba 280 years, with the median of the oldest A. pseudoplatanus not exceeding 200 years.

Grow slowly, stay longer, dominate – beech dominance in the Uholka-Shyrokyi Luh reserve

Petrovska, Roksolana; Hobi, Martina; Brang, Peter; Bugmann, Harald
Paper ID: 182

Limited recruitment can exert dramatic effects on the composition and abundance of tree communities. The species capable of recruiting more saplings to poles (10 cm dbh) and to the canopy will eventually dominate a tree community. In old-growth forests, seedlings and saplings are often growing in deep shade due to the low frequency of large-scale disturbances. The survival of tree regeneration under such conditions depends on their capacity to tolerate shade.
We focus on the growth development of *Fagus sylvatica*, Acer pseudoplatanus and Acer platanoides regeneration in ontogeny (starting from seedlings to saplings 5 m height). In particular, we were interested in traits that could explain shade tolerance of beech vs. competitors and its better survival in deep shade. We tested two existing concepts of shade tolerance: i) biomass partitioning to leaf area (leaf dry mass per unit area) as the main trait of shade tolerance and ii) biomass partitioning to storage.
We found that beech was superior in the development of leaf and crown areas and competed much better for space, as a resource. The species annual stem increment was small and even for all height classes whereas mean annual shoot growth was comparable to fast-growing maple. Such biomass partitioning strategy enabled beech to win 5-10 extra years of life vs. competitors and to persist longer until canopy opening. In terms of storage strategy, there was no significant difference in the concentration of non-structural carbohydrates in the stem and roots of beech vs. competitors' for the given period.

Pressures from emerging renewable energy markets on protected forests: focus fuel wood

Future potentials of sustainable forest energy wood supply in Switzerland

Erni, Matthias
Paper ID: 110

Realistic assessments of future forest energy wood potentials require different strategies of forest management, considering ecological, economic and political constraints affected by timber market conditions, wood supply costs and available subsidies. We developed a conceptual framework for the simulations of the spatially explicit distributions of forest energy wood potentials in Switzerland over a 40-year period using Swiss National Forest Inventory data and different management approaches.
Derived is a theoretical potential of 9-16 M m^3/a (67-118 PJ/a) which was reduced by about half to two-thirds due to ecological constraints alone, to one quarter to one-fifth following additional economic constraints and to one tenth or less if subtracting current use. Especially, economic restrictions are decisive for the availability of the ecological potential. For example, an increase of 0.01 CHF/kWh can cause an increase in the potential of one M m^3. Also a more energy wood friendly market increased availabilities by 20-25% and subsidies to manage protection forests give a surplus of 30%, particularly in the alpine regions. Compared to current management, growing stock reduction scenarios increase the total amount of sustainably available forest energy wood over the next 30 years with a three- to four-fold. Only in the last decade of the simulation period the effect is slightly reversed. Under current market prices, the Plateau and Jura regions are promising for expanding energy wood mobilization due to greatest untapped potentials and lowest dependence on subsidies.
To increase Switzerland's limited potentials, reducing growing stocks is a reasonable strategy to mobilize more forest energy wood during certain times of the energy transition period to fill supply gaps of other renewables. These surpluses could contribute to decarbonization strategies for heat power and fuel, giving also more independence from (possible expensive and unsecure) foreign energy sources.

Fostering multifunctionality in community forest in the context of energy transition

Melnykovych, Mariana; Björnsen Gurung, Astrid; Seidl, Irmi; Olschewski, Roland
Paper ID: 179

Land use change, the demand for timber and wood fuel, and recently also climate change put forest ecosystems under pressure. Moreover, green energy policies lay further claim to forest resources for bioenergy. Forest management (FM), in particular at local level, needs to respond to these changes and challenges while at the same time it needs to address demands for other forest ecosystem services (e.g. recreation) and adapt to market fluctuations. Switzerland's local forest management has ample experience in sustainably managing forests owned by communities, yet also has to respond to the above-mentioned developments. Communal forests of the Ukrainian Carpathians face similar challenges, yet sustainable management has been rarely implemented. Adjusted FM practices could promote sustainable wood energy production, contribute to local economies and allow multifunctional use of forest. In our research we aim to (i) identify and analyse current challenges (climate change, energy transition, stakeholder expectations, market fluctuations) that community FM is facing in three selected case studies in mountainous regions of Switzerland, (ii) investigate how FM is responding to these challenges and which factors enhance the capacity of Swiss FM to adapt (e.g., silvicultural practices, subsidies, contracts, ownership, price guarantees, networks). Finally, we aim to explore transferability of these findings to the Ukrainian context, particularly to the communal forest of Boryslav, a town located in the Carpathians.

Forest-based bioenergy mobilization in the framework of rural communities' development in the Ukrainian Carpathians: sustainability challenges and solutions

Soloviy, Ihor; Melnykovych, Mariana; Björnsen Gurung, Astrid; Ustyc, Radmila; Maksymiv, Lyudmyla; Meessen, Heino; Kaflyk, Maria; Dubnevych, Pavlo
Paper ID: 192

Ukrainian national environmental and energy policies target an energy transition towards renewables. The country has abundant agricultural and forestry bioenergy resources. In the densely-forested regions, first of all the Carpathians, energy wood is the most prominent bioenergy source used to meet the heat demands of households and public buildings. Despite increasing forest areas and timber volumes, affordable energy wood remains scarce for local communities in many areas. The series of laws recently adopted by the Ukrainian Parliament will simplify land legislation and introduce new mechanisms for supporting electricity producers from renewable sources. These new policy initiatives will bring positive changes in the investment climate making the green energy business more transparent. Yet, bioenergy production is not always in the focus of such policies. This study assesses the significance and future potential of energy wood for regional economies and households from an environmental, economic and social perspective in the framework of energy transition process. The study employs a mixed-method approach combining literature review, a Best Practice contest and semi-structured interviews with relevant local stakeholders in rural forest areas of the Carpathian region. Main reasons were identified for the scarcity of affordable bioenergy, including the export-oriented wood business, the lack of forest road networks and efficient, environmentally friendly machinery, the short-term character of national forest strategies in relation to biomass production and mobilization, apart from other institutional settings that limit access to forest resources, illegal logging, unsustainable forestry practices and non-transparent timber markets. To address these problems set of innovative instruments were identified, as for instance, bioenergy certification schemes for forest products or community-driven bioenergy initiatives (e.g. local energy cooperatives). These approaches, ideally embedded in local strategies developed by the communities themselves, have the potential to stimulate an energy transition that simultaneously renders communities more sustainable and resilient.

Assessment of energy potentials of forest biomass in Ukrainian Carpathians

Vasylyshyn, Roman; Lakyda, Ivan
Paper ID: 144

Being an integral part of mountainous ecosystems, forests afflict the need to balance the multi-vector needs of the society and economic entities in various resources and ecosystems services. As a part of Eastern European Mid-latitude ecotone, mountain forests of the Ukrainian Carpathians represent a resource-rich forest management hotspot in the developing country. Given the low efficiency of energy use in Ukraine and growing energy demands driven by the inevitable need for accelerated development of the national economy, forests can and should play an important role of a renewable energy source.
The current developments of the research question in Ukraine include the methodological elaboration of definitions and procedures of computation of five types of forest biomass energy potentials: theoretically possible, technically accessible, environmentally safe, economically profitable, and socially conditioned. The existing assessment of the energy potentials had been carried out using the State Forest Account data at the level of the four mountainous regions – Lviv, Zakarpattia, Chernivtsi, and Ivano-Frankivsk. The approaches applied at computation allow downscaling the obtained results to the level of local communities to enable fulfilling their needs in wood biomass.
We envisage further research and evaluation of the energy potentials at the stand level in order to create the decision support system for implementing adaptive and risk-resilient forest management in the Carpathian region of Ukraine. To do this, we require the following data: the current information support of forests' growth and productivity; stand-level description of forest stands; geospatial information about location of the natural, economic, and social environment. The perspective results are expected to serve as a proof of concept for implementing the research approaches to the national forest management planning and as a case-study information source for dissemination within the IBFRA and IUFRO networks.

Deadwood and other old-growth attributes

Effects of past and present management regime on structural characteristics and old-growth features in hardwood floodplain forests in the Carpathian Basin

Demeter, László; Bede-Fazekas, Ákos; Molnár, Zsolt; Csicsek, Gábor; Ortmann-Ajkai, Adrienne; Varga, Anna; Molnár, Ábel; Horváth, Ferenc
Paper ID: 117

Primeval floodplain forests practically do not exist anymore in Europe. However, near-natural/old-growth remnant stands have survived along the great rivers and their tributaries in the Carpathian Basin due to low intensity forest management and the establishment of strict forest reserves. Old-growth forest characteristics (OGCs) were studied in 13 managed (rotation or selection) and abandoned semi-natural floodplain forests in Hungary and Ukraine by taking snapshot inventories of structural features.
Principal component analysis revealed a gradient of developmental stages, from large tree (mainly oaks) and hornbeam dominated closed canopy stands to stands with more gaps, very large trees and different kinds of deadwood. Results showed that only abandoned selection forests had significantly higher amount of very large trees compared to managed stands. All of the examined groups lacked the appropriate amount of small-diameter ingrowth of Quercus robur and Fraxinus angustifolia. The difference in structure between the abandoned selection and the abandoned rotation stands was greater and more significant than in their still managed counterparts. The studied forests are in the optimal forest developmental phase and the phases of innovation and degradation were almost completely absent. The structure of the abandoned selection stands was the closest to the patch mosaic structure typical of natural forests. Management approaches were responsible for preserving several old-growth structural features by the sanitary selective logging system in Ukraine.
We concluded that after 100-150 years of active homogenising management, the OGCs are slow to regenerate in just 20-30 years of passive management. Based on the differing histories of the studied forests and the differences in the present-day forest structure we recommend e.g. an increase in rotation cycle, total abandonment or structural complexity enhancement for a more sustainably management and conservation of hardwood floodplain forests from site to landscape level.

Tree microhabitats in managed and unmanaged temperate mixed forests (Hyrcanian forests-Iran)

Eshaghirad, Javad; Khanalizadeh, Ameneh; Rammer, Werner; Paillet, Yoan; Zahedi Amiri, Ghavamodin; Zare, Habib; J. Lexer, Manfred
Paper ID: 146

In extensive single tree selection systemstree microhabitats as indicator of biodiversity are mainly influenced by tree level factors such as tree species and DBH. Despite the ecological importance of tree microhabitats for biodiversity, there is a lack of information about the impact of single tree selection systems as a close-to-natural management strategy on tree microhabitat density in Hyrcanian forests. This study compared microhabitat density that were either unmanaged since at least 30 years or managed with a single tree selection system, and determined tree and stand level factors influencing the occurrence of microhabitats.A total of 120 circular sample plots were used to collect tree level microhabitat information at six different sites. The microhabitat density of managed and unmanaged forests was compared with Mann-Whitney U-tests. Generalized linear models were employed to analyze the effect of tree species, DBH, and plot-level predictors, basal area larger than the target tree, basal area density, size diversity and tree species diversity, forest site, and type of management (unmanaged, managed) on microhabitat occurrence. There was no significant difference in total number of microhabitats in managed versus unmanaged forests. Stem cavity with decay was by far the most frequent microhabitat type in managed (16.5 per ha) as well as in unmanaged forests (14.2 per ha). Hornbeam and oak trees have a much higher probability to host microhabitats than the dominant oriental beech. In addition, increasing DBH is positively correlated with microhabitat occurrence. After 30-50 years without management intervention the similarity in tree microhabitats between managed and unmanaged forests is striking. From the findings it may be concluded that the single tree selection management regime practiced in managed forests is a suitable approach to maintain forest biodiversity.

