Book of abstracts

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Dear colleagues, ladies and gentlemen, friends,

This year conference **Research Actualities in Bohemian Forest / Aktuality šumavského výzkumu /Aktuelle Ergebnisse der Böhmerwaldforschung** is already the eighth in a row. The current Book of abstracts contains more than 70 abstracts of both your posters and conference talks! It's great to see that the Bohemian forest ecosystem remains scientifically interesting and we can assume that there is still a lot to be explored.

The book of abstracts is full of interesting and diverse topics. One topic resonates throughout the whole year in the Šumava National Park – this year is called "the Year of dead wood". Dead wood (or maybe "decaying wood" is a better expression) has a lot of different benefits for the whole ecosystem. Our conference will try to show some of them in numerous presentations a posters.

I hope you will enjoy the conference and take home a lot of messages and new ideas.

On behalf of the organizational team

Jaroslav Červenka

ABSTRACTS

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The Book of abstract hasn't been proofread.

Monitoring of the mountain longhorn beetle (*Tragosoma depsarium*) using pheromone traps in the Šumava National Park in 2023

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The longhorn beetle *Tragosoma depsarium* is a 15–35 mm long representative of the Prioninae subfamily. It is found in mountainous areas across Eurasia but is considered one of the rarest longhorn beetle species. According to Czech legislation, it is protected as a strongly endangered species and is listed in the critically endangered category on the Czech Red List of Invertebrates. According to the IUCN, its population is declining across Europe and is classified as nearly threatened. The primary reason for its endangerment is its specific habitat requirements, as it prefers dead conifer wood in structured forest-like areas.

The recent occurrence of *T. depsarium* in the Šumava Massif was previously known from eight finds in the southern part of Šumava National Park. For extensive monitoring, we used detailed maps of dead trees from 2006–2012, indicating potential habitats for the species. The national park was divided into 3x3 km squares, and in 50 selected squares, we installed pheromone-baited flight interception traps. A total of 70 individuals were captured and marked, 68 males and 2 females. Most beetles were marked in the Jezerní luh area (25) and at the Ježová and Buková road junction (12). Eighteen marked individuals were recaptured in the same trap, some more than once. In Jezerní luh, one beetle flew a distance of approximately 550 meters, eight days after the first marking. Thus, we confirmed the presence of the species at 14 locations, and along with recent records, *T. depsarium* has been documented in 20 locations within the Šumava National Park. Currently, the species occurs in two regions of Šumava – in the south between Stožec and Nová Pec, and in the west between Prášily and Kvilda.

The method of using pheromone-baited flight interception traps has proven very successful and more efficient than previous random habitat searches and identification of emergence holes by a specialist. However, it is important to consider the limitations of this method, specifically the unknown distance over which the pheromone attracts the beetles. It is possible that *T. depsarium* is more widely distributed, but the traps were not placed in optimal locations. Future monitoring should include a study of habitat requirements at confirmed sites to better target future monitoring efforts and habitat protection.

Deadwood as a key microhabitat for spruce regeneration: 10 years of succession after bark beetle disturbance

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Long-term monitoring of the development of mountain spruce forests after bark beetle outbreaks helps to clarify to what extent these forests are adapted to such disturbances. It is well known that deadwood is a crucial microhabitat for spruce regeneration, especially in mountain spruce forests. However, the question remains whether the advantage of deadwood persists after intense disturbance, which significantly increases understorey temperatures and the risk of drought in elevated microhabitats.

Our aim is to assess the ten-year development of tree succession after disturbance of the tree layer. The hypothesis tested is that the disturbance led to increased regeneration mortality in microhabitats vulnerable to drought, such as sections of lying logs that are elevated above the ground and thinner in diameter. Specifically, the study aims to answer the following questions

Which characteristics of lying logs (diameter, height above ground, shading by surrounding vegetation, stage of decay, dominant decay type, and others) influence regeneration growth rate and mortality, and whether these relationships are modified by disturbance.

Field data were collected from 2011 to 2022 on two one-hectare plots: one affected by bark beetle disturbance in 2009 (Trojmezná, Šumava National Park) and one unaffected (Eustaška, Praděd National Nature Reserve). Generalised linear models were used to test the effects of deadwood characteristics on mortality and regeneration growth rates.

The disturbance at Trojmezná significantly altered temperature and light conditions in the understorey and probably caused 18-22% higher mortality but also 120% faster regeneration growth compared to the undisturbed plot during the observation period. Higher mortality at Trojmezná was seen in smaller individuals, threatened by intraspecific competition, growing on desiccation-prone logs (elevated, slightly decomposed, poorly shaded, decomposed by Armillaria spp., and in open canopies). Faster growth was observed on decomposed logs in contact with the ground. At Eustaška, mortality occurred mainly in smaller, competitively threatened individuals, while faster growth was observed in taller, less competitively threatened individuals growing in open canopies.

Despite dry summers following the disturbance, regeneration on dead wood was not significantly threatened. Instead, disturbance accelerated growth, with taller individuals benefiting most due to better microclimate and soil contact.

Living jewels under the water surface of the Bohemian Forest

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The Bohemian Forest is crossed by a network of many watercourses, small stagnant waters, and deep glacial lakes. These waters have been inhabited by fish for millennia. In the 1960s, fish and other organisms disappeared from the lakes and headwater streams due to anthropogenic acidification. In order to effectively protect aquatic ecosystems, it is important to identify the current distribution of fish species and their population structure.

The cross-border Interreg Bavaria-Czechia project has been running since autumn 2023. The aim is to carry out ichthyological monitoring at >150 sites in the Czech and Bavarian parts of the Bohemian Forest. In addition, in the case of brown trout, genetic analyses are carried out on a sub-sample of individuals to determine native genetic lines adapted to local conditions. From each locality environmental DNA from water and sediment is analysed to determine the extent of fish parasitism.

In the Czech part of the Bohemian Forest, >10,000 fish of 16 species and the brook lamprey were caught by electrofishing. >5,500 fish were brown trout, from which >3,000 samples were taken for genetic analysis. The second most frequently occurring species was the bullhead (79% of sites). Minnows were locally common, in small numbers burbot, grayling and chub. European perch and roach were habitat non-native. Brown trout and rainbow trout were not geographically indigenous. Natural fish reproduction takes place at most sites, brown trout genetic analyses indicate local lineages, and parasites such as *Tetracapsuloides bryosalmonae* have been detected locally. Monitoring is currently underway on the Bavarian side. Initial results show a similar composition of the fish communities as in the Czech localities. The results will be shared with users and presented at the final conference planned for spring 2026.

Microbiome of fine woody debris along ist decomposition

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Fine woody debris (FWD) represents the majority of deadwood stock in managed forests and serves as an important biodiversity hotspot and refuge for many organisms, including deadwood fungi. Wood decomposition in forests, representing an important input of nutrients into forest soils, is mainly driven by fungal communities undergoing continuous changes. Deadwood bacteria are involved in C and N cycles and together with fungi facilitate deadwood decomposition. While the assembly processes of fungal communities in long-lasting coarse woody debris have been repeatedly explored, similar information for more ephemeral habitat of fine deadwood is missing. Here, we followed fate of FWD of *Fagus sylvatica* and *Abies alba* in a Central European forest over 6 years by amplicon sequencing (ITS and 16S). The effect of microclimate on deadwood properties and microbial communities was addressed by comparing FWD decomposition in closed forests and under open canopies, as the large FWD surface-to-volume ratio makes it highly sensitive to temperature and moisture fluctuations. Fungal biomass increases and pH decreases were significantly higher under closed canopy in initial stages of decomposition indicating higher fungal activity and hence decay processes. Assembly patterns of the fungal community were strongly affected by both tree species and microclimatic conditions. Communities in the open/closed canopies and in each tree species were different throughout the whole succession with only limited convergence in time in terms of both species and ecological guild composition. Decomposition under the open canopy was characterized by high sample-to-sample variability, showing the diversification of fungal resources. Bacterial community undergoes continuous development resulting in more diverse community under the open canopy. Decomposing FWD increases local microbial diversity along the increasing heterogeneity of forest with canopy openings and contributes to ecosystem stability.

Modelling future microclimate of protected areas to improve species protection

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Effective protection of biodiversity in protected areas is often based on the known optimal conditions for the most important species. Yet future climate may not be optimal for the species. Microclimate buffering of forests may help the species survive, yet even the forests will develop.
We have used landscape scale forest simulation model LANDIS-II to derive forest composition and age structure for the 21st century using current management practices and several climate change scenarios of macroclimate.
Using our large network of microclimate sites, we have derived buffering properties of forests with various composition, age and structure to calculate future forest microclimate of the modelled forests.
We test if the protected areas will be suitable for hosting the protected species under current management measures. In case when the model predicts, that the species may be at risk in the future, we propose alternative management measures to alter microclimate buffering and test their ability to help the species.
The research is conducted in close cooperation with local nature protection entities including National Park Šumava.

Stony debris – unique habitat – also for bats?!

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The stony debris represent usually spatially limited, but valuable and specific natural habitat. In the context of their structure and microclimate, stony debris is known as a refuge of a particular, often relict fauna of invertebrates. But, we still know nearly nothing about their use by bats. This survey was undertaken to discover more facts about the relationship between this specific habitat and bats in conditions of the Bohemian Forest Ecosystem. The fauna and flight activity of bats were studied at two different localities of stony debris in the Bohemian Forest from 2022 to 2024. The locality Obří hrad is situated on the steep slopes of the narrow deep valley, at altitudes from 800 to 950 m a. s. l. The locality Ždanidla is represented by sub-peak stone debris at 1260 to 1300 m a.s. l. Acoustic detection was the main survey method, supplemented by netting and thermal imaging tracking. At least 16 bat species were detected together at both localities. A higher number of species, at least 15, were registered at lower altitudes (Obří hrad), while 5 bat species were found at high altitudes (Ždánidla). The Northern Bat (*Eptesicus nilssonii*) and the Common Pipistrelle (*Pipistrellus pipistrellus*) were the most frequent species on both sites, followed by the Parti-coloured Bat (*Vespertilio murinus*) on the locality Ždanidla and the Lesser Horseshoe Bat (*Rhinolophus hipposideros*) on the locality Obří hrad. It was found that at least some species, namely the Lesser Horseshoe Bat and the Northern Bat can use stony debris as a temporary shelter. The importance of stony debris as an attractive food habitat for bats is not clear and is under discussion. In any case, it is apparent from this pilot survey that the stony debris represents important habitat patches for bats in Bohemian Forest and we should pursue the subject further. Last but not least, these results are another strong argument for protecting these exceptional habitats.

The first species-specific monitoring of the European wildcat in southwestern Bohemia has begun

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The wildcat (*Felis silvestris*) is among the least explored mammals in the Czech Republic due to its hidden way of life as well as its similarity to some domestic cat individuals (*Felis catus*), therefore the use of genetic methods for validation is necessary. It is a critically endangered species protected by Law No. 114/1992 Coll. Wildcat populations, both in the Czech Republic and Europe, are threatened by many factors, e.g., loss and fragmentation of habitat or hybridization with domestic cats. Modern evidence of the wildcat in the southwestern part of the Czech Republic was obtained randomly thanks to the monitoring of other target species using camera traps, only a small portion was supported by genetic analysis. Nevertheless, the presence of wildcats was recorded in a number of locations in eight sub-areas, more continuously in the forested border areas of southern and western Bohemia, and more sparsely in central and northern Bohemia. Summarising these results has become an important starting line for further research and has shown an urgent need for species-specific systematic camera-trapping and genetic monitoring in all areas with confirmed occurrence. This challenge is recently followed up by a new project TACR (SS07010109): Analysis of population status and conservation genetics of the European wildcat as an important flagship species for biodiversity conservation. The project aims to obtain and update reliable data on the distribution, type of occurrence, and ecology of the European wildcat, mainly using non-invasive genetic monitoring in the southwestern part of the Czech Republic. Specifically: 1. To extend standard species-specific monitoring using hair- and camera-traps with subsequent DNA analysis of the collected material in areas with confirmed occurrence of the wildcat (Šumava NP and PLA, Český les, Slavkovský les and Křivoklátsko PLAs, Doupovské hory Mts, Dobříš region). 2. To evaluate the threats for the wildcat population with emphasis on the analysis of the presence of hybrids with the domestic cat. 3. To analyse the wildcat habitat preference and spatial activity/dispersal using telemetry monitoring. The results achieved will contribute to detailed knowledge of the range, demographics, and the state of the population in terms of genetics, which is a key prerequisite for effective protection of the species.

This project is financed with the state support of the Technology Agency of the Czech Republic and the Ministry of the Environment of the Czech Republic as part of the Program Environment for life.

Hydrological restoration in the mountain landscape within the transboundary project LIFE for MIRES: results and experience

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Šumava is one of the most important wetland areas in Central Europe with a high proportion of mires. The region, however, has been subject to significant interventions into the water regime in the past, mainly in the form of landscape drainage. The extent of reclamation and its impact on key water structures and valuable habitats have been the reason for launching a comprehensive programme of hydrological restoration in 1990s.

The programme is aimed at the restoration of near natural hydrological conditions and processes in the landscape and the rehabilitation of major water macrostructures such as wetlands, watercourses and springs. As part of the restoration programme, drainage systems were blocked and streams returned to their natural beds, including rehabilitation of links to the surrounding floodplain. Much attention was paid to disturbed springs, the proportion of which is alarming. Restorations were carried out according to three basic concepts: i) micro-catchment concept (whole hydrological units are addressed), ii) target water level concept (water table returned to near-natural levels) and iii) concept of one-off functional measures (to release strongly damaged ecosystems out of degradation trajectory and initiate their spontaneous recovery).

The restoration programme is currently in its third phase of implementation which is represented by the large-scale transboundary project LIFE for MIRES. It has been running since 2018 and will be finished this year (2024). The main project objective was to restore 2059 ha of damaged wetlands in the Šumava region. The project also had a strong focus on raising public awareness of the importance of wetlands and their role in addressing water issues in the landscape.

As of the end of September this year, 2005 ha of wetlands and mires (97%) had been restored during the LIFE project implementation. 196 km of drainage channels were blocked, 30 km of small mountain streams and 28 springs were restored. Technological procedures were developed and tested for the restoration of damaged springs and streams transformed into deep eroding gullies on slopes. Possibilities and methods of restoration of different habitats and situations will be presented on the example of specific sites. Monitoring of the restoration success using selected parameters (water table, water chemistry, runoff conditions, vegetation, microclimate, etc.) and recorded response of the ecosystems to the measures implemented will also be presented during the lecture.

