MENDELU
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Mendel
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Silva*Net* – Wood*Net* 2022

Proceedings Abstracts of Student Scientific Conference

Ing. Ondřej Hemr
Ing. Kateřina Sedláčková
Ing. Nikola Žižlavská

November 25, 2022
2022 Brno

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in Brno on November 25, 2022

Student Conference is organized by the Council of the Internal Grant Agency of Faculty of Forestry and Wood Technology MENDELU under the patronage of the Dean of Faculty (Faculty of Forestry and Wood Technology MENDELU) prof. Dr. Ing. Libor Jankovský and in cooperation with projects ASFORCLIC, HOMED and CZ.02.1.01/0.0/0.0/ 15_003/0000453 (Phytophthora Research Centre).

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Silva*Net* – Wood*Net* 2022

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Project Adaption strategies in forestry under global climate change impact (ASFORCLIC)

The ASFORCLIC focuses on the ambitious goals of raising the research profile and strengthening research excellence of the selected fields at the Mendel University in Brno in the highly demanding global climate change impact on the forest and whole bio-based sector.
The project will be implemented through four work packages (WPs) and three working groups (WGs). They excessively use MENDELU's Forest Training Enterprise Masarykův les (FTE) to pilot and evaluate research-based activities.

ASFORCLIC has the following objectives:

- To strengthen the research excellence of the Faculty of Forestry and Wood (FFWT) MENDELU in the field of the climate and global change impacts on forestry, the bio-based industry and market in Europe through the newly developed strong partnership with advanced research institutions in the area of forestry and wood research (demonstrated by high-profile joint publications);
- To enhance the scientific visibility of the FFWT MENDELU and open new networking opportunities (joint project applications, secondments of students and staff);
- To increase the competitiveness of the FFWT MENDELU in national, EU and international research grant competitions (competitive individual grant applications, joint collaborative project applications);
- To improve FFWT MENDELU researchers' and support research staff's profiles with a particular reference to early-stage researchers (ESRs) and project management/administration;
- To foster collaboration and dialogue with stakeholders to translate the research findings to policy and industrial cooperation.

More information https://asforclic.ldf.mendelu.cz/

This project has received funding from the European Union's Horizon 2020 Programme for Research & Innovation under grant agreement No 952314.

Cross-border risk management in forestry (FORRISK)

No borders exist regarding actual and potential risks in forestry among countries. Rising problems can easily and rapidly expand in areas and overcome national borders. In the project area, this has, in recent years, been experienced in the form of a severe and long-lasting drought and an unprecedented mass outbreak of bark beetles. Therefore, in this Interreg project FORRISK's cross-border cooperation in risk management has
been started.
The lead partner of the project is the University of Natural Resources and Life Sciences, Vienna (BOKU), which is implementing the project in close cooperation with the Mendel University in Brno (MENDELU) and the Federal Institute of Agriculture Economics, Rural and Mountain Research (BAB). The strategic partners in both countries also play an important role, both during the project and afterwards, in putting the project outputs - recommendations into practice. Czech associated partners are Forests of the Czech Republic, NP Šumava, ProSilva Bohemica, Municipal Forests of Volary, and Municipal Forests of Dačice.

The project activities aim to meet the following objectives:

- Intensive collaboration among partners and associated partners of the project
- Dissemination of scientific knowledge to the application sphere, state administration body and local authorities
- Reinforcement of knowledge level of competent forestry and public institutions
- Harmonized and optimized system of adaptive forest management with the target of minimizing the risk at cross-border regions
- Building of cross-border network for supporting information exchange and communication among scientific institutions, administration organs and forest owners

To achieve the above objectives, the first output of the project focuses on the comparison of Austrian and Czech border regions regarding forests, forest practices, risk, and legislative and future recommendations. The second output, "Manual for future crisis and risk management in forestry ", includes a comprehensive overview of recommendations on how to solve currently occurring and expected issues according to forest stand type, site conditions and size of owned forest land. The third output is an online platform (website) functioning as a communication tool and recommendation system, including possible management responses and keeping information up-to-date as much as possible to avoid or mitigate the occurrence of such huge problems experienced in recent years and to minimize economic and ecological losses as well as constraints in ecosystem services.

Interreg
EUROPEAN UNION
Austria-Czech Republic
European Regional Development Fund

More information: www.at-cz.eu/forrisk
The project FORRISK ATCZ251 is funded by ERDF.

EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

TENTO PROJEKT JE SPOLUFINANCOVÁN EVROPSKÝM FONDEM PRO REGIONÁLNÍ ROZVOJ

Výzkumné centrum pro studium patogenů z rodu *Phytophthora* CZ.02.1.01/0.0./0.0./15_003/0000453

Dotační titul: OP Výzkum, vývoj a vzdělávání
Výzva č. 02_15_003 pro Podporu excelentních výzkumných týmů v prioritní ose 1 OP
Doba řešení: 1. 12. 2016 – 31. 10. 2022
Příjemce projektu: Mendelova univerzita v Brně
Koordinátor projektu: prof. Dr. Ing. Libor Jankovský

Cílem projektu je vybudování komplexní infrastruktury a vytvoření mezinárodního, interdisciplinárního a multioborového výzkumného týmu se zaměřením na výzkum chorob dřevin rodu *Phytophthora*.
Aplikací a implementací inovativních technologií na bázi mikrobiologie, bioinformatiky, biologie, ekofyziologie, anatomie dřevin, genomiky a bioklimatologie, přispět k hlubšímu poznání faktorů ovlivňujících diverzitu, adaptaci a hybridizační procesy, které probíhají u rodu *Phytopthora*. Dále se pak zabývat evoluční historií tohoto rodu a molekulárními mechanizmy řídící náchylnost a odolnost dubů proti půdním patogenům tohoto rodu. Očekávané výsledky budou rozvíjet disciplínu fytopatologie dřevin, jako jednu z klíčových oblastí excelentního výzkumu na MENDELU, s pozitivními důsledky pro management a ochranu evropských ekosystémů. Bude prohlubována stávající mezinárodní spolupráce s předními světovými institucemi, s cílem a ambicí založit a udržet vzniklý mezinárodní tým VaV centra MENDELU, jako lídra v oboru a získat navazující projekty mezinárodní spolupráce ve výzkumu chorob dřevin rodu *Phytophthora*. V rámci projektu bude doplněna stávající infrastruktura laboratoří VaV MENDELU o špičkové přístroje a vybavení bezprostředně související s výzkumem chorob dřevin zapříčiněných parazity rodu *Phytophthora*.

Partneři projektu:

- Austrian Research and Training Centre for Forests, Natural Hazards and Landscape
- Svaz školkařů České republiky, z. s.
- Arboeko s.r.o.

Phytophthora Research Centre

ARBOEKO

BFW. Bundesforschungszentrum für Wald

http://www.phytophthora.org

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THE INFLUENCE OF HISTORICAL AND MODERN FOREST MANAGEMENTS ON THE CONDITION OF COPPICE – RESULTS IN 2022

Adamec Zdeněk, Friedl Michal, Kadavý Jan, Kneifl Michal, Knott Robert, Kománek Martin, Kostka Matěj, Kučera Aleš, Neubauer Štěpán, Uherková Barbora, Vichta Tomáš

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Key words: grazing, litter raking, sessile oak, soil, standards, thinning

1 INTRODUCTION

Throughout human history, forests were not only a source of wood materials, but were also a place for their cattle to graze or were used to rake the uppermost layer of litter. Today, these activities carried out in forests are called as "traditional management". New forest stands were created by the vegetative growth of new trees from stumps. However, all these „traditional management“ practices have been shown to be rather negative. This paper presents the results of a project aimed at assessing the impacts of managing these historical practices in coppice at the research plots located at Masaryk´s Forest Křtiny.

2 MATERIALS AND METHODS

The project measurements were carried out at study plots named "Hradisko", which are located in the Masaryk's Forest Křtiny. These plots were established in 2017 and are located in stands of sessile oak. The density of forest is 80 standards per hectare. In total, there are 15 research plots (40 × 30 m), which differ from each other by the type of forest management. So, plots of „No grazing and litter raking“, „Grazing and litter raking“, „Grazing and no litter raking“ and „No grazing and no litter raking“ you can find here. Control plots are located too. From each research plot 4 soil samples were taken. The dendrometric measurements of standards and sprouts were done in the end of vegetative season. The aim of this project is to evaluate the pedological and dendrometric measurements in connection with a different type of management. From the pedological properties, the subject of evaluation is mainly the carbon content and the supply of nitrate and microbial nitrogen. The evaluation of dendrometric values is focused on absolute and relative growth of standards and sprouts.

3 RESULTS

The aim of this research was therefore to compare different properties following different management. During evaluating the results significant differences were found in the quantification of litter. The highest amount of litter was recorded at the control plots. The amount of litter was around 7.6 tons per hectare. In other plots typical of a certain management, the values of litter were almost only half. Similar results were also found in the case of carbon stock in the soil environment. The highest values of carbon content were found again at the control plots. On the contrary, on the plots of traditional management, the values of the carbon

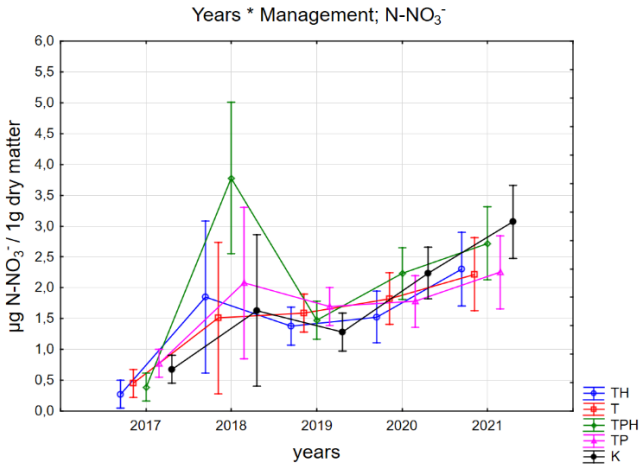

Fig. 1: Mean values of mineral nitrogen in years 2017-2021 between different treatments.TH - coppicing and litter raking; T- coppicing; TPH - coppicing, grazing and litter raking; TP - coppicing and grazing; K- control plots

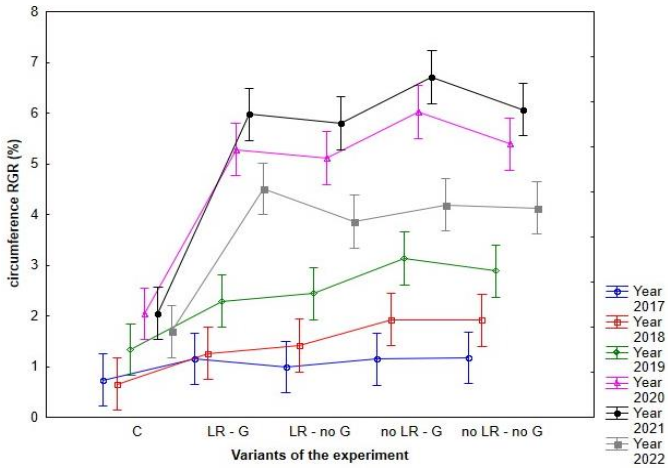

Fig. 2: Mean values (level of significance α=0.05) of circumference relative growth ratio of oak standards in years 2017-2022 compared between different treatments. RGR (%) – relative growth ratio of oak standards, C – control plots, LR – litter raking plots, G – grazing plots.

content were lower. The application of management did not affect the pH of the soil environment and the soils of all plots were rated as moderately to slightly acidic. On the other hand, during evaluation of the dendrometric values, the lowest values were found on the control plots and the increment values were several times lower than on the other plots. However, during the last year of measurement (2022), the values at all plots are considerably lower than during the previous years (2021, 2020).

4 CONCLUSIONS

The aim of this project and research was to evaluate the impact of the practices of traditional management on forest ecosystems, especially on pedological and dendrometric properties. A significant influence was confirmed in the case of both branches. In the case of pedological properties, the impact on the soil environment was rather negative. Lower amount of litter is also associated with a lower carbon content in the soil. Our dendrometric results are similar with hypotheses of Jones and Thomas (2004) for diameter increment of released trees. They stated that increased increment showed up very fast, but after its culmination, it will return to the original values before the tree releasing. Different management treatments effect is still statistically insignificant.

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Supported by the Specific University Research Fund of the FFWT Mendel University in Brno, project No. LDF_TP_2020005.

GROWTH RATE AND SAP FLOW OF *PICEA ABIES* (L.) KARST. SEEDLINGS UNDER ELEVATED CO_2 CONCENTRATION

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Keywords: “Baby“ sensors, Norway spruce, oven-dry wood density, transpiration

1 INTRODUCTION AND OBJECTIVES

The global atmospheric CO_2 (carbon dioxide) level is likely to increase to 550–1000 ppm (parts per million) by the end of the century. Therefore, it is an urgent task to perform more studies examining the adaptive capacity of European tree species in the face of climate changes, because the forests regenerated today will have to adapt and cope with the climate conditions that will be present during the life of the trees in the stand. The objective of the present study was to investigate the effects of elevated CO_2 on wood density, aboveground biomass, and sap flow of Norway spruce seedlings planted in the spheres at Bílý Kříž in the Beskydy Mountains, Czech Republic. In this research, we grew 84 per sphere of Norway spruce seedlings and we hypothesized that the strength of the CO_2 “fertilization” will contribute to higher biomass, wood density, however the transpiration will be lower in enriched CO_2 concentration.

2 MATERIAL AND METHODS

The experiment was carried out at the Bílý Kříž experimental ecological research study site situated in the Moravian-Silesian Beskydy Mountains, Czech Republic (49°30’ N, 18°32’ E). The altitude of the climatological station is 894 m a.s.l. In this research we used the two lamellar glass–domes, one with ambient 400±20 ppm CO_2 and one with elevated 700 ±20 ppm CO_2 concertation, to elucidate their effect on seedlings ecophysiological response. We observed biometrical parameters (tree height, diameter), aboveground biomass (leaves, branches, stems), a wood density, as well as daily pattern of sap flow using the THB (trunk heat balance) method. The method does not need any empirical, tree- or species-specific parameters. It is almost independent of the radial conductivity profile and directly outputs volumetric water flow values.

3 RESULTS

Based on this preliminary result, we can conclude that this elevated CO_2 concentration will improve aboveground biomass (statistically not significant) and wood density (statistically significant). From sap flow measurements, we observed few “normal” days in comparison with few dry days. “Normal” days are with satisfactory atmospheric conditions such as VPD (vapour pressure deficit), calculated from temperature and humidity of the air soil water content.

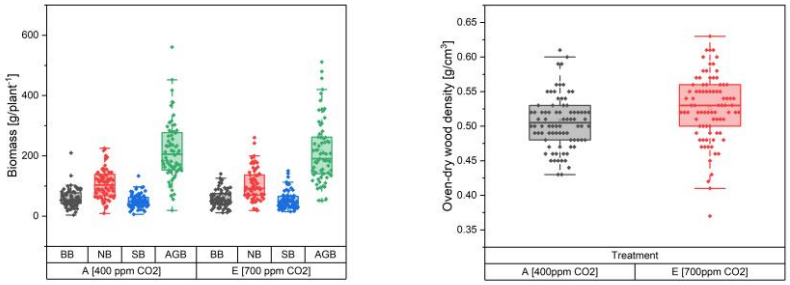

Fig. 1: Changes in aboveground biomass (a) and over – dry wood density (b) (g/cm^3) of (*Picea abies* L.) seedlings treated under ambient (400 ppm CO_2) and elevated (700 ppm CO_2)

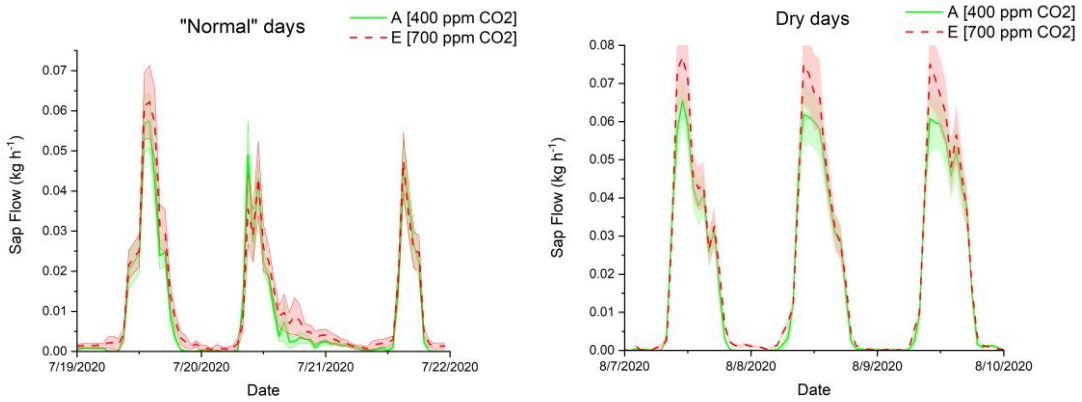

Fig. 2: Daily pattern of sap flow (kg.h^{-1}) of (*Picea abies* L.) seedlings on “normal” and dry days treated under ambient (400 ppm CO_2) and elevated (700 ppm CO_2)

4 CONCLUSIONS

In accordance with the hypothesis tested, our preliminary results confirmed existence of effects of CO_2 concentration on aboveground biomass and particularly on wood density, however the sap flow analyses showed us that in elevated CO_2 concentration we can expect lower values of sap flow, the one of the main reason for that can we that soil of the experimental site is quite rich with nutrients and water is not limiting factor.

ACKNOWLEGEMENT
The work was supported by the Internal Grant Agency of Mendel University in Brno with grant no. IGA-LDF-22-IP-024.

EFFECT OF CLIMATE IN RESISTANCE AND RESILIENCE OF SOUTH MORAVIAN FLOODPLAIN FOREST

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KEYWORDS: basal area increment, climate change, *Fraxinus angustifolia* Vahl., groundwater, *Quercus robur* L.

1 INTRODUCTION

Floodplain ecosystems in South Moravia are facing severe groundwater level decline dut to the climate change and water management. The combined impact of extended dry periods (low precipitation, high temperature) and decreased groundwater level on forest productivity is yet not well understood. In this regard, we have introduced a dendroecological study aimed on analyzing the basal area increament from tree ring width records representing the volumetric growth of the two species, namely, English oak (*Quercus robur* L.) and Narrow-leaved ash (*Fraxinus angustifolia* Vahl.). Growth resistance and resilience, calculated from tree rings were used to assess growth stability in relation to climate change. The preliminary results showed that resilience of both species decreased due to changes in groundwater level. Oak and ash responded differently to changing precipitation and temperature regime.

2 AIM & HYPOTHESIS

The objectives of the study were 1) to assess the ecological stability through resilience components of English oak and Narrow-leaved ash to the local hydroclimatic conditions and 2) to compare different species responses to different underground water statuses. The hypotheses used for the study were (i) oak and ash respond differently to climate change and ground water alteration and (ii) species-specific response differs among the sites with different water management.

3 METHODS

The study is conducted at the four sites with similar environmental conditions but different underground water level status in South Moravian floodplain forests: Pohansko, Lendice, Soutok, and Lanzhot. Pohansko is limited by underground water for a long time. In Lednice, the water level is stable after the river modifications. In Soutok and Lanzhot, the underground water level is decreasing within decades. 20-25 dominant and co-dominant oaks aged 100-120 years were chosen for sampling at each site. Two cores at breast height from the opposite sides were collected using a 0.5 mm increment borer (Haglof Sweden). The measurements were performed in the laboratory with Leica optical microscope and VIAS Timetable. Past4 software was used for measurements and crossdating. The basal area increment was calculated from the tree rings and then detrended with double detrending method to remove the age effect with ‘dplR’ package in R environment. Robust master chronologies were prepared, using which the resistance and resilience were calculated as previously described by (Lloret et al., 2011):

i) Rt = Dr/PreDr;
ii) Rs = PostDr/PreD;

where Rt – resistance; Dr – growth during disturbance; PreDr – growth before the disturbance; Rs – Resilience; PostDr – growth after the disturbance.

We have collected monthly climatic data (mean temperature, precipitation, underground water data) from Czech Hydrometrological Institute. Tree ring indices were correlated with these monthly climatic variables using Pearson correlation.

4 RESULTS

Results showed that the growth stability is negatively affected by groundwater decline to some extent at every location. Oak is more on the resilience component whereas ash is mostly on the resistance one. Oak in Lednice shows strong negative correlation with groundwater level which can be explained by root anoxia. Resistance in ash in every location shows much stronger correlation with groundwater level in summer and autumn months. In Lednice, the correlation is weeker in comparison with other sites.

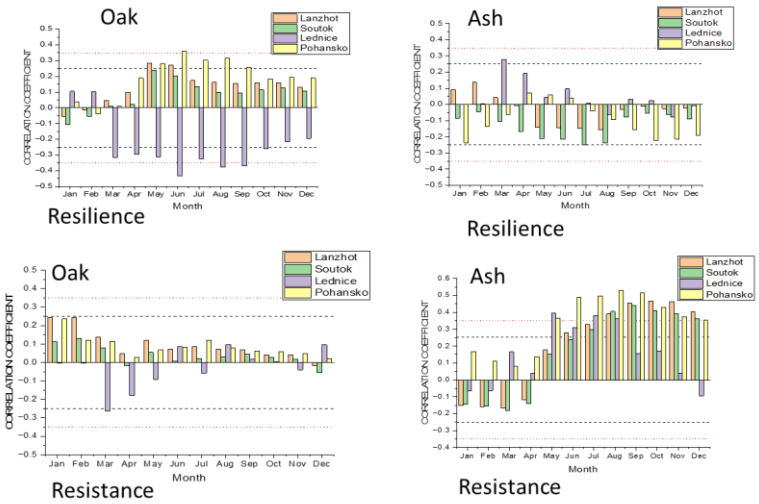

Fig. 1: Pearson correlation with resistance and resilience indices with groundwater level (black dotted line is the significance level at 0.05, and red dotted line is the significance level at 0.01)

5 CONCLUSION

Our results revealed that English oak is more resilient than Narrow-leaved ash in the conditions of South Moravian floodplain forests. Declined groundwater table, higher temperatures and lower precipitations are reducing the resilience of both species. Stress resistance and recovery differs between the two species.

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AGE STRUCTURE OF *DRACAENA DRACO* SUBSP. *DRACO* ON TENERIFE

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Key words: age, *Dracaena draco* subsp. *draco*, Tenerife

1 INTRODUCTION

Dracaena draco known as a dragon´s blood tree is a relict species of an ancient Mio-Pliocene Laurasian subtropical forest (Habrová et al., 2009; Krawczyszyn and Krawczyszyn, 2016). It is a monocotyledonous species from family *Asparagaceae* but it forms an exception due to secondary thickening (Krawczyszyn and Krawczyszyn, 2016). *D. draco* (with three subspecies) occurs in Macaronesia and African Anti-Atlas (Maděra et al., 2020). The *D. draco* subsp. *draco* is native to Madeira, but it became extinct on Porto Santo Island (Maděra et al., 2020). It is also native to Canary Islands, but naturally occurs only on Gran Canaria and Tenerife. On Tenerife Island, it grows naturally from 100 to 600 m a.s.l. (Maděra et al., 2020). Wild populations are rare, however, it is artificially cultivated here (Hoskovec, 2007). There is still a gap within the age of this species. As *Dracaena* species do not create tree rings by which could be calculated the age of the trees (Habrová et al., 2009; Adolt et al., 2012), the age can be estimated either by indirect method focused on the probability of flowering (published by Adolt and Pavliš (2004) and Adolt et al. (2012) for *D. cinnabari* and by Lengálová et al. (2020) for *D. draco* subsp. *caboverdeana* and for *D. ombet*) or by direct method. The presented project is focused on direct method which has not been used yet.