Dynamics and role of dead wood in primeval beech forests

Grebeniak, Halyna
Paper ID: 155

In the beech virgin forest, the volume of dead wood depends on structure of forest stands, their stage of development, intensity and frequency of natural disturbances, and populations of animal organisms. Dead wood volume varies from 4-626 m^3/ha in 1995 to 20-438 m^3/ha in 2006 in the Priborzhavsky reserve and reaches 28-167 m^3/ha in the Uholka-Shyrokiy Luh reserve. Dead wood is the important source of carbon, it regulates soil moisture and temperature, protects soil from erosion. Dead wood is the only possible living habitat for rare *Lucanus cervus* and *Cerambux cerdo*. Removal of dead wood from the forest degrades species biodiversity. Such species as *Hericium coralloides* (Fr.) Gray and also *Clavariadelphus pistillaris* (L.) Donk.) disappear from the forests poor on debris. Dead wood is important for birds nesting on the ground such as *Bubo bubo* and *Dendrocopos leucots*.

Diversity and abundance of large non-excavated tree holes in primeval and previously managed forests

Yatsiuk, Yehor; Wesołowski, Tomasz
Paper ID: 120

An abundance of the large tree holes depends on the forest structure and species composition and is largely affected by forest management. The occurrence of the large holes is quite rare and so, they are in great demand as species habitats. Tawny owl (Strix aluco) selects the large holes for nesting and is the most widespread bird across Europe. We were interested to study the types of large tree holes used by tawny owl and their abundance in the forests of different types. In the study, we compared the long-term data from the old-growth oak-dominated Homilsha forest (Ukraine) to the short-term data from the primeval Białowieża forest (Poland).
All big holes within studied plots were located on the ground, then described and measured. Data on tawny owl habitats were obtained during regular checks of all known holes. The owls used 36% of available holes in Homilsha and 17% in Białowieża. The breeding holes were on average situated in larger trees, had a narrower range of internal dimensions, and flat bottoms. The roosting holes were localized in smaller trees, at the lower height above the ground, and had not flat bottoms. The breeding holes survived longer (median 14 years) than the roosting ones (8 years) however, the latter were more abundant. The wild pear trees (*Pyrus pyraster*) were the most important as hole providers in the Homilsha forest while hornbeam trees (*Carpinus betulus*) were most often used in the Białowieża forest. Oaks in the Homilsha forest provided fewer holes than expected. The suitable large holes were found in the stands older than 80 years (positive correlation with age of forest stand) in both forests of Homilsha and Białowieża.

Habitat continuity of primeval and unmanaged forests in a changing climate

Monitoring the renewal of old-growth forest attributes and biodiversity values in a large Scots pine plantation restoration experiment for the conversion from managed to unmanaged forests

Culmsee, Heike; Aljes, Maria; Schneider, Heike; Wörmann, Ronja; Meyer, Peter
Paper ID: 112

The German National Strategy on Biodiversity aims at 5% of the forests in Germany to be set aside from human interventions. Contributing to this aim the German Federal Foundation for the Environment (DBU) that privately owns 53,000 ha of forests has already set-aside 15,800 ha of (near-) natural forests and is continuously converting additional forest area, of which >25,000 ha are even-aged Scots pine plantations, from managed to unmanaged forests. In a large Scots pine plantation at the DBU Natural Heritage Rüthnicker Heide situated in the northeast German lowlands, we established a large restoration experiment in order to test how different restoration measures may accelerate the renewal of old-growth forest attributes and related biodiversity values on the pathway to become natural forests. Within 180 ha of homogeneous forest stands, 16 plots (à 5ha) were installed in 2015 and first surveyed, before four different measures were implemented in 2015/2016 using a block design with four replicates. In treatments 1-3, 30 small- to medium-sized gaps (100, 250, and 500m²) were randomly distributed in each plot covering 20% of the plot area. In treatment 1, timber was harvested and removed. In treatments 2 and 3, 2/3 lying and 1/3 standing deadwood was produced, and, in treatment 3, additionally 2,500 saplings of deciduous trees ha-1 planted in gaps. Treatment 4 served as control without any treatment. Half of each plot was fenced to determine the potential influence of game. The experimental forests were than abandoned from management for long-term monitoring. Pre- and post-surveys include forest structure and composition (tree layers, dead wood, regeneration patterns), vascular plants of the herb layer, fungi, saproxylic beetles, and bird guilds. We present results on the first four years of observation, and critically discuss the role of developing old-growth forest attributes for accelerating forest conversion.

Legacies of natural disturbances influence saproxylic beetle communities across primary *Picea abies* forests of the Western Carpathians

Kozák, Daniel; Svitok, Marek; Wiezik, Michal; Mikoláš, Martin; Thorn, Simon; Čada, Vojtech; Janda, Pavel; Bače, Radek; Frankovič, Michal; Kameniar, Ondrej; Langbehn, Thomas; Svoboda, Miroslav
Paper ID: 156

Natural disturbances are the main drivers of spatio-temporal structural heterogeneity across forest stands. Windthrows and bark-beetle outbreaks create structural legacies such as standing and lying deadwood, openings in the canopy, and varying amounts of habitat trees, thus they are able to influence saproxylic species abundance and diversity. Saproxylic beetles have been intensively studied across temperate forest landscapes, however little is known about the influence of natural disturbances on their communities. We analyzed the influence of the natural disturbance history and structural biodiversity indicators known as key habitat for saproxylic beetles (deadwood, canopy openness and tree-related microhabitats) on saproxylic beetle communities. We sampled saproxylic beetles on 57 study plots across primary spruce forests located within the Western Carpathians, together with forest structure measurements and tree core sampling. Dendrochronological methods were used to obtain the natural disturbance history patterns, and structural indicators of biodiversity were used in order to quantify recent disturbance legacies. Linear mixed-effect models were used to relate diversity (taxonomic, phylogenetic, functional) and abundance of saproxylic beetles to disturbance characteristics and structural parameters of primary forests in the Western Carpathians. Increased time since disturbance and severity of the last disturbance promoted saproxylic beetle species richness, whereas historical high severity disturbances had a negative effect on species richness. Moreover, we observed a significant positive effect of disturbance-driven legacies (deadwood volume, root mean square DBH of standing deadwood, canopy openness, tree-related microhabitats) on the abundance, as well as the functional and phylogenetic diversity of beetles. This is the first study to demonstrate the importance of natural disturbance regimes and disturbance-driven legacies across primary spruce forests of the Western Carpathians for saproxylic beetles. Assessing the effect of natural disturbances on forest biodiversity is important in terms of ongoing climate change and associated changes in natural disturbance regimes.

Contrasting effects of disturbance on epiphytic lichen diversity in natural spruce mountain forests of the western Carpathians

Langbehn, Thomas; Mikoláš, Martin; Halda, Joseph; Svitok, Marek; Svobodova, Kristyna; Kameniar, Ondro; Kozak, Daniel; Svoboda, Miroslav
Paper ID: 186

To quantify the effect of natural disturbances versus forest structure on species richness of epiphytic lichens, we sampled 56 plots in 10 stands across 5 mountain ranges in the western Carpathian natural spruce forests along a historical disturbance gradient. We examined 5 to 9 different substrates, comprising of living trees, standing deadwood and logs on the ground on every 0.1 ha plot. Species richness per plot was rarefied to the same number of substrates. We used predictors from dendroecological disturbance history reconstruction spanning over the last 300 years, together with forest structure variables to regress epiphytic lichen diversity in a mixed model approach. Disturbance severity has a highly significant negative effect on lichen alpha diversity on the plot, while time since disturbance and disturbance frequency show no significant effect on lichen diversity in our study. Diameter of standing deadwood increases overall and red listed lichen diversity, indicating short term profiting of the lichen diversity after disturbance. Presence of large deadwood goes along with the occurrence of deadwood dependent species of the genera Absconditella and Cliostomum. Forest stands do not differ in richness of all lichens, but in richness of red listed lichens. Stands in valley bottoms inhabit more red listed species then stands in upslope situations.
Natural forest dynamics matter for the biodiversity of epiphytic lichens. This calls for large dynamic areas to keep a mosaic structure of patches with different disturbance history under a mixed disturbance regime to ensure effective conservation of lichen biodiversity. Rediscovering 6 extinct species and the high frequency of occurrence of critically endangered lichens Usnea capillaris and Mycoblastus sanguinarius underpins the extraordinary importance of the study area for biodiversity of lichenised fungi within the western Carpathians.

Adaptations of hole-nesting birds to tree holes: why studies in primeval conditions are irreplaceable

Wesołowski, Tomasz
Paper ID: 121

To understand biological adaptations one has to study organisms in proper evolutionary context, i.e. in conditions to which they have been adapted. As the hole-nesting birds have been adapting to breed in tree holes, if we wish to comprehend functional importance of different aspects of their breeding behaviour and ecology, we should study them nesting in tree holes. Conditions for such observations are rarely met in heavily transformed European forests, but one can still find them in the Białowieża National Park (E Poland), where last fragments of pristine European lowland forest have survived. All the abiotic and biotic processes leading to hole formation and decay still operate there, and diversity and abundance of tree holes is not reduced by human management. An entire assemblage of nest predators using diverse detection and attack techniques occurs there as well. Numerous studies of hole nesting birds breeding in such conditions were carried out there during the last 40+ years. Here I shall summarize some results of this work, concentrating on the evolutionary (adaptive) questions. I shall introduce tree holes as a biological opportunity, follow with listing challenges of successful breeding in such places (predation, soaking, darkness, microclimate). Then, I shall show diversity of solutions used by individual bird species to cope with these problems. Finally I shall stress an urgent need to preserve the last pieces of pristine forest as indispensable evolutionary and ecological laboratories.