Biodiversity and carbon sequestration potential of old forests outside strictly protected areas

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We attempt to assess the value of Czech old forests (age >130 years) outside strictly protected areas (national parks, nature reserves) and their maintenance (without timber harvesting) for biodiversity conservation and carbon sequestration. In 70 plots distributed in old managed forests in Czechia, we measure forest structure and volume including real tree ages and species composition of bird, beetle, fungi, lichen and vascular plant communities. We ask if increase of forest age beyond 130 years affects species diversity and occurrence of rare species, and carbon sequestration. The results of our previous study focussed on species diversity hot-spots of epiphytic and epixylic lichens in the forests in Czechia documented that species richness and occurrence of rare species in old managed forests do not achieve species diversity in adjacent strictly protected forests. However, the results indicated that further protection of sufficient area of old managed forests with natural tree species composition is necessary to prevent species decline in protected habitats with limited size.

The research was supported by TACR (grant SS06010420).

Ecological impact of the return of wolves to the Šumava/Bohemian Forest ecosystem

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Wolves were part of European ecosystems until they were heavily persecuted in the 19th century, causing local extinctions as their numbers and range drastically reduced. Now wolves are recolonising former areas, including the Bohemian Forest ecosystem after over 150 years of absence. The presence of wolves can have a significant impact on the landscape, contributing directly to the reduction of prey populations through predation, and indirectly influencing prey behaviour and space-use. This can have cascading effects at different trophic levels, as the behaviour and distribution of ungulates also influences browsing pressure and therefore forest regeneration. It is still largely unclear how the return of the wolf will affect Central European ecosystems, which have been characterised by the absence of large carnivores in recent centuries and are heavily influenced by human activities. This 3-year project cofinanced by the EU program INTERREG Bavaria – Czech Republic 2021-2027 aims to determine the spatio-temporal relationships between the 3 trophic levels of predator, prey, and forest rejuvenation. A joint management strategy for wild ungulates will be developed by the project consortium (Czech University of Life Sciences in Prague, Bavarian Forest and Šumava National Parks) based on the results. The project comprises 3 research areas of wolf, ungulate and forest monitoring. Wolf monitoring data is collected from GPS collars, opportunistic camera traps, audiorecorders, DNA and scat samples collected in the field, and is used to determine the number of wolves, their territories, diet and genetic connections between individuals. Ungulate monitoring is carried out through a standardised camera trap design across both national parks to determine the population density and distribution of wolf prey. Telemetry data of red deer is also collected using GPS collars to uncover trends in spatial behaviour of red deer as they are the most common prey of wolves. Impacts on forest is monitored through a standardised browsing survey spanning both national parks. Comparison with historical data will uncover if wolf recolonisation has impacted ungulate densities and behaviour and thus forest rejuvenation. The data collection is still ongoing, compiled results combining the 3 ecosystem levels as well as the common management strategy of wild ungulates can be expected in 2026.

Browsing survey in the Šumava National Park

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Ungulate browsing is considered one of natural disturbances in the Šumava National Park (SNP). On the other hand long-term browsing pressure of ungulates can have a significant impact on forest composition and structure. Since 2018 the large-scale monitoring is organized in a 3-year cycle to evaluate the extent of browsing damages on forest regeneration. We use a grid of 1000×1000 m with approximately 650 monitoring plots. Each plot is represented by a transect with 5 subplots. On each subplot exact height, tree species and browsing damages (lateral and terminal) are determined for the closest 15 individuals of height 20–200 cm.

Damage to the terminal shoot is essential for the height increment of all tree species. The total amount of browsed terminal shoots in 2024 was 10.7% with rowan being the most damaged tree (41.4%), followed by sycamore maple (38.5%) and other deciduous trees (31.4%), fir (22 .2%) and beech (19.0%). The minimally damaged tree species were spruce (1.9%) and pine (2.8%). Norway spruce is strongly avoided. Spruce is browsed intensively only if other, more palatable forage sources are depleted or not available. The damages varied significantly between selected areas. Highest browsing pressures were determined in forest districts Kašperské Hory, Srní and České Žleby. In forest districts Modrava, Stožec and Prášily, the damage was significantly lower.

Significant decrease in total browsing pressure on terminal shoot was recorded between the years 2021 and 2024. The total numbers were 12.2% resp. 10.7%. When comparing the territory monitored in 2018 with the years 2021 and 2024, there was also a significant decrease in damage for regeneration of 20–200 cm height. The average bite of terminal shoots decreased from 17.3% to 13.0% in 2021 or to 11.1% in 2024. There were also significant decrease of browsing damage almost for each tree species between the years.

Significant decrease of browsing pressure could be most likely caused by decreasing numbers of red deer, but other factors can have significant impact on amount of browsing pressure. Game management has been one of the big tasks from beginning of SNP when population of red deer were overgrown. Currently presence of wolves can also help to control the deer population. Most of the variables affecting browsing pressure should be explained in common running project of Administration of Sumava NP, Bavarian Forest NP and Czech University of Life Sciences – WoBoFE - the project is cofunded by the EU through the program Interreg Bavaria – Czech Republic 2021–2027.

To plant or not to plant? That is the question.

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Since 2018, we have selected five sites within the Šumava National Park for assessing natural regeneration. Four of these sites (Laka, Lenora, Říjiště, Perník) are clearings after logging, and one site (Poledník), after wind and bark beetle disturbance. At Poledník, no dead-wood was removed, so it represents a mountain spruce forest left without any logging or artificial regeneration. Two of the sites (Poledník, Říjiště) were not artificially reforested. On the remaining three sites (Lenora, Říjiště, Perník), artificial planting was carried out with the aim of altering the tree species composition of the subsequent forest stand.

We determined the density of regeneration on circular plots of 500 m², with the centres of the monitoring plots located at the intersections of a square grid laid over the clearing area. From these monitoring plots, we derived the density and species composition of the regeneration. The resulting density was then compared with the numbers of artificially planted tree individuals. One of the main objectives of our study was to determine to what extent artificial planting can influence the composition of the future forest.

On the localities without artificial planting, the average density of natural regeneration is between 1,753 and 12,502 plants per hectare, which is sufficient for forest environment restoration. The minimum density did not drop below 400 individuals per hectare (mountain spruce forest). In clearings where artificial planting was carried out alongside existing or emerging natural regeneration, the resulting average densities range from 2,220 to 5,900 individuals per hectare, with the minimum density not falling below 900 individuals per hectare. The proportion of artificial regeneration, assuming that all planted individuals survived, ranged from 15.4% to 55.5% at various localities.

The evaluation of the number of regenerating individuals in the clearings and the effectiveness of artificial planting shows that the entire process is dominated by natural regeneration and the returning prevalence of spruce forests, in which other tree species will undoubtedly survive as well. However, they will certainly not dominate the future forest generation. The forests growing in the clearings will be similar to those that grew before logging, more structurally complex in many ways, perhaps with more gaps, but still similar to the previous ones.

Changes in forest floor P availability in an unmanaged mountain spruce forest after bark beetle-induced tree dieback: A 15-years study

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In this study, we examined the variations in different phosphorus fractions in the forest floor (O and A horizon) of unmanaged Norway spruce stands in the Plešné (PL) and Čertovo Lake (CT) catchments in the Czech Republic over the period from 2008 to 2022. The forest in the PL catchment was infested by the bark beetle (*Ips typographus*) from 2004 to 2008, resulting in the death of approximately 90% of trees. In the catchment of CT, tree dieback has recently (since 2017) accelerated. We observed significant changes in soil nutrient chemistry after the tree dieback, and during the forest recovery. Ratio between total carbon and phosphorus in soil has been increasing over the years in the PL catchment, indicating loss of P during microbial decomposition. The concentrations of total phosphorus in water extracts (TP_{H2O}) started to increase and reached a peak (1050 µmol/g in the O horizon and 746 µmol/g in the A horizon) three years after tree dieback in the disturbed forest at PL catchment. A similar trend also occurred for soluble reactive phosphorus (SRP_{H2O}), which represented the major fraction of TP_{H20} during the period of its peaking concentrations. Due to forest regeneration and an increase in phosphorus uptake by trees in subsequent years, the TP_{H2O} began to decrease, and proportion of organic P increased. During the last years, a similar (but less pronounced) trend was observed in the forest floor at CT catchment with ongoing tree dieback.

Temperature buffering capacity of deadwood in temperate forests

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Extreme temperatures can be avoided by many organisms by using thermal buffers. Forests can have complex thermal characteristics on a relatively small area: on a higher resolution, forest gaps have different temperatures compared to closed forests; and on a fine resolution, dead or alive vegetation structures can buffer both cold and hot temperatures. In our study, based on 180 study sites and 3 forest structures, we focused on the thermal buffering capacity of deadwood. We found lower ground maximum temperatures near deadwood objects compared to open areas, especially in forest gaps. This ability to buffer temperature maximums has great implications in heatwaves, especially for ground-inhabiting organisms, however the buffering capacity of forest microhabitats are rarely quantified. As weather events become more extreme, especially in summer periods, the thermal buffering of forest microhabitats grow greater in importance for many organisms. Therefore, it is important to understand the capacity of natural forest structures as climate refugia in hot periods, and use this knowledge in applied climate protection.

Anthroposols in the forests of the Šumava National Park. The end of one craft.

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In the Šumava National Park, there are about a thousand square or rectangular objects ranging in width and length from 20 to 40 m. They are enclosed by several kinds of stone walls or stone earth to earth banks. Most of them are located at altitudes of approximately 1100 meters above sea level. They are difficult to see and locate in the rugged mountain terrain but were discovered through an analysis of airborne laser scanning lidar images. However, publicly available scans (ZABAGED DMR 5G) do not show them, and they are only observable on high-resolution LIDAR (DMR_NPS) at the Šumava and Bavarian National Parks (where they also occur), therefore our knowledge is limited to these areas.

Interpretation of the enclosures is not definite, but most of them can be considered seedbeds and/or forest nurseries. They vary in shape and size as well as the way the walls and ramparts are constructed. They probably began to be built sometime in the first half of the 19th century, though they could be older.

Following the displacement of the German population after the 2nd World war the construction of these forest nurseries/seedbeds ended and understanding of the enclosures and how they were managed came to an end. At present, they are not known to the public or oftentimes to local park rangers or foresters.

Pedological research revealed some details on the management of soils within these constructions. For example, some has been ploughed down to a depth of 30 cm. In other cases, apparently mainly on podzols, soil horizons O, Ah, Ep to has been removed down to horizon B; the surface was then fertilised with forest compost and sown directly. The removed soil was piled into banks defining the nursery area. Further soil loss occurred when the seedlings were picked up, when the original surface was reduced by a further 10-20 cm. Depletion of minerals caused that in some cases, enclosures are free of tree vegetation more than 100 years after the abandonment.

Each of the enclosure is distinct in origin, and by its own treatment forms a unique random statistical sample of nearly a thousand areas of anthroposols within the National Park. It is therefore an area where it would be possible - if there was interest - to observe the different succession of woody plants on a nutrient-accurate substrate.

Progress in glacial geomorphological research in the Bohemian Forest Mountain Range

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The study of glaciers provides us with valuable climate data, allowing us to observe the gradual alternation between warming and cooling periods in the past. In the current era of global climate change, such data is crucial, as it can potentially serve as a basis for future climate predictions. The Bohemian Forest is one of the Central European mountain ranges where glaciers were documented during the Last Glacial Period. Situated between the southern margin of the Fennoscandian Ice Sheet and the glaciated Alps, palaeoglacial research in this region can significantly contribute to our understanding of past climate in Europe. Despite the relatively long history of glacial research in the Bohemian Forest, some questions remain unresolved or are still a matter of debate. Opinions on the extent of glaciation differ, and detailed glacial geomorphological research using modern dating methods has primarily focused on north-oriented sites. Our presentation will summarize the current progress in addressing these questions. We will also outline our research results, which appear to be unique for the Bohemian Forest and Central Europe as a whole.

Monitoring of the Eurasian otter (*Lutra lutra*) in the Šumava National Park and Protected Landscape Area between 2015 and 2022

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The river otter is the largest carnivore species living in Czech freshwater. In the past centuries, this species reached the brink of extinction in the Czech Republic and in large parts of Europe. This was due to hunting for fur, illegal killing, and decrease of habitat quality and prey species availability in running waters. During the 1980s and 1990s, the situation gradually improved both in the Czech Republic and in several other European countries. In the years 1989-1992, 1997-2000, 2006, 2011, 2016 and 2021, a relatively rough but country-wide monitoring of otter occurrence was performed, aimed at documenting the development of this species' distribution in the Czech Republic. The Czech S-JTSK monitoring grid, consisting of 11,2 x 12 km squares, was used as spatial unit in all these monitoring sessions. A comparison of these country-wide results between 2006 and 2011 indicated a possible decrease in the area of confirmed otter occurrence within the Natura 2000 Site of Community Importance (SCI) Šumava. Thus, in 2015 the Administration of Šumava National Park, as the responsible Nature conservation authority, implemented a finer-scale otter monitoring in the entire National park (NP) and Protected Landscape Area (PLA) Šumava, covering most of SCI Šumava. From 2015 to 2022 this monitoring was run once per year, in autumn, using 5,6 x 6 km monitoring squares as spatial unit. In all (but one) monitoring squares falling at least partially within the borders of NP and PLA Šumava, two monitoring sites were selected, mostly under suitable bridges, where signs of presence of the Eurasian otter were searched for. The main output of this finer-scale monitoring are 8 yearly maps of squares with confirmed Eurasian otter occurrence. The percentage of monitoring squares with confirmed otter occurrence fluctuated between 81% and 91% between years, with a mean value of 86,6% and a median value of 87%. No clear trend could be observed from 2015 to 2022, but based on these results, the Eurasian otter seems to occur relatively stable in the entire SCI Šumava. Although even this finer-scale monitoring has limits, we believe it would provide hints about potential serious negative changes from year to year, which were not recorded so far. For the years following 2022, the Administration of Šumava National Park plans to repeat such monitoring actions once every two years, to maintain an overview on the development of the otter local distribution in the long term.

Forest ecosystem monitoring concept of the Bavarian Forest National Park

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Recently climate change has led to more frequent and severe dry and hot summers in central Europe, resulting in rapid changes in the forest ecosystems. Resulting water stress and bark beetle infestations have caused significant losses of forest cover and declining forest conditions on large scales and these disturbances will continue to occur more regularly in the future. Therefore, it is of great importance to monitor the conditions and developments of forests continuously and more frequently. The observation of the forest ecosystem dynamics is one of the main tasks of the Bavarian Forest National Park (NP). It is Germany's most important research site for remote sensing-based forest monitoring and has a long history of acquiring such datasets.

To achieve a continuous and full scale monitoring able to detect the rapid changes, both ground-based and remote sensing methods are utilized and combined. While ground data is very important to detect long-term trends and get information on variables not measurable by remote sensing sensors, they only cover selected parts of the forest. Remote sensing methods offer more cost-efficient ways to collect data across the whole NP area and can be repeated more often.

Ground data is acquired along small-scale monitoring areas that were already mapped regularly from 2002, some even from the 1980s onwards. In these, all trees and their structural parameters are mapped and surveyed with very high accuracy. Also, the 20 ha cross border plot is the largest monitoring area and is managed jointly with Sumava NP.