2 MATERIALS AND METHODS

We focused on cultural individuals (artificially planted). The mentioned direct method to know the age of *D. draco* subsp. *draco* on Tenerife consisted in questionnaire survey of local people if they know when they planted their dragon tree which usually occured in their home gardens. It was done mostly by direct questioning. We also measured DBH, trunk height and number of branch orders. Moreover, we asked local people if the dragon tree is irrigated or not. The DBH was measured at standard 1.3 m above the ground. We used ArcGIS Field Maps application (in mobile phone) in the field to target and to measure the individuals of this species. Both south and north populations were measured and analysed separately due to quite different conditions between each other (there si more precipitation per year on the North of the Island). The data were analysed and the age structure of *D. draco* subsp. *draco* on Tenerife was found.

Fig. 1: Measuring *D. draco* subsp. *draco* on Tenerife Island

3 RESULTS

The most abundant (overall) age class is 21–30 years. The same applies for the north population. Within the south population, the most abundant age class is 1–10 years. The both populations are quite young (except few very old trees on the North of the Island where the age can be only estimated). (More will be presented at the conference).

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POSSIBLE CAUSES OF FOREST RECLAMATION DECLINE IN LIMESTONE QUARRY MOKRÁ

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Key words: abandonment area, forestry reclaimed, soil properties

1 INTRODUCTION

This paper presents research of forestry reclaimed areas within limestone quarry Mokrá, South Moravian region. It has an area of 150 ha and is among the largest limestone quarries in the Czech Republic. Limestone quarry Mokrá is still under mining process however restoration of the East part started approximately 30 years ago. Forest reclamations are usually held on internal deposited material. Overal the area has been successfully reforested however there are places where seedlings repeatedly die. These areas have been pedologically studied to clarify possible reasons of the decline.
Two hypotheses clarifying the decline of seedlings pronounced possible reasons: 1) lack of soil water; 2) chemical soil properties.

2 MATERIAL AND METHODS

The research was carried out on five forest reclamations in the eastern part of the quarry. Five forest reclamations (*Quercus robur*, *Quercus petraea*, *Acer pseudoplatanus*, *Tilia cordata*) were approximately from 15 to 25 years old. After preliminary botanical survey, sixteen sampling sites were demarcated: 9 for prosperous (Pr) forest stands and 7 for unsuccessful reforestation containing dead trees or trees at high risk of mortality (D). Physical soil properties assessments were based on mixed and undisturbed soil samples analysis, taken from depth of 0.02-0.1 m of mineral soil. 57 soil samples were taken totaly (i.e., from 5 to 7 samples per treatment from one sampling site). Mixed samples were taken as triplicates.
We assessed soil hydrolimits [% vol.] including maximum capillary capacity (Θ_{MCC}), retention water capacity (Θ_{RWC}), porosity (P), minimal aeration capacity (A_{MCC}), bulk density (ρ_d) [g cm^{-3}], soil texture, specific density (ρ_s), soil reaction (pH/H_2O and pH/KCl), soil organic carbon (SOC) and total nitrogen (Nt) contents [%] and C/N ratio and such available untrient as P, K, Mg and Ca contents [mg kg^{-1}], using standard analytical procedures (Bremner 1996; Bremner and Mulvaney 1982; Zbíral et al. 2011). The results were processed using the program STATISTICA 12.

3 RESULTS AND DISCUSSION

Among all, available K, sand, and clay contents significantly differed between Pr and D. Soil samples from Pr showed slightly higher contents of clay and lower contents of the sand (Fig. 1). The soil textural classes were very similar according to the USDA triangle diagram with dominance of silty clay loam.
Available content of K (Fig. 1) showed lower values for D; however, all measured values were assessed as middle to favourable for forest soils. The lowest value (129 mg·kg^{-1}) was measured within Pr of pine forest. Content of K was evaluated as middle to favourable for forest soils. Considering very high contents of available Ca

(Pr – 7.948 mg·kg^{-1}, D – 8.359 mg·kg^{-1}) there is a possibility of Ca and K antagonism; and K might be displaced from soil sorption complex (Ujwala, 2011).
Available content of phosphorus varied from low values (9 mg·kg^{-1}) to favourable values (97 mg·kg^{-1}). Mg showed favourable or surplus contents. The found status of nutrition shows a deficiency of some elements (N, P, and C) and a significant surplus of calcium and magnesium.
Water retention capacity showed strong ability to hold water (average values of Θ_{RWC} ranged in Pr – 36.2 % and D – 34.1 %). Average values of porosity ranged in Pr – 45.6% and D – 46.1% which shows middle values. However, A_{MCC} was 4.7 % in Pr and 6.3 % in D, which means unfavourable conditions for water availability and risk of frequent anaerobism.
pH/KCl was mostly over 6.5 (neutral). Contents of SOC (Pr – 1.86 % and D – 1.77 %) and Nt (Pr – 0.17 % and D – 0.18 %) were evaluated as low to moderate. The C/N ratio ranged between favourable values of between 8 – 18 (10.2 for Pr and 10.1 for D in average).

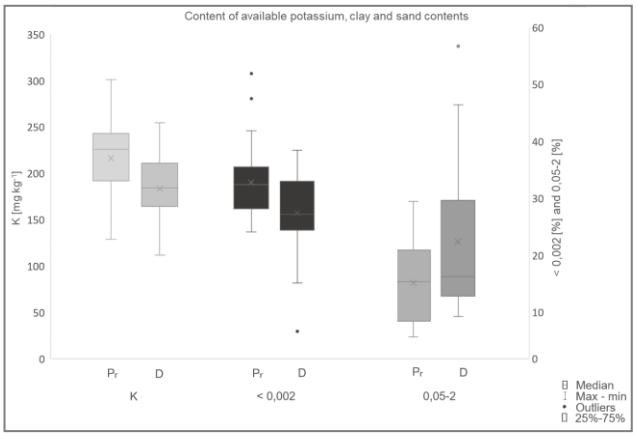

Fig. 1: Content of available potassium, clay and sand contents in prosperous (Pr) and decline (D) forest reclamation

4 CONCLUSION

All soil samples showed strong water holding capacity, middle values of porosity, and low minimal aeration.
Statistically significant soil properties were content of available potassium, clay and sand contents when compared declined and prospering reclamations. Nutrient content showed a deficiency of some elements (N, P, and C) and a significant surplus of calcium and magnesium.
The pH/KCl was neutral, reaching values over 6.5 pH/KCl. Contents of SOC and Nt were evaluated as low to moderate and C/N ratio had favourable values (between 8-18).
However, based on the results we cannot clearly explain reasons for the decline, the soil conditions were found as limiting in sense of soil hydrophysics and some aspect of soil trophism. Following studies can focus on detailed tree physiology and microsites characteristics.

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INFLUENCE OF DIFFERENT TREE SPECIES COMPOSITION ON THE COURSE OF HYDROLOGICAL EXTREMES IN MICROWATERSHEDS

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Key words: baseflow, baseflow index, micro-catchment, stormflow, Thomson weir

1 INTRODUCTION

Today, with rapidly changing land use, global climate change and the increasing need for quality drinking water, there is a growing interest in better use and understanding of valuable ecosystems, which forests undoubtedly are (Sun et al., 2008). To better use and understand forests, experimental watersheds are being established worldwide as a primary tool to assess the impact of forest and forestry interventions on the hydrological regime in the landscape and the overall water balance (Bosch and Hewlett, 1982; Brown et al., 2005). However, flood peak reduction in small catchments depends not only on the forest cover and distribution of stands within the catchment, but also on age, spatial and species composition (Kantor, 2003).

2 METHODOLOGY

2.1 WATERSHEDS DESCRIPTION

Three experimental microwatersheds of similar natural conditions, size, morphological characteristics, and shape with different composition of forest vegetation, which are part of the network of stabilized research watersheds of the ÚTOK LDF MENDELU, can be found on the territory of the Masaryk Forest Training Enterprise Křtiny. In the Kanice microwatershed, mixed spruce-beech stands predominate, in the Křtiny microwatershed predominate spruce stands and in the Útěchov microwatershed we encounter a predominance of beech stands. The analysis of the current tree composition in the catchments was carried out using remote sensing data from the Sentinel-2 satellite, by combining several vegetation indexes.

2.2 DATA GATHERING AND PROCESING

The flow measurement data were obtained using the ultrasonic level gauge US3200 together with the HYDRO-LOGGER H2 data logger (both Fiedler Automatic Monitoring Systems AMS, České Budějovice, Czech Republic). Climate stations to obtain climate data (MeteoUNI, Amet, Velké Bílovice, Czech Republic) were installed in the hollows within one kilometre of each spillway. Using hydrograph analysis, hydrologically extreme periods (EOE) within stabilized forest micro-watersheds with beech, spruce and mixed stands were identified using the percentile of exceeding 90 (Willems and Lloyd-Hughes, 2016). These were then classified according to episode duration into short-term and long-term extreme runoff episodes. EOE's themselves would be evaluated primarily using the baseflow index (BFI), which is determined by the ratio between the volume of baseflow and total runoff over a given period. Due to the above, the BFI index indirectly refers to the ability of a catchment to retain water and use it efficiently, but also to the ability to reduce flood runoff. EOE's were further compared between microwatersheds, considering different tree species composition.

3 RESULTS AND DISCUSSION

It was found that the stormflow ratio during hydrologically extreme periods was 61% of the total runoff in spruce stands, almost twice as high as in beech stands with a 32% ratio. Using runoff characteristics, the highest water-use efficiency of beech stands (min. baseflow index for short rainfall ø 0.63, median 0.65; for long ø 0.42, median 0.45) and the lowest water-use efficiency of spruce stands (min. baseflow index for short ø 0.40, median 0.33; for long ø 0.14, median 0.11) were found (Fig.1). This agrees with the results of a publication (Kupec et al., 2019), in which the authors evaluated the water management efficiency of stands in rainfall-free episodes. The results of these authors are also consistent with the observed decrease in water-use efficiency under long-term hydrological extremes. As mentioned, the results indicated decreasing water-use efficiency of stands in all three experimental watersheds with longer duration of extreme runoff episodes, with the lowest decrease of 32% in min. baseflow index recorded in the watershed with predominant beech vegetation cover and the highest decrease of 66% in the watershed with spruce stands (Fig.1).

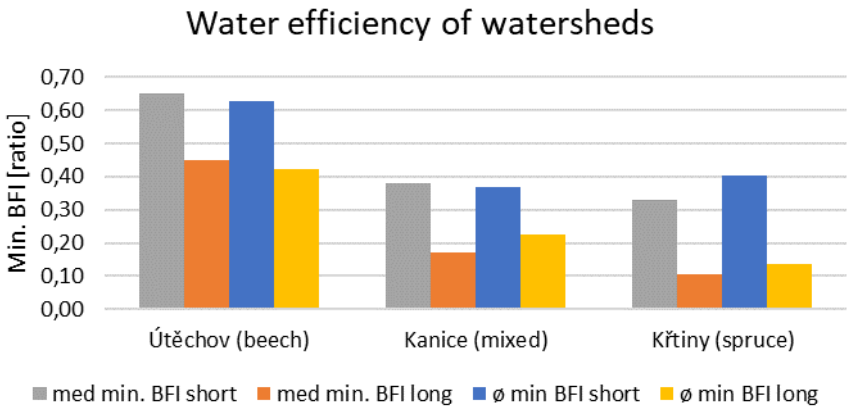

Fig. 1: Median and average of the minimum BFI of the experimental microwatersheds

The results can serve as a basis for future forest management in the area of the ML Křtiny and beyond and suggest possibilities for adaptation measures in forest ecosystems to climate change.

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WILD BOAR HUNTING AS A TOOL FOR FOREST PROTECTION

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Klíčová slova: forest ecosystem, forest damage, natural regeneration, *Sus scrofa*, wildlife management

The IGA project deals with the impact of wild boar rooting on the forest ecosystem, especially on the plant component but also on the entomofauna. The soil characteristics of the disturbed areas allow for the establishment of pioneer plants and species tied to loose soils, as well as anemochoric tree species. These ecosystem impacts are of interest to us, but the results of the monitoring will be known in the coming year.

This year we can therefore present further parts of our research activities related to wild boar. Any negative impacts on forest and other environments are largely influenced by the density of wild boar in the area. This depends, among other things, on the intensity of hunting pressure, which is determined by the number, hunting activity and equipment of hunters, and their motivation to hunt. To better understand the motivation of hunters to hunt wild boar and to propose effective solutions in the form of high-quality motivational tools for practice and government, we organised an extensive sociological survey. This targeted hunters associated in hunting organisations and individual hunters, not organised in associations, across the Czech Republic.

The survey was conducted via a questionnaire application between 21 June 2022 and 30 September 2022. The 52-question questionnaire was visited by 4,883 hunters, with 23.5 % completing the survey.

The results showed that the average Czech wild boar hunter spends 6.1 hours/week on hunting preparation, 10.3 hours/week on actual hunting, and 47.6 hours to hunt one wild boar. This is a summary result that includes both intensive and extensive hunters. Hunters reported that 56.5 % hunt 0-10 wild boar per year, 23 % hunt 11-21 wild boar, 11 % hunt 22-35 wild boar, and only 9.5 % of hunters hunt more than 36 wild boars. A very interesting finding is the proportion of wild boar hunted by hunting method. More than 65 % of wild boar were taken by still hunting and not even one percent were taken by trapping (see Fig. 1). 48.1 % of hunters agree with hunting of adult sows, but nearly 80 % of all hunters actively hunt them.

In terms of hunting satisfaction, 29.5 % of hunters are satisfied with their current hunting activity and 46.5 % would like to hunt more but do not have the time to do so.23.4 % of hunters use photo traps for hunting, 23.1 % of hunters use night vision scopes, 19.3 % own a thermal imaging device but only 4.4% have a shot silencer on their gun. 41.4 % of hunters have hunting equipment worth from 77 thousand to 210 thousand Czech crowns, 36.2 % worth from 21 thousand to 75 thousand Czech crowns.

Hunters consume most of the venison produced from wild boar in their own households (39.5 %) or give venison to friends and acquaintances (17.6 %). The hunting ground user consumes 18.6 %, 8.7 % is sold to the final consumer and 15.5 % goes to the meat buyer. The main motivation for hunting wild boar was identified by hunters as "the need to control wild boar numbers" and equally important is "hunting attractiveness".

These are only preliminary results, which will be statistically evaluated in collaboration with sociologists and then published in a quality scientific journal.

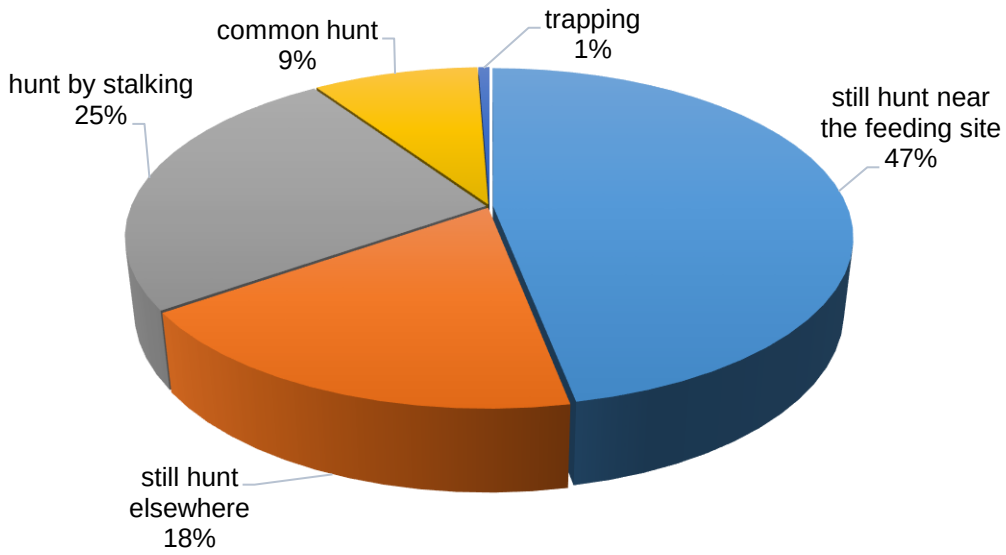

Fig. 1: Percentage of wild boar hunted by hunting method

ACKNOWLEDGEMENT
The research was supported by the Specific University Research Fund MENDELU.

NUTRIENTS DYNAMICS OF MISTLETOE *VISCUM ALBUM* L. AND ITS HOST *TILIA CORDATA* MILL.

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Keywords: calcium, hemiparasite, leaf development, nitrogen

1 INTRODUCTION

Trees in urban areas provide us with a lot of benefits, from aesthetics to sanitary functions and it is very important to preserve them from any kind of damage. One of the factors threatening the vitality of trees is perennial evergreen mistletoe - *Viscum album* sp., which can even cause the death of its host (Zuber, 2004). Nowadays, the area of *Viscum album* is increasing and thus action should be taken to suppress its spread (Zuber, 2004). Mistletoe negatively affects its host in many aspects: it slows down the growth and development of a tree, affects the quality of fruiting, and negatively affects the quality and quantity of wood, making the host more vulnerable to infection with other decomposing pathogens (Zuber, 2004). It is also known from past research that mistletoe drains nutrients and water from its host (Glatzel, 1983). Nevertheless, there are not many studies examining the dynamics of nutrient levels of mistletoe and its host during the growing season (Gebauer et al., 2012). Hence, this article describes the nutrient dynamics of mistletoe (*Viscum album* supsp. *album*) and its host tree (*Tilia cordata* Mill.) during the vegetation season.

2 MATERIAL AND METHODS

Our research took place on the territory of the Brno city cemetery, Czech Republic (49°10’14,55” N and 16°35’38.83” E). This area was heavily infested with the mistletoe, *Viscum album*, growing on the linden trees, *Tilia cordata*. Leaf samples of both species were collected from 10 linden trees infected with mistletoe 6 times during growing season. One mistletoe per tree was used for leaf sampling. 16 leaves were collected from both each linden tree and mistletoe. Moreover, 16 one-year old leaves of Viscum were collected till their falling.

Six leaves per species and per sampling day were scanned to measure projected leaf area (PLA). Then these leaves were dried and leaf mass per unit area (LMA) was calculated. Remaining samples were dried for nutrient analysis: nitrogen (N), phosphorus (P), calcium (Ca) and potassium (K), which was done in the accredited laboratory (Laboratoř Morava, Czech Republic).

3 RESULTS AND DISCUSSION

The development of the leaf area took two months longer for *Viscum* than for *Tilia*, and for *Viscum* it lasted until the beginning of September (Fig. 1A). Similarly, slower leaf development was observer for other mistletoe *Loranthus europaeus* growing on oak (Gebauer et al., 2012). The LMA analysis has shown that *Viscum* leaves were always heavier per unit leaf area than *Tilia* leaves (Fig. 1B). Moreover, LMA differences between the two species increased during the growing season and LMA of current-year *Viscum* leaves was 3 times higher compared to *Tilia* leaves at the end of growing season (Fig. 1B). Correspondingly, the highest LMA values were observed for

perennial evergreen species (Poorter et al., 2009). A higher LMA was also associated with leaf succulent (Poorter et al., 2009).
Nutrient analysis has shown that current-year *Viscum* leaves had 1.6, 4.9- and 3.9-times higher N, K and P, respectively, than *Tilia* leaves at the end of growing season (Fig. 2). It corresponds with observations that mistletoes have higher nutrient concentration in leaves than its host (Zuber, 2004; Glatzel, 1983; Gebauer et al., 2012). Nevertheless, calcium concentration in current-year *Viscum* leaves was like *Tilia* leaves (Fig. 2). The opposite result for calcium was found for *Lornathus* and a higher calcium concentration in mistletoe leaves was explained by higher transpiration of the mistletoe compared to its host (Gebauer et al, 2012). It seems that *Viscum* can get rid of excess calcium.

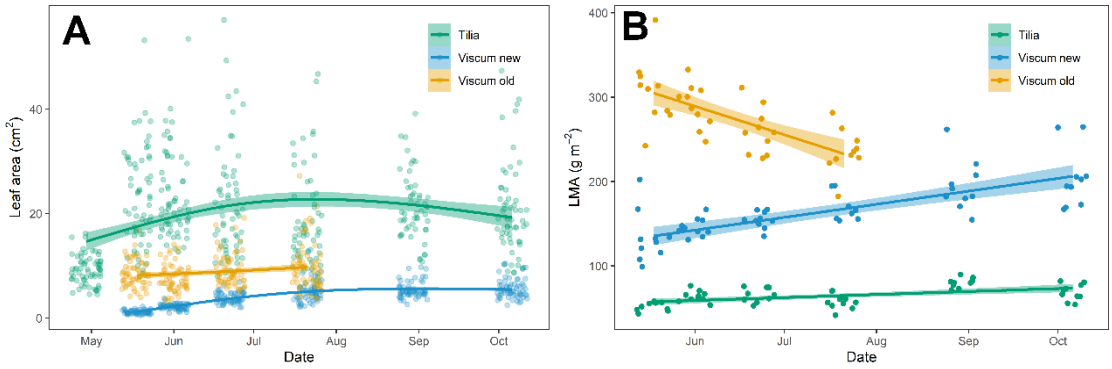

Fig. 1: A – Leaf area development during vegetation season. B – Leaf mass per area (LMA) development during vegetation season. Green line - current-year leaves of *Tilia*, blue line - current-year leaves of *Viscum*, orange line - one-year old leaves of *Viscum*.

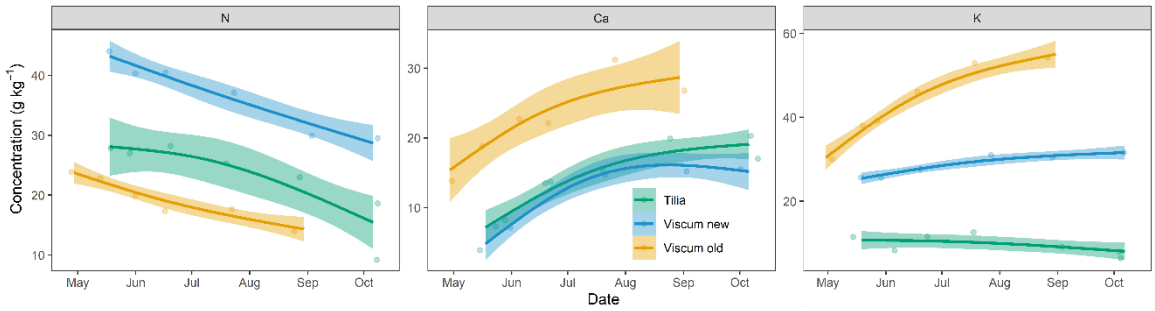

Fig. 2: Nitrogen (N), calcium (Ca) and potassium (K) dynamics during vegetation season. Green line - current-year leaves of *Tilia*, blue line - current-year leaves of *Viscum*, orange line - one-year old leaves of *Viscum*.