Effects of nitrogen emissions and land-use change

Innovative multifunctional forest management for societal benefits: the focus on Ukraine's Carpathians

Melnykovych, Mariana; Nijnik, Maria; Soloviy, Ihor; Nijnik, Anatoliy; Henyk, Yaroslav; Henyk, Oksana
Paper ID: 178

In this paper, we explore existing demands for forest ecosystem services at a local level, in the Ukraine's Carpathians, as well as institutional capabilities and practical issues of the contribution of non-wood forest products and services (NWFP&S) to the well-being of rural communities. In our research, we applied participatory techniques (based on interviewing of stakeholders) in combination with the mixed methods of analysis (qualitative and quantitative).
Our findings indicate that NWFP&S are considered to be important for communities living in remote, highly forested areas, where the human well-being is usually lower than in other, more accessible, and socially and economically advanced regions. In the Carpathians, forest-depended communities heavily rely on forest products and amenities and are dependent upon the supporting ecosystem services of the trees. Forest also contributes to the sense of identity of many community members, whilst economically, timber remains very important. A challenge for innovative multifunctional forest management is thus to attain a proper balance between the provision of NWFP&S and wood production.
We conclude that priorities and concerns of forest-dependent communities are to be considered and addressed. Their demands for multiple ecosystem services are to be identified and included in forest management plans. All relevant stakeholders are to be involved in the decision-making to build resilience and enhance sustainability of remote mountain localities. Commercialization and value-added processing of NWFP should be explored to raise the household income, while small-scale, green tourism is considered to enhance sustainable harvesting of NWFP. Finally, it is crucial to increase environmental awareness and strive for social cohesion with the promotion of eco-social innovation in marginalized rural areas.

Indication of the environment by indicators of the hydrogeochemical state of the forest ecosystems of the Carpathian Biosphere Reserve

Paparyha, Petro; Zhovynskyi, Eduard; Kriuchenko, Nataliya
Paper ID: 143

During the past ten years, the scientific department of the Carpathian Biosphere Reserve (CBR) and the Institute of Geochemistry, Mineralogy and Ore Formation (IGMO) have started to monitor the hydrogeochemical state of the snow cover on the highest mountain peaks of the CBR area. The content of the main ions of salt composition, pH index, and the micro-component composition of the snow water were analyzed.
The results showed that snow water belonged to the hydro-carbonate-sodium type. Its general mineralization ranged from 17.8 to 39.9 mg/dm^3. The maximum amount of sulfates varied from 3.5 to 5.3 mg/dm^3 at the rate of general mineralization from 27.0 to 39.9 mg/dm^3. By the nature of the distribution, three groups with different concentrations and stable connections of the chemical elements were identified: i) group with chemical elements (Rb, Cd, Sb, Cs, Au) that exceed concentrations by 5-20 times compared to the control group; ii) group with chemical elements (Cr, Mn, Fe, Co, Ni, Ba, Pb, Ce, La, Sn) that exceed concentrations by 2-4 times compared with the background level; iii) group of other elements with concentration that does not exceed 2 times compared to the control group. Additionally, the concentration of heavy metals (Zn, Cu, Ni, Cr, Co) was higher in the snow cover near the borderline with Romania and decreased gradually towards the area of Ukraine that may indicate the presence of transboundary pollution.

Identifying underlying drivers of forest clearances in Switzerland

Troxler, David Edgar; Zabel von Felten, Astrid
Paper ID: 129

As in most European countries, also Switzerland's Forest Act prohibits deforestation. Hence, the forest is conserved in its area and spatial distribution. Deforestation is thereby defined as an either temporary or permanent change of use of forest land for non-forestry purposes. However, derogations from the ban on forest clearing may be granted under well-defined conditions, e.g. when important reasons outweigh the interest of forest conservation. Accordingly, some 140ha are cleared annually. In the tropics, the drivers of deforestation and their development over time have been extensively studied. However, surprisingly little is known about the drivers and locations of deforestation that is not located in the tropics or in developing countries.
In the first ever systematic investigation of the Swiss national database on permissions for forest clearances from 2001 to 2017, we revealed that most of the projects that receive a clearing permission are infrastructure projects. In terms of the number of authorized clearing applications, transport related reasons have been by far the most important contributors to clearances, followed by constructions, water supply and water construction related reasons. While these are direct drivers, the underlying indirect drivers of forest clearances, such as demographic pressure, need for renewable energy infrastructure, urban sprawl or the distance to waters or roads, are not yet well understood. In this talk, we will present results from a spatial econometric analysis of the underlying drivers of forest clearances in Switzerland between 2001-2017. Based on this case study, we will try to generalize our findings for further countries. Knowledge about these drivers is important as foundation for future policy making and to provide data driven findings in a currently heated debate on competing landuse options and potential reforms of the forest clearance ban. Our study adds to the growing body of literature on trade-offs between conservation and sustainable economy development that are pressing in many European countries.

Long-term research and monitoring in primeval forests: experiences, benefits, prospects

Are the natural disturbance regimes of European and North American beech forests comparable?

Demant, Laura; Jung, Christopher; Meyer, Peter
Paper ID: 158

Naturalness can be defined as the degree to which forests are shaped by natural processes. In Europe, the potential natural vegetation (PNV) is often taken as a reference for maximum naturalness. The PNV, however, does not include disturbance as an element of natural forest development, being, rather, a hypothetical projection of the climax vegetation. In North America, natural disturbances are often used as a measure of naturalness. From the relation between area and recurrence interval of disturbances, Seymour et al. (2002) derived an index of natural disturbance, which was used to quantify how closely forest management systems emulate the natural disturbance regime. When transferring the relation found in northeastern North America to central European forests, frequent large-scale shelter wood cuttings would be considered natural. This is not consistent with the widely held view that small-scale gap formation characterizes the disturbance regime of European beech forests.
For European beech forests, attempts to derive naturalness on the basis of natural disturbance regimes are rare. We asked whether the approach of Seymour et al. (2002) can be transferred to the European beech forest landscape, focusing on storms as the major disturbance agent in temperate broadleaved forests. As there are almost no primeval forests left in central Europe it is difficult to quantify the natural disturbance regime empirically. Therefore, we compared the return intervals of gust speeds within the distribution ranges ofAmerican and European beech and found that the annual exceedance of wind speeds > 24.5 ms-1 (storm) in Europe and northeastern North America are comparable but differ with respect to seasonal distribution. In northeastern North America storminess is more pronounced at the beginning and within the vegetation period, in central Europe in winter. Presumably, this leads to differences in the spatial extent and recurrence interval of disturbances between the two regions.

Successful long-term research on self-regulated forest dynamics – lessons learnt over a period of five decades

Meyer, Peter
Paper ID: 160

Against the backdrop of global change, long-term research is becoming increasingly important. Experiences from the last few decades, however, show that many long-term monitoring programs have failed or performed unsatisfactorily. Using the example of five decades of research in strict forest reserves (SFR), it is shown how problems characteristic of long-term research can be approached.
One central research topic in SFR is the self-regulated dynamics of tree populations. Two main problems accompanied monitoring; guaranteeing that monitoring is properly orientated to the research goal (target-orientation) and preventing subjectively biased analysis of the growing pool of data. Guaranteeing target-orientation is regarded to be an intrinsic problem that monitoring has to cope with in the long run. Subjectively biased data analysis is a result of insufficiently (often ex-post) defined research questions in combination with a large and complex data pool.
To guarantee a maximum degree of target-orientation, we developed a conceptual model of the main demographic processes, structure attributes, environmental factors and their relations in respect of tree populations. This model formed the basis for the protocol and helped to generate a versatile and future-proof data pool. It is also applied to prevent subjectively biased data analysis. To this end, admissible research questions are derived in a so called “hypothesis workshop”. The procedure is constructed in the manner of a game board, with tokens depicting processes, structures, environmental factors and relations.
Using the example of an SFR affected by severe storms and bark beetle attacks, the procedure of deriving research questions and conducting data analysis is demonstrated. The results showed that the disturbances have triggered a highly diverse regeneration of the tree layer and resulted in increasing resilience of the forest stand, presumably even under climate change.

Leaf area index based on hemispherical photos and leaf-litter collection and its relations with environmental factors in a virgin Silver fir - Beech forest from Southern Carpathians (Romania)

Mihaila, Victor-Vasile; Boura, Marlène; Braga, Cosmin; Stefan, Gheorghe; Crisan, Vlad; Dumitru-Dobre, Constantin; Petritan, Ion Catalin; Petritan, Any Mary
Paper ID: 169

Stand leaf area, influenced by tree age, forest structure and environment, is impacting both the productivity and the water consumption of forests. Using hemispherical photos (“fisheye lens” technique) and the litter trap method we aimed to compare leaf area index obtained by two methods and also to investigate how different environmental drivers influence it under natural conditions (unmanaged stands). For this we installed randomly six plots in the Sinca virgin forest (Romania), a mixed silver fir - beech mountain forest, in which we measured the stand characteristics and collected the litter fall, from 8 litter traps arranged in a systematic way throughout each plot. The photos were recorded in midsummer so that the canopy can be at its maximum potential. In lab, the photos were processed with the Winscanopy software (Regents Instruments Inc.) and light intensity (percent of above canopy light) and first LAI index were obtained. The litter was collected in late autumn and after sorting it into six different categories (leaves, needles, branches and fruits by species, other plants and other organic matter) the leaves and needles dry weight was measured. Using the gravimetric approach, which correlates the dry weight of leaves and leaf area using green-leaf-area-to-dry-weight ratios (leaf mass per area, LMA) determined for fresh leaves subsamples, the second LAI index was computed. The ratios were determined with the help of a high resolution scanner and image analysis software for leaf area (WinFOLIA, Regent Instruments Inc.). After a statistical comparison of both obtained LAI indexes, using a spatial model we investigated how both LAIs are influenced by tree densities, species composition and other stand and environmental factors.

Detecting change in a primeval beech forest – the second Sample Plot Inventory in the Uholka-Shyrokyi Luh Forest

Stillhard, Jonas; Abegg, Meinrad; Korol, Mykola; Brändli, Urs-Beat; Brang, Peter; Hobi, Martina
Paper ID: 164

Temporal dynamics of the tree population in primeval European beech forests (*Fagus sylvatica*) on landscape scale are not well understood as representative, repeated data at that scale is missing. To close this gap of knowledge, 222 sample plots, established and first assessed in 2010 within the core zone of the Uholka and Shyrokyi Luh forests of the Carpathian Biosphere Reserve (CBR), Ukraine, are re-assessed in summer 2019. These forests are one of the largest remnants of primeval beech forests in Europe.
This sample plot dataset will provide a representative and unique insight into the temporal dynamics of this primeval beech forest, allowing for a better understanding of all demographic processes which determine such forest ecosystems. The studied forest is considered as a model for natural beech-forest ecosystems and the data will also provide thresholds for abundance of important biodiversity-related structures such as tree related microhabitats (TREM's) and downed deadwood. These thresholds are of high relevance for conservationists, practitioners and scientists. Furthermore, the dataset will serve as a vital ground-truth for remote sensing datasets and products such as maps of canopy gaps.
We will present the collection of the data, give an overview on the data and present preliminary results on plot level data. Additionally, we will give an impression of the forests, the logistics and the tough field work.