The most comprehensive ground data set is the sample-based forest inventory, which follows concentric plots distributed all over the national park. It was initiated in 1981 and this summer the 4th iteration took place with an optimized sampling design along 1054 plots. In addition to many structural parameters, microhabitats, conditions and remote sensing visibility are recorded for all living trees and standing deadwood. Data on lying deadwood, tree regeneration, other vegetation and ground cover is also recorded using the line intersect sampling approach.

To monitor the forests over the whole NP, airborne remote sensing campaigns are performed. High-resolution multispectral and hyperspectral imaging as well as laser scanning is implemented to detect the 3D-structure and properties of the forest. Open-source data from Sentinel & Landsat satellite programs are incorporated to monitor the full national park forest by filling gaps between the high-resolution airborne acquisitions. Along the monitoring and inventory plots, handheld and drone-based laser scanning is used to automatically map the forest structure with high precision and to enlarge these plots.

In this presentation, the remote sensing side of the forest monitoring concept is introduced and the data acquired is shown. Also, preliminary results of the different methods will be provided.

Cortinarius subgenus *Telamonia* s.l. on altitudinal gradient of raised bogs

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The subgenus *Telamonia* (sensu Funga Nordica) represents a taxonomically difficult group within the genus *Cortinarius* due to its high species diversity, variability of morphological characters, and their mutual similarity, especially in old stages. Species of the subgenus *Telamonia* belong to the dominant ectomycorrhizal fungi in raised bogs. Better knowledge of their ecology can significantly contribute to a correct interpretation of mycobiota changes in these threatened habitats.

The aim of the study was to find out which *Telamonia* species grow among sphagnum in selected raised bogs, which ectomycorrhizal tree species their potential hosts are, and whether their occurrence is affected by altitude. Seven raised bogs in the Šumava National Park (740–1175 m a.s.l.) were regularly visited, and groups of fruitbodies including those in a young stage were collected. Microscopic and macroscopic features together with ITS sequencing and phylogenetic analysis were used to identify the species. Altogether 25 species were found. The most common species, *C. flabellus, C. flexipes, C. fulvescentoideus*, and *C. sphagnoravus*, occurred throughout the studied altitudinal gradient. The relationship between other species and altitude could not be evaluated due to the limited number of records. Four species were found in the Czech Republic for the first time, and two other species are possibly new to science. Identification of potential ectomycorrhizal hosts for the *Telamonia* species was limited by the structure of the vegetation.

Development of forest spatial structure after bark beetle disturbance

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Natural disturbances are an integral part of the dynamics of mountain spruce forests. They significantly influence their structure and character, create new environments, change resource availability, and are the driving force of forest biodiversity. However, the frequency and intensity of natural disturbances are increasing due to climate change. Therefore, there is an increasing need to understand the effects of large-scale disturbances on forest structure and function, including the ability of forests to regenerate. The extent to which forest structure is resilient to large-scale disturbances and whether the structure is carried over to the next generation of forest is not yet fully understood. The Field-Map technology was used to repeatedly measure the structure (trees, stumps, seedlings, and lying dead wood) of a mountain spruce forest in the Šumava National Park, which is regenerating after an intensive disturbance caused by a bark beetle (*Ips typographus*) outbreak. The results of spatial analyses showed a strong clustering pattern. Live individuals were significantly aggregated among themselves as well as to standing dead trees, although the effect weakened with increasing distance between individuals. As a result of clustering, newly regenerating individuals mirror the former forest structure. Areas with a high number of trees in the parental stand are likely to remain densely vegetated in the future, and spruce-free gaps formed before the disturbance are likely to be preserved. The spatial structure of the forest may therefore persist for a long time, even in the case of nearly complete canopy dieback due to large–scale disturbance.

How do fungi respond to forest spring restoration?

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Restoration of forest springs is expected to affect all components of the forest ecosystem. We focused on fungi representing decomposers and mycorrhizal symbionts, which can be studied at low cost using fruitbody monitoring, to know their reaction. Permanent plots of 30 x 30 m were established at 3 localities near Borová Lada and 3 localities near Přední Výtoň, and will be regularly visited before and after revitalization. So far, we have recorded 194 species, of which *Cortinarius chrysolitus, C. helvelloides, C. rubellus, C. scaurus, Myriosclerotinia scirpicola, Psathyrella pertinax* and *Tubaria confragosa* are on the red list.

Thermal monitoring of wetland ecosystems in the Šumava National Park

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Wetlands represent important ecosystems for water retention and energy balance in the landscape. Water and its properties, such as high thermal capacity and thermal inertia, help to mitigate temperature maxima at different spatial and temporal scales. Despite many studies focused on biological, chemical and hydrological processes, there is a lack of research, which is focused on energy balance change in wetlands in relation to soil water content. The main aim of our study was to asses Surface temperature change of drained wetlands prior and after revitalization. The area of interest included 10 wetlands in National park Šumava (Zhůří, Nová hůrka, Slučí tah, Skelná, U Tremlů, Dobrá, Černý kříž, Nové údolí, Vlčí jámy and Raškov) and 5 Wetlands in National park Bavarian Forest (Großer Filz, Kreuzstraßl, Kleine Au, Finsterauer Filz and Siebenellen). The Surface temperatures were acquired by Unmanned Aerial System (UAS: drone – Matrice 600, thermal camera WirisPro) from the 100 m height two times per year in the beginning (June/July) and late vegetation season (August/September). The thermal monitoring started in 2019 and finished in 2024 as a part of the Life for Mires project. The Surface temperatures were standardized using Z - score method where the reference localities included non-drained wetlands part. The data analysis is based on the thermal trajectories through time to show main features of Surface temperature change after wetland revitalization (e.g. severity of the change). The resulting thermal trajectories well-described the temperature change after wetland revitalization, showing a rise in the Surface temperatures immediately after the restoration (overheating of the barren soil) and than a decrease of this values with increasing of soil water table. The resulting spatio-temporal variability of Surface temperatures is reflecting wetland type and level of surface water table. The Surface temperatures change was higher at the localities with higher soil water table (e.g. Skelná) in comparison to wet meadows (e.g. Dobrovodské louky, Slučí tah). The dry periods significantly affected the thermal response of the wetlands resulting in higher Surface temperatures. The well-functioning wetland ecosystems contribute to the ecosystem stability and resilience to mitigate climatic and hydrologic extremes.

Recent advances in the monitoring of ungulate populations in the Bohemian Forest Ecosystem – camera traps in the focus

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The monitoring of wild ungulate populations is an important task in many contexts, such as the prevention of browsing damages in economically managed forests, the promotion of biodiversity and the transmission of diseases. Camera traps have proven to be a valuable tool to accomplish this task, since they are relatively easy to manage and can deliver information on a variety of parameters such as sex ratio, age structure and population density. The first large-scale camera trapping study aiming for wild ungulates in the Bohemian Forest Ecosystem was undertaken in 2018/19 within an Interreg project, delivering the first population density estimates of red deer in the region across seasons. The estimates were validated against independent methods, such as a spatially explicit capture-recapture model based on faeces genotyping. While camera trap data processing proved to be a laborious work in this project, this task has since been facilitated by the use of Artificial Intelligence (AI), which supports species classification, counting of detections and estimation of distances to observed animals. This leads to a significant reduction in the manual labour required and speeds up the processing of camera trapping data significantly. Consequently, camera trapping becomes a viable tool for the long-term monitoring of ungulate populations in the Bohemian Forest Ecosystem and elsewhere. Such a possibility is crucial for an adaptive management strategy accounting e.g. for climate change and the return of the wolves.

Small freshwater pearl mussel juveniles – a great hope for the future

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Only a fragment of the original populations of freshwater pearl mussel (FPM; *Margaritifera margaritifera*) still lives in rivers Teplá Vltava, Vltava and Blanice in the Šumava NP and PLA. There are app. 1,000 adults living in the rivers Teplá Vltava and Vltava but reproduction still lacks. Even the hyporeal phase of their life cycle is successfully taking place in the river, however, in summer due to the strong fish migration from the Lipno reservoir and their competition, there is a lack of host fish (trout) in the Vltava. The problem is currently being solved by an anti-migration barrier above the dam, which should ensure the return of trout and the renewal of the entire FPM life cycle. In the upper part of the river Blanice, app.12,000 adults still live there, however, the population has been without reproduction for decades, which has many known (bottom stability, poor food detritus, land use changes in catchment) and unknown causes. Both populations were previously enhanced in 1995–2005 by the introduction of juveniles reared by J. Hruška.

Until the problems with reproduction are solved, the semi-natural breeding of FPMs, releasing them and the strengthening of both populations is ongoing thanks to previous and current projects. Since 2021, the releasing of juveniles takes place in Teplá Vltava – 3,649 individuals aged 5 to 10 at the time of releasing. In 2024, for the first time, juveniles were released directly into the river Blanice (outside the rearing river facility) – 785 individuals aged 5 to 7.

Releasing plots are assessed in advance in terms of the stability and composition of bottom sediments, as well as their permeability for juveniles, flow speed, oxygen conditions in the hyporeal, etc.

Monitoring of plots takes place by viewing marked areas with an aquascope and detailed photodocumentation of the bottom. Juveniles have been living on successfully selected microhabitats in Teplá Vltava for more than three years, and we regularly find 20-80% of released individuals, depending on the season, the time after the flood and on the specific plot. In case of suitable conditions, the juveniles do not escape and stay together on plots in small colonies.

Larger subadults aged 8 to 12 can also be photographed with a scale and thus measured approximately their growth in specific locations in the river using a non-invasive method.

Although these are small individuals of 1.5-4 cm in size, they are a great hope for the future of the populations in both rivers.

Karel Klostermann and the discourse on Bohemian Forest

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The poster is focused on the role of the fiction of Karel Klostermann (1848–1923) in establishing the Czech idea of the identity of Bohemian Forest, a mountain range that was not surprisingly reflected in Czech culture until the second half of the 19th century. The central motif of the research is the event of the great storm of 1870 and the subsequent bark beetle outbreak, which Klostermann thematizes in his prose and which became a defining event for the story of Bohemian Forest, as well as for recent debates about the role of disturbances in the Bohemian Forest National Park.

Long-term study of water macrophytes in the upper Moldau River, related to the water tourism

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Despite the Czech legislation, boating is allowed in some parts of the upper Moldau River (Teplá Vltava, Warme Moldau, and Vltava, Moldau) on the territory of the Šumava National Park, however with a regulation in the beautiful stretch between Soumarský Most and the bridge near Pěkná. The regulation consists in the number of boats (canoes or kayaks) per hour and day – or also a guidance –, depending on the water level, and in a paid registration.

To assess the effects of boats on the river bottom and its biota, an indirect method based on the number of macrophyte fragments in the river streamline was used before (2004–2009) as well as after (2010–2022) the regulation. The data show a significant improvement resulting from the regulated boating.

To get a better idea of a long-term development of submerged water macrophytes in the upper Moldau and of a direct impact of boating on the plants, 10 permanent transect were established in 2005 between the bridges in Soumarský Most and Pěkná, which have been since monitored twice a year (when possible) for the summer and autumn aspects.

Non-intervention management in Bohemian Forest National Park does not significantly influence the annual water budget of forested catchments

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The catchment of the Modravský potok (92.7 ha) has been monitored by the Czech Hydrometeorological Institute (ČHMÚ) since 1971. The catchment includes a large part of the non-intervention zone around Březník (35% of the catchment), as well as clear-cut areas from interventions in the 1990s and after the Kyrill storm between 2008 and 2011 (25% of the area). 32% is composed mainly of mature spruce stands, and 7% consists of meadows and natural non-forested areas (as of 2013). Although forest dynamics in the catchment between 1992 (when the national park was established) and 2013 were considerable, these changes did not affect the hydrology of the catchment. The average annual precipitation was 1517 mm, the average runoff was 1117 mm, and the average evapotranspiration was 401 mm. No statistically significant trends were observed for the entire period from 1971 to 2023, nor for the period from 1992 to 2023 (national park existence). However, a series of dry and warm years from 2014 to 2018 did lead to reductions in runoff. Compared to the Czech national network of small catchments GEOMON (15 catchments distributed in forested, mostly mountainous areas), the observed change was relatively small Compared to the years 1994-1998 (20 years ago), annual runoff at Modravský potok decreased by 24%, although precipitation also decreased by 14%, and evapotranspiration increased by 23%. In the GEOMON catchments, the decrease in runoff over the same period averaged 42%, with a similar decrease in precipitation—15%. Therefore, the Modravský potok catchment experienced a smaller decline in runoff than most of the Czech Republic. The reasons cannot be attributed to changes in the forest state within the catchment but rather to the fact that the Modravský potok catchment has high elevation, a large amount of precipitation, and low average annual temperatures compared to GEOMON catchments. Thus, the impact of climate change is less pronounced hydrologically compared to the rest of the Czech Republic and the effect of management (non-intervention zones within the catchment) is not detectable.

Aluminium speciation in the lakes of the Bohemian Forest: Decline of toxic Al fraction is limited in the most acidified lakes

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Aluminium (Al) is a toxic element for aquatic life and plants. It dissolves under acidic conditions (typically pH < 5.5) from secondary minerals (primarily gibbsite, $Al(OH)_3$) naturally occurring in soils. High concentrations of Al often limit the survival of fish and zooplankton in acidified lakes and streams. All Bohemian Forest lakes were significantly acidified by sulfur and nitrogen deposition starting in the 1960s, resulting in the loss of their fish populations and most zooplankton species. Acidification peaked in the 1980s, and a slow recovery began in the 1990s, continuing to the present day (with some interruptions, such as bark beetle infestations).

Al is chemically complex, and different groups of compounds have varying levels of toxicity. For toxicity purposes, three groups are defined based on their chemical nature: (a) Inorganic monomeric Al (Al_I) includes inorganic Al^{3+}, aqua complexes such as $Al(OH)^{n+}$, and Al complexes with SO_4, Si, and F. (b) Organic monomeric Al (Al_O) consist of dissolved Al bound to humic and fulvic acids. (c) Acid-soluble Al (AlAS) consists of coagulated, insoluble colloids and particles.

Only the fraction Al_I is toxic to aquatic organisms. Dissolved inorganic compounds coagulate on the gills of fish and zooplankton in the form of colloidal $Al(OH)_3$, suffocating the organisms due to reduced oxygen supply. Al_I also block enzyme activity in body tissues and eggs, leading to cell and embryo mortality.

The highest Al_I concentrations were observed in the most acidified lake, Čertovo. Concentrations declined from around 0.9 mg/L in the 1980s to 0.5 mg/L in the 1990s and 0.2 mg/L in the 2000s and 2010s. However, following a bark beetle infestation (and a subsequent decline in pH) since 2022, Al_I concentrations increased again to about 0.4 mg/L. In Černé Lake, Al_I levels were around 0.7 mg/L in the 1980s, 0.3 mg/L in the 1990s, and have gradually declined to 0.05-0.1 mg/L today. In Plešné Lake, Al_I concentrations were around 0.8 mg/L in the 1980s, 0.3 mg/L in the 1990s, and have decreased to about 0.1 mg/L currently. In Prášilské Lake, Al_I levels were around 0.3 mg/L in the 1980s, dropping to 0.05 mg/L in the 1990s, with similar levels measured today. In Laka Lake, Al_I concentrations have remained <0.05 mg/L, even in the 1980s, and the current Al chemistry is similar.