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IMPACT OF LOCAL AND LANDSCAPE FACTORS ON DIVERSITY AND FUNCTION OF SPIDERS IN TROPICAL FORESTS OF THAILAND

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Keywords: Araneae, food webs, forest management, forest protection, land use, species traits, reforestation

The dramatic decline in tropical forests is one of the most serious environmental problems in recent history (Lamb 2014, Rosa et al. 2016). Most of the tropical forests of Southeast Asia are under the pressure of deforestation and land-use change (Asner et al., 2009; Vityakon et al., 2004). It leads to the loss of functionally important organisms and alters the local food-webs (Barnes et al., 2014; Derhé et al., 2016; Potapov et al., 2019). The decline in spider diversity affects the ecosystem processes such as decomposition and primary production (Lawrence and Wise, 2000; Nyffeler and Birkhofer, 2017; Michalko et al., 2019). Spiders are influenced not only by local factors (habitat structure) but also by landscape factors (landscape structure) (Horváth et al., 2019). Nevertheless, it is still largely understudied how the local and landscape factors affect the diversity and functions of spiders in tropical forests.

We studied predator-prey interactions along the agricultural intensification gradient in dry dipterocarp forests of Thailand. We sampled web-building spiders with their prey and measured the availability of potential prey within 21 dipterocarp forests. We evaluated the vegetation structure and landscape composition for each plot. Furthermore, we measured species traits such as web type and body size. Vegetation structure and land use can determine selected species traits, which can affect the interactions between spiders and their prey. The vegetation structure did not influence the food-webs, however, the food-webs were affected by the land use. The evenness of captured prey was affected by the proportion of agroecosystems. It showed a hump-shaped relationship, thus indicating weak to moderate landscape diversification could support ecosystem functioning in dry dipterocarp forests. The web type influenced the prey composition and the total number of captured prey was affected by the total prey availability. We revealed that the land-use change from forests to agricultural landscapes is a significant threat to the functioning of the dry dipterocarp forests.

In the next experiment, we sampled spiders to reveal the impact of reforestation by native and non-native tree species on spider diversity in Northeast Thailand (Sakaerat Silvicultural Research Station). We aimed to study various indicators of spider diversity (taxonomic, functional, phylogenetic) including the interactions between spiders and their prey in reforestations with native (*Shorea* spp., *Hopea* spp.) and non-native (*Eucalyptus* spp., *Acacia* spp.) tree species and compare them with natural control (dry evergreen forest). Collected data from the first sampling period (June 2022) are now

processed and will be analysed after the second sampling of material (November 2022).

Furthermore, we analysed how the reforestation type (*Eucalyptus*, secondary succession) affects the presence of trophic cascades in comparison to natural control represented by dry evergreen forest. The trophic cascade was represented by the effect of invertebrate predators on the decomposition rate. The study took place in North-Eastern Thailand. We performed the experiment in three forest types which were represented by six spatial replications: dry evergreen forest (control), secondary forest and eucalyptus plantation. In each stand, we placed three plots (treatments) of the size of 1 m^2 (1 × 1 m) randomly at a distance of at least 5 m: a) natural control, b) fenced control and c) fenced predator exclusion. We manipulated both types of manipulations in the same way/time to avoid possible confounding effects. The decomposition rate was measured by the litterbags method and each bag contained 1 g of dried leaf of the most dominant tree species/forest type (Lawrence & Wise 2000). Three litter bags were placed in each plot in the middle of May 2022 and were collected for weight measurement in June 2022. In our preliminary results, we revealed that predator exclusion increased the decomposition rate in secondary forests. Our preliminary data suggest that spiders may be responsible for the shift in the decomposition rate in the secondary forests as they were the dominant predator group. Therefore, they are an essential part of the proper functioning forest ecosystem of Thailand.

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PERSIST – SWEDISH HYDROLOGICAL SOFTWARE IN TRAINING FOREST ENTERPRISE KŘTINY

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Keywords: conceptual model, hydrological modelling, microwatershed, semi-distributed model

1 INTRODUCTION

In this paper we deal with hydrological modelling in PERSiST (Futter et al., 2014) on the background of Kanice forest micro watershed – we explore the ways to calibrate and refine model parameters with respect to land use, terrain morphology and sub-basin approach within the semi-distributed PERSiST model, which we already took advantage wile working around the common uncertainties with local field data (Deutscher et al., 2021).
Literature refers to many types of hydrological models of which we mention the lumped, semi-distributed and conceptual model: i) in lumped model the streamflow routing and streamflow generation processes in general are as compartment represented by an average response of a process over a whole watershed. ii) semi-distributed model allow accounting for variability, but this is limited to the number of partial spatial components. iii) conceptual model of "gray-box model" is rather based on observed on assumed empirical relationships among variables. With conceptual model we test our assumptions, specify them, or refute them at all (Liu et al., 2017).

2 MATERIALS AND METHODS

We worked on the 2020 data from Kanice catchment specified elsewhere (Deutscher et al., 2021) and in PERSiST hydrological model. We tried several approaches: i) homogenous parameters on the whole catchment, ii) subdivision of the catchment based on different tree species composition, iii) influence of the presence of forest roads and iv) subdivision of the catchment into units with different slope gradients.
The model itself uses measured values of precipitation, temperatures, discharge, transpiration, and soil moisture in hourly step. It also accounts for growing degree threshold, canopy interception, ET adjustment, soil porosity, infiltration velocity, retained water depths, maximum capacity, and time response constant.

3 RESULTS AND DISCUSSION

It turned out that it is the subdivision of non-smaller areas that leads to a more accurate model calibration (62 %), especially distinguishing the presence of forest roads. The increase in model accuracy was achieved in proportion to the amount and accuracy of the data used. We evaluated the water balance of the model and the quantification of its components. We show that evapotranspiration is the largest contributor to the water loss from the watershed, in our case accounting for 68.7 % of the precipitation over the whole period, while the runoff quantities were quantified by the model at only 3.2 % of the precipitation. Thus, despite a possible slight underestimation of the model (in the case of runoff), it is shown
and confirmed how much influence woody vegetation has on the components of the water balance of the forest micro-watershed. We have also concluded that even the

lumped version of the model (no spatial differentiation of the land use) gives the modeled values with reasonable accuracy. The number of parameters use multiply the amount of time needed for calibration and processing of the model setup. One of the result highlights is the influence of the existence and density of forest roads which accounted for relatively high model accuracy although they area of the forest roads is futile compared to the other land use components. This gives us the example of hydrological model conceptualization and its use in forest environment.

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DEVELOPMENT OF MERCHANTABLE STEM VOLUME EQUATION FOR DOUGLAS FIR IN THE CONDITIONS OF THE CZECH REPUBLIC

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Keywords: merchantable stem volume, Pseudotsuga menziesii, stem profiles, stem shape, volume tables

1 INTRODUCTION

Douglas fir (*Pseudotsuga menziesii* [Mirb.] Franco) is important commercial species of forest stands in North America as in the Europe (Podrázský et al., 2020). Current representation of Douglas fir in the Czech forests is 0.26% (Čihák, Vejpustková, 2022). Douglas fir is an interesting tree, because it can partially substitute declining Norway spruce (Podrázský et al., 2020). Due to the low representation of Douglas fir in the forest stands, volume equation for Douglas-fir merchantable stem volume determination in the Czech Republic is missing. As alternative volume tables of silver fir (*Abies alba* Mill.) are used for it. The aim of this study is to develop new merchantable stem volume equation for Douglas fir.

2 MATERIALS AND METHODS

Dataset was collected from approximately 150 felled sample trees of Douglas fir. On these sample trees merchantable stem volume (v), breast height diameter (dbh), total tree height (h) and diameter at intervals of 1 m along the stem (d) were measured. The Smalian method was used to determine volume of these sections. The merchantable stem volume was calculated as sum of section volumes. Sample trees were felled at Training Forest Enterprise Masaryk Forest Křtiny, Training Forest District Hůrky and Forests of Písek city. Stands were selected through all age classes, where trees with merchantable volume could be expected. Four types of volume equations were tested: Equation of Petráš and Pajtík (1991) for silver fir and its modification from Valenta and Šešulka (2015), Equation of Omule et al. (1987) for Douglas fir in British Columbia and Equation of Vallet et al. (2006) for Douglas fir in France. For all tested equation selected goodness of fit criteria were calculated (determination index – R^2, mean of residuals – MR, standard deviation of residuals – SD, standard error of residuals – SE, root mean square error – RMSE and Akaike´s information criterion – AIC (Akaike, 1973).

3 RESULTS AND DISCUSSION

Four tested types of volume equations provided similar results (Tab. 1). The best values of evaluated criteria were found for volume equation of Omule et al. (1987). Parameters of this final volume equation are written in formula 1:

$$v = e^{(10.13854+1.67411\ln(dbh)+1.306623\ln(h)} \quad (1)$$

The results are shown that volume equation defined by Omule et al. (1987) is provided unbiased estimation of merchantable stem volume for Douglas fir in the Czech Republic as same as in the British Columbia.

Tab. 1: Values of evaluated goodness of fit criteria

Model	MR	SD	SE	R^2	AIC	RMSE
Vallet	-0.008225	0.292934	0.027316	0.957842	-279.309	0.29434
Omule et al.	-0.008362	0.290694	0.027107	0.958476	-279.070	0.29340
Petráš, Pajtík	-0.009921	0.291243	0.027159	0.958307	-272.597	0.29802
Valenta, Šešulka	-0.010173	0.291237	0.027158	0.958306	-272.595	0.29803

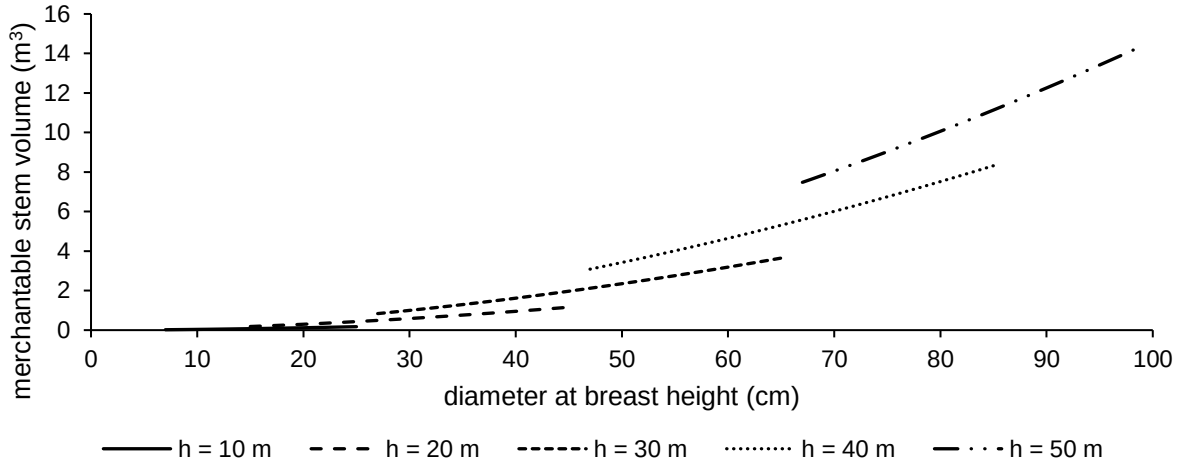

Fig. 1: Fitted values of merchantable stem volume modelled by volume equation (Omule et al. 1987) in relationship to diameter at breast height and total tree height (10-50 metres).

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DIEBACK ENVIRONMENT FROM A FOREST SOIL PERSPECTIVE – 2ND YEAR PROJECT REPORT

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Keywords: bark beetle, forest hydrology, Norway spruce, soil biochemistry, soil moisture

1 INTRODUCTION

In Central Europe, disturbance to Norway spruce (*Picea abies* (L.)) stands has largely been attributed to droughts in 2018 and 2019 (Hari et al. 2020; Kornhuber et al. 2019). However, our understanding of forest soil responses to drought-induced tree mortality is far from complete (Allen et al. 2015). For example, while tree canopy removal can cause increased air and surface temperatures, forest floor and topsoil moisture levels often increase (Špulák et al. 2021). In this study, we assess the significance of different post-disturbance management conditions on forest regeneration and parallel effects linked with soil condition in three representative forest types, i.e., clear-cut sites, disturbed forest with dead trees and living (healthy) uncut forest. The study was realised under four "work packages": WP1 – Soil typology; WP2 – Soil biochemistry and biology; WP3 – Humus conditions and soil carbon; WP4 – Physical and hydrophysical properties. Owing to the large dataset obtained for soil properties, this study focuses on soil enzymatic activity and soil moisture dynamics.

2 MATERIAL AND METHODS

The design strategy ensured that each study locality included three treatments (living forest, disturbed forest and clear-cut sites) with similar soil and meteorological conditions, the plots being established using the design of Fidler et al. (2021). In 2021, study sites were established in two Bohemian (Benešov, Vilémov) and three Moravian (Vranov, Velká Bítes, Černá hora I) spruce monocultures, the site list being expanded to include three new Moravian spruce monocultures (Černá Hora II, Vír, Letovice) and repeat sampling at Vilémov in 2022. A more detailed description of the study localities is provided in Vichta (2022). At each plot, soil samples were obtained using two sampling protocols. The first focused on vertical differences in soil enzymatic activity in the forest floor and topsoil, with soil enzyme activity from C-hydrolases (C-cycle) and N-hydrolases (N-cycle) being determined using fluorogenic substrates, according to Bárta et al. (2014), and labile carbon levels in the soil determined by measuring POxC, according to Weil et al. (2003). The second protocol established the vertical dynamics of soil water in the soil column and individual soil layers, the soil water regime being measured using TDR or TDT sensors (EMS Kučera, Brno) at three depth profiles (10, 30 and 60 cm). The resulting time series covered the period of rainwater replenishment (October to December 2021) and period of intensive vegetation growth (May to July 2022). All tests were performed at a significance level of 5 % (i.e., $p < 0.05$) using the Statistica software package v.14.

3 RESULTS AND DISCUSSION

There was a significant difference between the living and disturbed forests and the clear-cut site at Vranov, with N-hydrolase activity being higher in the living and disturbed forest. At Černá hora and Velká Bíteš, the amount of labile carbon was highest in the living forest. For all other localities, there was no significant difference in C-hydrolase and N-hydrolase activity and the amount of labile carbon between different forest stand sites. All sites showed a similar soil water content (SWC) distribution within the soil column, with sites at the disturbed site having the highest SWC, followed by clear-cut sites and living forest sites. Overall SWC values for the entire column were significantly different between clear-cut and living forest sites, however, with SWC being higher in the living forest at Velká Bíteš and clear-cut sites at Vranov and Černá Hora. According to Kopáček et al. (2020), the impacts of forest disturbance on SWC are particularly significant in the upper forest soil layer, a finding confirmed in our own study, with significant differences in SWC at 10 cm depth at all localities.

4 CONCLUSIONS

Our results confirm the general assumption of disturbed forests with dead trees being 'wetter' than clear-cut sites, followed by living forests. While we found similar results with the amount of labile soil carbon, there were no clear differences between stands in C-hydrolase and N-hydrolase activity. As such, we suggest that deeper layers are primarily influenced by soil substrate properties and not by disturbance to forest cover. Further phases of this research will focus on the organic and organic-mineral soil layers (to a max. depth of 30 cm).

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ARE GREEN BRIDGES LOCATED OFF THE MOTORWAY NETWORK IN LOWER AUSTRIA A JUSTIFIED SOLUTION FOR ENHANCING PERMEABILITY FOR MAMMALS?

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Keywords: animal behaviour, landscape connecting, landscape fragmentation, mitigation measures, photo traps, road ecology, traffic safety, wildlife overpasses

1 INTRODUCTION

The development of road infrastructure is increasingly fragmenting the natural habitats of wildlife and causing genetic disjunction of populations. This process is known as landscape fragmentation (Forman et al. 2003, Clevenger & Wierzchowski 2006, Jaeger et al. 2016). The degree of landscape fragmentation by road infrastructure is reflected by wildlife-vehicle collisions (WVC), which generate considerable economic damage, but also injury or death to road users or wild animals. Currently, WVC are increasing year by year, for example in the Czech Republic where 15.5 % of WVCs are registered from all accidents for 2021 (Czech Police 2022). For this reason, there is a growing need across whole word for exact testing of already applied preventive measures (van der Grift 2011). In the future, we expect that road infrastructure will continue to grow with the needs of people (Laurance et al. 2014) and this will support the increasing risk of WVC. Many European countries have applied several mitigation measures, including green bridges (wildlife overpasses), to reduce WVC and to increase the permeability of the landscape. Not every measure applied in practice has been successful, and therefore follow-up testing of the effectiveness of preventive measures is quite appropriate. Green bridges provide permeability for wildlife across the linear barrier. These special structures are one of the economically challenging and often debated structures that are usually built over highway infrastructure. This study is one of the first to elucidate the effectiveness of mammal permeability, behavioral aspects on selected green bridges located outside the highway network. Studying the effectiveness of applied measures and green bridges is extremely important for possible optimization and improvement of similar structures in the future.

2 MATERIAL AND METHODS

Eight green bridges in Lower Austria, near the towns of Mistelbach, Retz and Maissau, were selected for the study. These green bridges have been built relatively recently (2005-2015) and are located on first class roads with an average traffic of about 9000 vehicles per day (Straßenmeisterei Retz, pers. comm. 2022). The traffic volume is about 2-3 less compared to motorways. The green bridges have a similar structural design (presence of a vegetation strip and a dedicated road); however, they have different width and length parameters.

Automated infrared phototraps (Browning, Coolife) were chosen for data collection purposes and were placed in the middle of the green bridge to cover the entire body of the green bridge. Monitoring began during January 2022 and is planned to continue until the end of 2022. So far, a total of nearly 16,500 records of wildlife and human activity have been recorded on the green bridges. The data collected is in the process

of being evaluated. The plan is to answer questions about human influence on the use of green bridges for wildlife, overall permeability for wildlife, influence of object design and parameters on functionality of the bridges, assessment of the direction of movement, location and behaviour of wildlife on green bridges. We will expect the comparison of collected data with another obtained data from green bridges on motorways at the same time within the landscape of Lower Austria.

3 PRELIMINARY RESULTS

The total records of human activity (53.6 %) on green bridges to date outweigh the records of mammal activity (46.4 %). Seven mammal species have been recorded i.e., roe deer (57.7 %), brown hare (35.3 %), red fox (4.6 %), marten (0.9 %), badger (0.9 %), wild boar (0.1 %), domestic cat (0.1 %) and unspecified animals (0.4 %). Mammals that are among the most frequent victims of wildlife-vehicle collisions (Statistik Austria 2022) i.e., roe deer, hare, fox, marten were recorded on all monitored green bridges.
Of the human activity, the most prevalent records were cars (42 %), pedestrian passage (21.6 %), forest and agricultural equipment passage (17.9 %), cyclists (7.8 %), pedestrians with dogs (7.4 %) and other human categories i.e., motorcyclists, horse riders, trucks, etc. (3.3 %).

4 CONCLUSIONS

The data obtained so far suggest that even green bridges on roads with lower traffic intensity are permeable to mammals and used also for human activities. Green bridges represent a compromise for maintaining landscape permeability for wildlife while helping to increase traffic safety. The need for further research in road ecology is essential given current trends.

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ANALYSIS OF DENDROMETRIC PARAMETERS OF BEECH STANDS WITH DIFFERENT MANAGEMENT TYPES AT THE TRAINING FOREST ENTERPRISE MASARYK FOREST KŘTINY

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Keywords: Dauerwald, diameter analysis, even-aged forest, uneven-aged forest

1 INTRODUCTION

Remeš et al. (2015) investigated increment in beech stands aged 37-48 years, where at a density of 150-160 target individuals/ha the increment was 0,39-0,52 cm/year.
Brang et al. (2014) summarizes the possibilities of close-to-nature silviculture and concludes that management systems need to be revised. He concludes that the focus should be on increasing not only tree species diversity but also to individual trees. This contribution is focused on comparison of DBH (diameter at breast height) and volume of 6 beech forest stands with different management at oak-beech vegetation zone.

2 METHODS

The selection of stands was made on the property of the Training Forest enterprise Masaryk Forest Křtiny (Czech Republic). The types of studied management:

1. Increment thinning - strong release crown thinning, which aims to completely free the crown area and maximize thickness growth.
2. Borgreve – Voropanov thinning – heavy crown thinning and cut off physiological old trees, which also aims to maximise growth.
3. Shelterwood – Forest regeneration with reduced density (below 70 %).
4. Dauerwald - forest in conversion to permanently creative, with elements of group selection and permanent forest production.
5. Nature reserve - an area that is free from human influence. For this purpose, an area without human intervention for 60 years has been used (the Březinka Nature Reserve).
6. Uneven-aged forest - conversion of forest to Uneven-aged forest - for beech may have elements of group and individual selection.

The basic information about the selected stands according to the management method are in Tab. 1. All management types are at approximately the same elevation on nutrient-rich edaphic series.

Tab. 1: Information about selected stands of different management types

MANAGE-MENT	INCREMENT THINNING	SHELTER-WOOD	BORGREVE-VOROPANOV	DAUERWALD	NATURE RESERVE	UNEVEN-AGED
ID FOREST	348_D7	341_A11	315_A8a	169_A12/1b	346_A 16/5/3	109_C9
EDAPHIC SERIES	B – Nutrient-rich					
VEGETA-TION ZONE	3	2	3	3	3	3

ALTITUDE (m a. s. l.)	480	408	507	505	487	501
AGE (year)	74	114	85	123	169	100

3 RESULTS AND DISCUSSION

We evaluated the 20 largest trees (by diameter) per management type which represented production potential of each stand. These trees were then drilled and sampled for increment analysis using a Pressler's orthosis. Mean diameter and volume of all stands were comparable, only the “Nature reserve” showed higher values of these parameters. However, this is due to the age of this forest stand in comparison to the other management types. In contrast Borgreve – Voropanov and Increment thinning managements were considerably younger than the others but described parameters of the largest trees were similar as the others (except Nature reserve management).