Posters

Natural regeneration processes in strictly protected subalpine spruce forests in Western Carpathians

Adamus, Michał; Szewczyk, J.; Szwagrzyk, J.
Paper ID: 195

Norway spruce is one of the most important tree species in Europe [1], especially in mountainous areas of Western Carpathians, where it grows naturally. Lately, mainly due to climate change, spruce stands has suffered from windbreaks and insect infestation of increased intensity. After a large bark beetle outbreak in Tatra Mountains and significantly smaller one in Babia Góra National Park we analyzed the regeneration processes and stand dynamics in this two sites on the basis of data from 130 systematically distributed permanent plots. The plots ware located in strictly protected subalpine forest stands. We counted and measured nearly 7000 seedlings and saplings on 6 hectares altogether. Our hypothesis was that different disturbance severity in both analyzed stands should result in significantly different spruce regeneration structure We found no significant differences in regeneration densities and structures in both compared stands despite the differences in tree mortality in recent decades [2]. It seems that differences in its structure and densities of spruce regeneration appears after much longer period of time regardless of the gap size [3].

[1] Brus, D.J., Hengeveld, G.M., Walvoort, D.J.J., Goedhart, P.W., Heidema, a.H., Nabuurs, G.J., Gunia, K., 2011. Statistical mapping of tree species over Europe. Eur. J. For. Res. 131, 145–157.
[2] Kathke, S., & Bruelheide, H. (2010). Interaction of gap age and microsite type for the regeneration of *Picea abies*. Forest Ecology and Management, 259, 1597–1605.
[3] Sproull, G. J., Adamus, M., Bukowski, M., Krzyżanowski, T., Szewczyk, J., Statwick, J., & Szwagrzyk, J. (2015). Tree and stand-level patterns and predictors of Norway spruce mortality caused by bark beetle infestation in the Tatra Mountains. Forest Ecology and Management, 354, 261–271.

Conservation-oriented active management of Central-European oak forests on the basis of old-growth oak forests as reference sites

Aszalós, Réka; Bölöni, János; Frank, Tamás; Gálhidy, László; Bódis, Pál; Koncz, Péter
Paper ID: 188

In the framework of a running LIFE project (LIFE4OakForests) we started the conservation-oriented management in four protected forest areas in Hungary and Italy. The active management has been started on the 26 pilot sites and will effect altogether 2500 ha Natura2000 Quercus petrea and Quercus pubescens dominated oak forests. A novel forest management guideline was compiled for these dry and dry-mesic oak habitats including expert knowledge, previous studies in Hungary and Italy and a literature review. The amount of deadwood to be created was defined by our previous investigations in several Hungarian abandoned (old-growth) oak forests and by data of other old-growth oak forest studies, determining approximately 50 m^3/ha deadwood as natural in these habitats. The most important microhabitats to be created were defined on the basis of expert knowledge and literature review. As the management actions aimed at to emulate natural processes, the management guideline defined the imitation of small-scale gap-dynamics and also of intermediate severity disturbances.
On the basis of the management guideline, the following conservation-oriented management actions have been started: girdling of standing living trees, bark stripping of tree individuals, felling of trees to create downed woods, high stumps, and gaps in the canopy. Besides creating small-scale gaps, treatments aim to mimic intermediate severity disturbances with the creation of larger gaps and high amount of residual structure. Microhabitats, like hanging barks and piles of branches, are going to be created to provide nesting, breeding, sheltering habitats for forest-dwelling species. In the course of the LIFE project (until 2026) the report of old-growth oak forests as natural references and the forest management guideline for the active management of the dry and dry-mesic Central-European oak forest will be finalized and published.

Characterization of the Uholka-Shyrokyi Luh forest with 3D point clouds from airborne laserscanning

Berkela, Yuriy; Ginzler, Christian
Paper ID: 159

The characterization of the state and the changes of forest structure in primeval forests is very time demanding. Remote sensing techniques allow us to quantify the structure over large areas. Passive sensors like Landsat, Sentinel2 or WorldView have the potential to classify regions of disturbance and the extraction of gaps in the forest. However, small disturbances and small gaps are often not visible in these data.
In 2018 a LiDAR dataset was acquired from the primeval beech forest of Uholka-Shyrokyi Luh (Ukraine). The average point density is 30 points per sm and the data covers ~165 skm. As an active sensor, LiDAR penetrates the top of the vegetation and a 3D point cloud of the top of the vegetation, from inside the vegetation and from the ground is retrieved. These 3D points allows us to generate a wide range of products. The two important ones are the digital terrain model from the last returns of the laser pulses representing the terrain without vegetation and the digital surface model, representing the top of the crown cover. However with LiDAR more characterization of the forest structure can be calculated, which are of high ecological value. We demonstrate the potential to quantify the different light regimes in the forest using a variety of techniques of 3D point cloud analysis. Examples of datasets for forest layers, gap distribution and synthetically hemispherical imagery will be presented.

Impact of high-altitude forests on the populations of rare arctic-alpine plant species

Cherepanyn, Roman
Paper ID: 191

Changes in natural conditions and human exploration of highlands lead to the formation of an unfavorable environment for rare species. Most of the original plant communities in the Carpathians have undergone a transformation. Some species disappeared as a result of the destruction of crooked woods in the subalpine zone. Anthropochores have expanded and secondary plant communities have formed. Due to climate changes, the establishment of nature protected areas and decline of farming in the highlands, we observe the contrary on some territories – rising of the upper forest limit, increase of shrubs communities.
Many arctic-alpine species on the southern border of their distribution, in the mountains of temperate latitudes, tend to show a reduction in their population range and changes in population structure. In the Ukrainian Carpathians, the arctic-alpine element of flora equals 67 species, which is about 7,4% of the highland flora. 28 species are listed in the Red Book of Ukraine (2009). Ecotopes transformation and changes in habitat properties are the most threatening factors for arctic-alpine species. Drying of highland bogs may result in a decrease of the Pedicularis oederi Vahl population area. The narrow ecological-coenotical amplitude of Lloydia serotina (L.) Reichenb. and overgrowing of its ecotopes by *Pinus mugo* Turra due to rising of upper forest limit, lead to a reduction in the number of individuals. Shrub invasion into high mountains grasslands is threatening for the Saxifraga aizoides L. population.
It is important to eliminate human impact on populations with low vitality and species with significant rarity level. However, absolute nature protection does not always give the desired effect. Therefore, it is important to control demutation processes in primeval ecosystems to reserve endangered plants and if it is necessary to take active protection measures. Controlled grazing can help conserve rare communities and renew traditional management forms.

Vegetation structure on an altitudinal gradient in primeval forests of the Gorgany Nature Reserve (Ukrainian Carpathians)

Chernyavskyi, Mykola; Shpilchak, Myron; Klimuk, Yuliia
Paper ID: 118

The rocky debris, occupied by crustose lichens, mosses, and vascular plants, still remains in the Gorgany Nature Reserve of the Ukrainian Carpathians. The relict dendroflora of the rocky debris has a scientific significance for studying the history of vegetation cover during the postglacial period and dynamic trends of the high mountain ecosystems in connection with climate change. Here the scientific profile “Horizontal evolutionary series of phytocoenoses” was established in 2005.
The profile is 1090 m long and stretches along the southwest slope of the tract of Dzhurdzhi. We established 14 permanent plots along the profile and studied the vegetation composition and forest structure. The profile shows changes of phytocoenosis, from the initial establishment of trees until the formation of the three-layered uneven structure of the beech-spruce-fir old-growth forest.
Single trees of *Pinus sylvestris L.* and *P. cembra L.* grow on the scree slopes, which are the beginning of the profile. Behind the scree, two-layered tree stands of Swiss-pine-spruce stands are formed. The species composition of the herb-shrub cover is poor, boreal species predominate, with a cover of up to 90%. Mosses form a continuous coating of up to 100%. Swiss-pine-spruce stands gradually change into three-layered spruce-fir stands with a cover of grass-shrub layer 55-60% and mosses 70-90%. Vegetation below this layer changes to the beech-spruce-fir forest. The grass-shrub layer is uneven here, occurs mainly in canopy gaps, and has a cover of 5-10%. The species composition is much richer than in the previous plots and is typical for the broadleaved forest, while moss cover is 3-7%.

How does canopy gap definition affect gap fraction and size-distributions in virgin beech forests? — A methodological comparison

Feldmann, Eike; Drößler, Lars; Hobi, Martina; Stillhard, Jonas; Tabaku, Vath; Lorenz, Katja; Demant, Laura; Meyer, Peter
Paper ID: 161

Gap formation is a process of outstanding importance for natural forest dynamics. The studies of beech (*Fagus sylvatica* L.) virgin forests show large variation in gap fractions and size distributions. It remains unclear, however, whether this is attributable, in part, to different gap definitions.
To evaluate the effect of different definitions on gap fraction and size distribution, we applied four definitions to tree crown maps of five virgin beech forest remnants. Gaps were assumed to be present where trees did not exceed a particular dbh or height threshold and gap area wasat least 20 m^2. Different thresholds were either dbh < 7 cm or height < 1/3, < 1/2 or < 2/3 of top height, respectively. Otherwise, the canopy was considered to be closed.
On average, gap fraction increased exponentially with increasing thresholds. However, the rates of increment differed markedly between the stands. The application of mean increment factors, i.e. mean rates of change in gap area when changing the gap definition, led to under- and overestimations of up to 40% and 60%, respectively. Also, gap size distributions changed considerably. The increase of thresholds generally resulted in the emergence of new (rather small) gaps and the expansion and coalescence of existing gaps. As a consequence, the area in lower gap size classes mostly remained constant, while the area in larger gap size classes increased.
Due to high variation in gap fraction increment factors, we concluded that adjusting results under different gap definitions can only partly improve comparability. Our findings suggest that it is necessary to agree on a standard gap definition, which should be ecologically substantiated. As there are indications that beech trees depend on gap formation until they exceed 2/3 of top height, we propose applying the latter threshold (< 2/3 of top height) in this type of forest.

Using fake larvae to assess predation pressure from terrestrial predators in water-filled tree holes

Gazzea, Elena; Yaremchuk, Mykola; Diedus, Valeriia; Jonker, Marlotte; Gossner, Martin M.
Paper ID: 148

Water-filled tree-holes are abundant tree microhabitats in temperate forests. The insect larvae in these microhabitats contribute not only to forest biodiversity but most likely also provide food sources for terrestrial predators such as insects, small mammals and birds. Predation in these system is, however, not well understood.
To measure predation pressure, we modelled prey items imitating insect larvae using white plasticine und exposed them at the aquatic-terrestrial habitat interface. We tested which predators attack these fake larvae, how high the predation pressure is after two days and two weeks, and whether predation pressure differs between the core area and the transition zone of one of the last primeval beech forests, the Uholka division of Carpathian Biosphere Reserve in the Ukrainian Carpathians. By this we aimed at evaluating the use of fake larvae to measure predation pressure in this system.
After two days on average between 25% (Core) and 40% (Transition) and after two weeks between 80% (Transition) and 100% (Core) of fake caterpillars were attacked by predators, with highest predation pressure observed by small mammals followed by insects and birds. Among studied groups, insects appeared to need longest for detecting potential prey items and were the only group that showed significant differences in attack rates between forest types; attack rates were higher in the core zone compared to the transition zone. Our study shows that fake larvae might be suitable for measuring predation pressure from terrestrial predators on insect larvae in water-filled tree holes, but comparisons to real larvae are needed for calibration.