Al_I concentrations in Laka and Prášilské lakes are safe for fish populations. Plešné and Černé are near the threshold, while Čertovo Lake remains toxic.

Surviving trees are key elements in the fate of ectomycorrhizal community after severe bark-beetle forest disturbance

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Bark-beetle outbreaks are a critical event in the Norway spruce forest life cycle. However, gaps still remain in our knowledge of disturbance effects on ectomycorrhizal fungi (EMF), key players in forest productivity and nutrient cycling. While majority of available studies focused on the EMF communities in managed forests, context of natural disturbances remains understudied.

We investigated an unmanaged natural spruce forest in the Šumava National Park in the catchment of Plešné lake that has been affected by a severe forest dieback. After a decade since the disturbance, the advance of natural forest regeneration in the study area (~60 ha) was variable due to the legacy of pre-disturbance forest structure and microsite heterogeneity. The forest structure ranged from open canopy and sparse tree cover to areas with dense spruce regeneration to patches of closed-canopy forest. We asked whether is the forest succession mirrored in EMF community composition. For that purpose, EMF communities were described using soil DNA sequencing for 41 plots within this area.

We found that relative abundance of EMF in soils was positively related to amount of surviving trees and regeneration density. Additionally, the number of surviving trees, but not the regeneration density, had positive effect on EMF species richness and tended to support preservation of late-successional EMF species. Our results suggest that trees that survive the bark beetle disturbance are key for the fate of the EMF community in natural forests.

The heterogeneous forest resulting from natural post-disturbance succession ensured by non-intervention regime provides wide variety of microhabitats that allows maintaining diverse EMF community even after severe stand replacing disturbance.

Applying landscape ecological principles in comprehensive landscape protection: Šumava National Park as a case study

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The poster presents an approach applying landscape ecological principles in spatial nature conservation with the Šumava National Park (NP) as a case study. The Šumava NP was chosen for this study as the largest NP in Czechia with an extensive database and turbulent history and ongoing debates about its management and zonation. This approach consists of several subsequent methodological steps using spatial environmental, landscape ecological and geographical data. Each step is supported by studies from the Šumava NP. This approach has an ambition to be an objective tool for managing protected areas taking into account all relevant factors. It starts with the first step, the characterization the study area from the physical-geographical, socioeconomic and management point of view. Then, landscape trends and processes are analysed including land cover changes a persistence, landscape structure, fragmentation and connectivity from current and long-term point of view as well. The third step focuses on key species and contains habitat suitability modelling for finding areas of high conservation values. To sum up, the fourth step synthetises all the previous steps, carrying out prioritization with respect to local specificities and values related to species, habitats and the whole landscape. It can be used as a tool for defining conservation priorities with implications for establishing protected areas or their zonation.

Changes in soil phosphorus availability in unmanaged spruce forest after bark beetle attack – from dieback to recovery

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We studied the effect of tree mortality on phosphorus availability in soils of two unmanaged mountain forest catchments of similar altitude, vegetation, and soil chemistry (Plešné, PL; and Čertovo, CT; Šumava National Park; Czech Republic). Bark beetle infestation caused widespread dieback of the Norway spruce trees in PL (2004–2008), and all dead plant biomass remained on the forest floor. CT catchment remained unaffected till 2017 and served as a control.

To evaluate changes in soil chemistry during the forest dieback and following recovery, we performed three soil sampling surveys in 2010, 2015, and 2020. Soils were sampled from 0.25 m^2 pits (50 × 50 cm) in the PL and CT catchments at elevations between 1028 and 1320 m in the spring to early summer, the sampling grid covered whole catchments (20 pits in each catchment).

The concentration of mobile P form (water-extractable reactive P; SRP) in the forest floor exhibited high spatial variability from 0.01–0.02 mmol kg^{-1} to more than 4 mmol kg^{-1}. The average pools of SRP in the forest floor decreased gradually from 8.3 to 1.8 mmol m^{-2} during 2010–2020, as a result of increased P assimilation due to forest recovery. No significant changes were observed in CT catchment yet; however, we expect the increase in P availability in forest floor currently.

200 years history of forest management in Šumava – using information from forest management plans and maps

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Forest management plans (FMP) and maps are the most complex materials reflecting the state of the forest in certain time. First historical FMPs in area of Šumava were made in the middle of the 19th century. We can get rich information from historical materials and transforming them to the digital database using modern methods and technologies. This can help us in understanding and describing the development of Šumava forests in last 200 years. In 2023 work on completing accessible archive forestry maps and stand descriptions that belongs to the Šumava National Park area started. The complete materials were transformed into digital shapes. The maps are elaborated into vector shapes in GIS (Geographic information system). Particular polygons of spatial forest division units are plotting on GIS. Information about stand descriptions (tree species representation, stand age, managment and quality, etc.) is assigned as attribute figure to each polygon. The final output will be a vector digital stand map with connected database of describing information. This database will be available for further research, as a base layer for determination of new monitoring plots, determination of the most valuable primary forests remains, and the last but not least there will be chance to explain differences in development of present Šumava stands.

Trophic structure of fish communities in the tributaries upstream of the Lipno Reservoir

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River obstacles, particularly dams, are known to disrupt the natural environment in streams, having a major impact on fish communities. Cyprinid species often migrate from reservoirs upstream into the reservoir's tributaries, where they can cause changes in the trophic structure of native fish communities. The aim of this study was to evaluate the trophic structure of a fish community, primarily composed of cyprinid and salmonid species, across seven locations in the Vltava River upstream of the Lipno reservoir. Stable isotope analysis was utilized to determine trophic positions, trophic niche width, and trophic niche overlap between species. These trophic relationships were then analyzed to assess the potential for food competition. The findings revealed that salmonid species had higher trophic niche sizes than cyprinid species. There was observed trophic niche overlap between salmonid and and cyprinid species, with the most significant overlap occurring with both the common dace (*Leuciscus leuciscus*) and common roach (*Rutilus rutilus*), indicating potential competition for food. However, the presence of cyprinid species did not have a statistically significant effect on the trophic niche width of salmonid species. From the perspective of protecting native salmonid species, special attention should be given to the European grayling (*Thymallus thymallus*), which is threatened by food competition from cyprinid species, particularly common dace. Furthermore, in situations where the biomass of prey in the river is relatively low, there could be potential competition with the brown trout (*Salmo trutta* m. *fario*), as brown trout are opportunistic feeders.

Changes in soil and water composition after forest disturbances in unmanaged mountain catchments

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The Plešné Lake (PL) catchment (an unmanaged mountain spruce forest) was severely impacted by atmospheric acidification from the 1950s to 1990s and then disturbed by a bark beetle infestation from 2004 to 2008, which killed >75% of the spruce trees. All the dead biomass was left behind in the catchment area. To assess changes in water chemistry after forest disturbance, we compared changes in soil and water composition in the PL catchment–lake system with the less affected catchment of Čertovo Lake (CT). We analysed the ionic and nutrient composition of throughfall, inflows and outflows of the lakes, as well as changes in the composition of the soil in the period 1997–2021. Tree mortality changed the composition of the soil and all water flows in the PL catchment compared to the CT catchment. Soil moisture, base saturation and pH increased significantly in the PL catchment. The extent, timing, and duration of the changes in water composition differed for the individual constituents. In the tributaries, concentrations of NO_3^-, K^+, H^+ and ionic aluminium (Al_i) increased most rapidly, while terrestrial export of dissolved organic carbon (DOC) and phosphorus (P) forms began more slowly. Immediately after tree death, the increase in NO_3^- concentrations was delayed by the increased availability of DOC in soils and N immobilisation in microbial biomass. Then, NO_3^- quickly became the predominant anion within 5–7 years after the bark beetle infestation and then began to decline. Terrestrial exports of Al_i, K^+, H^+, Mg^{2+} and Ca^{2+} followed the trends in NO_3^- leaching. In contrast, the increased DOC and P losses persisted until the end of the study. Our results suggest that: (1) terrestrial element losses and water quality deterioration after tree death were less pronounced in the unmanaged PL catchment than elsewhere after clearcutting. (2) Denitrification and NO_3-N assimilation processes in the lake, as well as photochemical and microbial oxidation of organic acid anions contributed to significant H^+ neutralisation and an increase in lake water pH about a decade after tree mortality in the PL catchment. As a result, the lake's carbonate buffering system re-established itself after more than six decades of its depletion by atmospheric acidification. (3) This trend supported the biological recovery of PL Lake, including macrophytes. (4) Similar processes have recently supported biological recovery in other Bohemian Forest lakes, such as Laka, Prášilské, and Rachelsee.

How stable is the mountain forest in the Bohemian Forest in the long-term perspective?

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Stability and diversity maintain important ecosystem functions and enhance ecosystem resilience. Diversity, influenced by population variances and species abundances, enhances aggregate community resistance, but population resilience may be affected independently, potentially disrupting the entire ecosystem. Little is known about the long-term stability and diversity relationship and their effect on tree population dynamics in mountain forest ecosystems, which are currently under high stress, leading to enhanced instability.

We analyzed a 11740-year sediment record from Černé jezero to explore long-term forest dynamics. We asked questions about how stable the tree populations around the lake were, how their stability was related to changes in diversity, and how disturbances and climate might have affected the forest's stability. We used multi-proxy sediment analysis, including pollen, charcoal, chironomids, and radiocarbon dating.

Our results show that an increase in tree population does not always guarantee its stability. High forest stability and diversity is negatively correlated to disturbance and species richness. Our results highlight a potential paradox in nature conservation, namely, should we focus more on species richness or forest stability?

Critically endangered *Sedum villosum* in the Šumava National park

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Sedum villosum is a small, heliophilous, competitively weak species associated with sloping fens and springs, springs in wet peaty meadows, or loose stands of bryophytes along small upland streams. Before the fall of the Iron Curtain in 1989, the Šumava population was considered extinct (Grulich 1991). The original sites were lost as a result of land reclamation, direct destruction or abandonment. Surprisingly, in 1992, Dr. L. Kirschner discovered a small population on the slope of the previously inaccessible Kostelní vrch, and in 2004, the Bavarian botanist W. Güthler discovered a small population in former peaty meadows near Knížecké Pláně. Both populations were inventoried in detail in 2015-2016. The population near Knížecí Pláně occurred only on 2 m^2. The total number did not exceed 450 plants, but the plant number decreased to 51 individuals present in 2017. We therefore decided to take a radical step - in autumn 2017 we mowed the stand, completely removed part of the *Sphagnum* carpet and replanted the *Sedum* plants on bare peat in the restored habitat. The harvested biomass was used as mulch on other microlocalities with removed *Sphagnum* carpet. To check the success of this measure, a regular counting of flowering and sterile plants is carried out annually. Following the intervention in 2018 and 2019, both the number of sterile and flowering plants increased significantly. In 2024, we recorded more than 5,500 flowering and approximately 34,350 sterile plants. The stands are mowed when the seeds mature and the mowed material is targeted for placement in other new microlocalities with removed *Sphagnum* carpet. As a result, not only the number of plants but also the total area where the species now occurs has increased significantly since 2017. In contrast, the population on the second locality, i.e., on Kostelní vrch, is relatively stable, grows on an area of approximately 13.5 m^2 with the number of flowering and sterile plants around 290 and 3000 in 2024, respectively. However, the population may be threatened by the decline of spruce stands in the immediate vicinity, especially if a large number of trees falls into spring area or in case of a significant change in the water regime.

Spiders (Araneae) of the Šumava National Park and Protected Landscape Area (Czech Republic)

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Data on the spider fauna (Araneae) of the Šumava (Bohemian Forest, Böhmerwald) National Park and Protected Landscape Area (southwest Bohemia), gathered in the period 1858–2023, were summarized. We abstracted faunistic data from all available literature and our own research initiated in 1971. In our own research, we focused on all available habitats, both natural ones and those influenced by humans. These included peat bogs, mountains forest, mountain meadows, wetlands, riverbanks and buildings.

Altogether, we identified a total of 455 spider species, many of which belong among rare and endangered in the Czech Republic. Overview of their ecological preferences and importance for nature conservation are provided. Within the Czech Republic, nine species are found only in Šumava: *Carorita limnaea*, *Centromerus dilutus*, *Dictyna major*, *Gnaphosa badia*, *G. microps*, *Micaria aenea*, *Pardosa ferruginea*, *P. hyperborea* and *Cybaeus tetricus*. The last-mentioned species is also the first record for the Czech Republic.

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Stable isotope composition of modern terrestrial and aquatic organic matter sources to Černé lake sediment

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Reconstructing changes in trophic levels and associated biodiversity from lake sediment cores is complex because it involves many intricate processes. The equation "a lot of organic matter in sediment = increased trophic level" only applies if we are certain that all the OM is of autochthonous origin. Further complications arise at the water-sediment interface due to bacterial activity, which can significantly affect the composition of organic substances that are then preserved in the sediment.

The aim of the research is to unravel the main flows of organic substances from the watershed and the water column into the sediment and to determine whether seasonality affects sediment development.

From April 2023 to May 2024, we collected vegetation and soil samples from the forest, shore, and littoral zone (O and A horizons) five times. Samples were always taken from three locations in the Černé jezero (Black Lake) watershed, selected due to significant inflow into the lake, where the input of allochthonous OM is thus most significant.

We monitored OM production in the water column using sediment traps, for which we created a supporting structure with ropes and buoys. We placed the sediment traps in two sets on this structure, each set consisting of three sediment traps located 5, 10, and 15 meters below the surface. At the beginning and end of the research, we also collected surface lake sediment layers, which represent the annual accumulation of OM in the lake. The isotopic ratio 12C:13C was analyzed in all samples.

Although we do not yet have all the data processed, we can already draw conclusions from the completed plant and soil analyses. Plants show an ^{13}C isotopic signal from -25,7 to -34,93‰. A large number of plant samples were collected, originating from coniferous and deciduous trees, shrubs, herbs, ferns, lichens, and mosses. In the case of the A horizons, values range from -25,20 to -27,10 ‰. O horizons show values of -25,88 to -29 ‰, littoral soils -25,5 to -28,97‰.

We have not yet processed the results from the sediment traps. The current results do not indicate seasonal changes, but the heterogeneity between different locations in the watershed is evident.