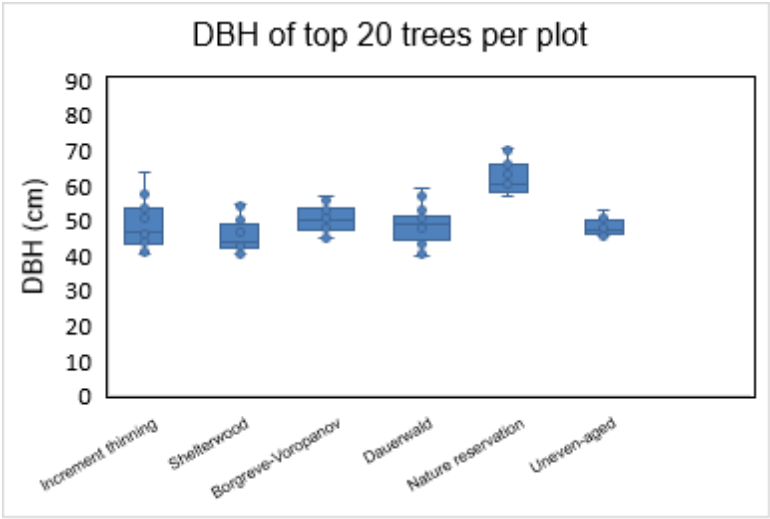

Fig. 1: DBH of top 20 trees per plot which were drilled for next analysis

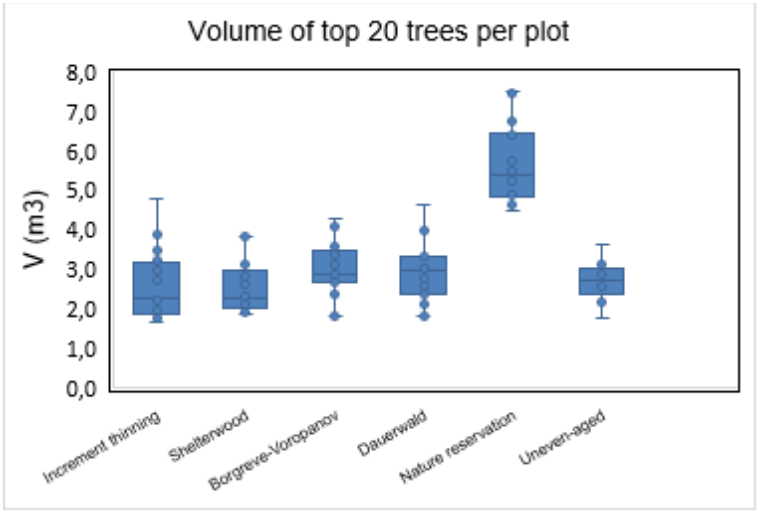

Fig. 2: Volume of top 20 trees per plot which were drilled for next analysis

4 CONCLUSION

The different management forms show approximately similar DBH and Volume values except for Nature Reserve. Based on our results, we can conclude that beech can grow faster after heavy crown thinning. Production of these stands can be same as in older forest stands (age difference more than 20 years). These results are preliminary so further analyses are needed and will be conducted on the basis on the of the trees' competence (CI) and their resistance to climatic variation.

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INFLUENCE OF CLIMATIC FACTORS ON THE GROWTH DYNAMICS OF STANDS WITH DIFFERENT STRUCTURES AND ITS EFFECT ON THE SOIL

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Keywords: global climate change, stand structure, volume production

1 INTRODUCTION

Due to ongoing global climate change (GCC), forest ecosystems are initially weakened by abiotic factors. Secondary biotic factors damage the debilitated stands. GCC is characterised by increased air temperatures and changes in the annual distribution of precipitation (Cavin et al. 2013). These factors increase the risk of reduced tree growth and mortality in the ecosystem (Adams et al. 2012). Nowadays, mixed stands seem to be a promising adaptation strategy for sustainable management under risky climatic conditions (Pretzsch and Schütze 2021; Pretzsch et al. 2021). Mixed stands can outperform monocultures in production (Jactel et al. 2018) and are more efficient in the use of resources (Forrester 2014). Evenly, the production dominance of mixed stands can be amplified during dry periods (Dănescu et al. 2018).

2 METHODS

In total, seven triplets, always involving three different stand structures (A, B, C) described below, have been established countrywide (Polánky, Hradec Králové, Šumava, Beskydy, Křtiny). The triplets consist of all four main tree species in the CR (i.e., beech, spruce, pine, and oak) depending on altitudinal zones. Each triplet area is more extensive than 0.5 ha (individual plots with an area of from 40x40 m to 50x50 m, depending on species and structural diversity), and all three plots (A, B, C) occur at the same site (soil and climate). All trees in each plot were inventoried (DBH, tree height, crown base height, stem positions, and crown projections).
Each triplet consists of three forest stands with different structures:
A – monospecific even-aged stand (monoculture)
B – even-aged mixed stand (two individually mixed tree species)
C – uneven-aged mixtures (differentiated stands with rich structure – DBH, tree height, spatial differentiation, and species richness)
Increment cores are taken from upper-layer dominant trees using a Pressler borer for growth response assessment. Part of the soil samples have already been taken and are under lab analysis to evaluate the influence of stand structures on soil properties.

3 RESULTS AND DISCUSSION

In Figs. 1-3, the spatial arrangement of the trees in each variant within the triplet (A-C, Polánky) is shown. Subsequently, stand structural parameters (Clark-Evans index,

Artenprofile index, Shannon index, Gini index, etc.) will be calculated from inventoried data. Preliminary results include the first analyses of the spatial pattern of the stand.

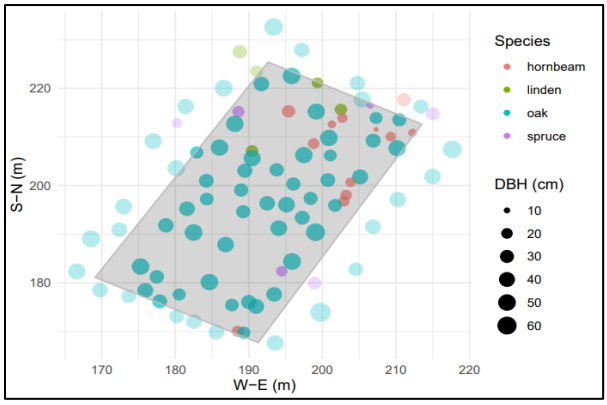

Fig. 2: Tree diameter distribution at A category

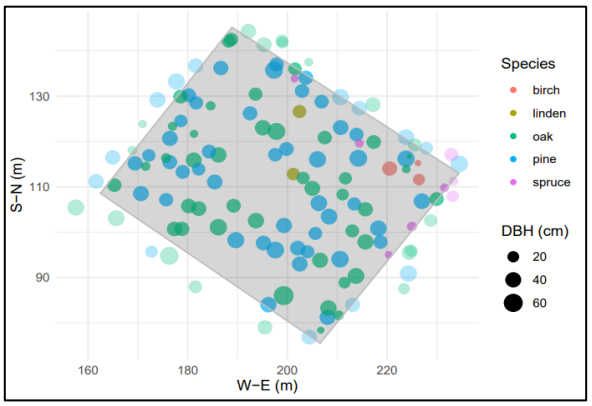

Fig. 1: Tree diameter distribution at B category

4 CONCLUSION

Based on the first-year data, we can conclude that studied variants within triplet differ in the distribution of diameter classes. However, not all datasets have been analysed yet to generalise preliminary results. In Fig. 2, an excellent example of the individual type of mixing, which was one of the main objectives and criteria for selecting the B category, is represented. In contrast, spatial stand differentiation is depicted in Fig. 3. At Polánky, mainly pine with admixed oak occurred in the upper layer, whereas a mixture of oak, spruce, birch, and mountain ash constituted the stand understory.

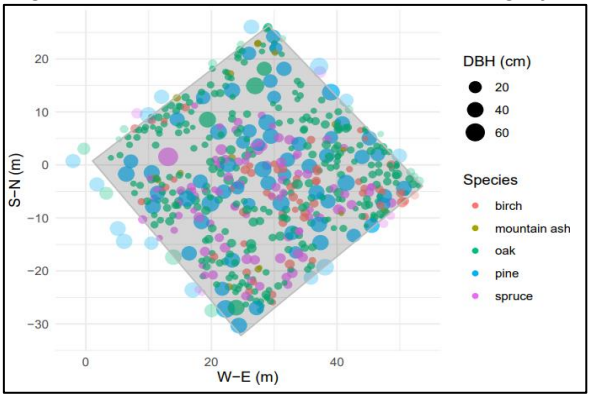

Fig. 3: Tree diameter distribution at C category

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MONITORING OF BARK BEETLE INFESTATION USING MULTITEMPORAL REGRESSION IN SPECTRAL TIME SERIES ACQUIRED BY UAV

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Keywords: bark beetle infestation, drone, multispectral data, remote sensing, UAV

1 INTRODUCTION

Permanent monitoring, early identification, and harvesting of affected trees are essential in forest protection. Conventional ground methods are time consuming, and, in the case of large, damaged area, they are usually expensive and not efficient, as they require the assessment of individual trees. Remote sensing data are useful for detecting and monitoring areas infested by bark beetles (Hall et al., 2016), as they provide global, spatially continuous, and periodic data on vegetation condition (Trumbore et al., 2015). Remote sensing data can also contribute to reduce costs associated with field campaigns. Early warning systems are needed to curb the spread as well as to help foresters know the factors facilitating bark beetle attack. The effects of bark beetle on leaf properties affect reflectance in the near-infrared (NIR) and shortwave infrared (SWIR) spectral domains (i.e., 730–1370 nm) (Abdullah et al., 2019). Approaches based on multi-temporal spectral indices have proven to be the most effective to detect bark beetle effects at the green attack phase (Fernandez-Carrillo et al., 2020).

2 METHODOLOGY

In the first two years of the project, two localities (Proklest at University Forest Enterprise Křtiny and Deblín – Municipal Forests Brno) were captured repeatedly using an unmanned aerial vehicle equipped with multispectral camera. Data were collected every two weeks during the growing season and includes a ground investigation of tree defoliation using the ICP Forest methodology. A normalized differential vegetation index (NDVI) (Figure 1) and a normalized differential red edge index (NDRE) were calculated from each dataset for a given time point. In the created canopy height model, individual trees were identified, and mean values of vegetation indices were calculated. Since the values of vegetation indices differ during the vegetation period, a theoretical spectral model of tree behaviour will be created using multitemporal regression (Fernandez-Carrillo et al., 2020), where the vegetation index at the beginning of the vegetation period represents the explanatory variable and other time points represent the response variable. Trees that show significant residual values will be the infested ones. The goal will be to find out at what moment the infected trees can be detected first (ideally in the green phase attack phase).

Bitemporal regression models were constructed for the health status analysis, where the vegetation index (VI) from the beginning of growing season is used as the independent variable and VI during the growing season is used as the dependent variable (Figure 2). It is assumed, that residuals of these models will then represent infested trees.

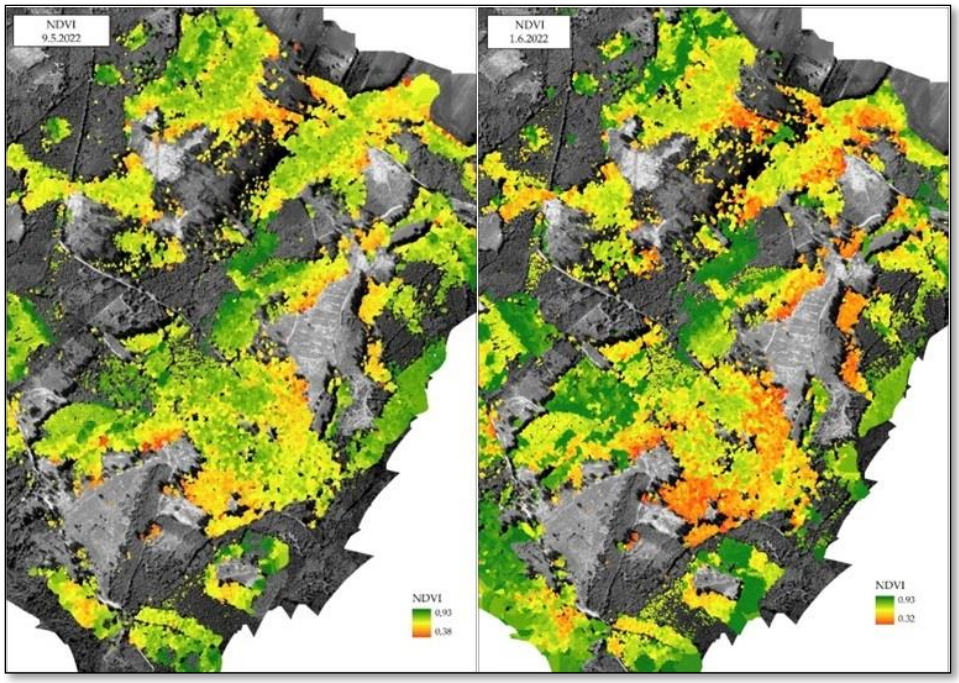

Fig. 1: NDVI – comparison of results carried out on May 9th and June 1st

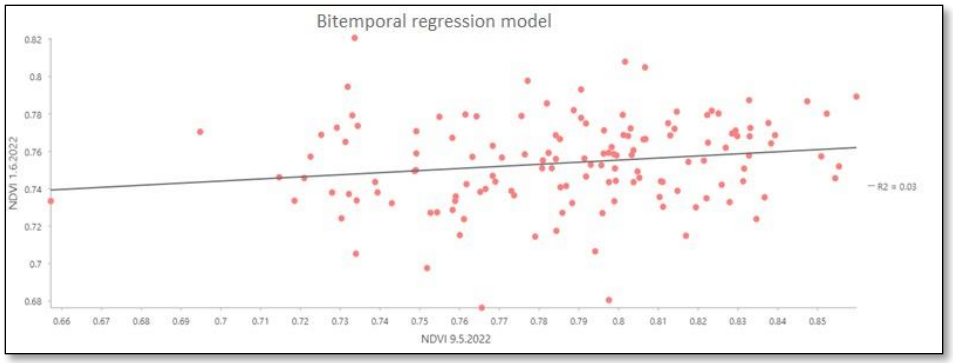

Fig. 2: Bitemporal regression model of spectral behaviour of vegetation

Within the project, an article (Evaluating Recent and Future Climatic Suitability for the Cultivation of Norway Spruce in the Czech Republic in Comparison with Observed Tree Cover Loss between 2001 and 2020) has already been published.

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POTENTIAL USE OF MOBILE LASER SCANNING USING LIDAR INTEGRATED IN A MOBILE DEVICE FOR FOREST ROAD MAPPING

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Keywords: forest road wearing course damage, LiDAR, mobile laser scanning, terrestrial laser scanning

Currently, there is a significant wear on the surface of forest roads built in the Czech Republic, which are approximately the same length as all other roads administered by the state and its regions. Although they are not as used as other roads, they are a subject to rapid wear, as logging trucks carry the maximum permitted load on roads, and forests create a specific microclimate. To ensure good condition and durability of forest roads, more efficient and more flexible surface damage detection adaptable for forest environment are needed.
To this date, the most used method of data acquisition and road condition monitoring is tacheometric surveying with the use of total station, but the actual process of data acquisition is relatively time-consuming. Therefore, this work aimed to test the possibilities of mobile laser scanning using LiDAR integrated in a smartphone device, as the smartphone devices and their optical sensors are becoming more advanced. The technology itself and its applicability to assessing damage to forest road wearing course was tested, as well as comparison with other hand-held mobile laser scanner and terrestrial laser scanner with greater precision.
The objectives of this project were achieved by scanning sections of selected forest road in Training Forest Enterprise Masaryk Forest Křtiny using three laser scanning alternative methods. In total, three damaged sections of forest road, each with a length of 150 m, were selected according to its damage for the purpose of testing the accuracy of chosen laser scanning method. On each section, reference crosses were spray-painted at each side of the road at 10 m intervals. Their spatial coordinates X, Y, Z were taken using total station Trimble M3 in local coordinate system for the laser scanning accuracy comparison, serving as reference values. Then the road sections were laser-scanned with the entire width of the road surface. Firstly, a Faro Focus 3D laser scanner was used for terrestrial laser scanning method. Secondly, hand-held mobile laser scanner Geoslam Horizon ZEB was tested and thirdly, iPhone 13 Pro with applications 3D Scanner and Polycam was used as another hand-held mobile scanning device.
The results of scanning methods were processed into point clouds where the reference crosses were identified, and the point clouds then aligned. Positional and height accuracy was validated based on the deviations from the tacheometric surveying. Afterwards, from each scanning method, data were processed into digital surface models (DSM) of the road and transverse profiles between the crosses, as well as distances between them along the road, were compared with the reference crosses measured by total station. A comparison of DSMs was also carried out – in this case, DSM from TLS was used as reference model, as it was the most accurate measurement to tacheometric surveying.
The differences in accuracy for each comparison were evaluated in MS Excel, where the deviations were statistically calculated. The overall results show that the most

accurate scanning method was, as expected, terrestrial laser scanning. Because the data from Faro Focus 3D were found to have minimal positional and height deviations compared to tacheometric surveying, they were used as a reference for evaluation of transverse profiles and DSM height differences accuracy (Fig. 1).

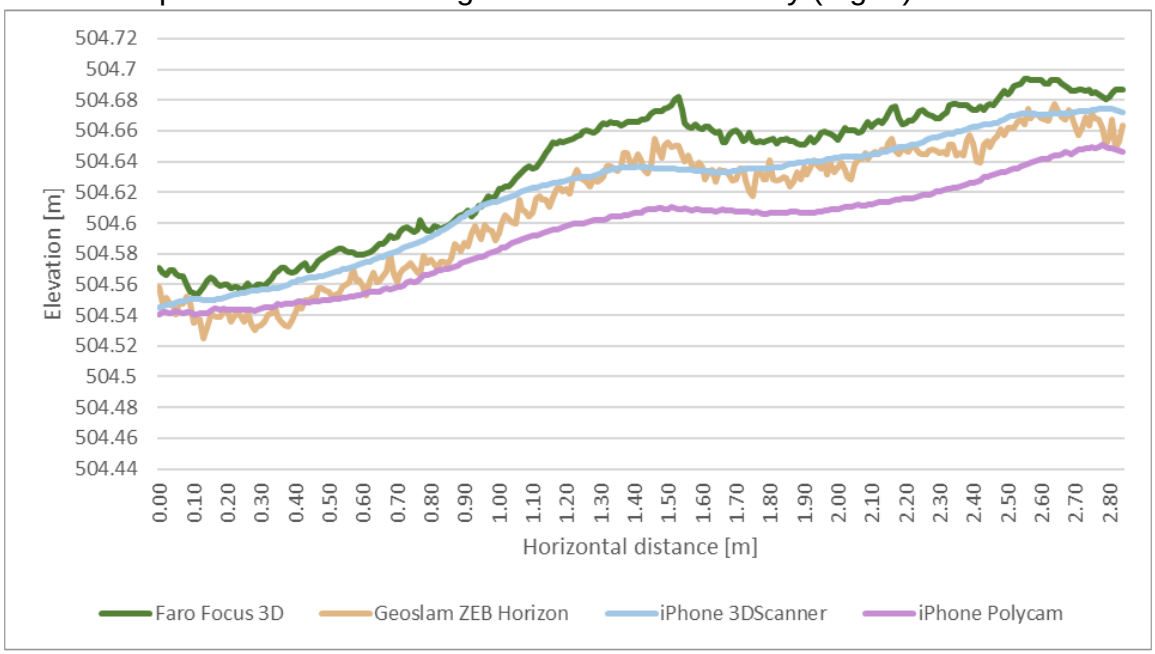

Fig. 3: Evaluation of transverse profiles and digital surface models height differences accuracy

The results were very similar, with the GeoSLAM ZEB Horizon scanner achieving a RMSE of 0.03 m, Polycam app 0.04 m and 3D Scanner app 0.02. Ultimately in the case of use of iPhone 13 Pro apps, there were surprising results, according to which this technology can be considered very promising, when comes to fast data collection and easy mapping and inspection of forest roads without depending on the GNSS signal, but still only locally (cross section of forest road up to 4 m) and further research on all the methods must be made.

ACKNOWLEDGEMENT
This research was supported and funded by Internal Grant Agency MENDELU within the project IGA-LDF-22-IP-027 (Potential use of mobile laser scanning using LiDAR integrated in a mobile device for forest road mapping).

GROWTH OF TREES IN NEWLY ESTABLISHED AGROFORESTRY SYSTEMS

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Keywords: alley cropping, Czechia, height growth, mortality

1 INTRODUCTION

The term agroforestry refers to a type of land use that combines trees and agricultural crops and/ or livestock on the same area of land. Integrating trees into the agricultural landscape offers several positive ecological effects such as carbon sequestration, increased biodiversity, reduced nutrient leaching and pesticide drift, improved microclimatic conditions, improved water availability in the agroecosystem, protection against wind and water erosion (Torralba et al., 2016; Kay et al., 2019).
Silvoarable agroforestry (SAF) includes, in terms of timber production, systems in which tree species and crops are grown in the same area to produce different qualities of (timber) raw material. Potentially because in the agroforestry method of tree cultivation there is not yet enough data for the Czech and Slovak Republic based on which we could determine the increments and expected yields.

2 MATERIAL AND METHODS

The realization of the first research oriented to the quantification of the benefits of SAF in the conditions of the Czech Republic is a subject of the last few years only. This project has therefore focused on obtaining initial knowledge from the establishment and maintenance of young SAF in Žabčice and Rostěnice. Both plots are in the South Moravian region.
This paper aimed to evaluate the first phase of the establishment of SAF in terms of the success of tree growth. Walnut (*Juglans nigra* L.) and poplar (*Populus* x *canadensis* Moench.) for the study plot Žabčice. Wild service tree (*Sorbus torminalis* L.), lime (*Tilia platyphyllos* Scop.), wild cherry (*Prunus avium* L.) and sycamore (*Acer pseudoplatanus* L.) for the study plot Rostěnice.

3 RESULTS AND DISCUSSION

In the first year, 81 % of the 216 holes sown with walnuts were occupied (Fig. 1). Walnut sowing is also routinely carried out at the nearby Židlochovice Forest Enterprise with satisfactory results (Hrib, 2001). The total number of individuals in the second year reached 252, which means 36 individuals more than needed to cover each hole. At present, the assurance of the walnut planting is secured by the annual replanting of these individuals into unoccupied holes (holes in which not a single walnut has taken hold). In 2022 we record 256 live individuals after replanting. Wild cherry and sycamore have made the largest increments in the first years in Rostěnice. Wild cherry and sycamore height increments averaged 67.8 cm and 58 cm, respectively. The analysis of the functionality of different types of protection, damage to trees, and the progress of weeds is presented in the publication Mitrová et al. (2022).

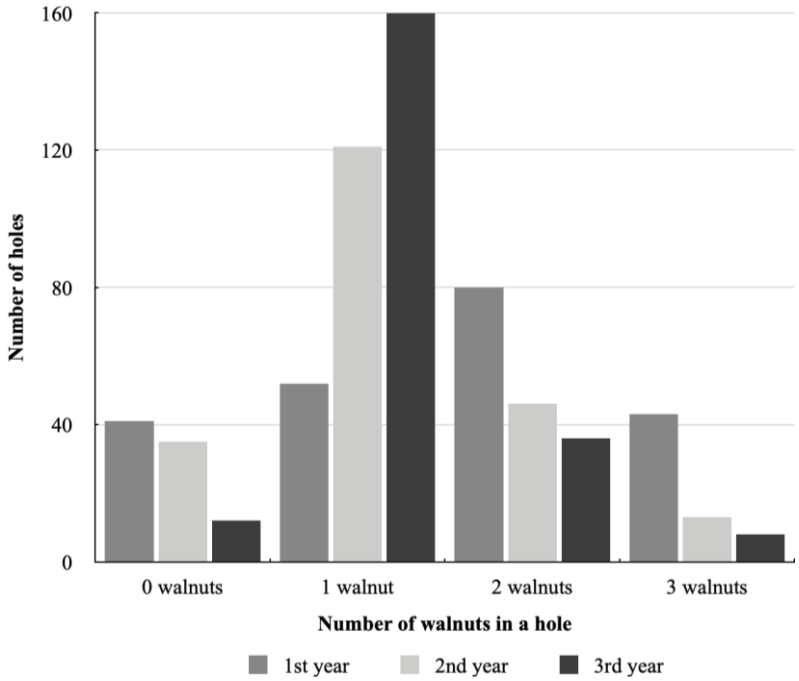

Fig. 1: Numbers of unoccupied and occupied holes in the first (2020) second (2021) and third year (2022) after replanting.