Tuberculosis of common ash in the forests of Ukraine

Goychuk, Anatoliy Fedorovych; Drozda, Valentyn Fedorovych; Kulbanska, Ivanna Mykolayivna; Shvets, Marina Vasylivna
Paper ID: 119

The phytosanitary condition of common ash (Fraxinus excelsior) in primeval and new forests of Ukraine is deteriorating at an increasing pace. The current unstable state of F. excelsior, is a complex problem in which adverse abiotic and biotic factors are systematically interconnected. This greatly complicates the diagnosis of its pathology as a multi-faceted phenomenon.
The ash tuberculosis, or bacterial cancer, is one of the main reasons for the rapid decline of F. excelsior on a landscape scale. It affects trunks, branches and shoots as well as inflorescences of common ash. The bark around the infected area develops minor swellings, microcracks and small tumors filled with exudate. The ash flowers do not form one-winged fetuses, but instead they concentrate around the undeveloped leader bud in the shape of a small dark brown tuberculosis cluster that visually resembles a cluster of grapes. As an old-growth attribute, the tuberculosis considerably slows ash growth and development over time.
Our research assesses a number of biotic and abiotic factors that cause ash tuberculosis, such as the hydrological regime, forest age structure, and entomofauna composition. The physiological, biochemical and other characteristics of complex pathogenic microflora associated with ash tuberculosis are also studied. Pseudomonas syringae pv. savastanoi is found to be the most common and most harmful pathogenic component. Other isolated bacterial microbiota include Erwinia sp. and Xanthomonas sp, and such micromycetes as Ulocladium botrytis, Acremonium strictum, Cylindrocarpon didymum, Fusarium sporotrichiella, and Fusarium heterosporum.
Our study develops a set of recommendations on how to slow down the spread of ash tuberculosis by creating favorable conditions for ash development, observing cenotic optimums and tree composition. The potential for future research lies in deeper understanding of antagonistic interactions among all components of microbiota in an attempt to find biological means of prevention and management of ash tuberculosis.

Vegetational development in the „Feldseewald“ since its designation as strictly protected forest reserve

Hauck, Fidel; Winter, Barbara
Paper ID: 138

Long-term studies of vegetation are an important tool for investigating natural processes in strictly protected areas. The ground vegetation is an indicator for changing site conditions and biodiversity. The strictly protected forest reserve “Feldseewald” was designated in 1993. It is located in the highest sites of the low mountain range black forest in the southwest of Germany. Main tree species are Norway spruce, European beech, Silver fir and Sycamore maple. The present study compares data from vegetation surveys of the last 30 years with a current inquiry, with the aim of studying the dynamics since the site’s designation as a strictly protected area. All woody and herbaceous plants and mosses growing on mineral soil were recorded. The previous study by Ludemann (1994) and the two studies by Schottmüller (1996, 1997) were completed with the aim of identifying and mapping the phytosociological communities in the Feldberg-area. In 2016, 50 plots were revisited to determine how the vegetation developed. The number of species and the floristical composition changed very slightly within the last decades, which might be caused by the low harvest intensity in the last decades before the designation as forest reserve. The abundance and cover of species indicating acidic soil conditions increased. Species indicating semi-open forests and (subalpine) megaphorbs decreased in their abundance and cover. This might be related to the increment of canopy cover and less disturbance due to hivernal damages (avalanches, snow damage).
The cover of the shrub layer increased significantly on the majority of the plots but most on conifer dominated plots. This indicates a decrease of browsing intensity in the area. Still, silver fir and sycamore maple are browsed too heavily to regenerate successfully. On ten percent of the plots the canopy cover collapsed due to bark beetle attack (spruce) or fungal infestation (beech).

Owl Conservation and Education in South Africa – Successes of 20 Years Owlproject.org & EcoSolutions.co.za

Haw, Jonathan; Kohl, Ingrid
Paper ID: 199

Traditional medicine or „muthi“ is a billion Rand Southern African industry. The apartheid era placed restrictions and censure on this industry which forced most traditional healers and sangomas to operate in secrecy (Suppression of Witchcraft Act of 1957). The post-apartheid era has allowed traditional healers and the use of traditional medicine to venture into the light. Traditional medicine markets or “muthi” markets are now found in all major cities and throughout rural villages. As in many cultures globally, owls have featured prominently in South African folklore and mythology. Through site visits to “muthi” markets and the participation of traditional healers in a simple questionnaire, the uses associated with owls and their body parts have emerged. In Southern African “muthi” owls are distinct as they are used for both traditional cures as well as for spiritual curses and “witchcraft”. The conclusion of this discussion will explore possible mitigation including the potential for wildlife rehabilitation centers and zoological gardens, who routinely receive owls which require euthanasia, to contribute to this market in a way that reduces the exploitation associated with the wild harvesting of owl species by traditional healers. In 1998, owlproject.org was founded and has been working with 74 schools and about 200.000 children so far. Owlproject.org is making a significant difference socially, in society and for owl conservation. Owlproject.org enjoys international recognition, has international collaboration partners (e.g. the Duerrenstein Wilderness Area, Austria) and is part of the worldwide study “Owls in Myth and Culture” of the Global Owl Project GLOW.

How habitat conditions and spatial neighbourhood interactions influence seedling mortality in an alluvial temperate forest

Holík, Jan; Janík, David; Adam, Dušan
Paper ID: 168

Niche partitioning, interactions with host-specific enemies (e.g. fungi, herbivores) and intraspecific competition for resources are all believed to drive species coexistence in tree communities. And yet, their role has been only rarely examined from the perspective of individual seedlings in temperate forests. Using a long-term data set of fully-mapped seedling plots, we examined the effects of habitat conditions and interactions with seedling and adult neighbours on seedling mortality in an old-growth alluvial temperate forest. We addressed how their roles vary over life stages, life forms and in individual species, and whether the spatial distribution of seedlings may affect interactions with their neighbours.
Our results demonstrate that seedling mortality was affected both by interactions with neighbours and habitat, with large variation between life stages, life forms and individual species. We found that density dependent seedling mortality can be identified on a fine scale of up to 2.5 m, reflecting the scale dependence of seedling-to-seedling interactions. We did not find clear evidence suggesting that seedling mortality would be relatively more affected by habitat conditions than biotic interactions. However, conspecific adults had a negative effect on seedling survival, indicating the importance of host-specific enemies or asymmetric competition. We also found positive seedling-to-seedling interactions at various community levels, probably reflecting the linkage between seedlings and favourable habitat conditions. Our results suggest that habitat conditions and biotic interactions influence seedling mortality, and that scaling of biotic interactions may provide a more complex understanding of tree species coexistence in temperate forests.

Dynamics of beech forests recovery at the tree line in Uholsko-Shyrokolozhansky massif of the Carpathian Biosphere Reserve

Kabal, Myroslav; Chernyavskyi, Mykola; Hleb, Ruslan; Sukhariuk, Dmytro
Paper ID: 115

The beech dominated primeval forests occupy 8.8 thousand of hectares, growing at the altitude between 500 and up to 1280 m.a.s.l. in the Carpathian Biosphere Reserve at the Uholsko-Shyrokolozhansky area. The long-term, intensive pasture farming caused the tree line to decrease at least for 150-200 m. In the affected forests, the tree line is represented by thinned, predominantly single-layered beech stands. During the last 20 years, with the termination of pasture farming, beech successfully recovered.
We studied beech succession on 200 x 50 m permanent plots at the tree line in the affected by pasture farming forest (altitude 1160 m.a.s.l.). All mature trees with dbh > 6 cm and regeneration with height > 10 cm were recorded. Plots were divided into sub-plots with the low density of beech trees (72 trees/ha), medium (112-152 trees/ha) and high density (208 trees/ha). The density of regeneration fluctuates between 41.3-100.5 thousand of trees per ha. Under the forest canopy, the natural regeneration in less abundant (5.5-35.0 thousand trees per ha) because of light limitation. We compared our data with the data from beech permanent plots situated between 900 and 1020 m.a.s.l.

Monitoring owl populations in a natural mountainous forest in the Austrian alps (Duerrenstein Wilderness Area, IUCN category i, UNESCO world heritage site)

Kohl, Ingrid B.I.; Hochebner, Thomas; Schütz, Claudia; Rotheneder, Gerhard
Paper ID: 197

The Duerrenstein Wilderness Area (IUCN Category I, UNESCO World Heritage Site), including Spruce-Fir-Beech Primeval Forest Rothwald, is a natural mountainous forest rich in deadwood. As a result of the deadwood, topography, climate and deep snow cover until May, the area is hardly passable for many months and hardly anything was known about the owl populations in the area. Through targeted surveys from 2015 to 2019, population densities of Boreal Owl Aegolius funereus, Eurasian Pygmy Owl Glaucidium passerinum, Tawny Owl *Strix aluco* and Ural Owl *Strix uralensis* have been surveyed. With the Eagle Owl Bubo bubo as foraging guest and the Long-eared Owl Asio otus breeding for the first time in 2017, six owl species occur in the area. Data reveal Boreal Owls and Tawny Owls to be the most common species in the study area. In 2016, a beech mast increased the density of small rodents. In the following breeding season Boreal Owls showed a significant increase in breeding densities from 12.1 to 20.0 territories/10 km^2. Breeding success was rather high with at least twelve broods with fledglings confirmed. The species breeds exclusively in natural tree cavities, usually provided by Black Woodpeckers Dryocopus martius. Tawny Owls showed a slight increase from 12.7 to 13.9 territories/10 km^2. Pygmy Owls showed relatively low densities of 3.0 territories/10 km^2. Ural Owls have been reintroduced to the area (1.2 territories/10 km^2). Breeding activity and breeding success of owls were highly dependent on beech mast and small rodent populations.

