GOZDARSKI INŠTITUT SLOVENIJE
SLOVENIAN FORESTRY INSTITUTE

EUFORIA

European Forest Research and Innovation Area

EUFORINNO

European Forest Research and Innovation

The final EUFORINNO conference
31st August - 4th September 2015,
Rogla, Slovenia

Programme and Book of Abstracts

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FOREWORD

European forests are critical to carbon storage, biodiversity conservation, water quality and a number of ecosystem services, socio-demographic stability and economic revenue. EUFORINNO (http://euforinno.gozdis.si/presentation/) is a means for the Slovenian Forestry Institute (SFI) to raise its scientific excellence and infrastructure, and better exploit its innovative outputs.

The project has brought so far an unprecedented increase in the scientific infrastructure, excellence and visibility of SFI, and contributed to awareness on the role of forests and forestry for nature and people. It has contributed to a deeper integration within the European Research Area (ERA), and with its final conference it contributes to the European Forest Research and Innovation Area – EUFORIA - an increase of forestry research excellence and awareness throughout Europe.

EUFORINNO relies on 8 excellent research partners who support SFI in building its long-term strategy, welcome researchers from SFI during their secondments abroad, and provide on-site training on new methodologies, data interpretation and publishing. In the organization of the final conference the partner leaders, and members of the EUFORINNO Advisory Board, have agreed to take an active role in the conference programme committee and are contributing their own keynote presentations in the different conference sections.

Without our great partners, Reinhart Ceulemans, Monika Konnert, Dieter Ernst, Zachary Kayler, Danny McCaroll, Giorgio Matteucci, Heljä-Sisko Helmisaari, and Håkan Wallander, there would be no project, and no EUFORIA!

Together with our most distinguished invited keynote speakers, Petr Baldrian, Cristina Cruz, John Dighton, Arthur Gessler, Jožica Gričar, John King, Antoine Kremer, Hrvoje Marjanović, Rainer Matyssek, Nate McDowell, Emilia Gutiérrez Merino, Hans Göransson, and Mike Starr, they are a guarantee for an outstanding scientific conference presenting the latest research and expanding horizons in forest science and innovation worldwide.

Furthermore, the project has relied on permanent collaboration, exchange of students and developing common strategies within the South-East European region; we have organized a number of regional workshops on the main EUFORINNO topics with the help of our friends and experts from the region, the National Contact Points (NCP), especially Prof. Saša Orlović, Prof. Dalibor Ballian, Doz. Elvis Toromani, Prof. Phil Aravanopoulos, and Prof. Ibrahim Ortaş, while other NCPs, together with our partners, have contributed with their lectures, students, and topics. We are happy that we can welcome almost all our NCPs and their colleagues also at the final EUFORINNO conference.

Yet the essence of the project is the EUFORINNO management and working group leaders, and all the colleagues who have built up an effective project team, with its core group of early stage researchers, both employed within the project and contributing to it through active participation at secondments, trainings, workshops, conferences, through guardianship of new equipment, developing and producing standardized operation procedures, building up the new open access repository, contributing to the publishing centre, and preparing the IP management strategy. It was a pleasure to collaborate with all of you!

Finally, thanks to the local organizing committee, and all collaborators from different departments of SFI, and co-organizers of the Round table, adding their hands to the organization of all events during the conference!

I am looking forward to the lectures, presentation of EUFORINNO impacts, and posters, and hope to finalize the conference with an effective contribution to further development and recognition of forests, forest science, and forestry in the European forest research and innovation area.