4 CONCLUSION

These are the first practical and partially research findings from the establishment of not only a specific research and demonstration area but also an agroforestry system in the Czech Republic. It is apparent from them that when establishing an agroforestry system, it is necessary to respect certain aspects and to build on the knowledge in the field of forestry, landscaping, etc. These are also some of the first data recording tree growth in modern SAF in the Czech Republic. Due to their specificity, they cannot be objectively compared yet, but they will be essential for the establishment and management of similar areas in the future.

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LONG TERM DEVELOPMENT OF ASPEN STANDS IN MONGOLIA AND IN THE CZECH REPUBLIC

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Key words: aspen, long-term development, pedoathracology, *Populus tremula*

1 INTRODUCTION

In 200-year forestry history in Central Europe, aspen (*Populus tremula* L.) was marked an undesirable species with no commercial perspective. For that reason, aspen, birch and similar so-called "weedy" species have been overlooked or even cut from "commercial forest stands" and kept in localities with low economic value. Nowadays aspen creates 0,7 % (IFER) of the composition of Czech landscape, despite its wide ecology amplitude. A general view on the aspen slowly changes on a background of the bark beetle outbreak in Central Europe. Positive ecological role of aspen includes high quality of humus, fast growth, wide ecology amplitude, carbon stock, support of biodiversity and aesthetics. More often we can hear challenges to using this tree for planting on calamitous places after a clear cut (Čížková et al. 2020). Insufficient complex knowledge of this species could be a limiting factor for wider use of aspen.
This project is focused on the long-term development of aspen stands in Central Europe (Czech Republic) and Central Asia (Mongolia). In both localities, pedoanthracology samples were taken for a macrocharcoal analysis. Project aims to describe if aspen could create a stable long living systems species, or if it is just a temporary/seral species with its pioneer strategy.

2 METHODOLOGY

Communities of interest were forest stands where aspen has been currently dominant. Samples for a subsequent pedoanthracological analysis were taken from a soil profile, which was divided into layers. Each 10 cm thick layer comprised a sample of 10 litres of a fine-textured soil (Novák et al., 2022). Separation of charcoal fragments were done by wet sieving procedure (Carcaillet, Thinon, 1996). The sieve mesh was of 1 mm in size. It is difficult or impossible to identify charcoals smaller than 1 mm (Robin et al., 2013). Samples have been identified based on a standard identification key (Schoch et al., 2004) using the microscope Olympus SZ 61. Determined charcoal pieces were weighed for accuracy of 0,1mg.
Empirically selected charcoals will be sent to Radiocarbon Laboratory in Prague for radiocarbon dating using the C 14 Accelerator Mass Spectrometry. Attention will be paid on *Populus* charcoal pieces.
Obtained data will be evaluated on:

a) Stable aspen community- aspen will often repeat itself in individual (consecutive) layers, its representation will be similar across individual horizons, and the species composition of the following (younger, higher-lying) horizons will not be directed towards successionally higher communities (towards a potential vegetation). Stable aspen stands (*Populus tremuloides* Michx.) are described in northern America, where aspen stands have been found in mountainous locations for several generations (Novák et al., 2022).

b) Temporary aspen community - in the species composition, it is evident that the aspen community is replaced by a successionally higher stage in time. The representation of aspen in individual horizons is not constant and has a long-term downward trend. This seral function is described in the climatic conditions of Central Europe (Úradníček, Maděra a kol., 2001), and in the Southern Carpathians.

3 RESULTS

Based on partial results (2 soil profiles in the Czech Republic) it seems that aspen is a succession species in climatic conditions of Central Europe. One piece of aspen charcoal was found in the first layer (0-10 cm thick) from the Javorníky Mountains. Rest of samples were determined as dominant fir (*Abies alba* Mill.) in the Javorníky Mountains, or beech (*Fagus sylvatica* L.) in the Lidečko region. In Javorníky, the Hercyn spieces composition of forest was dominant (Tab. 1.).

In the second layer, there is a significant increase of anthracomass. This could be caused by more intensive forest fire in this period.

Tab.1. Results from the Javorníky Mountains

Layer	**0-10 cm**	**10-20 cm**	**20-30 cm**	**30-40 cm**	**40-50 cm**
Anthracomass (g)	0,359	2,358	0,794	0,037	0,327
	species composition in individual layers (%)				
Abies sp.	59,7	61,0	47,6	41,7	72,2
Fagus sp.	11,1	23,0	9,5	33,3	0,0
Picea sp.	8,3	9,0	23,8	16,7	16,7
Betula sp.	4,2	0,0	0,0	0,0	0,0
Populus sp.	2,8	0,0	0,0	0,0	0,0
Acer sp.	2,8	1,0	0,0	0,0	0,0
Quercus sp.	1,4	1,0	4,8	8,3	0,0
Pinus sp.	1,4	0,0	0,0	0,0	11,1
unidentified	2,8	1,0	14,3	0,0	0,0

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RESILIENCE AND SYNERGY EFFECT IN SPRUCE-BEECH-LARCH MIXED FORESTS

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Keywords: competition, European beech, European larch, increment, Norway spruce, tree-rings

1 INTRODUCTION

Global climate change affects both temperature and precipitation (Trnka et al., 2011). These facts require adaptation of our forests and forestry management via modifying the species composition. A great benefit of mixed stands is their higher resistance to abiotic and biotic factors, which results in increasing their ecological stability (Hanewinkel et al., 2013). Resilience, on the other hand, shows the ability of an ecosystem to retain its structure and function prior to extreme events (Lloret, 2011). As a suitable admixture seems to be European larch (Larix decidua Mill.). Its major advantage is relatively fast growth and transmits a significant amount of light and precipitation through the crown (Úradníček and Chmelař, 1995).

2 AIM AND HYPOTHESIS

The main aim of this study is to evaluate: i) how sensitive European larch reacts to extreme conditions (2018) and ii) whether the admixture of larch can positively influence the growth of other commercial tree species - spruce (Picea abies (L.) Karst.) and beech (Fagus sylvatica L.) in mixed stands. We have hypothesized that the radial increment of larch is less sensitive to extreme conditions compared to spruce or beech.

3 MATERIALS AND METHODS

The study was carried out in the forests of ŠLP ML Křtiny, where we established 3 experimental sites of size 0.30 ha with similar exposure, slope, and age (30-70 years). Structure of the experimental sites was divided into 2 types: i) mixed stand included larch as admixture: beech-spruce-larch (45-30-25%) mixed stand and ii) control stands: beech-spruce (65-35%) stand and pure larch (100 %) stand.
Parameters such as the position of the tree within the stand [x,y], diameter at breast height, and species were recorded with Field-Map technology. 10 wood cores at breast height have been collected using a 0.5mm increment borer (HAGLÖF CORETAX) on each experimental site from each tree species (total 60 pc). Past4 software was used for cross-dating and the standard dendrochronological analysis was performed. Competition indices (CI5 – 5 competitors; CI10 – 10 competitors) were calculated on the base of Hegyi (1974), and resistance and resilience were calculated via method described by Lloret (2011). Subsequently, we corelated competition indices and DBH with resistance and resilience. Mathematical and statistical calculation were provided via software MS Excel and R program.

4 RESULTS

Between competition indices and DBH was recorded strong relationship on all sites (R^2 = 0.59-0.92). The results showed significant differences between both types of experimental sites (Fig. 1).

Fig. 1: Linear regression of DBH (red), CI10 (blue) and CI5 (green) to resistance and resilience for A) beech-spruce-larch mixed stand, B) beech-spruce control stand and C) pure larch control stand. Purple line shows observing year 2018.

Beech showed a higher positive correlation (R^2 = 0.67) between competition and resistance in the beech-spruce-larch mixed stand in 2018, than in the control stand (R^2 = 0.34). Larch showed a similar low positive correlation (R^2 = 0.001-0.004) on both sites and spruce showed a higher positive correlation (R^2 = 0.21) in the control stand than in the beech-spruce-larch mixed stand (R^2 = 0.005). The correlation between competition and resilience in the beech-spruce-larch mixed stand in 2018 showed high positive corelation (R^2 = 0.72) for beech and low positive corelation (R^2 = 0.11-0.18) for larch and spruce. On the control stands all three tree species showed low positive corelation (R^2 = 0.01-0.11), which represent lower availability to reach pre-disturbance stay. The correlation between DBH and resistance or resilience had an opposite character in all cases, then the correlation between competition and resistance or resilience. This performed, that competition analysis gives us a better understanding of trees reaction to extreme conditions than if we use only DBH values.

5 CONCLUSION

The results confirmed the existence of a positive effect of the presence of European larch in beech-spruce-larch mixed stand, the highest positive effect was observed on beech. Larch performed a higher growth response and less sensitivity to extreme conditions than spruce.

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USE OF CAMERA TRAPPING FOR MONITORING WILDLIFE AND DENSITY ESTIMATION

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Keywords: abundance, distribution, hunting, population, ungulates

RANDOM ENCOUNTER MODEL (REM)

Using the (REM) method, it is possible to obtain an estimation of the population density of the most game species based on the detection index (y/t), which is obtained from the camera trap recordS. This index is subsequently used to determine the size of the daily home range – DR (for an individual or a group of animals) using the formula (Fig. 1).

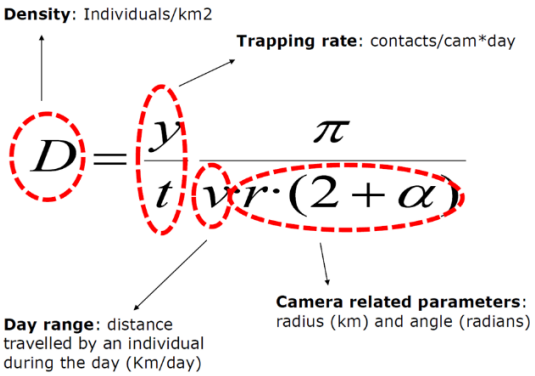

Fig. 1: The description of the basic formula to calculate population density.

The procedure for calculating the DR is based on the assumption that all individuals in the studied population are active at the peak of the recording intensity of the camera traps and that the level of animal activity in all parts of the day corresponds to the recording intensity of the camera traps. A recent field experiment (unpublished data) found that the behavior of most ungulate species, and thus the camera trap record, can be divided into two categories of movement speed: 1) feeding and 2) moving. Differentiating these two categories of movement speed and their mutual ratio within one day will make the estimation of DR size more accurate.

When installing a camera trap in the field, it is necessary to follow the recommendations of the manufacturer of a particular type of

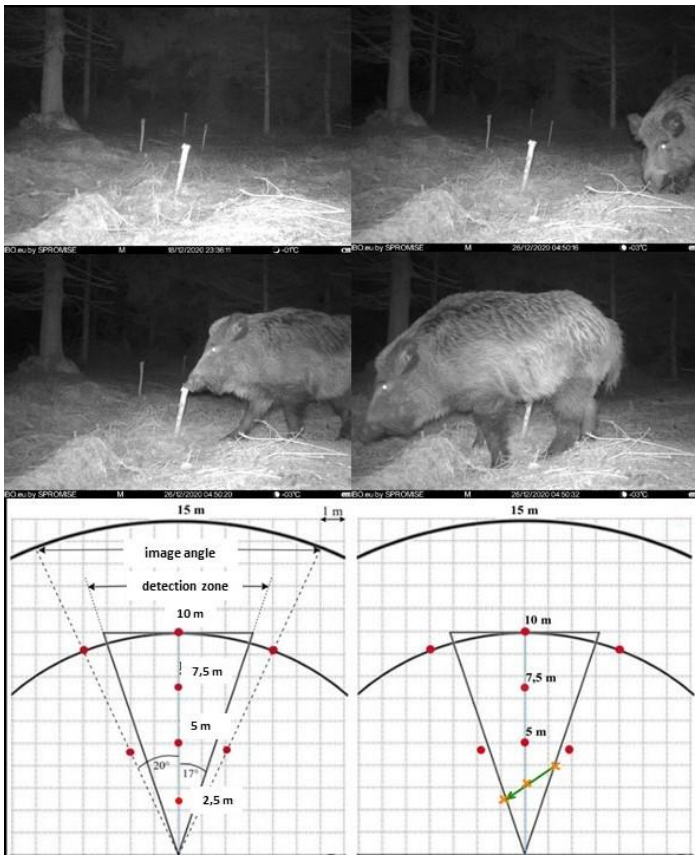

Fig. 2: The analysis of the animal movement.

camera trap so that the recording is taken under optimal and, above all, standard conditions. In front of the photo trap, 8 markers (marking pins) are placed in the field so that they form an arc at a distance of 2,5; 5; 7,5 and 10 m from the camera trap (Fig. 2). The area marked out in this way in front of each camera trap will subsequently facilitate the analysis of individual images and the determination of the speed of animals movement.
Models of camera traps with infrared (invisible) illumination are used for night photography. These camera traps are placed randomly (without bait) in the field, for example in the intersections of a square grid above the study area. For larger species of ungulates (deer, boars), the density of camera traps in the vertices of a square network with dimensions of 1.5-2 km * 1.5-2 km proved to be ideal. Motion sensitivity in all camera traps is set to medium.

The recording was set to a sequence of 3 images in case of detection the movement of the animal. The length of exposure of the camera traps in the study area depends on the purpose of the recording. For a sufficiently high-quality description of the red/roe deer and wild boar populations, a minimum duration of exposure of 1.5 months is required on average (depending on the population density). In general, it can be said that the number of at least 100 different contacts of the selected game species with the camera for each of the two movement speed categories can be considered sufficient.
On particular images (series of images), where the length of the movement path of the animal can be determined by image analysis, we determine and write the following variables into the database (Fig. 3):

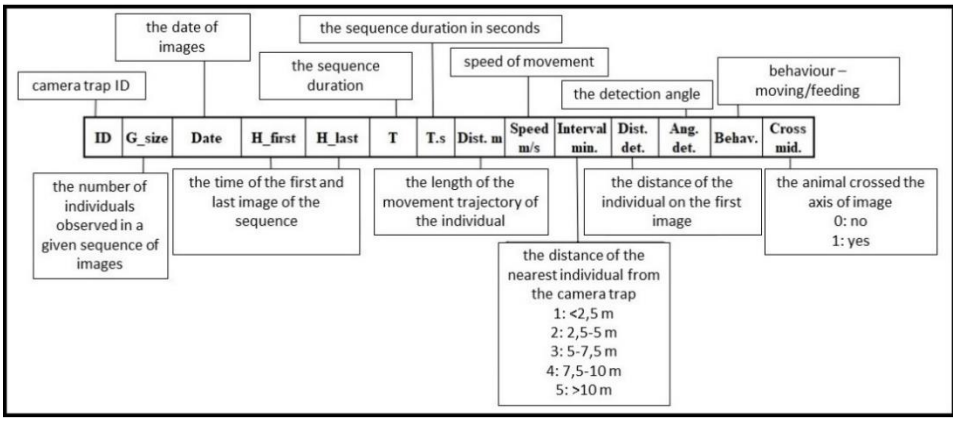

Fig. 3: The design of the database used for the image analysis.

ACKNOWLEDMENT
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THE EFFECT OF THE NOISE AND VIBRATION LEVEL OF A CHAINSAW DURING SALVAGE CUTTING ON THE HEALTH OF ITS OPERATOR

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Keywords: forestry, injury, occupational health and safety, work safety

1 INTRODUCTION

Chainsaws are essential tools for logging. However, a high number of occupational accidents are associated with them. In addition to injuries such as cuts, the chainsaw operator is also exposed to the vibration and noise factors caused by the chainsaw. These factors can cause various health ailments.
This study focuses on the rate of vibrations and noise level in the chainsaw Model Stihl MS 362 which belongs to the group of the best-selling professional chainsaws worldwide.

2 MATERIAL AND METHODS

2.1 RESEARCH AREA

This research was conducted in the Czech Republic, with the forest company Lesy města Brna a. s., Forest District of Deblín. The total number of measured Norway spruce trees (*Picea abies* (L.) H. Karst.) was 121.
Prior to logging, the diameter at breast height (130 cm) from the ground to the nearest 0.5 cm using a forestry caliper. Furthermore, the moisture content of each tree was also measured at a height of 130 cm from the ground.
The trees were divided into two groups. The first group (Group I) included trees infested by the European spruce bark beetle (*Ips typographus*) in 2022. There was a total of 73 trees in this group with trunk diameters from 15.5 to 52.5 cm. The average value of the trunk diameter was 29.0 cm. The moisture content of logging trees in this group ranged from 83.5 to 99.8%. The average moisture content of these trees was 93.5%. The second group (Group II) included trees infested by the European spruce bark beetle in 2021. There was a total of 48 trees in this group with trunk diameters ranging from 20.0 to 45.0 cm. The average value was 32.0 cm. The moisture content of the trees from 11.8 to 29.3 %, while the average moisture content of the trees in this group was 20.0 %. To achieve the goal of the research the production process was split into the following operations: Cutting off tree buttresses; felling; delimbing.

2.2 CHAINSAW

Throughout the measurement, the chainsaw was operated by the same person. The same chainsaw was always used to log all the trees. Specifically, it was a Stihl MS 362 chainsaw. Also, one type of saw chain was used throughout the logging process, the STIHL 3/8" Rapid Super (RS), 1.6 mm, 40 cm with 60 links. This saw chain was sharpened by the logger before each tree was logged.

3.3 VIBRATION AND NOISE MEASUREMENT

The goal of this research was to evaluate the rate of vibrations at the front and rear handles of a chainsaw that affect its operator during the logging of trees with different

wood moisture contents. Two accelerometers (Datalogger CEM model DT-178 A.) were used to measure the vibrations. The vibration measurements on the chainsaw handles were carried out according to the valid standards: EN ISO 22867, EN ISO 5349-1, and EN ISO 5349-2.
Furthermore, the noise effect on the logger was measured. The noise was measured according to the applicable standards: EN ISO 22868 and EN ISO 9612. Noise in close proximity to the logger's ear was recorded using a Sound Level Datalogger CEM DT-173. During the measurements, the microphone was firmly attached to the logger's helmet, close to his ear.

3 RESULTS AND CONCLUSIONS

The results represent the average of all measurements in each operation in each group.
In Fig. 1 you can see the vibrations acting on the logger the front handle of the chainsaw. The results show that in all measured operations the vibration at the front handle is higher in Group I. The highest difference in vibration between the two groups of trees is in the "Felling" operation, where the difference is 36.8%.
Fig. 2 shows the vibrations acting on the rear handle of a chainsaw. Also, in this case, the highest difference in vibration between the two groups is for the "Felling" operation, namely 6.9%. However, in this picture, it can be seen that the highest vibrations at the rear handle of the chainsaw were measured at the Group II of trees during the "Delimbing" operation.

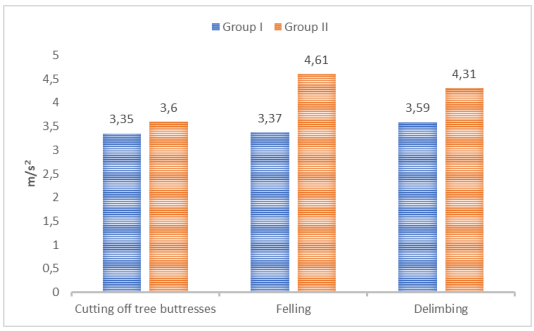

Fig. 1: Rate of vibrations at the front handle

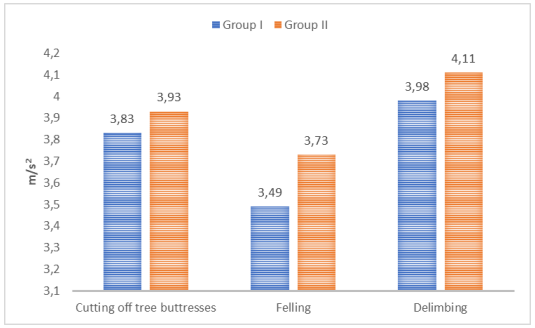

Fig. 2: Rate of vibrations at the rear handle

It was found that the logger is most exposed to noise when processing tree Group I during the "Delimbing" operation (Fig. 3). During this operation, he was exposed to an average noise level of 99.01 dBA. On the other hand, the lowest noise level was recorded during the "Felling" operation in Group I. The greatest difference in noise exposure between the two groups was in the "Cutting off tree buttresses" operation.

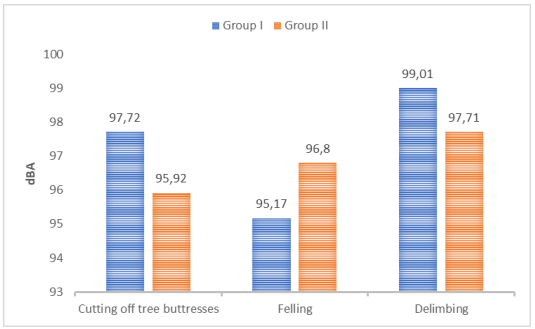

Fig. 3: Noise measurement values

ACKNOWLEDGEMENT
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ANALYSIS OF GROWTH ATTRIBUTES IN MIXED STAND WITH CHANGING DOMINANT COMPOSITION OF BEECH AND OAK UNDER THE INFLUENCE OF ONGOING CLIMATE CHANGE

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Keywords: beech, climate change, competition index, oak, relationships

1 INTRODUCTION

Ongoing climate change causes an increase in the average air temperature and a changing temporal and spatial distribution of precipitation. This increases evapotranspiration demands and leads to gradual vegetation change across ecosystems worldwide (Gonzalez et al., 2010). Drought then increases the risk of mortality, reduces the growth of species in the ecosystem and changes ecohydrological relationships (Adams et al., 2012). In mixed stands of oak and beech, oak can be a weaker competitor (Bonn, 2000 Scharnweber et al., 2011). Mette et al. (2013) state that the more light-demanding oak can only compete under less favorable abiotic conditions than beech (i.e. warm and relatively dry habitats or wet and clayey soils, or if oak is favored by forest management). Pretzsch et al. (2013) states that oak can compete with the more dominant beech in case the given natural conditions limit the competitiveness of beech, and it can therefore be assumed that the response of both species to climate change can ensure a competitive balance.

2 METHODS

Research circular plots with a size of each 0.5 ha, four in total, have been established at the University Forest Enterprise Masaryk Forest of Křtiny. The plots represent different admixture of the following two main tree species:

1) Monoculture of beech (*Fagus sylvatica* L.)
2) Monoculture of oak (*Quercus petraea*)
3) Mixed stands beech and oak (with proportion of 50/50)
4) Mixed stands beech and oak (with proportion of 50/50)

The selected trees on plots were targeted by FieldMap, a dendrochronological analysis was performed, and a competition index was determined for them to express interspecific competition. Calculate the competition index according Heigy (1974):

$$CI = \sum_{j=1}^{n} \left(\frac{DBH_j / DBH_i}{DIST_{ij}} \right) \times w_n \qquad (1)$$

where CI = total competition index of the target tree, DBHj = stem diameter of competing tree, DBHi = stem diameter of target tree, DISTij = distance between target tree and competing tree, n = 5 competing trees, wn = 1 - mortality was not considered

3 RESULTS AND DISCUSSION

Preliminary results include first analyses of the position tree species the stand.
From these outputs we can then calculate the competition index (Fig. 1 – 2).