Nutrient availability and habitat filtering shape saproxylic beetle community patterns along deadwood decomposition

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Fresh deadwood is nutrient-rich but full of species-specific secondary metabolites, while advanced structural decomposed wood is inflated by fungi and other microbes. This exerts high evolutionary pressure, particularly on early colonisers of tree species with high C:N ratios, which should lead to functional adaptations and shifts in community patterns until decomposition is complete. However, as most deadwood studies focusing only on the early stage (i.e., three years), the ecological principles driving saproxylic communities over time are not fully understood. Here, we tracked saproxylic beetles from experimental exposed wood of three dominant species in Central Europe, *Picea abies*, *Abies alba* and *Fagus sylvatica*, over the course of a decade. In specific we tested the two fundamental hypothesis explaining local diversity, the species-energy and the habitat heterogeneity hypothesis for beetle communities along decomposition. Specifically, we predicted stronger habitat filtering in tree species with higher C:N ratios, with a rapid decline in abundance and species number in the early stage of decomposition after the nutrient-rich phloem and cambium layers are depleted (species-energy) and an increase in species number and richness in the advanced stage of decomposition (habitat heterogeneity). We found consistent patterns of decreasing abundance and species numbers, but not of richness along decomposition in all tree species supporting the species-energy hypotheses. Community patterns switched non-linearly from habitat filtering, which was more pronounced in spruce with highest C:N ration, to a random pattern in the end of the early stage. Although community patterns showed a slight hump shaped curve, they remained within the boundaries of random assemblages, indicating that communities of saproxlic beetles within a tree are mainly driven by decreasing nutrient availability.

Important parasitic cnidarians of salmonids

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Fish stocking in open waters is a common practice of fisheries managers. The origin of the stocked fish may be from a variety of sources, at the best local, but between watersheds or transboundary trade is common. A health check is carried out, at the time of transfer and stocking, the subsequent fate of the fish is hidden under the surface. So far, fisheries managers have paid little attention to the possible transmission of parasites and infections causing serious diseases. Therefore, within the framework of the Interreg project Bavaria-Czechia 01-020 "Sumava Fish Jewels", the educational poster "Important parasitic cnidarians of salmonids" was created. The poster draws attention to the parasitic cnidarians Myxozoa, which can cause fatal diseases in salmonids. Myxozoa are a group of microscopic parasitic jellyfish that have evolved to reduce their body. Currently, more than 2,600 species have been described, but diversity is significantly underestimated. Some species are economically and commercially significant. eDNA methods offer a less invasive way to explore myxozoan diversity and improve pathogen monitoring. The poster gives five examples of highly important myxozoans including their morphology, hosts, parasitized tissue, manifestations and visual documentation. To increase the reach of the information, the texts are presented in Czech, English and German. The poster is presented during thematic fisheries and ecological events, free copies are available for those interested. Further outputs and progress of the solution are available on the project website: www.fishjewels.cz.

Multi-proxy Temperature and Environmental Reconstruction during the Late Glacial and Early Holocene in the Bohemian Forest, Central Europe

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Multi-proxy temperature reconstructions can provide robust insights into past environmental conditions. By combining different proxies we can disentangle the temperature signal from the indirect climate effects on the environment. This study uses a multi-proxy approach to reconstruct temperature and palaeoenvironmental conditions during the Late Glacial and Early Holocene (13.5-8 cal. ka BP) in the Bohemian Forest, Central Europe. We assessed the similarity of the temperature signal based on chironomids, isoprenoid glycerol dialkyl glycerol tetraether lipids (isoGDGTs), and pollen within a comparison with locally modeled temperature data generated by the CHELSA_Trace21k dataset. Pollen, macroscopic charcoal remains, and geochemistry were further used to reconstruct past environmental conditions such as vegetation dynamics, fire activity, the input of lithogenic material, nutrient content and the sources of organic matter. All temperature reconstructions were positively correlated and followed the same long-term trend. However, results also show that chironomids-inferred July temperature had lower amplitude variations compared to the other temperature curves. IsoGDGTs show the most

pronounced decrease in temperature values at the onset of the YD, corroborating that this cooling event was more marked during winter than summer. However, a decrease of less than 1 °C during summer and two short-term warm events at 12.6 and 12.2 cal. ka BP provoked a modest and asynchronous response of the vegetation to the onset of the YD. Finally, pollen-based temperature reconstruction showed a lag in the response to major climatic events, such as the onset of YD and Holocene. Our study increases the understanding of the climate-vegetation-environmental feedback during the Late Glacial and Early Holocene in the Bohemian Forest, Central Europe.

Factors influencing the survival of adult Eurasian lynx (*Lynx lynx*) females at the core and at the edge of the BBA lynx population distribution

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The Eurasian lynx inhabits Central Europe with protected, mostly small and endangered populations, whose survival is mainly threatened by illegal killing and traffic mortality. Both lynx mortality rates and the relative importance of different mortality causes are hard to quantify, as dead lynx are often not retrieved. However, data from long-term, population-level camera-trapping following individual lynx fates allows estimating the number of animals disappearing yearly. As adult reproducing lynx females show high fidelity to their home-range, their disappearance from monitored sites strongly suggests their death. The Bohemian-Bavarian-Austrian (BBA) lynx population inhabits a transboundary region including 2 large strictly protected areas, the Šumava and Bavarian Forest National Parks (NP), several Protected Landscape Areas (PLA), and their unprotected surroundings (open landscape, OL). Using camera-trapping data from most of the BBA area, and the "lynx year" (1st May till 30th April) as

time unit, we studied apparent survival from year to year (based on detection probability) of adult females which reproduced between lynx years 2017 and 2021. We tested whether this parameter differed significantly between (1) monitoring years, and areas with different (2) habitat quality (Habitat Suitability Index obtained from a habitat model built on own data from the entire area); (3) levels of protection (NP, PLA, OL); (4) hunting systems (no hunting, hunting by NP employees, state forest – own hunting ground, state forest – rented hunting ground, private forest hunting, small forest owners – rented hunting ground). Adult females' apparent survival was significantly affected by the hunting system and the level of protection. Females recorded (also) in areas with no hunting had higher apparent survival than females recorded (also) in state forest – rented hunting grounds, private forest hunting or small forest owners – rented hunting grounds. Besides, females recorded (also) in NP had higher apparent survival than females recorded (also) in OL. After excluding the NP areas from the analysis, the level of protection had no more significant effect, suggesting that passive protection not linked to specific active measures (as is often in PLAs) can barely affect lynx survival. Although our results require careful interpretation, they can help identify lynx mortality hot spots in the BBA area and understand the underlying mechanisms.

Recolonization of the Bohemian Forest Ecosystem by the grey wolf

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At the beginning of the new millennium, the grey wolf began its return to some parts of Central Europe. In the Czech Republic wolves currently occupy mainly the adjacent hills and mountains of the border regions. Our study covers the area of the Šumava National Park (SNP) and Protected Landscape Area and the Bavarian Forest National Park (BFNP).

To understand the structure of wolf occupancy (generally the territorial system of packs) a variety of monitoring methods to collect data in the field was used. These include snow tracking, and the collection of scat, urine, blood and fur samples. Later genetic analyses reveal relationships between individuals and pack members. In addition, images from camera traps are the second most commonly used source of information on occupancy and population distribution. Specialised methods such as vocal provocation, telemetry, recording of predation on livestock and wild living animals also contributed to the determination of wolf territories. All the collected data are annually analysed using GIS tools to identify the centres of highest wolf activity - these centres indicate the core areas of proposed wolf territories.

The recolonization of the Bohemian Forest ecosystem began in season 2015/2016, when the permanent occurrence of first individual was documented. In the season 2016/2017 there were two individuals who formed a pair and had their first pups in the season 2017/2018. These first pups were born in BFNP but then the whole pack settled close to Srní in SNP. Later, based on genetic analysis, the descendants formed most of the other wolf packs in the study area. The number of wolf territories in the Bohemian Forest ecosystem has been increasing since the beginning of the wolf recolonization. Seven wolf territories were confirmed in the study area in the 2023/2024 season. Further monitoring is needed to understand the connections and interactions between the packs, to reveal the role of solitary individuals that have been recorded in the area and more importantly the deeper insight into wolf ecology is needed to understand its role in this unique ecosystem.

Ecology and diversity of snow algae in Czech mountains

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Snow algae are psychrophilic photosynthetic microorganisms that are adapted to the extreme environment of melting snow fields. Their colourful blooms are a prominent feature of mountain and polar regions worldwide and are currently the focus of an increasing number of studies because of the significant effects on albedo reduction and subsequent acceleration of snow and ice melting. As a result of climate warming, they are threatened by a significant habitat loss in the temperate zone, namely at lower altitudes, as they require a long period of snow melt. Most frequently, they are formed by microalgae from the order Chlamydomonadales (Chlorophyta) with a life cycle that includes transitions between flagellates and cysts. In contrast to the alpine zone, their diversity below the timberline is still poorly explored, which also applies to mountains in Czechia, including the Bohemian Forest. The first record of snow algae in the Bohemian Forest (19–21 May 1992) is from the vicinity of lakes Černé, Prášilské and Plešné. Only near the Plešné Lake, the concentration of cells was dense enough to produce green colouration of snow. Both cysts and flagellates of various species from the genus *Chloromonas* were observed, as well as a cyanobacterium and snow fungi. Later, green snow blooms were occasionally recorded in many areas of the national park (in most cases around 1000 m a.s.l., generally they were rarely found below 800 m a.s.l. in Czechia). They usually appear in April and last till the complete melting of snow. However, an earlier start of the blooming season can be induced by warm winter climate as was documented this year in the Krkonoše Mts., where we observed the blooms already at the beginning of May. In contrast to higher mountain ranges, red blooms have not been reported yet in the Bohemian Forest, as they are typically found above timberline. In our current project, we will use ITS2 rDNA metabarcoding combined with morphological data to assess their species composition and altitudinal patterns in Central Europe to understand their current and future distribution under climate change. We will greatly appreciate the collection of snow algae samples (it is very easy – see the poster for instructions) or just the records of snow bloom occurrence.

Growth and assemblage dynamics of temperate forest tree species match physiological resilience to changes in atmospheric chemistry

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Human-induced environmental changes are altering productivity and species composition in forests, significantly impacting tree physiology, growth, water uptake, and nutrient acquisition. Investigating the intricate interplay between plant physiology and environmental shifts, we analyzed tree-ring isotopes ($\delta^{13}C$, $\delta^{18}O$, and $\delta^{15}N$) to track long-term trends in intrinsic water-use efficiency (iWUE) and nitrogen availability for European beech, Norway spruce, and silver fir in an old-growth temperate mountain forest (Boubín reserve) since 1501 CE. Our findings reveal that Norway spruce has experienced iWUE saturation, exacerbated by acidic precipitation, resulting in growth declines during periods of high acidic air pollution and increased drought frequency. Conversely, the deep-rooted European beech shows physiological resilience to acid deposition and benefits from higher nitrogen deposition and air temperatures, maintaining climatically unrestricted stem growth. Silver fir demonstrates the most dynamic response to acidic air pollution, with contemporary adaptations in leaf gas exchange enabling accelerated stem growth under cleaner air conditions. These differential species responses underscore shifts in species competition, whereby European beech is gaining dominance as Norway spruce recedes. Our study integrates tree-growth dynamics with physiological and nutrient availability trends, revealing the pivotal role of atmospheric chemistry changes in shaping temperate forest ecosystems and enhancing interspecies competition dynamics.

News from the long-term monitoring of butterflies (*Lepidoptera*) in Šumava. Changes in the distribution of diurnal butterflies and observed nocturnal butterflies

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The group of butterflies (*Lepidoptera*) has been monitored for a long time in the Šumava Mts. region. The monitoring is also a continuation of a number of past projects, for example the cross-border project "*Silva Gabreta Monitoring - Implementation of cross-border monitoring of biodiversity and water regime*" in 2017 and 2018. The actual monitoring is carried out by transects (defined areas or 15-minute ones) and in the form of night catches (Honda generator EX7 + UV discharge lamp 125-250 W) and battery mini-traps (UV fluorescent lamps 4-16W/12V + LED diodes 4 W/12V + LEPILED systems / power banks).
Exceptional messages are continuously published. Among them was the species *Nycteola degenerana* found in the Czech Republic after 50 years with a link to willows (*Salix* spp.) using the ecotone effect after disturbances. In recent years, also in the Šumava, emerging species associated with the spread of garden plants such as the southern white sedge (*Pieris mannii*), Křišťanov (Z. F. Fric, 12.7.2020) or a complete treatment of the occurrence and bionomics of the Šumava Mts. population of the *Lycaena helle* (Peškarová et. al., 2024).
Among the finds of important and abnormally rare species from Šumava Mts., we can mention, for example, the mountain heather *Xestia rhaetica* (Luzný Mt., Smrčina Mt.) only in even years or *X. collina* (Poledník Mt., Velký Polec peat bog, Třístoličník Mt.) in others. Others are extremely rare species, which however cannot be verified due to rapid climate changes: *Xestia alpicola* (finds only until 2015, Mrtvý luh peat bog and Plechý Mt.), *X. sincera* (last find Roklan Mt.). Against this trend, increased abundances appeared, up to 2 orders of magnitude, in even years for the species *Erebia euryale* or *Xestia speciosa* (2018, 2020) and which decreased again in years with climatic fluctuations (2022, 2024). It is also important to monitor the spread of species such as the fruit-bearing white sedge (*Aporia crataegi*) in the NW - SE direction (Železná Ruda - Kvilda - Nová Pec) with a link to disturbed areas with rowan (*Sorbus aucuparia*), which continues outside the Šumava itself (military area Boletice and others) or for a species related to honeysuckle (*Lonicera nigra*) in places of open forests of the montane stage, which is the two-rowed white band (*Limenitis camilla*) spreading from the SE to the NW of the Šumava Mts., or the wetland pearlwort (*Boloria eunomia*) gradually occupying meadows with rdesna (*Bistorta major*), today already in the NW part of Šumava Mts., from Kvilda and Srní.
The dynamics of occurrence and findings of selected species correspond to changes in anthropogenically little-disturbed ecosystems and are also a response to climate change. Unregulated natural processes in the territory are a basic requirement for maintaining populations with long-term occurrence, on the other hand, meadow species require extensive care associated with blocking succession (mowing, grazing).

Are wolves re-establishing a landscape of fear in the Bohemian Forest Ecosystem?