Hojka Kraigher
Chair of the Programme Committee & EUFORINNO Project Coordinator

Foreword

List of Abstracts

Programme overview

	Monday, August 31st	Tuesday, September 1st	Wednesday, September 2nd	Thursday, September 3rd	Friday, September 4th
08:00 - 09:00		Arrival and registration	Biodiversity & ecosystem processes	Forest disturbance, management and modelling	Round table: Forest science and innovation in Europe
09:00 – 09:30		Opening of the conference			
09:30 - 11:00		Forest genetic diversity and climate change			
11:00 - 12:00					Press conference
12:00 - 12:30					Closure of the conference
12:30 - 13:00					Lunch
13:00 - 14:00		Lunch	Lunch	Lunch	
14:00 - 15:00	Arrival and registration	Carbon dynamics in time and space	Excursion to a forest reserve/ research plot	Future forest research and innovation in Europe	Departure or participants
15:00 - 18:00				Impacts of EUFORINNO	
18:00 - 19:00	Welcome mixer	Posters with pizza and beverages			
19:00 - 19:30			Local tourism with wines of the region		
19:30 - 21:00				Conference dinner and awards ceremony	
21:00 - 22:00					

Scientific programme

Tuesday	**September 1st**	
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10:00-10:30	**Monika KONNERT (KN2)**	**Genetic monitoring in forests - LIFEGENMON**
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11:30-11:45	Marjana WESTERGREN	Forest genetic monitoring – delineation of monitoring …
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16:15-16:45	**Danny McCARROLL (KN7)**	**Stable isotopes in tree rings**
16:45-17:15	**Jožica GRIČAR (KN8)**	**What information is stored in phloem structure…**
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17:30-17:45	HAFNER Polona	Environmental signals in *Quercus robur* tree ring widths…
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18:00-21:00	***Posters with pizza and beverages***	

Scientific programme

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Scientific programme

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16:45-17:00	Saša ZAVADLAV	Use of stable isotopes in forest ecosystem: on the progress of SIL at the SFI
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19:30-22:00	***Conference dinner and awards ceremony***	

Scientific programme

Friday,	**September 4th**	
Round table	***Forest science and innovation in Europe***	***Moderators: Reinhart Ceulemans and Primož Simončič***
09:00-11:00	**Hojka KRAIGHER,** SFI, Head of Programme group P4-0107 "Forest Biology, Ecology and Technology", Scientific Board for Biotechnical Sciences, SRA, member of LEGS Committee, Science Europe **Tadej BAJD**, President, Slovenian Academy of Sciences and Arts **Miha HUMAR**, Vice-Dean, Biotechnical Faculty, University of Ljubljana, member of the Scientific Board for Biotechnical Sciences, SRA **Rainer MATYSSEK**, Chair for Ecophysiology of Plants, Center of Life and Food Sciences Weihenstephan, Department of Ecology, TUM **Primož SIMONČIČ,** Director, SFI, Slovenian representative in LULUCF in 2007 **Representatives** of the ministries, responsible for forestry, science, technology, environment, Slovenian Research Agency, Biotechnical Faculty – Uni. Ljubljana, Slovenia Forest Service, and of international organizations	Contributions (5 minutes each): Overview of forestry scopes and challenges Forestry and wood science in Slovenian evaluation schemes Forest research and monitoring and its financing in Slovenia Climate change and research infrastructures in forestry The Slovenian reality and prosperity of science Smart specialization and natural resources The global perspectives in forest science and innovation The Slovenian and international horizons Needs & expectations from forests, forestry & wood industry Discussion (1 hour)
11:00-12:00	**Press conference**	
12:00-12:30	**Closure of the conference**	
12:30-14:00	*Lunch*	

KN1 S1

ADAPTIVE RESPONSES OF TREES TO CLIMATE CHANGE

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Keywords: paleobotany, adaptation, migration, hybridization, oaks

Adaptation of long lived tree species to ongoing rapid climate change is a pivotal question in ecology and forest management. There are indeed concerns that trees may not be able to cope with future environmental change, due to their long generation time. However, there is a growing body of evidence stemming from different sources of information that were recently documented (Quaternary evolutionary history; observations from population and species transfers; provenance experiments) that trees may have resources and mechanisms to cope with climate change. I will review the genetic and ecological mechanisms that have facilitated adaptation of trees during historical "natural" warming periods taking as an example European oaks. Assembling lessons from phylogeography, paleobotany and simulations, I will show how oaks have responded quite rapidly to environmental change, despite their low evolutionary rate at the gene level. I will further examine how these mechanisms may be stimulated during the ongoing climatic changes.