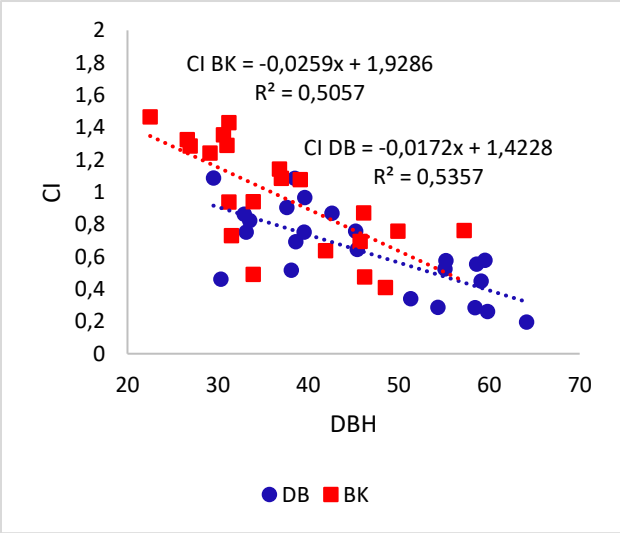

Fig. 5: Graph of the dependence of comtetition index (CI) on the target stem diameter at the breast height (DBH) in mixed stands of European beech (BK) and Sessile oak (DB).

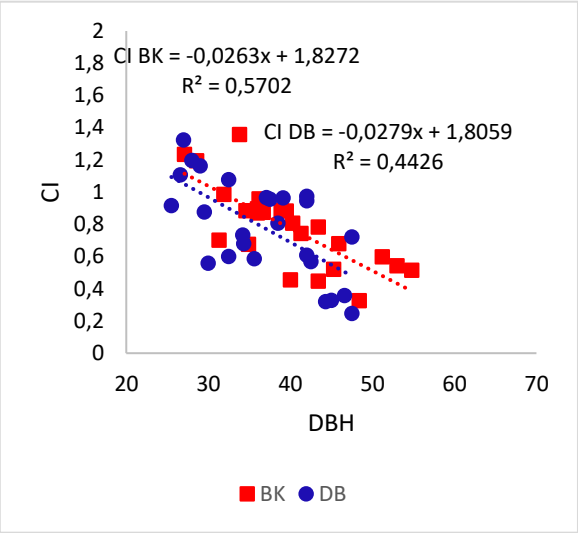

Fig. 4: Graph of the dependence of comtetition index (CI) on the target stem diameter at the breast height (DBH) in monoculture of European beech (BK) and Sessile oak (DB)

4 CONCLUSION

Considering the initial phase of the project's data evaluation, it can be concluded that the DBH of target tree depends on competition index. This is evidenced by preliminary data presentation in Figures 1–2. Target trees of oak as well as beech show similar proportion between their DBH and CI in monoculture stands. The beech in the mixture has a lower DBH than in the monoculture however the same CI. On the contrary, oak has a slightly higher DBH in the mixture than in the monoculture with the same CI. The CI values are slightly higher for beech in the mixture than in the monoculture. Oak has a slightly lower CI in the mixture than in the monoculture.

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EFFECTIVENESS OF DEFENSIVE MEASURES AGAINST THE LARGE LARCH BARK BEETLE (*IPS CEMBRAE* HEER) AND THEIR IMPACT ON NON-TARGET INVERTEBRATES

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Klíčová slova: bark beetle, *Ips cembrae*, *Larix decidua*, trap tree

1 INTRODUCTION

Large larch beetle (*Ips cembrae* (Heer, 1836)) is a Euro-Siberian species of bark beetles (Scolytinae) (OEPP/EPPO, 2005), which is the facultative primary pest attacking larch stands (*Larix decidua* Mill.) in Europe. *I. cembrae* usually creates 2 generations depending on the climate (Krehan, 2004) and altitude (Grodzki, Kosibowicz, 2009). Between 2000 and 2020, an average of 468±66m^3 of larch wood was logged annually by salvage logging. Between 2005 and 2008, the share of logged wood infested by *I. cembrae* increased by 0.5 % and between 2015 and 2019, the most severe outbreak of *I. cembrae* occurred and the share of salvage logging increased up to 4.5 % (Anonymous 2022). Standing poisoned trap trees were successfully tested against the spruce bark beetle (*Ips typographus* L.) (Juha, Turčáni 2008). The aim of this study was to compare effectiveness of poisoned standing and laying trap trees in forest protection against *I. cembrae*.

2 METHODOLOGY

On 5 model localities in Děčínský Sněžník (FD Děčín), 1 slot trap (Theysohn) (FL), 1 poisoned lying trap tree (L) baited with pheromone Cembräwit were installed. Under the lying trap trees (lenght = 4 m) in the middle and on the edge, 2 catching devices (1 x 1 m) (LST, LOK) were placed. The pheromone lure Cembräwit was placed in the middle of the trap tree. In a group of 11 standing trees, there were 6 control non-poisoned trees and 5 poisoned trees up to a height of 4 m. Two (OT, FOT) from the 5 poisoned trees had 2 catching devices (0.8 x 0.8 m) in height 0.3 m and 2 m to collect dead bark beetles. One of the poisoned trees with devices was baited with pheromone lure (FOT). The samples from defensive measures were collected every 2 weeks and kept in 75% solution of ethanol. Non-target Arthropoda in samples were divided into taxonomic ranks. Cantharidae, Carabidae, Cerambycidae, Cleridae, Curculionidae, Elateridae were determined into species by specialists. The normality of data was analysed by Shapiro–Wilk (SW) test and differences were tested by Mann–Whitney U test and Kruskal-Wallis H test.

3 RESULTS AND DISCUSSION

In total, 19 812 imagoes of *I. cembrae* were captured by defensive measures. The high effectiveness of lying (L) and standing poisoned trap trees (FOT) was confirmed (SW: $W = 0.595$, $p = 0.0000$; KW: $H (3, N = 180) = 74.541$, $p = 0.0000$) (Fig. 1). A statistically significant difference was found between the catches of *I. cembrae* on the edge (LOK) and in the middle of lying trap tree (L) (SW: $W = 0.689$, $p = 0.0000$; MW: $z = -2.311$, $p = 0.0207$) (Fig. 1). No difference was found between the catches of bottom (FOTD) and top (FOTN) of the poisoned standing baited trap tree. Slot traps (FL) caught only 1180 imagoes and poisoned trees (OT) without pheromone caught a low number of images (370 pcs).

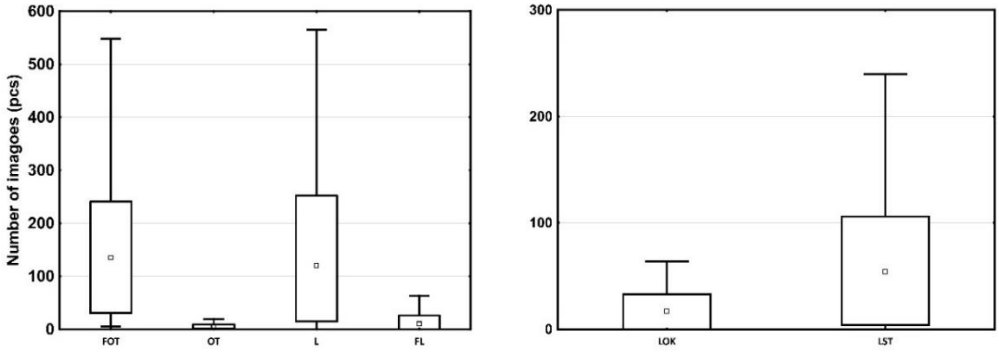

Fig. 1: Numbers of *I. cembrae* captured by measures (left) and in the edge (LOK) and in the middle (LST) of L

Totally 7166 imagoes of Arthropoda were caught (Tab. 1). FOT most negatively (SW: W = 0.608; p = 0.0000; KW: H (3, N = 181) = 62.339 p = 0,0000) affected *Thanasimus formicarius* L. (Cleridae) killing 1681 imagoes (Fig. 3). *T. formicarius* is predator of bark beetles that was attracted by pheromone lure Cembräwit.

Tab. 1: Non-target Arthropoda (pcs)

FAMILY	FL	FOT	OT	L	%
Apocrita		18	13	2	0.46
Araneae		328	271	13	8.54
Buprestidae		14	13	2	0.40
Cantharidae		749	626	17	19.43
Carabidae	1	92	92	4	2.64
Cerambycidae	9	69	43	38	2.22
Cleridae	52	1439	269	233	27.81
Coccinellidae	1	21	32	6	0.84
Curculionidae	1	283	321	9	8.57
Diptera	1	337	374	51	10.65
Ectobiidae		27	36	11	1.03
Elateridae	53	401	272	24	10.47
Ensifera		46	47	2	1.33
Formicidae	1	19	6	5	0.43
Heteroptera	1	28	30	5	0.89
Hydrophilidae	17	0	0	0	0.24
Chrysomelidae	3	4	12	1	0.28
Lepidoptera	2	13	22	4	0.57
Lymexylidae	4	3	0	0	0.10
Opilionida		14	5	2	0.29
Raphidioptera		4	7	0	0.15
Symphyta		64	68	5	1.91
Tenebrionidae	28	17	1	8	0.75
SUM	174	3990	2560	442	7166

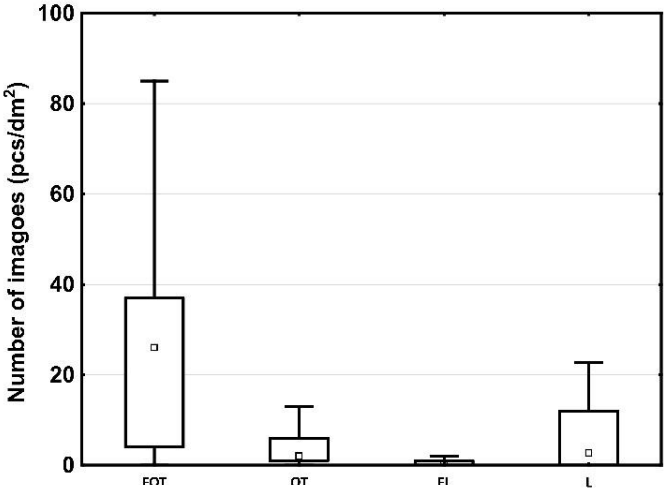

Fig. 2: Numbers of captured imagoes of *T. formicarius*

Our results indicate that poisoned standing and lying trap trees with pheromone lure are usable in forest protestion of larch against *I. cembrae*. Poisoned trap trees affect population of bark beetles predators (Cleridae) and soldier beetles (Cantharidae).

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MAPPING ABRASION MANIFESTATIONS USING UNMANNED AERIAL VEHICLES AND LASER SCANNING

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Keywords: abrasion, GeoSLAM, laser scanning, photogrammetry, Structure from Motion, UAV, unmanned aerial vehicle

1 INTRODUCTION

UAVs (Unmanned Aerial Vehicle) are currently used in many fields of human activity to create 3D surface models and orthophoto images, e.g. (Eisenbeiss, 2009). The aim of the project is to verify the possibilities of mapping and monitoring abrasion on water reservoirs using UAV aerial imaging and laser scanning. The objective will be achieved by repeated scanning of the banks at the Dlouhé Stráně – lower reservoir. Photogrammetric processing methods will be tested on images taken with a small DJI Mavic 2 Enterprise drone equipped with an RGB camera with a resolution of 12 MPix and laser scanning with a large DJI M600 Pro drone carrying a GeoSLAM Horizon laser scanner.

The aforementioned reservoir is located at an altitude of 824.7 m and has a total volume of 3,405,000 m³ and an area of 16.3 hectares. The entire pumped storage plant is used to regulate the power grid. The fluctuations in the level of the lower reservoir result in bank erosion and significant abrasion, which is exacerbated by the shape of the banks, which have a pronounced slope exceeding 45° in some places.

Due to the slope of the banks and their rocky structure, it is difficult to monitor abrasion using conventional geodetic methods. In the past, attempts have been made to use classical tachymetric measurements of points on banks stabilised by iron roxors, but the method of stabilisation was not optimal and did not produce conclusive results. In addition, the steep slope of the slopes prevents the movement of people. The possibilities of abrasion monitoring by unmanned means are discussed e.g. in (Troy et al., 2021).

2 OBJECTIVES AND METHODOLOGY

The aim of the project is not only to create a 3D model of the banks, but above all to develop a methodology for regular monitoring of abrasion. It was thus necessary to choose the optimal method of permanent stabilization of the so-called incision points at the edges of the mapped area. These control points were oriented in the local coordinate system using a total station from the opposite side of the reservoir from permanent sites. Subsequently, the points are used for coordinate attachment of images and point clouds for subsequent comparison. Neither imaging nor scanning was dependent on the growing season, as the banks are devoid of vegetation due to surface movements.

The photogrammetric processing of the images was done in AGISOFT Metashape Professional software, where control points were traced on the images and their coordinates were inserted. Subsequently, a photogrammetric point cloud and a digital surface model were created using the Structure from Motion algorithm. The processing of the laser scanner data was performed in GeoSLAM Hub and GeoSLAM Draw software, where the cloud was placed in a coordinate system

based on the tracing of control points and the input of coordinates. The comparison of the models, and in particular the calculation of changes between raids, was performed in Cloud Compare software.
For the so-called oblique images, there may be poor merging of the photos and inaccuracies in the model, e.g. Fig. 1
Preliminary results (Fig. 2) show that both methods are suitable for mapping abrasion manifestations. The advantage of laser scanning over photogrammetric processing is the ability of laser pulses to penetrate vegetation. For both methods, the appropriate placement of the insertion points is crucial. Quantification of abrasion symptoms will only be possible after a repeat scan, which will take place by the end of 2022.

Fig. 1: example of a section through the resulting point cloud (left photogrammetry, right laser scanning)

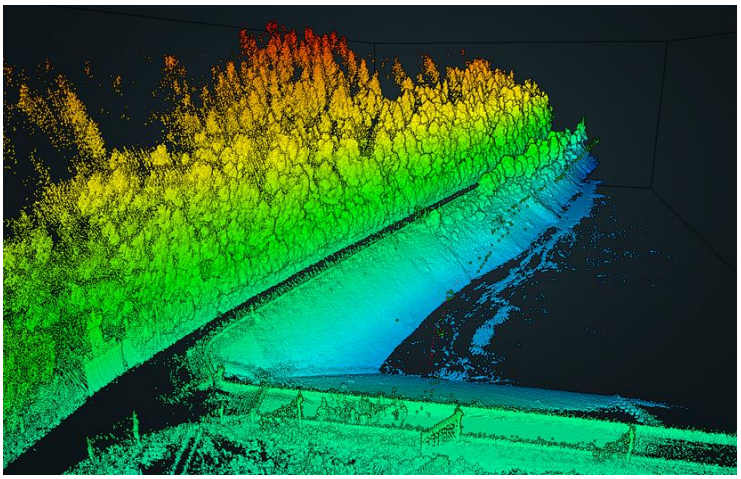

Fig. 2: Sample point cloud from GeoSLAM Horizon scanner in Agisoft Metashape environment

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INFLUENCE OF VEGETATION DEVELOPMENT ON SELECTED SOIL PROPERTIES

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Keywords: agricultural landscapes, anti-erosion measures, linear elements, soil granularity, soil probes

1 INTRODUCTION

Windbreaks (protective anti-erosion forest strips formed by rows of trees and/or bushes) are an important group of linear elements in agricultural ecosystems. They play an important role in improving landscape stability (Burel 1996) and protecting soil from erosion, and create local microclimate islands with better air temperature, humidity, soil temperature and evapotranspiration conditions (Litschmann and Rožnovský, 2005; Podhrázská et al., 2008). The aim of this project was to record and compare selected soil properties between two windbreak systems, one new and one long-established, and thereby highlight the importance of different vegetation elements in the landscape.

2 METHOD AND MATERIAL

This study examined two sites of different ages situated in south Morava (Czech Republic), the first being an 80-year-old windbreak in the cadastral area of Hruška, east of the town of Břeclav, and the second a three-year-old newly established forest vegetation belt (Fig. 1) in the cadastral area of Rostěnice, part of the Rostěnice-Zvonovice municipality, south of Vyškov. These field studies build on previous laboratory-based analyses addressing the impact of vegetation elements in the countryside.

Soil samples were collected in the spring of 2022 from a depth of 0-10 and 20-30 cm in four transects, with three of the transects comprising six sampling points and one transect two sampling points. At each site, physical and hydrophysical soil parameters was determined for 40 intact soil samples. In addition, 40 broken soil samples were taken, which were then dried, sifted through a 2 mm sieve, and used to determine the pH of the soil. Other parameters examined included soil volume and specific gravity, porosity and selected hydrolimits (RVK and BV), proportion of organic matter, soil texture and the carbon/nitrogen ratio (C/N).

3 RESULTS

When determining the grain size of soil at the forest vegetation belt, preliminary results indicate that the mean representation of individual fractions (clay, silt and sand) at depths of 0-10 and 20-30 cm were very similar. However, both silt and sand showed high variability, differing between site and depth. At 0-10 cm, for example, sand variability had a wider range than silt, tending toward a greater proportion, while the silt fraction had a wider range at 20-30 cm, though tending toward a lower proportion (Fig. 2), confirming erosion of finer soil fractions from the soil surface layer. Further

quantification for the other soil analysis parameters will be completed after repeat measurements, which will take place by the end of 2022

Fig. 1: Newly established forest vegetation belt at Rostěnice-Zvonovice. Photo taken by N. Žižlavská using a DJI Mavic 2 Enterprise drone with resolution 12 MPix.

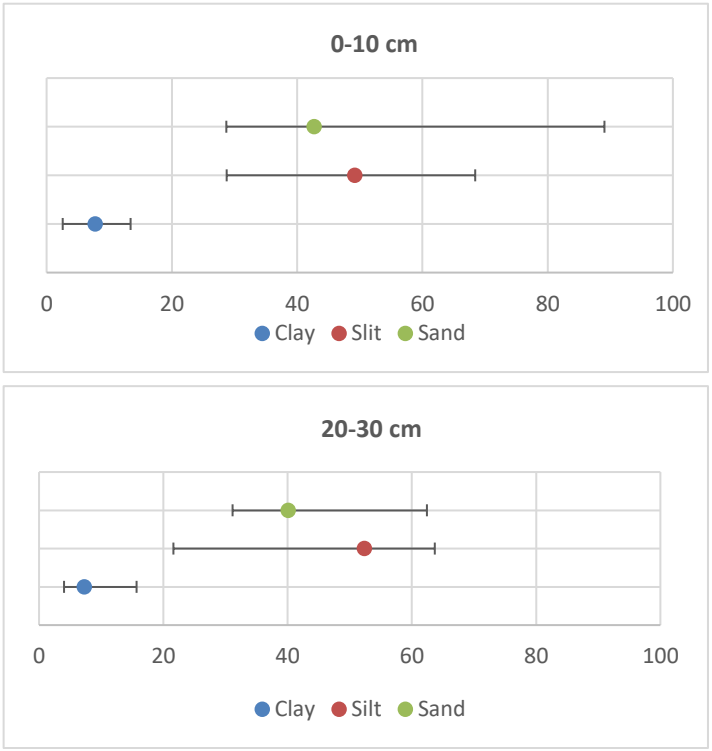

Fig. 2: Soil granularity at depths of 0-10 and 20-30 cm at the Rostěnice site.

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IMPACT OF FOREST DIEBACK ON FOREST FLOOR WATER BALANCE IN NORWAY SPRUCE MONOCULTURES

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Keywords: forest hydrology, land cover, soil hydrology, soil moisture, water resources

1 INTRODUCTION

The forest floor is a defining feature of forest ecosystems. Also known as the detritus or O horizon, it consists of one or more organic subhorizons termed the litter (OL), fragmentation (OF) and humus (OH) horizons (Zanella et al. 2009). While it also plays a significant role in terrestrial ecosystems and in controlling water loss, few studies have examined how forest disturbance and subsequent restoration affect water storage in the floor cover (Xia et al. 2019). Moreover, forest floor characteristics (e.g., thickness, coverage, and soil organic matter) may cause changes at the microsite level (e.g., litter decomposition, soil moisture, carbon and nitrogen stock) that subsequently influence rate of forest succession (Wang et al. 2021). The aim of this study was to quantify how forest post-disturbance management conditions affect floor moisture regime in Norway spruce monocultures.

2 MATERIAL AND METHODS

This study expands on a previous project (IGA project LDF_TP_2021006) by including the issue of forest floor moisture regime on the same spruce monoculture study sites, i.e., Vilémov in Bohemia and Černá hora, Velká Bíteš, Vranov in Moravia (Czech Republic). The design strategy used ensured that each locality included three different treatments representing i) living forest, ii) disturbed forest with dead trees and iii) clear-cut sites, each with similar soil and climatic conditions. For a more detailed description of the methodology and research sites, see Fidler et al. (2021) and Vichta et al. (2022). Floor moisture was measured 5 cm below the surface using TMS-4 sensors (Tomst, Czech Republic), each sensor being fixed in a “bed” of the organic horizon 2 mm fraction. Values were automatically recorded in the “raw moisture data” format every 15 minutes over the study period.

Triplicate undisturbed soil samples were used to determine physical a hydrophysical soil parameters at each site and treatment. In addition, a ca. 5 L disturbed sample was homogenised, air-dried and sieved to a obtain a 2 mm fraction, which was then used to calibrate the TMS-4 sensors in the laboratory using standard calibration methods. The calibration equations were then used to convert “raw moisture data” into actual volumetric soil moisture values for each treatment and site, the final values being aggregated into daily averages.

Owing to high variance in the data, the non-parametric Kruskal-Wallis test (Kruskal et al. 1952) was used to test for significance, with significance level set at 5 % (i.e. $p < 0.05$). All tests were performed using the Statistica software package v.14.

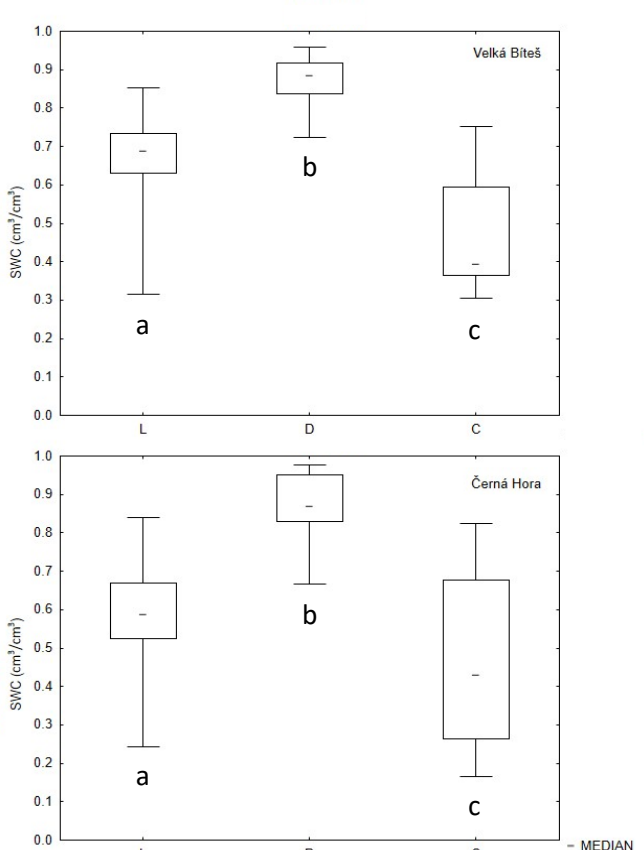

Fig. 1. Floor moisture regime for all stand treatments at Velká Bíteš and Černá Hora (L = living forest, D = disturbed forest with dead trees, C = clear-cut sites)

3 RESULTS AND DISCUSSION

While significantly higher forest floor moisture was recorded in disturbed forest with dead trees at Velká Bíteš and Černá Hora (Fig. 1), it was significantly higher in clear-cut sites at Vranov and Vilémov, with living stands always mid-way at all localities. These differences are most likely due to differences in understory coverage at each site, which in turn is related to the number of trees per hectare. While clear-cut sites at Vranov and Vilémov had lower herb coverage than Velká Bíteš and Černá Hora, they had higher coverage of undergrowth comprising compact grass turf.