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Predation risk is a main driver of behaviour in many prey species, and differences in perceived predation risk across space is often referred to as the "landscape of fear", resulting in a mosaic of risky places and times. Many studies from North America show that wolves influence *Cervus sp.* activity and habitat selection. However, the extent wolves are influential in shaping ecosystem interactions through the non-consumptive effects in Europe is still unclear due to the complexities of human-dominated landscapes. The Bohemian Forest is the largest strictly protected continuous forested area in Central Europe, and is of great importance for the protection of wildlife species especially animals with large home ranges. After over 170 years of absence, the first wolf pack was confirmed in the protected area in 2017. The return of this large carnivore has the potential to restore trophic cascades, and thereby also resulting in consumptive and non-consumptive effects on wild ungulates. Red deer are the main prey species for wolves in the area, and it is possible that they have adjusted their behaviour in response to predation pressure from wolf recolonisation. This study examines red deer behaviour before and after wolf recolonisation using movement data from the Bavarian Forest and Šumava National Parks. Changes in red deer activity as well as habitat selection at diel and seasonal time scales will be investigated using integrated step selection analysis to analyse habitat selection at diel and seasonal time scales. Additionally, human disturbance variables such as hunting seasons and zones, and distances/density of roads and settlements will also be included to account for anthropogenic influence. Anticipated responses of red deer to wolf recolonisation include increased selection for closed habitats and denser vegetation cover (as wolves generally use a cursorial hunting strategy) during night and twilight when wolves are most active, and altered diel activity patterns. This research offers insights into how wolves influence ungulate behaviour, providing valuable data for ungulate and conservation management and implications for trophic cascades in the European context where wolves are recolonising historic ranges.

The Giant Liver Fluke (*Fascioloides magna*) in the Bohemian Forest Ecosystem

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Fascioloides magna is a parasitic helminth with eco-epidemiological importance for free ranging and farm ungulates in Europe and North America. As an invasive parasite, *F. magna* is expanding its range to new areas in Europe with red deer as the most important definitive host. While the permanent occurrence in Czechia (former Czechoslovakia) has been documented almost for one century, new foci in border regions of Czechia established recently. The Šumava National Park (SNP) has been known for the presence of *F. magna* in red deer for two decades already. Contrary to that, infection of red deer in the neighbouring Bavarian Forest National Park (BFNP) was surprisingly reported much later, in the autumn of 2019. The limited knowledge on distribution and occurrence of *F. magna* and its prevalence in both definitive and intermediate hosts in the Bohemian Forest Ecosystem gave basis for a cross-border research project. To address these topics, livers of red deer (n=734), roe deer (n=159) and wild boar (n=539) harvested in the SNP, BFNP and Bavarian State Forest enterprise Neureichenau (SFNR) in the hunting season 2021/22 were examined. Overall, the prevalence of *F. magna* was 15.3% in the total red deer sample. When comparing the subareas, red deer prevalence was 16% in SNP,

14.7% in BFNP and 12.2% in SFNR indicating a spreading of *F. magna* infection in southeastern direction. Only one roe deer was *F. magna* positive, and none of the wild boar. The two freshwater snail species serving as intermediate hosts of *F. magna* were recorded throughout the area at regular spots (*Galba truncatula*, n=684; *Radix labiata*, n=848). However, of all snails collected, only one single *Radix* individual was infected with *F. magna*. Our study confirmed *F. magna* to be an established species of the Bohemian Forest Ecosystem. The use of anthelmintics for control of *F. magna* in the NPs is no longer considered, not only due to difficult dosing at sparse feeding sites and possible resistance, but also due to the significant extent of non-intervention area.

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Predicting bark beetle-induced mortality from Norway spruce increment core images using deep learning

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Changes in growth patterns in a tree-ring sequence preserve information on biotic (e.g. competition) and abiotic (e.g. drought) stresses experienced by an individual tree in a given year. While some big stressors might leave lasting legacies, the impact of minor ones can accumulate for years. Looking at such growth patterns can provide information about tree health, its resilience, and consequently, its susceptibility to parasites and death.

We tested the ability of state-of-the-art machine learning algorithms to predict Bark beetle-induced mortality in Norway spruce from increment core samples. Rather than relying on tree-ring measurements, we used directly high-resolution core images. These preserve additional features such as color, early- and late-wood, resin canals etc. that can be learned by the model. We developed our model on more than 500 core samples from Bark beetle-infested plots in the Šumava National Park.

If successfully implemented, this method can help to inform forest and/or conservation management decisions while removing the need for timely core sample measurements and data pre-processing.

Restoration of springs – retention of water in the landscape directly at its source

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The mountains and highlands are important spring areas that generate most of the watercourses. Springs are an extremely important hydrological structure with a significant impact on the water regime of the whole landscape. At the same time, these are distinct biotopes inhabited by specific species and their communities, which significantly enrich the biodiversity of the area. A large number of springs were in the second half of the 20th century meliorated, the incipient streams were straightened, deepened and converted into a network of drainage ditches. In NP and PLA Šumava, restoration of drained springs has taken place or is underway as part of the finishing Life project. Our TAČR project follows it by comparing degraded, restored and preserved springs, analyzing their vegetation (higher plants and bryophytes), occurrence of macromycetes and some groups of aquatic invertebrates (a separate talk will be devoted to these) and evaluating changes in the water regime, including water chemistry and temperature. Since the project started in the spring of 2024, only the first, preliminary results will be presented. Rather, it will be an introduction to the entire project.

The following colleagues participating in the project: Iva Bufková, Jitka Kučerová, Martina Vašutová, Kamila Vítovcová, Klára Řehounková, Lenka Šebelíková, Jindřiška Bojková, Vanda Šofrová and several students.

Retention capacity of deadwood and soils at different stages of post-disturbance development in the Bohemian Forest

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Deadwood serves as a key component of the forest water cycle providing critical habitats, which enhance forest resilience and biodiversity (Kuehne et al., 2008). Studies have shown that deadwood's water retention varies with decay class, tree species, and management practices, influencing hydrological processes and forest recovery (Harmon et al., 1986; Boddy, 2001). Post-disturbance management after bark beetle outbreaks affects deadwood's role in water retention (Seidl et al., 2016). Research gaps remain regarding the comparative retention capacity of deadwood and soil across different post-disturbance development stages in even-aged and old-growth forests.

This study was conducted on 24 research plots (0.2 ha each) in the Bohemian Forest (900-1100 m a.s.l.), spanning six categories of vegetation types and management practices: living old-growth forest, living first-generation forest after old-growth, living even-aged forest, and forests affected by bark beetle with three management practices (no intervention, bark peeling, clearcutting).

GLM analysis showed that for early decay deadwood, basal area of living trees and tree regeneration cover had significant positive effects on moisture, while daily maximal air temperatures had a negative impact. These factors did not significantly affect deadwood in intermediate and late decay, which had more stable moisture levels. Also internal factors like log volume and bark peeling influenced moisture only in early decay. Water volume was highest in old-growth forests (73 $m^3\ ha^{-1}$), compared to managed forests (3 $m^3\ ha^{-1}$), with no intervention stands in bark beetle-affected areas retaining 56 $m^3\ ha^{-1}$ and clearcuts holding 16 $m^3\ ha^{-1}$.

The organic H horizon of the forest floor and the upper A horizon played key roles in soil water retention. In Podzols, the loose spodic Bhs horizon, rich in organic matter, also positively influenced the water regime. Besides horizon thickness, the proportion of rock fragments was crucial, with soils containing 50-80% coarse fragments being more prone to water deficits. Overall, the soils were highly water-retentive, with usable water capacity ranging from 118 to 340 mm, supplying water to the stands for tens of days without rainfall. The main root zone (30-40 cm deep) accounted for 40-60% of this capacity.

The coldest place in the Šumava Mts., Březník – Luzenské Valley

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The history of meteorological observations on Březník (German Pürstling) dates to the last ¼ of the 19th century, when a precipitation measuring station was established at the site of the gamekeeper's lodge. After the WWII and the displacement of local residents (1951), there was no meteorological observation for many years. It was not until 1986 that a meteorological screen with air temperature measurement was installed on Březník at the northern end of the Luzenské (Lusen) Valley (1137 m a.s.l.), then still in the border zone behind the Iron Curtain. In 1987, thanks to the cooperation of several enthusiasts and local administrators, continuous measurements of monthly precipitation and the height of the snow cover were also implemented.

The average annual air temperature has risen from 1.9 °C (1988-2010) to 3.9°C (2014–2023). Still it is the coldest location in Šumava. During the same period, at the highest Šumava/Bayerischer Wald weather station Grosser Arber (DWD), the average temperature was 4.6 °C, at the frostiest Šumava station Kvilda – Perla 4.2 °C, at Churáňov profi meteorological station (CHMI) 6.0 °C. While the Churáňov locality warmed at a rate of approximately 0.4 °C per 10 years since 1988, the trend in Březník was 0.8 °C per decade, i.e. twice as fast. During the period 1988–2023 in Březník, the coldest month was January with an average monthly temperature of -5.8 °C (but for the last 10 years -4.2 °C), the warmest July was 11.7 °C (for the last 10 years 12.9 °C), the most warm up here was in December, from -5.8 to -1.7 °C. On average, it freezes here 240 days a year, the most frequent was 262 times in 2003, last year (2023) there were only 215 frosty days, but the most in the whole of Czechia. It regularly freezes here even in the summer months, and it's not just mild frosts, for example -7.7 °C in June 2006, -4.6 °C in July 2019, or -5.7 °C in August 2018. Similar temperature conditions exist in the entire nearly 2 km long valley (forestless part) along the Luzenský stream, as can be seen from the experimental measurement at other locations. On the opposite southern edge of the valley, at the confluence of the Luzenský stream and the Tyčový stream, similarly over 200 frosty days a year occur regularly, even with stronger summer frosts. The Luzenské Valley is not only exceptional in its low temperatures, but also in its high amount of precipitation and amount of snow. The long-term annual average (1988–2023) of total precipitation in Březník is 1606 mm, the seasonal maximum height of the snow cover is 152 cm, and the number of days with snow is 167.

The Luzenské valley is climatically exceptional in our conditions, due to its area and altitude (1135–1160 m), its location among the highest peaks on the windward side of the mountain range, as well as the construction and development of the surrounding landscape in the Šumava NP.

Current distribution of an old-growth forest beetle *Peltis grossa* in Šumava mts.

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Peltis grossa is a critically endangered beetle species from the family Trogossitidae. Its presence indicates old growth forests of high conservation value. The species was considered extinct for about hundred years in Šumava National Park area (NPŠ), probably surviving in some small refugees in broader region (e.g. Čertova stráň Nature Reserve). First recent finding in the national park area was made accidentally during the control of bark beetle pheromone trap near Stožec (Medvědí cesta) in 2018. Direct search methods such as reporting adults and exit holes, peeling the bark of snags and checking bark beetle pheromone traps were used to find the species. As trogossitid beetles are mostly night-active, visual control of forest stands potentially occupied by P. grossa was organized during summer nights, focusing on living adult beetles on standing dead trees with polypore fungi, espetially with Fomitopsis pinicola. We have found that in the national park area P. grossa inhabits mostly dead spruce snags originated by windstorms and subsequent spruce bark beetle outbreaks. Recovering of the population is dependent upon a massive supply of deadwood by bark beetles within the refuge area. P. grossa started spreading out mainly through core zones of the national park especially in north-west direction, with tens of recent sites. Actual finding from 2024 (Gsenget near Prášily) shows continuing recolonization and return of the species in the study area. Distance between the first and the most distant recent site in NPŠ exceeds more than 45 km that were reached in 6 years. It would be also important to explore other directions of P. grossa possible spreading in the future, particularly in Boletice Military Training Area. As several suitable forest stands with dominance of silver fir are present there (similarly to Čertova stráň Nature Reserve), discovery of small P. grossa population in the area can be expected.

Dead yet dangerous? Unravelling the role of wild boar carcasses in African swine fever transmission and control

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African swine fever (ASF) is a viral disease affecting both wild boar (*Sus scrofa*) and domestic pigs and has caused a pandemic. To understand disease transmission pathways and improve control strategies, it is crucial to explore the multifaceted role of wild boar carcasses in ASF outbreaks.

Using 74 wild boar carcasses placed systematically between July 2020 and July 2021 in the Bavarian Forest NP, we investigated 1) wild boar behavior towards dead conspecifics, 2) the role of carcass temperature and pH in potentially inactivating ASF virus (ASFV), and 3) the utility of drone-based thermal imaging for carcass detection. Moreover, we placed 41 piglets and limbs in spring, equipped with VHF transmitters, to examine the scattering behavior of scavengers.

The camera trap monitoring revealed no evidence of cannibalism but documented frequent direct contact with carcasses, particularly in later decomposition stages, including chewing on bones, underscoring the potential for ASFV transmission. Carcasses were detected by wild boar on average after 65 days post-placement. Scavengers, primarily red foxes, scattered carcass remains on average 230 m, usually 10 days after carcass placement. They often moved remains into denser vegetation, further complicating carcass removal and increasing disease transmission risks. Carcass temperature and pH monitoring showed significant temperature increases during active decay, with pH rising above 8 but not dropping below 4, a critical threshold for ASFV inactivation. We suggest that temperature and pH dynamics alone are insufficient for natural ASFV inactivation. Drone-based thermal imaging was tested across various environments and conditions. Detection rates reached up to 80% in open habitats during warmer conditions (above 3°C) but dropped significantly in dense forests and cooler temperatures. This highlights the method's limitations in certain contexts and suggests that carcasses can go undetected during early decomposition stages when ASFV is most infectious.

Our findings emphasize the need for refining early carcass detection strategies to prevent the spread of ASFV.

Managements of non-forestry areas in the Šumava National Park

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The secondary non-forest area in the Šumava NP is about 10 600 ha (the total area of the Šumava NP is 68 460 ha). Agricultural management is the main contributor to the maintenance of meadows and pastures, especially in terms of maintaining a diverse landscape mosaic. Approximately 5 000 ha of meadows and pastures are farmed. More than 100 agricultural entities farm in the NP. The existence of farmers is crucial to ensure the management of the secondary non-forest area. The Administration's staff sets the conditions under which the areas can be farmed. These include, in particular, the dates of mowing, the dates and intensity of grazing, but of course also other conditions that take into account the achievement of the conservation objectives in the area of the National Park.

In areas that are not being rented for various reasons but require care, extension management is implemented. These include manual mowing (mainly with a brush cutter), mowing with light and special machinery, extensive grazing (mainly by sheep), cutting back of trees and, last but not least, reduction of invasive plant species (especially *Lupinus polyphyllus*). On small but important areas in terms of species diversity, special management measures are implemented - verticutting and sod removal. These activities are carried out mainly for the benefit of competitively weak species such as *Sedum villosum*, *Hamatocaulis vernicosus* and *Gentianella praecox* subsp. *bohemica*. Extension and special management activities are financed by the Administration mainly from the funds of Ministy of Environment, as well as from the European grants and to a limited extent from its own resources.

Gentianella bohemica management and conservation

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Gentianella bohemica, the Bohemian gentian, is one of many rare and endangered species that only occurs in Central Europe. The taxon is listed in Annex II and IV of the European Union Habitat Directive 92/43/CEE. This species is threatened with extinction. Its historic distribution area includes northern Austria, Czech Republic, eastern parts of Lower Bavaria and southernmost Poland. In Czech Republic, there are currently 48 live localities, whereas in Germany eight and in Poland four populations. In addition to the 28 populations in Lower Austria there are only a few more sites of Bohemian gentian in the Upper Austria. The decline in the number and extent of populations is probably related mainly to land use changes (abandonment, succession processes, intensification, eutrophication, deliberate afforestation etc.). During the last years, extreme weather conditions also seemed to play a deleterious role, particularly in dry types of habitats.