Long-term telemetry study of reintroduced ural owls *Strix uralensis* in the duerrenstein wilderness area, austria (iucn category i, UNESCO world heritage site)

Kohl, Ingrid B.I.; Leditznig, Christoph; Aigner, Franz
Paper ID: 196

In the first half of the 20th century the Ural Owl *Strix uralensis* became extinct in Austria. In 2008 a project was started to reintroduce the owl to Austria's woodlands. The Duerrenstein Wilderness Area (IUCN Category I, UNESCO World Heritage Site), including Spruce-Fir-Beech Primeval Forest Rothwald, is a natural mountainous forest, rich in deadwood and rich in natural breeding cavities for owls. Therefore, it was chosen as one of two release sites. In the Wilderness Area long-term telemetry is used to monitor success and to learn about Ural Owls' habitat selection, foraging preferences, breeding success and dependence on beech mast and rodent cycles. From 2009 to 2018, 154 owls were released in the Wilderness Area. 14,210 daily owl positions and 16,800 kilometers of movement have been registered by 114 transmitters of three telemetry systems: radio telemetry (n = 64), satellite telemetry (n = 3) and since 2014 GPS-GSM-telemetry exclusively (n = 47). For the release the ideal age of around 90 days was determined. Movement routes of up to 150 km, survival rates of about 75% in the first year after release, and various causes of death (e.g. predation by Golden Eagle) were recorded. Since 2012, Ural Owls were found breeding in nest boxes. With telemetry, several Ural Owl broods were found regularly in natural cavities in maple and beech trees since 2014. First priority is raising awareness for the importance of deadwood and natural breeding cavities for biodiversity and breeding success of owls.

Land use changes in the Carpathians 1819 – 2018: how many forests remain

Kuchma, Tetyana; Furdychko, Orest; Tarariko, Oleksandr; Landin, Volodymyr
Paper ID: 185

Over the last 200 years the Carpathian region experienced several major political transformations from Habsburg Empire to World Wars and Soviet Union expansion and collapse, which brought forth significant land-use and forest cover changes and fragmentation [1]. The aim of the research is to quantify rates and spatial patterns of forest cover change in response to socio-economic transformations. The historical land use dataset [1] of the Carpathian region (1819-1980) from digitized historical maps of three time periods: Habsburg period (1819 – 1873), World Wars period (1923 –1945), Socialist period (1950–1980) was used supplemented by land cover data derived from resent satellite images (2014-2018).
A set of landscape metrics was applied for forest cover fragmentation assessment of each time period and the efficiency of ten landscape metrics was confirmed, in particular: the largest fragment index, the edge density index, core area index, Shannon diversity index, Simpson's evenness index, contact index, the circle index, patch density index, the proximity index and the cohesion index. The map of forest cover change magnitude was developed highlighting the unchanged forest areas over the last two centuries, according to the historical maps. This data was compared with statistical information of State Forest Resources Agency of Ukraine on primeval forests and protective forest areas in administrative districts of Ukraine.
These results confirm the efficiency of landscape metrics as a tool for forest structure monitoring, modeling and comparing the different land-use scenarios.
Juraj Lieskovský, Dominik Kaim, Pál Balázs, Martin Boltižiar, Mateusz Chmiel, Ewa Grabska, Géza Király, Éva Konkoly-Gyuró, Jacek Kozak, Katarína Antalová, Tetyana Kuchma, Peter Mackovčin, Matej Mojses, Catalina Munteanu, Krzysztof Ostafin, Katarzyna Ostapowicz, Oleksandra Shandra, Premysl Stych & Volker C. Radeloff (2018) Historical land use dataset of the Carpathian region (1819–1980), Journal of Maps, 14:2, 644-651, DOI: 10.1080/17445647.2018.1502099

Peculiarities of natural regeneration of tree species in primeval beech forests of the Ukrainian Carpathians

Lavnyy, Vasyl; Sayats, Maryna
Paper ID: 114

Natural regeneration of tree species in the primeval beech forests ensures greater genetic diversity and biological stability of forest stands, it also promotes the adaptation of young trees to environmental conditions. The process of natural regeneration of tree species was studied in the Carpathian Biosphere Reserve and Uzhansky National Nature Park at the Uholsko-Shyrokoluzhanskyi area. We analyzed species composition, tree height structure and gaps size affecting regeneration in the primeval beech forests.

In general, all plots showed high regeneration density with species composition dominated by beech. The abundance of regeneration increases with the gap size. In total, 23 gaps were recorded for 10 plots (1 ha each), the number of gaps per hectare ranged from one to five, while the area of one single gap varied from 98 to 1,372 m^2. The total area of the gaps per hectare varied from 117 to 4,138 m^2. Depending on size, gaps were grouped into small (area up to 200 m^2), medium size (201-500 m^2), and large (>500 m^2). Seven of the 23 gaps belonged to small, six to medium size, and ten gaps belonged to large ones. The average area of one gap was 510 m^2.

Number of self-seeding and underwood on separate “gap” amounted from 2,810 pcs./ha to 72,663 pcs./ha. Share of the beech on separate “gap” ranged from 6.2% to 98.7%. Besides the beech in natural regeneration have also occurred sycamore and Norway maples, ash, silver fir, elm and cherry.

With the increase of the gap size was observed a tendency to increase of the quantity of self-seeding and underwood, but this relationship has only moderate distress communications.

In general, all plots showed good natural regeneration of tree species. In the composition of underwood on most plots dominates beech and by the height – small fraction of underwood.

With increasing of the height of underwood in it gradually increases the share of beech.

Natural regeneration of tree species in the primeval beech forests ensures a greater genetic diversity and biological stability of this forest stands. Permanent natural selection promotes the adaptation of young trees to environmental conditions, including the current climate change.

Orchid populations in primeval and unmanaged beech forests of Transcarpathia

Loya, Vlasta
Paper ID: 190

European beech (Fagus syvlatica L.) is the most distributed forest tree in Transcarpathia. Pure beech forests are predominated. Although beech forests are characterized by a relatively low number of vascular plant species the forests are important habitats for orchid populations. There are 1186 orchid species localities of 51 species and subspecies in Transcarpathia. Most of the localities are related to the beech forests. Group of orchid species of European and Eurasian elements is associated with the beech forests most of all. A number of specimens in the populations are relatively low. For example, we observed maximum number in Dactylorhiza fuchsii (Druce) Soó populations 270 specimens, in Dactylorhiza fuchsii subsp. sooana (Borsos) Borsos populations 110 specimens. Most of the species tend to occur between forest and meadow in ecotone where increasing the number of individuals is observed. Saprotrophic (Neottia nidus-avis (L.) Rich.), semisaprotrophic (Epipactis purpurata Smith) rhizomatous orchid tend to have optimal conditions in pure beech forests. The specimens number in populations reach a maximum of 55 and 65 respectively. While Neottia nidus-avis is a common orchid species it is listed in the Red Data Book of Ukraine. Presence of orchid populations is a certain indicator of ecosystems condition. Among studied N. nidus-avis 18 population, we noticed only N. nidus-avis or 4-8 plant species in the herb layer. So, such beech forests are characterized by low species diversity but are important for orchid populations. Primeval and unmanaged forests play a pivotal role in forest orchid populations existing. Logging and deforestation lead to forest orchid species eliminating from the ecosystems.

Dynamic and factors affecting natural regeneration of stone pine in Lebanon

Nakhoul, Joseph; Prevosto, Bernard; Bousquet-Melou, Anne; Fernandez, Catherine; Nemer, Nabil; Abboud, Jihad; Kattar, Salim
Paper ID: 198

Forests will be facing climate change with altered temperature and precipitation affecting natural regeneration and renewal of trees stands. This makes it necessary to better understand this natural process in order to model vegetation dynamics. *Pinus pinea* is a species of great economic and ecological importance in Lebanon. However, there is a lack of knowledge about the distribution of stands, their dynamics and their development in relation to environmental factors. In addition, the natural regeneration of older stands appears particularly problematic.
In our study, we characterized the natural regeneration and dynamics of stone pine stands according to abiotic variables of the environment (climate, soil, topography, etc.) and local vegetation variables (stand density and maturity, vegetation undergrowth, etc.) in the Mount Lebanon region. We found that stone pine stands are old and rarely regenerating with a dynamic that goes towards oaks specifically Quercus calliprinos.
Moreover, we tested the influence of vegetation and soil disturbances on pine regeneration as well as the influence of litter on seedling emergence. Sowing experiments were conducted in an adult stand with various types of site preparation (flipping, burning, control), and with predation included or not. Germination speed was the lowest in control medium. More results are expected for emergence rate and survival period in upcoming experiments.
In addition, laboratory experiments evaluating the influence of litter (present, absent or burned) and needle macerates on germination are underway. The results show a slow rate of germination in the presence of dry litter as well as a disturbance of seedling growth in the presence of dry litter and a high concentration of macerate. An autotoxic effect of pine pine on natural regeneration has been demonstrated.

Ecological light pollution in National parks, Biosphere and Nature reserves of the Ukrainian Carpathians

Peregrym, Mykyta; Pénzesné Kónya, Erika; Vasyliuk, Oleksiy
Paper ID: 152

People benefit a lot from artificial light at night (ALAN), but in the same time it has led to a significant increase in light pollution of the night sky during the past decades. It has serious consequences on reproduction, navigation, foraging, habitat selection, communication, trophic and social interactions of the biota with the next cascading effects for ecosystems (Longcore & Rich, 2004, Bennie at al., 2016, Hopkins et al., 2018, and others). Widespread incursion of ALAN within protected areas has been evidenced for some countries, however, the common situation with ALAN impact on protected areas within Ukraine is unclear yet. This research attempted to estimate the level of ecological light pollution on 10 National Natural Parks, 1 Biosphere and 1 Nature Reserves in the Ukrainian Carpathians. Kmz layers of these protected territories and the New World Atlas of Artificial Sky Brightness (Falchi et al., 2016), through Google Earth Pro, were used to calculate it. The results show that there is 58.12% of total area of studied protected territories the with level of artificial brightness in the range from 3.48 to 13.9 μcd/m^2 or 2–8% of the natural background, as well as there is 38.03% of total area of these protected territories in which artificial brightness of their night skies is in the range from 13.9 to 55.7 μcd/m^2 or 8–32% of the natural background. Unfortunately, protected plots without ecological light pollution are absent in the region. Although, the minimal level of artificial brightness which has a significant influence on biodiversity is unknown yet, it has been established that a sky with light pollution between 8 and 16% (from 6.96 to 55.7 μcd/m^2) can be considered polluted from an astronomical point of view (Falchi et al., 2016). Nevertheless, the situation is unique for Europe, therefore these areas have the special value for biodiversity conservation and some of them can be recognized as refugia where natural habitats are almost not influenced by ALAN. Based on obtained results, recommendations for improving of nature conservation management are given in the context of ALAN problem.
The research is supported by grant EFOP 3.6.2.-16-2017-00014.