Our results showed that forest stand undergrowth coverage can have a significant effect on the main hydrological processes (i.e., precipitation, infiltration, runoff, evapotranspiration) and, consequently, on subsequent development of terrestrial ecosystems.

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Wood*net* 2022

ADVANCED TOOL MATERIALS AND THEIR INFLUENCE ON THE PARAMETERS OF CNC MACHINING OF WOOD-BASED MATERIALS (PART I)

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Key words: CNC, cutting force, friction, machining, machining quality, tool coatings, tool wear, wood-based materials

1 INTRODUCTION

The project is focused on the proposal of a methodology for choosing a suitable tool material or coatings and cutting conditions depending on the machined material, considering energy consumption during machining and the quality of the machined surface. Part of the performed experiments will be the analysis of the machining process from the point of view of cutting forces with the elaboration of the Ernst-Merchant theory into the conditions of CNC milling.

During the wood machining, the main problem is generally a high proportion of friction during chip formation, which leads to excessive heating of the tool (Horman et al. 2014). Wood-based materials have a low thermal conductivity, therefore the heat generated during machining is concentrated in the cutting tool (Igaz et al. 2018). In the surface layers of the tool, the temperature while wood is being machined can be up to 850 °C. At such high temperatures, some structural changes in the material can occur, such as a decrease in hardness and abrasion resistance resulting in a faster blunting of the tool. A common solution to reduce the coefficient of friction is to apply a suitable tool coating, which has a positive effect on both the friction of the tool against the material and the easier chip evacuation from the cut. There is a wide range of hard coatings mostly based on carbides and nitrides on the market (Berger et al. 2010), which are deposited in a microscopic layer to the surface of the tool. The main advantage of tool coatings is the possibility of application practically on any substrate of any shape of an already finished tool. This can be done by two basic methods, i. e. the chemical deposition (CVD) and newer physical deposition (PVD). Both methods have many other variants depending on the coating material (Raheem, 2019). CVD and PVD coating are also often used methods to deposit a thin layer of carbon in its hardest sp3 structure (Deutchman and Partyka, 1990), so called Diamond-like Carbon (DLC) (Folea et al. 2010).

The goal of the project is to quantify machining parameters of tools designed for CNC machining of commonly used wood-based materials. In particular, to analyze the machining process focusing on the cutting forces and energy consumption during machining and to create a methodology for choosing the appropriate tool coating and cutting conditions depending on the machined material.

2 METHODS

The project is divided into three phases:

1) measurement of energy consumption during machining (evaluation of cutting forces)
2) evaluation the machined surface quality
3) creating a simple methodology how to select an appropriate tool coating (material) and cutting parameters according to machined material

Representatives of the most used wood-based materials were selected for the experiment: (native wood (spruce/oak wood); agglomerated material (MDF/Chipboard); laminated material (HPL/plywood)).
In the first phase of the project, the machining will take place while machining the MDF board.
For the experiment, standard types of tools (Vydona s.r.o.) will be used (monolithic end mill and spiral end mill) with different modification of tool materials and coatings (non-coated, lapped surface, TripleCoating Si coating, Hyperlox coating and Diamond Coating (DLC)).
CNC milling will take place on a standard Morbidelli m100 CNC machine. The cutting forces measurement will be carried out on the three-axis piezoelectric dynamometer 9257B Kistler. The connection of the measuring apparatus is a laptop with evaluation software DynoWare, an A/D converter DAQ system-data bus type 5697A, a multi-channel amplifier Type 5070A, and a piezoelectric three-axis dynamometer Kistler 9257 B. The sampling frequency of the measurement data recording will be set to 4,000 Hz due to the possibility analyze the dynamic course of forces on the cutting edge. During the experiment, the cutting parameters will be methodically changed: feed per tooth (chip thickness) and depth of cut for both conventional and climb milling. The values of the forces acting on the workpiece and the tool will be measured and compared with the theoretical calculation. In the further phases of the project, the quality of the machined surface will be evaluated for the given machining conditions and the materials used.

3 CONCLUSIONS

In addition to scientific value, the results of this research can have a significant impact on practical application, where they can help in choosing the right tool for machining different wood-based materials.
For example, DLC coatings, due to their properties, appear to be a possible universal solution for machining wood-based materials, including native wood. However, it is necessary to prove this hypothesis by comparing the cutting parameters of different tool materials on different machined materials.

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THE INFLUENCE OF THE TEMPERATURE ON THE MECHANICAL PROPERTIES OF WOOD

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Keywords: bending test, DIC, impact loading, thermal treatment, wood

1 INTRODUCTION

Wood thermal treatment is developing significantly nowadays all over the world due to multiple reasons such as the declining trend of durable timber production and the increase in demand for sustainable construction materials (Esteves et al. 2009). The main two improvements of the thermal treatment are improvement in resistance to water absorption and dimensional stability by annihilation of the hemicellulose (Pelaze et al., 2013). The treatment also improves the biological durability, wood colour, and acoustic properties (Cao et al.,2022). On the other hand, thermal treatment can harm mechanical properties. Two of the most important mechanical properties affected by heat treatment are the modulus of elasticity and the bending strength. The effectivity of the thermal treatment depends on wood species and process conditions and it has a stronger effect on some properties, for example, the bending strength is affected drastically more than the modulus of elasticity (Bekhta Niemz, 2003). Also, the severity of the thermal treatment of different species can be significant (Bengtsson et al.,2003). One of the most common mechanical tests is the impact test. The thermal treatment makes the wood more brittle and consequently, it affects the absorbed energy in impact bending tests (Kubojima et al. 2000).

2 MATERIAL AND METHODS

Five species of beech (*Fagus sylvatica L.*), oak (*Quercus robur*), spruce (*Picea abies), ash (Fraxinus excelsior)* and Larch (*Larix decidua*) were selected for this research. The boards were provided from the local sawmill.

2.1 SAMPLE PREPARATION AND THERMAL TREATMENT

The boards with 5 cm thickness were cut and each wood species was divided into three groups. The first series of group which was called the non-treated group (NTT) was not thermal treated. The second groups of each species were thermally treated in 180°C for two hours and were called low thermal treated groups (LTT). And the last groups were treated in 220°C for two hours and were called high thermal treated group (HTT). After thermal treatment of the second and third group, the test samples of dimension 20*20*300 mm were prepared from the boards. Before and after thermal treatment, the samples were evaluated by naked eye to eliminate all of the samples with defects and abnormalities.

2.2 IMPACT TESTS

The test was carried out on the drop-weight impact testing machine DPFest 400 (Labortech s.r.o., CZ). The tests were done in a common temperature room (≈20°C). In total, 336 samples were prepared, colored in speckled pattern, stored in an environment of 20 °C and 65 % relative humidity and tested by the impact testing machine. Due to extreme high speed of the process of the impact, a set of high-speed

(HS) equipment with The frame rate of 50000 fps rate. For lower resolution (1024×672 Px), a Photron Fastcam SA-X2 1000K-M2 with a cell size of 20 μm equipped with a lens Nikon Micro-Nikkor G and two teleconverters was used.

2.3 DIGITAL IMAGE CORRELATION METHOD (DIC)

After recording of the impact tests, the next step was the processing of the images. For this task, the digital image correlation method was considered. A highly effective software called Vic-2D v. 2010 (Correlated Solutions, Inc.) was used.

3 RESULTS

The results showed that the total work required for the breakage decreases by the severity of the thermal treatment. Figure 1 compares the value of the total required work for all of the groups.

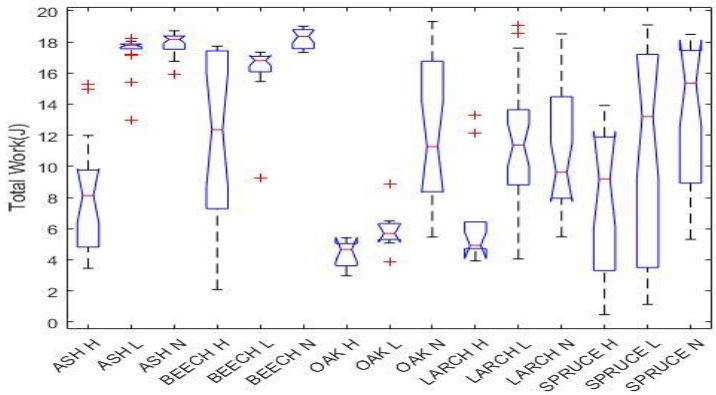

Fig. 1: The total required work for the groups

4 CONCLUSIONS

The severity of the treatment on the mechanical properties showed a clear pattern in a way that HTT samples absorbed the least impact energy, the LTT samples absorbed more and the NTT samples absorbed the highest amount of the impact energy thus the required work required for the breakage decreases by the thermal treatment.

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EFFECT OF ROOTING SPACE VOLUME WITH STORMWATER SUPLY ON TREE VITALITY

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Key words: leaf water potential, rooting space volume, structural soil, vitality

1 INTRODUCTION

The main stress factors of the urban underground environment are changes in soil physical properties and soil compaction, limited air exchange, water capacity and infiltration and resistance to root penetration (Roberts et al. 2013). The period of tree active growth is primarily influenced by the size of the rooting space (Street Trees Standard for of the City of Prague, 2021). The optimal volume of the rootable soil is related to the ability to use rainwater within the root zone and its own accumulation in a given soil volume, the field water capacity. When using substrates with components with high water holding capacity together with an efficient rainwater management system (HDV), it is possible to plant trees in smaller soil volumes than specified in CZ Standard SPPK A02 007:2020. A structural soil (Watson 2019, Urban 2008) covered with a permeable surface can be used when constructing the space adajacent to the tree planting pit. Structural soil is a mixture of soil and aggregate of medium or coarse-grained fraction, which ensures the required load-bearing capacity and aeration. In a study conducted in containers, the structural soil retains 7-10% moisture (by volume), similar to sandy loam soil, has greater infiltration capacity, good drainage and good aeration (Grabosky et al. 2009). In the Czech Republic, the use of a structural soil is only rarely followed by a rainwater management (HDV). Vegetation provides the following key services in relation to HDV: infiltration, accumulation, filtration and evaporation (Vítek et al. 2018). In turn, sufficient rainwater in the root zone ensures the growth and survival of vegetation and therefore the fulfillment of aesthetic and environmental functions. By retaining water in a rootable space, the runoff of rainwater can be reduced by 90%, for this case, tree pits must reach 2.5% - 8% of the total runoff area with a paved surface (Grey et al., 2018).

2 METHODOLOGY

2.1 MATERIAL AND METHODS

The project takes place at the research area of the Center for Research and Development of Blue-Green Infrastructure (CVVMZI) on trees planted in 3 sizes of rooting volume: 2m³, 3m³ and 6m³ with a 0,8m depth, filled with a structural soil (85% gravel of fraction 32/64, 5% compost, 10% biochar). The tree pits are covered with a 5cm of gravel surface. The size of the rainwater collection area is determined according to the calculation of water consumption by DeGaetano (2010), according to the dimensioned rainfall. 5 *Tilia cordata* trees are monitored for each volume and 3 control trees of the same species in a natural soil also with rainwater supply. After planting, during establishing phase, the trees were irrigated with 60l - 1 x 14 days. Within the first years tree establishing and growth in the structural soil with rainwater supply is monitored and in subsequent years growth dynamics depending on the volume of rooting space provided will be evaluating.

2.1 VITALITY MEASUREMENTS

Physiological vitality of trees is monitored by visual assessment and measurement of appropriate parameters: currently leaf water potential, in next years: growth, photosynthesis and fluorescence (Dendrometer and PhotosyncQ measurements). Leaf water potential (Plant Moisture Stress - PMS) is measured in a Scholander pressure chamber PMS 1000 (PMS, USA) during the day and before dawn. Soil moisture is monitored to a depth of 1 m with a PR2 profile moisture probe (Delta-T Devices, Ltd., Cambridge, UK).

3 RESULTS, DISCUSSION AND CONCLUSION

Already in the first year of the experiment, the difference in Plant Moisture Stress between the trees planted in the structural soil and the control trees in the natural soil was confirmed. During the summer day measurements of PMS on trees in structural soil range from 18 to 19 bar, while trees in natural soil show 22 bars. Measurements of PMS during the fall day on trees in structural soil range from 8 to 13 bar and trees in natural soil show 16 bars. Predawn fall measurements of PMS on trees in structural soil range from 4 to 5 bar and trees in natural soil show 10 bar. As PMS increases above 20 bar plant vigor declines. The effect of different volume of structural soil is not significant yet, as the root system has not yet hit the limits of volume provided. The difference in visual assessed vitality is less noticeable in the phase of tree establishment, but corresponds with the leaf water potential measurement. Further measurements will follow within next 15 years, when the effect of a rooting within the provided volume is expected.

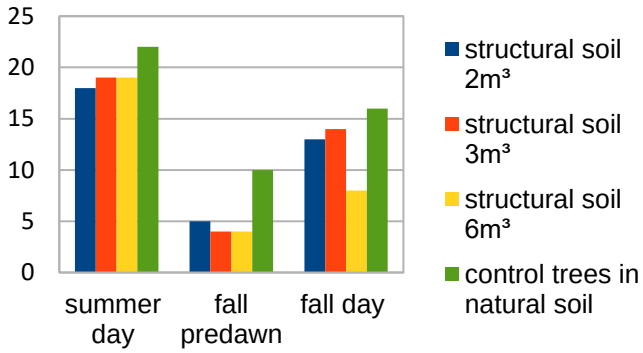

Fig. 1: Plant Moisture stress (Bar)

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EFFECT OF BARK PARTICLE SIZE AND USED RESIN ON THE MECHANICAL PROPERTIES OF BARK BOARDS

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Key Words: bark particles, internal bonding, melamine-urea formaldehyde resin, modulus of elasticity, modulus of rupture, urea formaldehyde resin

1 ABSTRACT

The purpose of the project was to produce single-layer particleboards containing particles of spruce and pine bark, size (2-5 mm, 5-8 mm and 8-15 mm), which were adhesive with 5 and 7% urea formaldehyde (UF) and melamine-urea formaldehyde resin (MUF). The result of the project is the determination of the effect of bark particles and the type of resin on physical and mechanical properties: bending (MOR & MOE), internal bonding (IB), equilibrium moisture content (EMC), thickness swelling (TS), water absorption (WA), density profile (DP), were tested and compared to reference wooden particleboard.

2 INTRODUCTION

The bark is the outer part of the tree, which has many functions: it protects the trunk from mechanical damage, wood-destroying insects and fungi, it prevents water loss and mitigates the effects of temperature changes in the season. (Oskolski and Van Wyk, 2010). The bark contains substances such as: terpenes, waxes, balms, essential oils, free fatty acids, alcohols, sterols, resins and others. Bark analysis showed a low cellulose content, the wood contains 40 to 50% cellulose, the inner bark/phloem contains 18 to 25% and the outer bark/cork contains 3 to 17% (Ugolev 1986). The content of polysaccharides in the bark is 44.1 to 47.6%. (Daineko and Faustová, 2015) found that the lignin content in the outer bark is higher than 20%. Another use of the bark is the production of building insulation boards, fiberboard and particleboard (Sullivan, 1970). In almost all types of boards, barks from different trees were incorporated, increasing the proportion of bark causes a decrease in strength, because the mechanical properties of the bark are worse than those of the grown wood (Kelly, 1977). Bark generally has less fiber than wood, so strength is slightly lower. In addition, many softwood barks are relatively rich in resins and waxes, which can reduce the consumption of adhesive and hydrophilizing agents (Burrows, 1960).

3 MATERIAL AND METOTDOLOGY

The bark chips were plasticized for three days at a temperature of 50 °C. Subsequently, it disintegrated into leaf particles used a DIEFFENBACHER knife ring flaker MRZ/MSF 1400. The particles were dried in a conventional chamber oven at a temperature of 70°C to a moisture content of 6% and sieved on a screen sorter for the required fractions.

3.1 PRODUCTION OF BOARDS

Particle boards were manufactured in the laboratory. The UF and MUF resins were applied by nozzle in a rotary blander. Bark particle mats were formed by hand into a mold with dimensions of 600 × 450 mm and pressed to a thickness of 12 mm

at a temperature 180 °C. The pressing process has been 240 seconds at a pressure of 3.5 MPa, and then the pressure was reduced by 0.5 MPa in four steps of 20 seconds.

4 RESULTS AND DISCUSSION

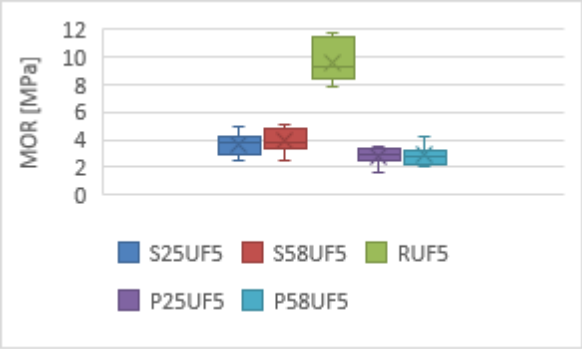

Fig. 1: Modulus of rupture

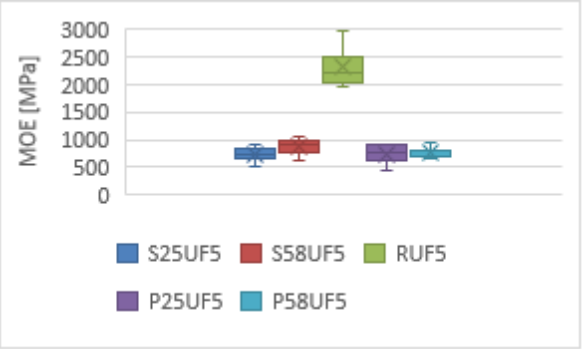

Fig. 2: Modulus of elasticity

From the graphs showing the results of the bending test (MOR and MOE) according to the standard EN 310, it can be seen that experimental boards made of spruce bark bonded with 5% UF resin and sizes 2-5 mm (S25UF5) and 5-8 mm (S58UF5), as well as boards made of pine bark with particle sizes of 2-5 mm (P25UF5) and 5-8 mm (P58UF5) show almost identical values, therefore it can be concluded that the size of the particles does not have a significant influence on the bending strength of the experimental boards. On the contrary, the reference board made of wood particles bonded with 5% UF resin (RUF5) shows an increased strength in bending compared to boards made of bark particles. This result was expected from the results of previous research (Kelly 1977).

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I would like to thank Internal Grant Agency MENDELU for the provided financial resources used in this project IGA-LDF-22-IP-011.

ANALYSIS OF ENZYMATICALLY TREATED TANNINS – METHOD DEVELOPMENT CHALLENGES

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Keywords: condensed tannins, high-performance liquid chromatography, hydrolysis, UV-Vis spectrophotometry

Fungi are able to release a spectrum of intracellular and extracellular enzymes that help them with the digestion of the present substrate and allow them to grow. The selection of a „qualified“ fungal strain with a suitable enzymatic „palette“ is therefore very important to point the biodegradation to a desired pathway. Furthermore, the optimal cultivation conditions (e.g. time, temperature, duration, pH value, air flow, light conditions, nutritions – direct energy sources and essential elements) have to be taken into account because they affect the fungal growth, production of those enzymes and the nature of the final hydrolytical residues. However, as the fungi are living organisms, they might have varying demands and despite their fulfilment, they might behave not expectable.

Method development is therefore challenging in the first step during hydrolytical treatment setting and controlling, and then, in the second step, when an analytical technique is being developed and/or optimized to i) follow the process in terms of enzymatic activity and to ii) characterize the chemical changes of hydrolytical products at a particular moment, as well as over the whole set time period.

Tannins are complex polyphenolic compounds found in variety of higher plants playing the defense role against pests. Their chemical composition is dependent on the species and the way how they are obtained. Tannins are typically extracted from the tree bark and heartwood, where they represent a higher percentage of the mass compared to other tree parts.

The available analytical assays, when it comes to the compounds of natural origin, have their main limitations in the: 1) selectivity and specifity, when a mixture of more compounds and/or very similar compounds being hardly separable from each other is present; 2) accuracy within the desired range; 3) availability of relevant external standards with similar structure for the method calibration; 4) price of such chemically well-defined, pure standards.

Several assays for observation of the fungal growth and chemical changes in liquid medium in relation to the cultivation time were optimized for this particular application that might be easily further adapted also for use with other fungal strains. The same purpose should be given to a totally new method for molecule size determination, which is currently under development.

ACKNOWLEDGEMENT
The research was supported by the Specific University Research Fund MENDELU (Grant No. IGA-LDF-22-IP-028).

COMPREHENSIVE COMPARISON OF THE UNDERUTILIZED WOOD SPECIES FOR MANUFACTURING LAMINATED STRAND LUMBER

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Keywords: adhesives, bending properties, laminated strand lumber (LSL), wood-based composites

1 INTRODUCTION

LSL is one of the high yield new EWPs used as structural composite lumber, consisting of oriented wood strands up to 300 mm long that are bonded and compressed to form panels up to 90 mm in thickness. LSL shows superior mechanical properties with less variability than solid lumber of the same species (Moses et al., 2003). It is used almost in all structural applications like lintel, beam, joist, ceiling, floor, rafter, etc. (Williamson, 2002; Vining, 1993).

Properties of the LSL are dependent on the density of the panel, wood species, strands geometry, adhesive, and the orientation of the strands (Moses et al., 2003). Each factor is related to another one and it is important to compare it in the final LSL.

Particle geometry is one of the main factors influencing the performance and strength of wood composites (Marra, 1992). Therefore, to further improve the bending properties, geometrical parameters other than strand thickness must be investigated. The relationship between strand length and thickness (slenderness ratio) also plays a key role. A previous study concluded that bending strength is fairly well correlated to the slenderness ratio of the strands and constantly increases up to a ratio of at least 300 (Post, 1958).

2 MATERIAL AND METHODS

The debarked logs were cut into 300 mm long cutouts corresponding the final intended length of the strands for LSL. Afterwards the strands were produced on the laboratory knife ring flaker (MSF 1400, Dieffenbacher-CZ s.r.o., Czech Republic). The cutting process (moisture content and temperature of the logs, rotation speed, and knife space) was optimized for the Norway spruce (Picea abies L. Karst), as it was the first species used in the project. The pressing parameters and the strands orientation were optimized for the pMDI and MUF adhesive.