Especially dry conditions in spring seem to be unfavourable for young rosettes, as the juvenile plants are sensitive to drought. For the long-term conservation of populations, in the context of the climate change, it is particularly important to maintain sites with moving shade and a diverse micro-relief.

Without suitable management measures, populations will only survive in the soil seed bank. However, estimates of the seed bank characteristics suggest only a limited seed viability period restricted to approximately seven to ten years. During this time slot, the viability of buried seeds was proved to reduce rapidly. For this reason, there is an immediate need for action and/or continuity of running measures to rescue remaining populations in the four countries where the species occurs.

Scarification is carried out annually in sites with the Bohemian gentian in Šumava. This disturbance regime creates gaps in sward and gives the new plants an opportunity to germinate. Hand mowing or grazing also takes place on the sites. Thanks to regular and appropriate care, the populations in the Sumava region are thriving. In three of the five locations, the number of individuals is in the thousands.

The absence of disturbances promoted Late Holocene expansion of silver fir (*Abies alba*) in the Bohemian Forest

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A multy-proxy paleo-study was carried out on a sediment record from the high-elevation peat bog Blatenska Slat' in Šumava. Records of pollen, charcoal, plant macrofossils, insect remains and geochemistry were retrieved from two parallel cores from the center of Blatenska Slat'. In this 7000-year-long record, disturbances are remarkably absent: charcoal concentrations and numbers of bark beetle fossils are constantly low and the pollen record does not indicate any large disturbances. However, silver fir *(Abies alba*) replaced Norway pruce (*Picea abies*) as the local dominant tree between ca. 4300 - 1200 cal yr BP (2350 BC - 750 AD). The long-term peak of *Abies* pollen was already discovered in previous research from Šumava, but remained

unexplained until now. Our record supports the theory that silver fir benefits from an absence of disturbances. By comparing the increase of *Abies* pollen in the sediment record with local moisture indicators based on the geochemical record, and local climate simulations from the CHELSA database (Karger et al. 2023[1]), we found a correlation between the start of the domination of *Abies* and a long-term decrease of tthe seasonality in the local precipitation pattern. Therefore, we argue that the shift to fir-dominated forest was driven by changing precipitation patterns.

1 Karger, D.N., Nobis, M.P., Normand, S., Graham, C.H., Zimmermann, N., 2023. CHELSATraCE21k – High resolution (1 km) downscaled transient temperature and precipitation data since the Last Glacial Maximum. Clim. Past. https://doi.org/ 10.5194/cp-2021-30.

Inconsistent short-term effects of enhanced structural complexity on soil microbial properties across German forests

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Production forests are often stands with few canopy gaps and little deadwood, causing loss of biodiversity and ecosystem functions. We study the effects of experimentally enhanced structural complexity on soil across 156 plots (50 x 50m) in eight forests in Germany, where half of the plots underwent normal forest management, and in the other half, canopy gaps and various types of deadwood were created. Effects of increased structural complexity on soil microbial activity and biomass appear to be context-dependent, with effects varying across different forests. Soil microbial biomass increased with increasing soil water content, emphasizing the importance of water availability for ecosystem functioning. Within the first five years following treatment establishment, there was no significant increase in the impact on biotic soil properties. Despite the lack of significant immediate changes in soil functions, promoting structural complexity in production forests holds promise for enhancing long-term biodiversity and ecosystem health.

The composition and functional potential of soil fungal communities along the natural spruce forest gradient in Šumava Mountains

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During the past few decades, forest ecosystems with natural disturbance dynamics have become increasingly rare in central Europe. The symbiotic relationship between fungi and spruces has already been studied in recent years, but the changes in the overall soil fungal community composition along the natural forest regeneration gradient with respect to other fungal functional guilds remain unclear. To better understand the role of soil fungi in forest post-disturbance regeneration, we need data from non-managed forests. Wind and bark beetle disturbances in Norway spruce forests in the Šumava Mountains provide the unique opportunity to study how soil fungal communities develop in such forest ecosystems. The study plots are located in the Plešné and Čertovo Lake catchments where the structure of spruce forests spans from already decayed stands through regenerating to mature stages. Based on DNA sequencing (soil eDNA), we will describe the taxonomic and functional composition of soil fungal communities along the gradient. Additionally, other soil characteristics (such as extracellular enzyme activity, soil chemistry, and humus type) will be used to determine and explain changes in soil fungal composition. The poster will present preliminary results of ongoing diploma thesis.

Climate adaptation in natural forest systems

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Conifers are ecologically dominant and economically important, but under climate change mature trees are no longer adapted to their environment and are succumbing to drought, disease, early-budding and other challenges globally. If we could predict how individual tree genotypes would respond to different environments, we could — given environmental predictions — plant the right tree in the right space.

Tree growth is a function of the experienced (macro- and micro-) environment but also the genetics that underlie how an individual tree responds. While tree-ring studies are dominated by a focus on environmental responses, increment cores also carry signal from tree-specific, genetic responses. Using models derived from agricultural genomics, we isolate variation associated with tree-level genetic signals as well as tree-specific responses to environments modelled from historical weather station data. Confirmed using genetic relationships from millions of genetic variants (single nucleotide polymorphisms, or SNPs), these estimates are highly heritable and can be passed on to offspring. This makes them useful as responses in prediction modelling to evaluate tree performance in new environments and in association mapping to understand the genetic basis of how trees adapt to new environments.

We present results from a genetically diverse set of 700 trees backed by hundreds of thousands of year-tree observations from a multi-scalar sampling design covering 11 plots located in three national parks across Europe (Sumava, Berchtesgaden, Germany and Mercantour, France). Resulting tree-by-year estimates are highly heritable, with narrow-sense heritability estimated from the kinship generally greater than 0.7 for most environments tested. These refined estimates are used to map the genetic basis of adaptive response to environment in genome-wide association studies (GWAS). We find significantly associated genomic variants, even with a relatively small population size, but, more importantly, we show that our approach limits the confounding effects of population structure compared to a naïve model designed similarly to human population studies. We also use these estimates to predict genetic responses to novel environments in a cross-population prediction framework, identifying shared trait architecture across geographically, genetically and environmentally diverse popuations. Shifting the unit of observation from single observation per genotype to 10s-100s of longitudinal, annual growth measurements from tree-rings enables us to quickly infer the genetic basis of adaptive response in any population, providing the means to evaluate a tree's performance in any modeled environment. As environments shift under climate change, this provides a powerful tool to select parents for healthy, resilient forests.

Regional Seed mixture and its practical use in ecological restoration

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So far, the regional seed mixtures are not widely used in ecological restoration in Czech Rep. Only a few parts of the country have own regional mixture. Since the year 2019, the regional seed mixture has been developed by the Czech Union for Nature Conservation Šumava. A specific feature of such a seed mixture is that it consists of seeds from native plant species collected exclusively from the Šumava region. This regionality is especially important for maintaining genetic variability and for the adaptation of individual species to local conditions.This mixture is used both to restore areas without vegetation and to enrich existing species-poor grasslands. However, it also finds use in urban green spaces or private gardens. Currently, seeds are collected in several ways. The majority of the seeds are hand-collected from preserved species-rich meadows. For some plant species, seed production beds have been established, where plants are cultivated, and their seeds are subsequently harvested. In recent years, approximately 3 to 5 kilograms of herb seeds per year have been collected in this way. Currently, the available variants of the seed mixture is designed for drier, mesic, and wetter conditions. Starting this year, seeds are also being collected using brush harvesters, which allow us to obtain a diverse mixture of herbs and grasses in higher amounts. We also focused on the practical use of the seed mixture in the enrichment of species-poor grasslands and we verified the effect of the disturbance intensity on the establishment of individual species from the mixture. Altogether, 11 experimental plots were established. The experiment revealed that sward disturbance is a necessary condition for the successful establishment of the sown species. The ideal disturbance method proved to be the rotavator (i.e. disc harrowing), as it creates a sufficient areas of bare soil without vegetation.

Old-growth forests as biodiversity hotspots: the role of dead wood and deciduous trees in bryophyte conservation

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Old-growth forests support significantly higher biodiversity than managed or cultural forests due to their structural complexity and key ecological features. A major driver of this diversity is the abundance and variety of dead wood in various stages of decay and mature deciduous trees, which provide essential substrates for forest specialists, particularly bryophytes. These elements not only enhance bryophyte richness but also support a wide range of other organisms.

While large, intact forest reserves are typically prioritized as biodiversity hotspots, smaller old-growth fragments within cultural landscapes also play a crucial role in conservation. Although less species-rich, these fragments serve as important reservoirs for rare and specialized species. They act as sources of diaspores, contributing to recolonization and genetic diversity in surrounding areas. This phenomenon has been observed in our studies of sites in Šumava over the past years.

These smaller fragments also enhance regional biodiversity resilience by dispersing populations across multiple sites, reducing the risk of local extinctions from disturbances like windthrow, fire, bark beetle outbreak or disease. Relying on a single large area for biodiversity can increase vulnerability to such events, whereas a network of smaller patches strengthens ecosystem stability and conservation outcomes.

This study highlights the need to recognize and protect smaller old-growth fragments, especially in cultural landscapes, as they offer vital refugia for rare species and contribute to broader conservation goals. Their preservation ensures the survival of species dependent on old-growth structures while bolstering biodiversity resilience across larger landscapes.

Macroinvertebrates of the upper Vltava River catchment

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The study on water macroinvertebrate communities in 6 localities in upper Vltava River catchment was carried out in the years 2018-2020 within the project „Strengthening and protection of the freshwater pearl mussel population in the Šumava National Park“. Macroinvertebrate communities reflect the long-term state of water chemistry, including any chronic or episodic pollution. It thus provides important information that we cannot obtain, for example, through chemical analysis of water, based on one-time sampling.

Three localities were situated in Teplá Vltava River, where the freshwater pearl mussel (*Margaritifera margaritifera*) is found, other three samples were taken from Studená Vltava, Řasnice and Vltava River above the Lipno Reservoir. Sampling always took place in the spring and autumn seasons, and 5-8 different habitats were sampled in each locality. A total of 166 habitat samples was determined, with the taxa of Oligochaeta, Chironomidae and Trichoptera most prominently represented.

Saprobity indices, diversity indices and the EPT/Chironomidae ratio (i.e. the sum of Ephemeroptera, Plecoptera and Trichoptera related to the number of Chironomidae) were compared, as well as the representation of individual functional feeding groups and the occurrence of endangered and rare species. In the longitudinal profile of the stream, it was important to compare the macroinvertebrate community above and below the Volarský Stream, where we assumed a significant effect of the excessive input of nutrients. As expected, the higher localities were oligosaprobic, while the lower sites were on the beta – mesosaprobic level. However, the diversity index was high and relatively balanced in all localities, and there was no apparent degradation of the community due to increased saprobity below the Volarský Stream estuary. The composition of the functional feeding groups also corresponded without exception to the altitude, flow order and other environmental parameters. Therefore, the state corresponds to a higher flow order and investigated catchment represents a well-preserved river continuum with near-natural macroinvertebrate community of a meandering foothill river. The absence of freshwater pearl mussel below the Volarský Stream estuary is presumably caused by other factors, e.g. episodic pollution, while the higher saprobity is supposed to be within the limits of its ecological valence.

The genus *Aconitum* in the Bohemian Forest

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The *Aconitum* is a very attractive, extremely poisonous and taxonomically challenging plant genus. Hybridization and polyploidization are main evolution mechanism in the genus. Three groups of the genus occurs in the Bohemian Forest – yellow flowering diploid *Aconitum lycoctonum* L. and blue-purple or violet flowering diploid *Aconitum variegatum* L. and tetraploid *Aconitum napellus* agg., which is the most morphologically complex and conservation significant group of Monk´s-hoods of the Bohemian Forest. While only one taxon *Aconitum plicatum* has been accepted on the Czech side, several taxa of *Aconitum napellus* agg. are reported for the Bavarian side of the mountains.

Flow cytometry was used for the ploidy level determination of studied populations and geometric morphometry based on analysis of flower shape outlines was used for analysis of morphological variation.

Morphometric analysis confirmed high intra- and interpopulation variation in the *Aconitum napellus* group, manifested mainly in helmet shape and architecture of inflorescence and its indumentum. There are also significant differences in the phenology of the populations. Some characters seems to be correlated with environmental conditions of habitats. Based of studied morphological characters, no separated group can be well distinguished. However, some Bavarian populations lie on the edge of the observed morphologically variation. Similarly, some cultivated and escaped populations, which further complicate the issue of the *Aconitum napellus* group in the Bohemian Forest.

The ploidy analysis confirmed the tetraploid level of the studied populations of *Aconitum napellus* agg. and diploid level of *Aconitum variegatum.* The triploid level was detected in escaped plants corresponding to *Aconitum* ×*cammarum.* However, rare occurrence of triploid hybrids was also confirmed in one mixed population of *Aconitum plicatum* and *A. variegatum*. Potential hybridization both species through unreduced gametes of *A. variegatum,* which is morphologically indicated in some mixed populations, should be studied by advanced molecular methods. The use of these methods is the necessary condition for disentangling of an origin of the complex morphological variation of *Aconitum napellus* group in the whole Central Europe.

Diversity of grassland fungi in oligotrophic meadows with *Gentianella praecox* subsp. *bohemica*

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The diversity of fungi indicating nutrient-poor grasslands (CHEGD fungi) is studied in 9 localities of *Gentianella praecox* subsp. *bohemica* in the Šumava Mountains and in the Bayerischer Wald. The aim is to improve the knowledge of CHEGD fungi in both areas, to find out, how management for *Gentianella* (e.g. verticutting) affects their diversity, and to discover, if any species of CHEGD fungi could indicate a potentially suitable meadow for *Gentianella*. One or two permanent plots per locality (400 m2 if available) were established, localities will be monthly visited in 2024-2026 (July to November) and fruitbodies of CHEGD fungi will be monitored. This year's records of some rare CHEGD fungi (e.g. *Clavaria fumosa*, *Neohygrocybe ovina*, *Pseudotricholoma metapodium*) will be presented.