Amphibians of beech primeval forests in the Ukrainian Carpathians

Pokynchereda, Vira
Paper ID: 142

On the territory of the Ukrainian Carpathians are situated the largest areas of beech primeval forests in Europe, part of which compose the part of the UNESCO Transnational Serial World Heritage Site “Ancient and primeval beech forests of the Carpathians and other regions of Europe”.
The last thorough study of the fauna of these territories, in particular the fauna of Amphibians, was held within the framework of the Project “Conservation of Biodiversity of the Carpathians”, and was published in the monograph “Biodiversity of the Carpathian Biosphere Reserve (CBR)” (1997). Within the next years an intensive study of amphibians continued here, results of which were mainly published in the Chronicles of Nature of the CBR. They were mainly related to their species composition, distribution and state of populations. So, at present, this type of fauna of the studied areas includes 15 species of amphibians: 6 species from the Caudata and 9 from the Anura. Regarding the fauna of Amphibians of the beech primeval forests of the Ukrainian Carpathians, it includes 11 species, namely Salamandra salamandra, Lissotriton montandoni, Ichthyosaura alpestris, Triturus cristatus, Bombina variegata, Hyla arborea, Bufo bufo, Bufotes viridis, Rana temporaria, Rana arvalis and Rana dalmatina. Of these, Salamandra salamandra, Lissotriton montandoni, Ichthyosaura alpestris, Bombina variegata and Rana dalmatina are listed in the Red Data Book of Ukraine. Lissotriton montandoni is an endemic species of the Carpathians.
Within the recent decades, particular attention is paid to the state of populations of the above mentioned species, in particular to the dynamics of the number. This direction is particularly important in the context of global climate change. Many years of research demonstrate that on the territory of primeval beech forests populations of certain species, namely of salamanders, are more numerous and more stable than in other territories of the Ukrainian Carpathians.

Monitoring of forest bat fauna using mist nets: a case study from Eastern Ukraine

Prylutska, Alona; Vlaschenko, Anton; Kravchenko, Kseniia; Rodenko, Olena
Paper ID: 149

European bat species are an endangered group of animals. Several species are strictly forest-dwelling and require trees on different stages of decay for roosting. The most common approaches for summer bat monitoring in Europe are acoustic recording and captures from roosts. However, these methods provide only fragmentary data about species richness and abundance, without information about population structure. In order to obtain complex information about sex and age structure, we developed methods wich implies mist netting for a primary inventory and following monitoring of bat fauna in forests. Our study plot (about 400-500 ha) was placed in deciduous forest of the National Park “Homilsha forests” (Kharkiv region), which is the largest protected oak forest in Eastern Ukraine. Previous research is provided us with partial information about species richness in the area. We choose July for primary inventory and monitoring because by that time young individuals start to fly, but the autumn migration has not started yet. We conducted bat monitoring in 2008, 2011, 2014 and we are planning to do it again in 2019. Nylon mist nets were installed in nine points in different habitats during all night, totally 18 “net-nights”. Each time the mist nets were installed exactly at the same places. Bags with captured bats were kept near the net. In 2008 we revealed all 10 known bat species for the area during two weeks of our inventory.

Following years we caught from 8 to 11 bat species (Myotis dasycneme, M. brandtii, M. daubentonii, Nyctalus leisleri, N. noctula, Pipistrellus pygmaeus, P. nathusii, P. kuhlii, Eptesicus serotinus, Vespertilio murinus, Plecotus auritus). The total amount of captured individuals was from 332 to 545 per year. All bats were released back to the wild.

Underestimated role of low-value aspen stands: a case study of rare European fungus *Pleurotus calyptratus* in Eastern Ukraine

Prylutskyi, Oleh V.; Yatsiuk, Iryna I.; Savchenko, Anton O.
Paper ID: 139

Aspen (Populus tremula) stands are usually considered by both forest managers and conservationists as a low-value, transitional forest type. This widespread tree thrives after forest damages (e.g. clear-cuttings, wildfires), resulting in a fact that forest management has become a main driver for aspen distribution in Eastern Europe.
But are aspen stands really so conservationally insignificant?
In an ongoing work we assess a role of aspen stands in diversity of macrofungi in Common Oak-dominated forests in the Eastern Ukraine. Beyond traditional fungal diversity survey we carried out a 7-years long monitoring of fruitifications of *Pleurotus calyptratus* — oyster mushroom growing exclusively on aspen. It was chosen as a monitoring object due to it'shigh conservational status in Europe that is still not confirmed in Ukraine. We've selected a plot of total area ~1300 ha in Homilsha forests National Park and mapped all the suitable aspen stands including stand-alone trees, as well as occurrences of P. calyptratus fruitbodies.
Obtained results may be briefly summarized as follows:
- *Pleurotus calyptratus* formed fruitbodies more abundant in large aspen stands of suitable age then in small stands - habitat continuity can be a bottleneck for aspen-dependent species;
- We detected a rapid substrate turnover: P. calyptratus fruitbodies rarely appeared on the same tree for two years. In other words, P. calyptratus has extremely short period when the aspen log is suitable for its fruitification. Hence, to maintain a sustainable population of P. calyptratus the pool of appropriate substrates must be recovered on 70-100% annually.
This demonstrates that, although habitats of low economical value are often poor also in the sense of conservation, but this is now always the case. Old-growth aspen stands, as additional biodiversity hotspots, should be preserved alongside climax forest types.

Results of growth and phenology from different populations of European beech in the international provenance trial 1998

Seho, Muhidin
Paper ID: 113

Beech is one of the most important broadleaved tree species in central Europe. The natural distribution area covers mainly central and southern Europe and continuous from the Pyrenees in northern Spain, through the French central massif, the Alps, German low mountain ranges, the Carpathians to the Crimean peninsula on the Black Sea in Eastern Europe. Ongoing climate change will affect all goods that beech forests provide. Locally adapted beech populations which might be affected by changing conditions should be replaced with drought-resistant provenances. Therefore we have investigated different provenances of beech, which can be used for planting in order to stabilize forests in Germany in the face of climate change.
For this study we used data from the international beech provenance trial in southern Germany. This provenance trial was established 1998 at 26 sites in Europe. The aim of this study was to compare different provenances at cold and drought (Fichtelberg) and warm and drought climate conditions (Freiburg) in south-west Germany. The study compares growth and phenology characteristics of 36 beech provenances.
Results revealed that provenances from Austria, Czech Republic, Germany, Slovenia and Bulgaria showed better growth (height, diameter). The height and stem quality of the provenance from Hinterstoder (Austria) was significantly higher in comparison with all other provenances under both climate conditions. This provenance can be accepted as quite tolerant for different growth conditions and is suitable for both sites. In contrast, the most other provenances perform well only at one of the two sites. Based on the obtained results of this trial further development of new provenance tests should be discussed.

Properties of soils of primeval beech forests of Borzhava (Ukrainian Carpathians)

Shpakivska, Iryna
Paper ID: 180

The soils of primeval (climax) beech forests, localized on southern slope of Borzhava (Ukrainian Carpathians) on the altitudes 800-900 m a.s.l., are investigated. Physic-chemical properties of these soils representing seven different age phases (optimum, aging, disintegration, restoration, disjoint, young and pole stand) beech forests were studied. These soils are brown acid forest soils (Dystric Cambisols). Established, that the soils differed by parameters of actual (pH 4,0-5,1) and hydrolytic acidity (13,7-29,7 mg-eq./100g), contents of organic matter (Corg 3,8-6,7%), total of N (0,31-0,52 %) and P (0,17-0,21%). The ratio C:N does not correlate with phases of development of a beech forest. Most adequately reflected phases of development primeval beech forest the contents of the mobile forms of N-NH4 and N-NO3, phosphor and potassium, which one differed at 2-34 time depending on stage of development these forest.
The some of the soil microbiological activity indices (microbiological biomass, ammonification, nitrification, nitrogen mineralization, activity of saccharase, urease and ATPase enzymes) in upper layers of Dystrict Cambisols of the 7-th age phases of the Borzhava primeval beech forests are investigated. Most indicative among the studied soils biotic conditions indexes were the rate of nitrogen mineralization and nitrification and also value of ATPase activities in soils. Which one adequately reflected different age stages of the beech forest development. In particular, the maximum level of the indicated indexes was established for aging and disintegration phases of beech forest, that testifies to accumulation of nitrogen and phosphorum in soil, which one are limiting at phases of restoration of the beech forest ecosystems.

Coenotic Structure of Primeval Forests in the Ukrainian Carpathians and Their Multifunctional Significance

Stoyko, Stepan
Paper ID: 207

We conducted a comparative study of the primeval and cultural forest ecosystems aiming to define the degree of forest natural ecosystem. We selected six ecological criteria for classification of the forest natural ecosystem: i) conformity of natural dendroflora with certain environment and habitat; ii) different stage of development of dendroflora – juvenile, virgin, premature, mature, sub-senile, senile; iii) vertical forest structure; iv) natural condition of pedosphere and understory; v) presence of deadwood; vi) presence of aborigine fauna and flora.
We found several dendroflora types typical for the primeval and quasi primeval forest of the Ukrainian Carpathians: *Quercetumpetraeae (relict), Fageto-Quercetumpetraeae, Juniperetumsabinae (relict, fragm.), Alnetum glutinosae-syringosum Josikaeae (endemic), Betuletumpendulae (relict), Fagetumsylvaticae, Carpineto-Fagetum, Fagetumtaxosum (relict, on calcium soils), Fageto-Abietum, Fageto-Abieto-Piceetum, Piceetumabietis, Pinetum sylvestris (relict), Pineto cembrae - Piceeum (relict), Laricetopolonicae- Piceetum (relict), Alnetum viridis, Pinetum mugi.*

Beech forests for livelihoods: cases from Western Ukraine

Stryamets, Nataliya; Mattalia, Giulia; Sõukand, Renata; Stryamets, Sergij
Paper ID: 167

Forest landscapes have always provided tangible (wild food, medicine, fibers, and others) and intangible (spiritual, cultural, recreational and others) benefits for a local population living in the vicinity of forests. There is a need for research on the role of forests and forest products for cultural identity and traditional practices and livelihoods, especially in European countries. The aim of the study was to identify which benefits provided by beech forests are perceived by local communities in Western Ukraine. We conducted a literature survey, 86 semi-structured interviews and participatory observations in Bukovina and Roztochya regions concerning the use of wild taxa for food, medicine, recreation and cultural practices.
Out of 1673 documented uses of plant and mushroom taxa, our results show that beech was only used as firewood for smoking meat. Indeed, it is an important traditional practice, common both to Bukovina and Roztochya regions and related to religious festivities. Yet, the beech forests were very important habitats for collecting mushrooms (Boletus edulis Bull., 1782, Russula sp., etc.) for recreation purposes as well as to make a profit. The beech forests were characterized as light, easy to walk and pleasant for recreational activities. The cultural practices like smoking meat and collecting Boletus edulis are ever-present ritual food for Christmas holidays in both study areas. We discuss the importance of beech forests for rural livelihoods in our case studies, providing not only timber but also a great variety of other benefits (mushrooms for domestic consumption and for sale, firewood, etc.). In addition, cultural values are irreplaceable and need to be drawn to the attention of the decision-makers.
Research was supported by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation program (grant agreement No 714874)

Contrasting patterns of natural mortality in primary *Picea* forests of the Carpathian mountains and the role of historical canopy area removal