The physical properties of the LSL were measured on the standardized specimens 50 × 50 mm (moisture content (MC), density, distribution profiles (DP), thickness swelling (TS), water absorption (WA)). The bending properties (modulus of elasticity (MOE), modulus of rupture (MOR)) of LSL were tested on the standard size specimens with the dimensions related to the ASTM D1037.

3 RESULTS, DISCUSSION AND CONCLUSIONS

The statistically significant difference was observed between different types of adhesives for density measurement. There was observed decrease of the density between P10 and P15 (pMDI resin; MC of the strands after resin application 10% and 15%), which was caused by higher spring back effect of the final panels.

Bending properties of LSL for edgewise and flatwise testing on the specimens made from Norway spruce showed similar trends for the MOR and MOE. Specimens manufactured with the lowest MC of the strands after resin application showed the highest bending properties on the flatwise and edgewise specimens. The specimens with the MC after resin application 10 and 20% for pMDI resin showed higher MOR for flatwise and edgewise specimens. There was also observed the decrease in MOE for P15 specimens (pMDI resin and 15% MC after resin application) compared to the P10 and P20 specimens.

Specimens manufactured with pMDI resin and 10% MC after resin application showed expected results with the highest density, MOR and MOE.

MUF resin showed significantly lower density and bending properties.

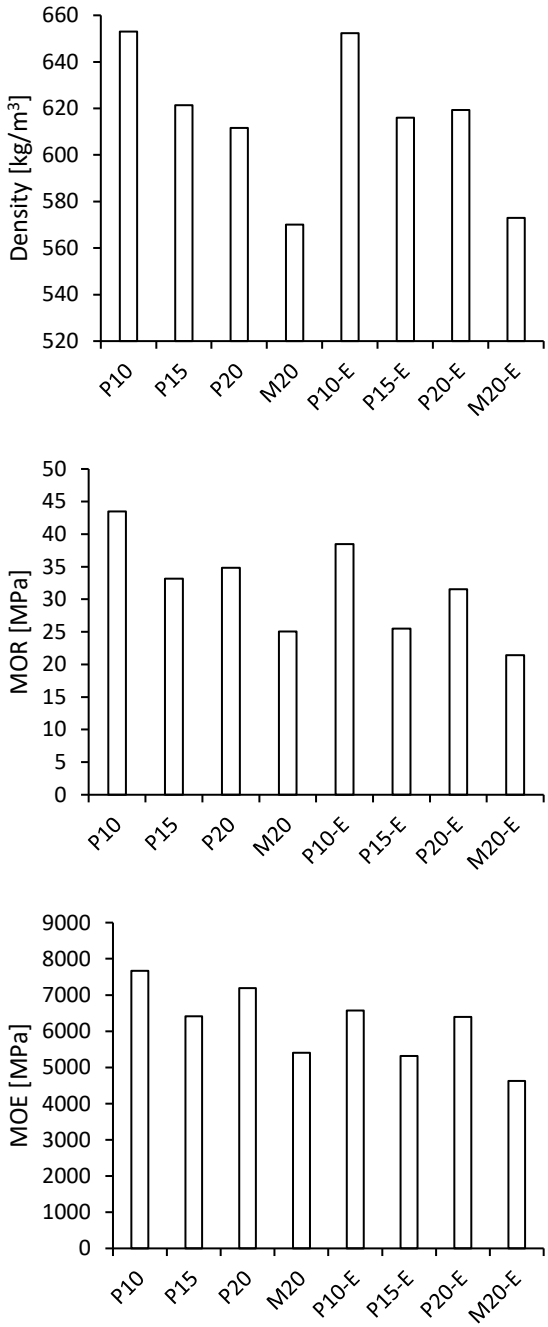

Fig. 1: Physical and mechanical properties of spruce LSL manufactured with different adhesives (P-pMDI, M-MUF), different moisture content of the strands after resin aplication (10, 15, 20 %) and flatwise and edgewise (E) testing.

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DETERMINATION OF THE WATER VAPOUR PERMEABILITY AND WATER VAPOUR RESISTANCE FACTOR OF SHEEP WOOL – METHODOLOGICAL DESIGN OF MEASUREMENTS

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Keywords: dry and wet cup, insulation, humidity, moisture properties, sheep wool, water vapour permeability water vapour resistence factor,

1 INTRODUCTION

The article focuses on the study of the moisture properties of sheep wool and the research of the potential of this material in contemporary timber buildings. For the use of sheep wool as thermal insulation in timber buildings, a detailed knowledge of not only its thermal but also its moisture properties is essential. When surveying the literature, we find that in most of the articles, authors focus on thermal properties such as thermal conductivity coefficient and specific heat capacity (Ahmed et al., 2019; Corscadden et al., 2014; Dénes et al., 2019; Pennacchio et al., 2017). However, significantly fewer authors have reported moisture properties (Tuzcu, 2007; Hegyi et al., 2020). Moreover, these moisture properties are obtained from experiments based on standardized methodologies that do not take into account the variability of the boundary conditions under which the experiment is performed. An example is the procedure reported in EN ISO 12572, which specifies the method, conditions and calculation of the moisture properties of the material by the cup method. The standard assumes that the boundary conditions are constant over the experiment, i.e. it assumes that the moisture vapour flux through the material corresponds to stationary conditions. In this paper, we compare the determination of water vapour permeability or water vapour resistance factor based on EN ISO 12572 and on realistic conditions that occur in the cup during the experiment, which do not correspond to the stationary flux requirement.

2 MATERIAL AND METHODS

For the determination of material characteristics of sheep wool such as the water vapour permeability and water vapour resistance factor, the method specified in EN ISO12572 has been modified. A 50 mm thick roll of sheep wool was used for the experiment. Ten samples were tested. The dimensions of each sample were 50 mm thickness and 170 mm in diameter. For five samples the bulk density was increased by 100 %. The sheep wool was inserted into a plastic tube with an inner diameter of 160 mm and a height of 50 mm. The 10 mm higher diameter of the sheep wool was selected because of the increased tightness between the material and the tube. The purpose of the plastic tube is to prevent the migration of water vapour through the sides of the examined material. The tube was placed on a steel grid together with the sheep wool and the whole assembly was then placed on an aluminium cup filled with desiccant – silica gel. The point of contact between the steel grid, the plastic tube and the bowl was sealed with butynel sealant. A sensor was placed in the test assembly to measure the relative humidity and temperature in the space between the desiccant and the examined material. The samples were then placed in a test chamber in which the temperature was maintained at approximately 23 °C and 50 % relative humidity.

The methodology from the standard indicates that the relative humidity in the tray above the silica gel should be 0 % at 23 °C. With a sensor in the space between the silica gel and the material under test, the actual values of the conditions inside the environment were detected and were subsequently included in the calculations to obtain the the water vapour permeability and water vapour resistance factor.

3 RESULTS

When comparing the results obtained by following the method specified in the standards with a modified method incorporating changes in partial pressures, nearly twice the values of the diffusion resistance factor were obtained.

Tab. 1: The comparison of method results

Water vapour permeability δ [kg·m-1·s-1·Pa-1]		**Water vapour resistance factor μ**	
EN ISO 12572	modified method	EN ISO 12572	modified method
1,59E-11	2,52E-11	12,3	7,8

4 CONCLUSION

The experiment demonstrated that the theoretical assumptions on which the normative procedure is based cannot be achieved in the case of measuring the moisture properties of sheep wool. The relative humidity of the air in the cup and therefore the gradient of the partial pressures of water vapour cannot be considered constant. Therefore, the calculation of the monitored variables cannot be carried out according to the normative procedure. If the non-stationary conditions of water vapour permeation through the sheep wool are not taken into account in the calculation, the error rate of such a procedure reaches approximately 58 %.

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THREE YEARS OF EXPERIMENTAL MODULE WOODENHAT

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Keywords: experimental module, heat, moisture, testing

Hygrothermal performance of building components is an essential part of integrated building design. Thanks to the energy crisis, we try to design more and more sustainable and nearly zero-energy buildings. Wood and wooden-based materials are susceptible to moisture, so they need a careful and safe design. Just a simplified approach is not enough, thus we need more advanced methods in energy performance as well as in moisture design (Slávik, Čekon, 2019).
Our project follows contemporary trends in timber components from a building point of view. Within this 3-years project it was developed a testing module with real behavioural data supported with laboratory testing and theoretical work. The last part of the project was focused on the numerical modelling of test components and comparison of measured data with results of numerical model. The main idea is a usage and verification of the numerical algorithms for modelling heat and moisture transport.
Advanced algorithms lack information about sorption behaviour of materials, and the influence of transport parameters on temperature and moisture. Some characteristics of common materials could be found in databases. Not all materials are available or similar like materials included in catalogues. Materials with significant influence on the model should be selected very carefully or measured. Selected significant materials were measured in the research centrum of Josef Ressel in Utechov. Sorption and desorption characteristics of façade's mineral wool and timber insulation were measured by dynamic vapour sorption. The method uses a small sample of material, which is continuously measured in time with variable ambient conditions. This approach offers faster and more accurate results (Slávik et al., 2021). Details are displayed in Fig. 1.

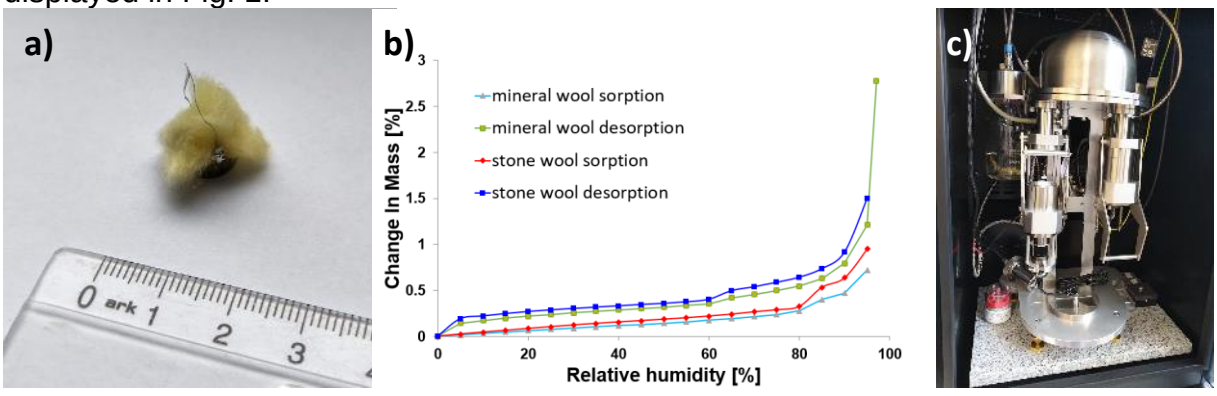

Fig. 1: Dynamic vapour sorption experiments a) sample preparation, b) results – sorption and desorption isotherms, c) DVS equipment

Thermal conductivity of insulation was measured by a transient - dynamic method by ISOMET device with needle probe. The method is based on dynamic response of the material to the heat pulse in a semi-infinite space. The method was originally developed for soils measurement (ASTM, 2014), (IEEE, 2017), but it could be applied for fibre insulation and loose material also. Relation between thermal conductivity,

moisture and temperature were investigated. Fig. 2 shows the experiment and preview of data.

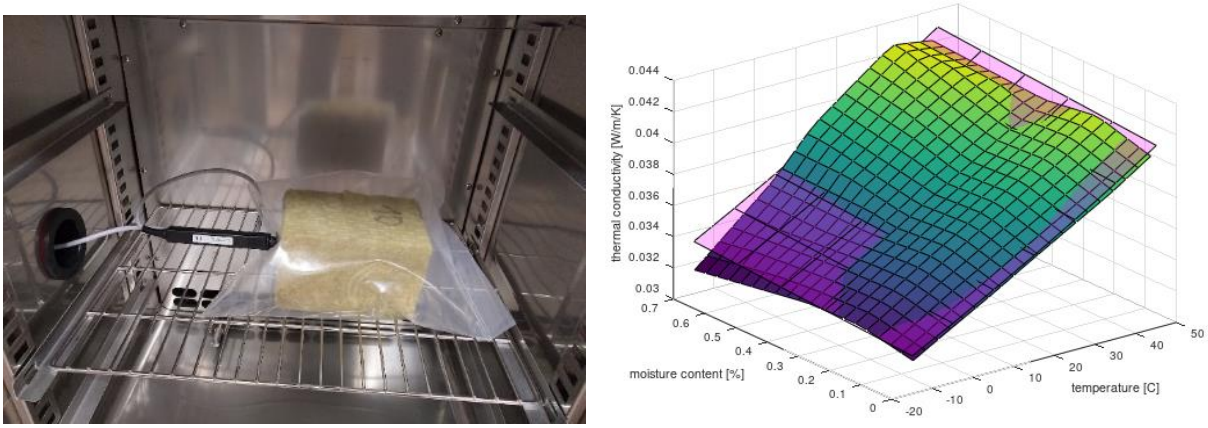

Fig. 2: a) scheme of test components, b) composition geometry and position of sensors, c) experimental wall from internal side, d) external side with radiation sensors, e) weather station

Twelve testing composition are measured since January of 2021 with boundary condition in interior as well as in exterior. Data of selected compositions were used for verification of the numerical model. Model was prepared in Delphin software, which is developed by Technical University in Dresden showed by Fig. 3.

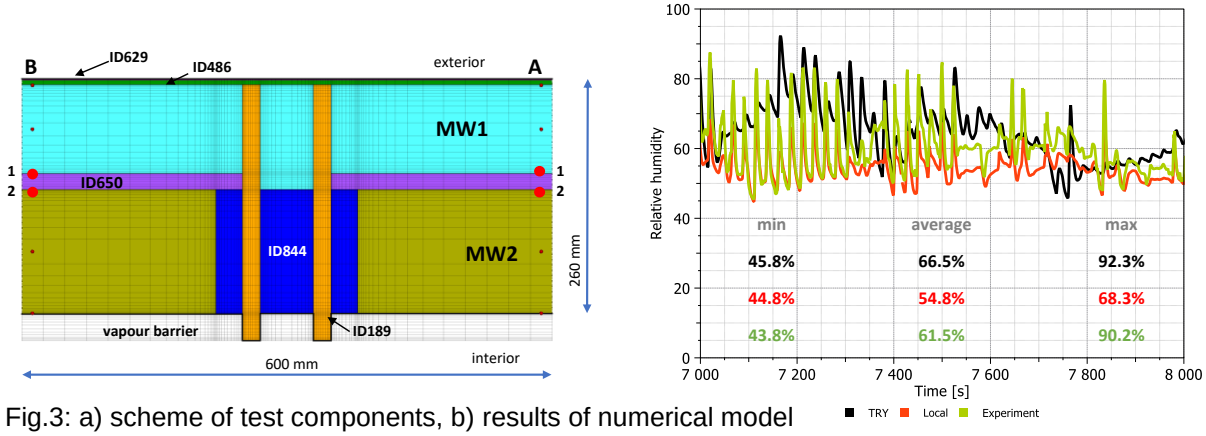

Fig.3: a) scheme of test components, b) results of numerical model

Simulation results displayed good compilation with data measured in control points. These results will assist in the understanding of hydrothermal regime and redistribution of moisture in timber components and could be used as a benchmark for testing of algorithms.

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PALAEOCLIMATIC POTENTIAL OF THE MULTI-CENTENNIAL OAK RING WIDTH CHRONOLOGY FROM WESTERN UKRAINE

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Keywords: dendrochronology, Quercus, tree-ring chronology, Western Ukraine, wooden churches

1 INTRODUCTION

Oak, due to its widespread distribution in Europe and its properties such as longevity, durability, distinct boundaries of tree-rings and extensive use in history, is one of the most used species in dendrochronology (Schweingruber, 1996). Therefore, in recent decades, multicentennial and multimillennial oak tree-ring width (TRW) standard chronologies have been compiled in Europe, which are used especially in dendroarchaeology and dendroclimatology (Nechita et al., 2018; Prokop et al., 2016; Wazny et al., 2014). Because the region of Ukraine is one of the few European countries without a well-replicated oak TRW chronology, there was an effort to compile one (Sochová et al., 2021). In the last years, a 165-year-long recent oak TRW chronology has been compiled, which has now been expanded with tree-ring series from historic constructions. In addition, the recent part of the chronology was used to find the climate signal. For more accurate dating, an analysis of the number of sapwood rings was also performed.

2 MATERIAL AND METHODS

Totally 247 oak samples (10-28 samples from each site) from 14 forests of different altittude and 86 oak samples from 18 oak wooden historical constructions (belfries, churches) have been taken using Pressler increment borer on region of Transcarpathian Ukraine. Also 75 TRW series from historical constructions located in Zemplin region (east Slovakia), are part of regional oak TRW chronology. The sampling, processing and dendrochronological dating have been performed according to standard dendrochronological methodology (Cook and Kairiūkštis, 1990).

3 RESULTS AND CONCLUSION

The standard oak TRW chronology for Western Ukraine so far consists of 408 TRW series from Transcarpathian (UA) and Zemplin region (SK) and covers the period from 1400 to 2020, from 1506 it consists of at least 10 TRW series.

After dendroclimatic analysis a significant negative correlation of TRW with the temperature in May and June, and positive with the temperature in January was found. An even stronger possitive correlation with the precipitation in March-August and also with drought indices in May-September were found (Fig. 1). This suggest, that lack of moisture is most significant limitation for oaks in this area. Thus this chronology can be used to find significant droughts in TRW in the past.

For all samples, average value of TRW (AVG, mm/year), average length of series (MLS) and number of sapwood rings were calculated. To assess the quality of regional

chronologies, population signal values (EPS) and interseries correlations (Rbar) were calculated. TRW series have mean EPS value 0.907, which is greater than 0.85, which is taken as the threshold (Wigley et al., 1984). For more precise dating we recommend using an estimate of 5–23 sapwood rings for for this area.

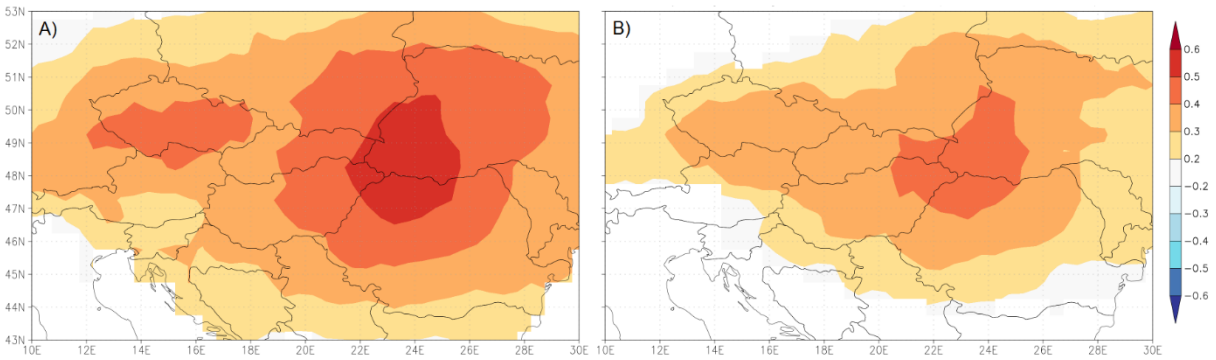

Fig. 1: Spatial correlations between tree-ring width and SPEI3 (A) and Precipitation (B) in May-July from CRU TS4.06 (Harris et al., 2020) for the period 1901–2020

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DROUGHT-DRIVEN SEASONAL DYNAMICS OF TWO-AGE DIFFERENT EUROPEAN BEECH STANDS

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Keywords: cell differentiation, *Fagus sylvatica*, radial growth, wood formation, xylogenesis

1 INTRODUCTION

The adaptation of European beech to local climatic variations is depicted in tree-ring width and wood anatomical differences (Arnič et al., 2021). Photosynthetic ability, cambial activity and growth rate productions progressively decline with tree age. As a tree grows and matures, it presents an evident change in the structure of its growth rings and xylem conduits. Ageing issues may arise if the kinetics of wood formation of young trees differs from that of old trees and how climatic variations and environmental stresses may impact the kinetics of wood formation and tree-ring growth (Čermák et al., 2019; Rodriguez-Zaccaro, 2019). Monitoring plastic responses of xylem phenology and anatomical characteristics of xylem cells can explain an age effect on growth trends and climate-growth relationships in trees. The findings of conifer ageing studies suggested that tree age should be included in the seasonal dynamics of timing and duration during wood production growth (Zeng et al., 2019). However, in a comparable study on European beech, the results showed a similar pattern of phenological phase occurrence during a non-dry year (Giagli et al., 2015). The purpose of this investigation was to see if age variation in mature beech trees may lead to different responses during a dry year.

2 MATERIALS AND METHODS

This study was carried out, in two age-different European beech stands (50 and 135 years old, respectively), in the Rájec-Němčice research plot in 2018. This year, we monitored the dynamics of wood formation as described in (Giagli et al., 2015). ImageJ software was used to perform anatomical measurements. During the 2015-2020 reference period, 2018 was the warmest and nearly driest growing season (Fig.1).

3 RESULTS

Although the dates of the phenological phases (i.e., the onset of cambial cell production, secondary wall thickening, and lignification) occurred on nearly identical days in both European beech stands, the maximum growth rate (Fig. 2) and as a result, the tree-ring growth was notably higher in the younger beech stand. The vessel anatomical characteristics of European beech stands aged 50 and 135 years were measured and compared (Table 1).

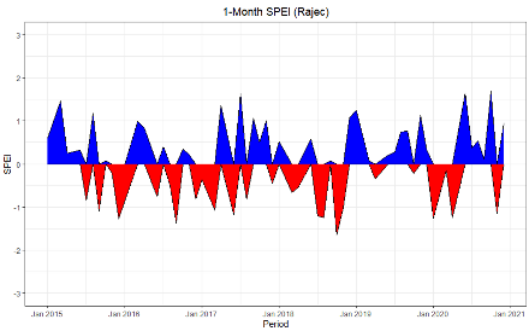

Fig. 1: Standardized precipitation evapo-transpiration index (SPEI) during 2015-2020.

Table 1: Differences in the anatomical vessel characteristics between the two stands in the whole TRW.

	50 years old	135 years
Mean vessel area (MVA, μm^2)	1994.6	2.052.9
Mean vessel diameter (MVD, μm)	43.1	45.1
Vessel density (VD, N/mm^2)	122.9	121.5
Water conductive area (WCA, %)	23.7	25.5
Tree-ring width (TRW, mm)	954.1	2329.9

4 CONCLUSIONS

Our findings revealed minor differences in vessel characteristics, while TRW in the older stand was essentially lower (> 50 %) than in the young beech stand during a dry year like 2018. A more in-depth examination of TRW segmentation may reveal a more sensitive response to local weather conditions.

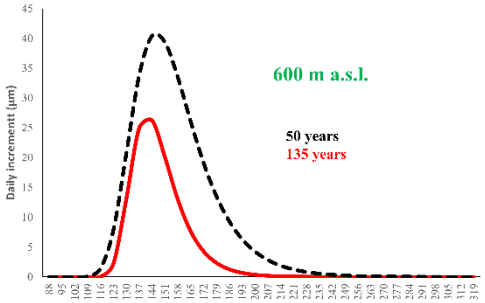

Fig. 2: First derivatives of Gompertz functions describing daily xylem growth increment (um/day) and the time of maximum cell production.

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