MonitAnt: Developing a European-level Monitoring strategy for mound-building Formica Ants and their associated animal communities

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Mound-building *Formica* ants are a group of keystone species widespread in temperate and boreal forests and natural grasslands. They provide important ecosystem services, especially in forest habitats. Their large and long-lived nests are habitat to a broad range of other species, so-called myrmecophiles, specific to *Formica* ants and may also play an important role in the nutrition and survival of endangered birds such as the capercaillie. However, an assessment of population trends and threat status of these ants and their associated animals across European countries is largely lacking. Within the MonitAnt project, we create a harmonized monitoring strategy that is freely available to stakeholders in policy making and also for citizen scientists (available here: bit.ly/456qx4V or via the QR code on our poster). The aim is to record long-term trends in population dynamics of mound-building Formica ants and their associated myrmecophiles. The project consortium consists of eight European countries while the Czech part is led by the Institute of Soil Biology and Biogeochemistry, Biology Centre of CAS with its focus area in Blanský les Protected Area and mainly in Šumava National Park. Apart from the overall aims of the project, we here monitor two distinct groups of ant-associated animals, largely overlooked within ant research: soil microfauna (tardigrades, rotifers and nematodes) and vertebrates, namely Galliformes birds such as capercaillie, hazel grouse, black grouse, etc. but also wild boar. The microfauna was extracted from the mound material, the centre of the mound and the nearby litter layer while the abundance and diversity were compared. For vertebrate monitoring we installed 50 camera traps in total across ten localities with proven presence of Galliformes birds in the national park, aiming at nest mounds of *Formica* ants for a duration of one year. We will identify animal species using the nests and record their activity such as feeding on ants or cleaning their feathers. By this approach, we hope to bring evidence that *Formica* ant mounds provide an important habitat for soil microfauna and that ants serve as a crucial food source for a variety of vertebrates including endangered birds. Here we present the project and preliminary results.

Effects of long-term drainage and re-wetting on peat biogeochemical properties in different peatland types in the Šumava Mountains

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All different peatland types, including bogs, fens, spruce mires, have been drained during the 20th century in the Sumava Mountains regions and under current time, they are restored using re-wetting. We evaluated the effect of long-term drainage on physico-chemical and biological properties of peat in these three peatland types and compared it to undisturbed (control) peatlands. This allows us to evaluate the intensity of peat degradation due to drainage and estimate its potential for recovery after re-wetting. Moreover, the state before restoration serves as a „starting point" for evaluation of the restoration effect on peat and contributes to the evaluation of the success of the restoration measures carried out.

We investigated the effect of long-term drainage and rewetting on peat physico-chemical and biological properties in bogs, spruce mires and fens. Long-term drainage (few decades) led to an overall ecosystem degradation, indicated by increased peat bulk density, reduced decomposability of peat, decreased pH, reduced soil microbial biomass and activity and reduced methane production compared to pristine sites. The effect of drainage was most apparent on fens, followed by spruce mires and lowest on bogs.

Rewetting of formerly drained peatlands is reflected in stabilization anaerobic conditions by increased pH and increased potential of methane production. Slight changes in microbial community composition towards the original composition were observed. Based on the measurement, following below ground indicators of ecosystem recovery after the rewetting were selected as suitable: pH, microbial biomass, anaerobic respiration, methane production and microbial community composition (especially methanogens). However, the measurement showed that 5-15 years after rewetting is not sufficiently long period for new peat layer accumulation, thus the peat physico-chemical properties are still strongly influenced by previous drainage and spreading of original (peat forming) plants is crucial for ecosystem functioning recovery.

Hydrological response to re-wetting is a relatively fast process, while ecosystem recovery and peat bio-geochemical properties recovery will take up decades. Response to re-wetting depends on peatland type and on the level of disturbance before re-wetting.

Influence of large predators' olfactory cues on deer behaviour and consequences for the browsing pressure on a fine-spatial scale

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Predator-prey interactions can affect temperate forest ecosystems, by triggering various behavioural responses in ungulate prey. In this study we examined the effects of predation risk on deer behaviour, and its consequences for the browsing intensity on tree saplings in an experimental approach in the Bavarian Forest National Park.

We conducted this experiment at twelve locations in a mountainous forest ecosystem, each comprising four plots with olfactory cues of wolf, lynx, cow and water (control). In each plot we planted 30 tree saplings representing the five most common tree species in the area, which we regularly monitored to assess deer browsing intensity and selectivity. Additionally, we placed a camera trap facing each plot to determine deer species, age and behaviour in terms of vigilance level, visitation duration and visitation frequency. The design of this study also allowed us to test for differences between seasons and time of the day.

The results show that deer modified their behaviour in response to predator cues in comparison to non-risky scent cues, with more pronounced effects in lynx treatments compared to control treatments. Roe deer showed a weaker behavioural response than red deer, and also visited the treatments for shorter period of time but more often than red deer. We observed the most significant changes in the visitation duration analysis, with red and roe deer spending less time in lynx treatments compared to control treatments, especially at dawn and dusk. In spring at dusk, we observed two cases with similar results in wolf treatments; however, we did not find any other impact of wolves on deer behaviour. Notably, our findings also show an increase in vigilance level of adult deer when accompanied by juveniles in lynx treatments during winter nights. As a consequence of these adaptations, we found a significant reduction in browsing intensity in lynx

treatments compared to control treatments, but not higher selection for preferred species in predator treatments.

By analysing multiple behavioural responses, this study provides interesting insights into the mechanisms of predator-prey interactions and their indirect impact on forest ecosystems. The findings highlight the important role of predators in temperate forest dynamics, demonstrating how they can indirectly influence forest vegetation through behaviourally-mediated effects. As one of the few studies showing all the interactions between trophic guilds in an anthropogenic landscape, this research sheds further light on the potential role of large carnivores in shaping patterns of tree regeneration in temperate forests.

A half-millennium record of disturbance history in the Bohemian Forest Ecosystem

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In a view of expected increasing trends in frequency and severity of wind disturbances, our research aims to shed light on the disturbance history throughout the Bohemian Forest Ecosystem. With a robust dataset of more than 7.000 dendrochronological cores, we present a trans-boundary study spanning the latest 500-year period, dating back into the early modern era. By analysing growth release and canopy recruitment events we aim to reconstruct the narrative of natural disturbances (i.e. windthrows and insect outbreaks) in the Šumava Mts. and the Bavarian Forest National Park and describe differences in disturbance history between regions and with respect to ecological gradients. Despite the same region and similar tree-species composition, historical forest trajectories mostly differ between the Czech-German border. Forest stands in the Šumava Mts. tend to be significantly older as a result of intensive exploitation after the World War II in the Bavarian Forest. While severe wind and bark-beetle events of the second half of the 19th century shaped the current structure of mountain forests on the Czech side, local thunderstorms of the 18th century were the most important natural disturbances in the Bavarian Forest. Results also revealed significant temporal differences in relation to types of forest ecosystem (e.g. spruce mountain forests, waterlogged and peat forests, ravine forests), suggesting specific disturbance regimes. Despite past human activities, 3% of trees on the Bavarian side and 30% on the Czech side could be considered as relicts of primeval forests, originated in the 17th and 18th centuries, and much of them died as a consequence of bark beetle outbreak during the 1990s.

Will the return of wolves affect the dynamics of the beaver population in the Šumava Mts.?

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Eurasian beaver (*Castor fiber*), Europe's largest rodent, spanning Europe from France to Russia and including Scandinavia. Similarly, Gray wolf (*Canis lupus*), which is found throughout the mainland of Europe, shares a comparable range. Both species suffered from human-induced persecution and hunting, leading to their complete extermination in many parts of Europe, including the Czech Republic. However, the situation has changed today. Beavers are now found throughout almost a whole country, with some exceptions (as southern Bohemia, and the north bordering mountains). Twelve years ago, wolves also began to return to our country. Currently, they inhabit all mountains on the Czech border, predominantly in areas adjacent to the borders of Saxony and Poland. The first documented permanent wolf territory in the Šumava Mts. is dated from the year 2015. It is evident that wolves are not selective in their choice of prey. Their diet in Europe encompasses a wide range of mammals, from small species, such as hares to the largest continental species, such as European bison and muskoxen. The results of studies conducted in Poland, Latvia, Belarus indicate that beaver constitute a significant portion of wolf prey, accounting for more than a quarter of their diet in some cases. It was hypothesised that beaver would constitute part of the wolf diet in the Czech Republic. However, the majority of the wolf prey found in Šumava consist of deer species, wild boar and hares. The situation changed starting in 2022 when we found three beavers killed by wolves. This information was corroborated through the utilisation of GPS data obtained from wolf telemetry collars. Furthermore, the increased interest of wolves in beavers and beaver territories is indicated by images from camera traps and other data from wolf collars. The preliminary analysis of wolf scats also suggests that beavers are becoming significant prey for wolves. Therefore, it can be assumed that beaver will become a regular part of the wolf diet, suggesting that wolves can create significant predation pressure on beaver population in the Šumava Mts.

Formation of Bohemian Forest lakes

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Eight glacial lakes with surface areas exceeding 2 ha are located on the territory of the Bohemian Forest. Stiller See, a very small lake (0.02 ha) located near Großer Arbersee, is also probably of glacial origin. However, there were even more glacial lakes in the same region at the end of the last ice age and at the beginning of the Holocene. During the Holocene, these shallow lakes disappeared due to natural infilling. So far, the infilled lakes (paleolakes) have been studied mainly in the Czech Bohemian Forest, where three such sites have been discovered – Malé Černé jezero, Stará jímka, and Stifterova díra. Some of them still turn into very shallow temporary lakes after high rainfall. In the past, it was hypothesized that all glacial lakes in the Bohemian Forest formed immediately after the melting of local glaciers about 10,000 years ago. Due to the recent research on the sediments of these lakes and the use of the latest radiocarbon calibration curves, this hypothesis can be rejected. Lake basins in the Bohemian Forest seem to be of different ages (formed at different stages of deglaciation) and/or some of them were filled with water after a considerable delay after the ice melted. Therefore, we can divide the lakes into those that were formed around the Pleistocene-Holocene boundary (~11,700 years ago; Laka, Prášilské jezero, Stifterova díra) and those that were formed ~14,500 years ago or earlier (Černé jezero, Čertovo jezero, Großer Arbersee, Kleiner Arbersee, Malé Černé jezero, Plešné jezero, Rachelsee, Stará jímka). Dating the oldest sediments in the older group of lakes is challenging. This is due to radiocarbon dating limitations, low content of organic matter, and changes in sediment accumulation rate in the newly formed lakes. Because of that, we do not yet know the formation time of the oldest lakes, even to the nearest thousand years. Given the published results of ^{10}Be dating of moraines damming some of the lakes (^{10}Be dates are available for Laka, Prášilské jezero, and Kleiner Arbersee), we assume that this maximum age is likely no more than 17,000 years. The research of lake sediments in the Bohemian Forest is important not only because of reconstructing the timing of local deglaciation and its consequences, but mainly because these sediments are important natural archives that can be used to study the history of the region from the end of the last ice age to the present.

Formation of the territorial system of wolves during their modern colonization

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In the last ten years, a strong settlement of grey wolves (*Canis lupus*) has developed in the Bohemian Forest Ecosystem (BFE). Wolves, as strongly territorial social animals, create and defend their unique space territory. The basic assumption and evidence is that the created territories overlap minimally with their neighbours. Recolonisation by this species is currently underway in Central Europe (CE); on the one hand, it is a charismatic species with significant impacts on colonised ecosystems and prey populations. On the other hand, its conflict potential makes it a major conservation challenge.

Our team has been studying the spatial requirements of wolves in CE since 2019, and since 2020, we have also been studying the emerging wolf population in BFE. So far, seven individuals representing five territories have been equipped with GPS collars. The monitoring period of individual collars varies considerably (from 4 days to 340 days) – during the period several types of movement modes and life strategies of wolves have been identified. Adult breeding wolves are clearly resident (defending their territory) and do not deviate much from this behaviour; we did not observe a marked tendency for them to visit their neighbours. Subadult wolves helped to document their affiliation with their natal pack – we find a strong correlation between their spatial requirements and the activity of their parents in the natal pack. In addition, these sub-adult individuals allow us to study dispersal behaviour in detail. Thanks to this, it is possible to determine when and at what frequency dispersal attempts take place, and also whether and where the final establishment of the young dispersers will take place. Last year, thanks to the running collars, it was even possible to observe the break-up of the pack and the replacement of that free area by a new dominant male, originally a floater (also equipped by a collar). The BFE population is, therefore, one of the best-documented wolf populations in CE, and thanks to GPS collars; we can understand very well how wolf populations are formed during recolonisation.

Microclimate affects forest recovery pattern after stand-replacing bark beetle disturbance

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The bark beetle outbreak caused large stand-replacing disturbances in the European coniferous forests. Our previous studies showed that the seedlings that emerged directly during the disturbance play a dominant role in the forest's natural recovery and that the spatial pattern of this natural regeneration mirrors the pattern of trees that formed the stand before the disturbance. We hypothesized that tree wells (aka thaw circles) are responsible for this specific tree spatial pattern. However, the exact factors and mechanisms responsible for this self-replicating spatial pattern remain to be discovered. Here, we explored the microclimate as one of the possible drivers behind this pattern.

We continuously measured air temperature near the ground at different distances to tree bases with TMS4 loggers in the natural coniferous forests in the Šumava Mts., Czech Republic. From these measurements, we calculated the duration of snow cover and melting date in different microhabitats and compared their microclimate during the growing season. Further, we followed the growth and mortality of thousands of spruce recruits and assessed their relative growth rate in relation to the distance to the tree bases.

We found that the microclimate in tree wells is specific. Vegetation and recruits in tree wells can profit from early snow melting and subsequent longer growing seasons. However, recruits in tree wells can suffer a higher risk of spring frost. Specific microclimate thus can contribute to previously observed lower mortality of recruits in tree wells (close to tree bases). On the other hand, the growth of recruits seems to be unaffected by the distance to tree trunks or snags. Our research indicates that microclimate can substantially affect forest recovery and should be integrated into future climate change assessments.

Statistical Operational Inventory in the Šumava National Park

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The Šumava National Park has the area of 48 936 hectares of forest land divided into six forest management units (referred to as LHC). The data about the forest in these LHCs has been collected since 2008 using statistical operational inventory methods. Across this area, 8 648 circular plots have been established, each covering 500 m² with a radius of 12,62 meters. The data collected includes information such as the volume of individual tree species, regeneration count and the amount of deadwood. The data is collected at regular twelve-year intervals using FieldMap technology. Currently, three LHCs have been remeasured through repeated inventory. The aim of this paper is to present the results of these three LHCs.

LHC Srní has 1 648 plots and covers the area of 9 583 hectares. The timber volume here amounts to 2 838 470 m³, which is 296 m³/ha, with the regeneration count of 8 330 per hectare and the deadwood stock of 61 m³/ha. LHC Borová Lada has 1 261 plots and covers the area of 7 637 hectares. The timber volume here amounts to 2 530 029 m³, which is 331 m³/ha, with the regeneration count of 9 244 per hectare and the deadwood stock of 33 m³/ha. LHC Stožec has 1 391 plots and covers the area of 8 415 hectares. The timber volume here amounts to 3 000 160 m³, which is 358 m³/ha, with the regeneration count of 9 648 per hectare and the deadwood stock of 86 m³/ha.

These data are being used by the national park to monitor forest trends and development in both intervention and non-intervention areas. It serves as the basis for determining the total allowable logging volume by zones and for tracking the fulfillment of the goals the national park has set in forest management. In terms of scope and the number of plots, this is the most extensive and regular monitoring conducted in the national park.