Synek, Michal; Janda, Pavel; Schurman, Jonathan Scott; Bače, Radek; Čada, Vojtěch; Mikoláš, Martin; Trotsiuk, Volodymyr; Chaskovskyy, Oleh; Teodosiu, Marius; Svoboda, Miroslav
Paper ID: 157

Mortality rate is an important factor of forest dynamics. Understanding the presumed low annual mortality rates in stands with no current severe disturbances is equally as important as evaluating the mortality rates in severely-disturbed stands. However, the history of the stand or its disturbance regime are rarely considered. We evaluated the mortality rates and the principal causes of mortality in 28 mountain Norway spruce (*Picea abie*s (L.) Karst.) stands. We resampled (five-year period) 371 plots in primary Norway spruce forests along the Carpathian mountain chain. Instances of mortality modes were classified into six categories (broken crown, broken stem, uprooted, competition, bark beetle / fungi, drought). The proportion of recent tree deaths related to bark beetle is rather high across all stands, even on plots with low mortality overall. The contribution of competition varied substantially as density-dependent competition was an important mortality agent for some localities only. Abiotically-caused physical damage was an equally frequent agent as competition, however, distribution among its different modes varied. Estimated overall annual mortality rate was within the published range of background mortality, however, the stand level mortality rates vaied substantially. At the plot level the moderate-severity disturbances had increased variability of mortality rates within most localities. It is very likely that many tree deaths are caused by a combination of factors based on the lack of clear evidence of mortality agents in some locations. When current mortality is combined with historical decadal canopy area removal, based on dendrochronological data, our results indicate inverse relationship between proportion of historical disturbance (mean, maximum, amplitude, standard deviation) and current mortality. This relationship is significant within 100 year time-frame, however the significance is lost in longer time-frame. This result can be related to lifespan of target species or frequency of high severity disturbances.

What can we learn about the light-demands of the forest understory from an unmanaged, old-growth forest?

Tinya, Flóra; Ódor, Péter
Paper ID: 165

Light is one of the most important drivers of understory vegetation in forests. Not only its amount, but also its spatial pattern strongly influences the forest understory. To maintain proper light conditions for the herb layer in managed stands, it is essential to possess evidences about the light–understory relationship in natural forests. Therefore, we studied the relationship between the amount and pattern of relative diffuse light and understory vegetation in an unmanaged, old-growth temperate mixed forest, with a multi-scale approach. The investigated Szalafő Forest Reserve is located in the Őrség region, Western Hungary. The recorded vegetation variables were the cover of the vascular understory (herbs, woody seedlings), the bryophyte layer, and some selected vascular understory species.
The pattern of light showed aggregations at two scales: 10×10 and 25×25 m. Both vascular understory and bryophyte cover had significant positive correlations with light availability, and their spatial pattern was related to it. The pattern of seedlings displayed the strongest relationships with that of light at a coarser scale (25×25 m) than herbs and bryophytes (10×10 m). At the species level, Festuca heterophylla, Fragaria vesca and Poa nemoralis were characterized as light-demanding herbaceous species (their spatial pattern was congruent with light), Brachypodium sylvaticum and Carex pallescens were transitional, while some species proved to be shade-tolerant (e.g. Ajuga reptans, Dryopteris carthusiana, Viola reichenbachiana). Regarding seedlings, the patterns of *Betula pendula, Carpinus betulus, Pinus sylvestris* and *Quercus petraea* were related to the pattern of light.
According to our observations in an unmanaged, old-growth forest, diversity and composition of vascular understory and bryophytes are related to heterogeneous light conditions. Forest management should maintain continuous shelter on the stand level; however, smaller gaps are necessary for the survival of light-demanding forest herbs and bryophytes, and larger gaps for tree seedlings.

Is phenology and growth of beech seedlings affected by warming temperatures? A greenhouse experiment

Vander Mijnsbrugge, Kristine
Paper ID: 130

The predicted climate change justifies research aiming at a better understanding of responses in tree populations to rapid environmental shifts. Because of their long life-span, phenotypic plasticity is considered as a major means of rapid acclimation to changing environmental conditions in woody species. One way to study plastic responses of tree populations to temperature variation is bringing together provenances in a common garden environment with variable temperature regimes. It is well known that the seedling phase of a tree is its most vulnerable life stage. From seedling dispersal to seedling recruitment major demographic and genetic interactions take place with consequences on the species composition, the structure and the dynamics of the populations, all of which will be affected by climate change. In this study we assess the temperature response of local and non-local provenances of beech seedlings originating from Belgium and surrounding regions in a common garden experiment, in which seedlings were subjected to two temperature regimes during the growing season, from spring to autumn. Bud burst, autumnal leaf coloration and growth were monitored in both conditions. Onset of bud burst was advanced in the warm condition, but duration of the process took longer compared with the cold condition. Surprisingly, no significant differences in onset and duration of bud burst were detected among the different provenances in the experiment. At the end of the growing season, higher plants started autumnal coloration earlier in the warm condition compared with the cold condition, whereas for smaller seedlings, there was no difference in the onset of the coloration between warm and cold condition. Height and diameter growth were retarded in the warm condition, with diameter growth being more affected than height, resulting in thinner seedlings for the same height.

Assessing understory complexity in beech - dominated forests (*Fagus sylvatica* L.) in Central Europe - from managed to primary forests

Willim, Katharina; Stiers, Melissa; Annighöfer, Peter; Ammer, Christian; Ehbrecht, Martin; Seidel, Dominik
Paper ID: 147

The presence of understory and its structure are key elements of the structural complexity of temperate forests, affecting several ecosystem functions and services. In temperate primary forests, understory is characterized by the presence of advanced regeneration, vertical heterogeneity, and the development of secondary crowns by trees not yet reaching the overstory. In the few remaining primary beech (*Fagus sylvatica* L.) forests in Europe, a high density of natural regeneration, as well as a multi-layered understory structure, has been observed. Despite the relevance of understory vegetation for ecosystem functioning, it has still been difficult to measure its three-dimensional characteristics in a quantitative manner. With the recent advancements in terrestrial laser scanning (TLS), we now have the means to analyze detailed spatial patterns of forests. Here, we present a new measure to quantify understory complexity. We tested the approach for different management types, ranging from traditionally and alternatively managed forests and national parks in Germany to primary forests of Eastern Europe and the Ukraine, as well as on an inventory site with more detailed understory reference data. The understory complexity index (UCI) was derived from point clouds based on single terrestrial laser scans and tested for its relationship with forest management and conventional inventory data. Our results showed that advanced tree regeneration is a strong driver of the UCI. Furthermore, the newly developed index successfully measured understory complexity of differently managed beech stands and was able to distinguish scanning positions located on and away from skid-trails in managed stands. The approach enables a deeper understanding of the complexity of understory structures of forests and their drivers and dependents.

Monitoring of wood-inhabiting cup fungi in young and old-growth oak stands in the North-Eastern Ukraine.

Yatsiuk, Iryna Ihorivna; Prylutskyi, Oleh Vladislavovych
Paper ID: 133

Fungi are widely used as surrogate species to evaluate and declare "conservational value" of forest areas in Europe (Helme et al., 2016). The same approach could be used in the North-Eastern Ukraine, where old-growth Quercus robur-dominated forests are one the most valuable habitats. Developing a set of umbrella and flagship species of fungi, characteristic for this region, can be used to simplify evaluation procedures, as well as raise awareness about the role of dead wood in supporting biodiversity.
What has been traditionally employed for such purposes are polypore fungi, Basidiomycota, associated with coarse dead wood. Nevertheless, Ascomycota (in particular, cup fungi with detectible fruitbodies), associated with other substrata, also may be tested for indicativeness.
In the National Park "Homilsha forest" we carried out 3-year monitoring of Sarcoscypha spp. and Urnula craterium cup fungi, which inhabit fine woody debris. These were selected due to their noticeable fruitbodies, well-defined fruitification period (early spring), as well as their Red-listed or otherwise protected status in neighborhood European countries. Despite species of Sarcoscypha genus are difficult to distinguish in oculo nudo, they apparently have similar ecological preferences, keeping the possibility of using them for conservational purposes. With these features, these fungi are treated as candidates for local umbrella and flagship species.
We monitored fruitification of Sarcoscypha and Urnula craterium on 2 plots (young, post-clear-cut and old-growth Common Oak stands), using distance sampling method. Besides that, route monitoring was applied to a larger area involving several managed and protected forest stands.
During this period, we refined our understanding of these species local distribution, as well as made first attempts to estimate their abundance, and analyze how their fruitification is influenced by forest age and local relief factors. In particular, Urnula craterium seems to be less abundant in the region, and tends to inhabit old-growth forest stands.

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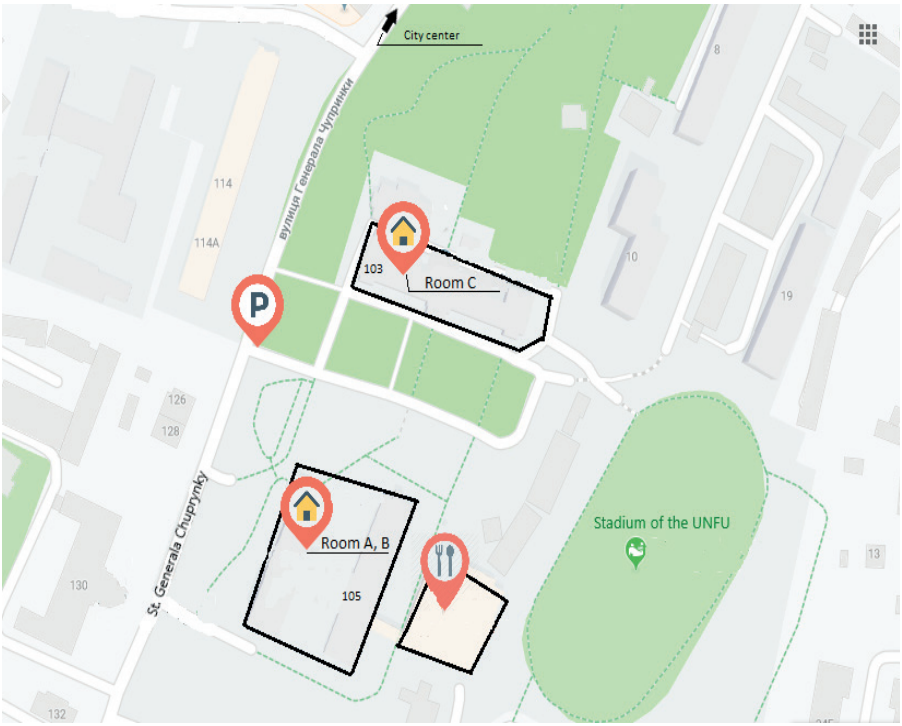
Situation map



	Old building: (Room C, auditorium 27, second floor)
	9-storey-building: (Room A, conference room, third floor) (Room B, auditorium 405, fourth floor)
	Shuttle stop
	Canteen