Acknowledgements
EU projects TREEPEACE, MOTIVE and FORGER

KN2 S1

GENETIC MONITORING IN FORESTS – EFFORTS FOR A EUROPEAN IMPLEMENTATION

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Keywords: genetic monitoring, indicators, verifiers, LIFEGENMON

Sustainable forest management is based on a long-term adaptability of forest ecosystems and starts at the lowest, the gene level. Forest genetic monitoring (FGM) implies the long-term observation of the status and the temporal developments (changes) in the genetic system of forest tree populations on the basis of criteria, indicators and verifiers. As genetic variation is the basis of adaptability, forest genetic monitoring is a crucial component of any sustainable forest management because it detects changes of forest adaptability before they are seen on higher levels. At the same time genetic monitoring is assumed to contribute essentially to the estimation and evaluation of the effect of influences on the genetic system in forests, thus making it an early warning and controlling system for ecosystem changes. In the present contribution suitable criteria, indicators and verifiers for a FGM system are presented and the objectives of genetic monitoring are described. The recently started European LIFE project (LIFEGENMON) aims to define optimal indicators and verifiers for monitoring of genetic diversity changes in time across a transect from Bavaria to Greece for two target species, *Abies alba* and *Fagus sylvatica*. In the same time it intends to prepare guidelines for forest genetic monitoring for these two and additional five forest tree species at a national, regional and European scale, to elaborate a manual for implementation of FGM and to disseminate knowledge on the necessity for conservation of forest genetic resources in general and observation of changes through genetic monitoring in detail. The project objectives and the expected results will be presented

Konnert M, Maurer W, Degen B, Kätzel R (2011): Genetic monitoring in forests – early warning and controlling system for ecosystemic changes. *iForest 4: 77-81.*
Graudal L, Aravanopoulos F, Bennadji Z, Changtragoon S, Fady B, Kjær DE, Loo J, Ramamonjisoa L, Vendramin GG (2014): Global to local genetic diversity indicators of evolutionary potential in tree species within and outside forests. *Forest Ecology and Management* http://dx.doi.org/10.1016/j.foreco.2014.05.002.

OV S1

ENDEMIC FOREST TREE SPECIES IN SOUTHEAST EUROPE, THEIR GENETIC RESOURCES AND USE

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Keywords: endemism, relict, in situ and ex situ conservation

The biggest biodiversity in the Old continent is established in the Iberian and the Balkan peninsulas due to wide variety of relief and climate. One of the indicators for biodiversity resources is the presence of endemic species. The endemic rate of Southeast European flora reaches up to 8-9 %, while in West, Central and North Europe it hardly gets near 1-2 % or even none. Most important endemic forest tree species from ecological and economic point of view in Southeast Europe are: Macedonian pine (*Pinus peuce* Grisb.), Bosnian pine (*Pinus heldreichii* Christ.), Serbian spruce (*Pinus omorica* (Panc.) Purc.), Greek fir (*Abies cephalonica* Loud.), Bulgarian fir (*Abies borisii regis* Mattf.), Balkan maple (*Acer heldreichii* Orph. ex Boiss.), Horse chestnut (*Aesculus hippocastanum* L.) and Rila oak (*Quercus protoroburoides* Don. et Bouz.). The valuable timber of Macedonian pine, ornamental characteristics of Serbian spruce and horse chestnut, as well as anti-erosion properties of Bosnian and Macedonian pine, make them very useful forest tree species. Most of these endemits including relicts, i.e. paleoendemits, require additional measures and concerns for their protection. The conservation of forest genetic resources of endemic species is performed by both in situ and ex situ methods.

OV S1

DETERMINATION OF GENETIC VARIATION EXISTING IN ANOTOLIAN BLACK PINE NATURAL STAND AND PLANTATION AREA IN KASATURA BAY

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Keywords: nature conservation area, Black Pine (*Pinus nigra*), genetic variation, RAPD, isozyme

The aim of this study is to determine the magnitude and pattern of genetic variation existing in Kasatura Bay Nature Conservation Area Anatolian black pine (*Pinus nigra* Arnold) natural stand (designated as a Nature Conservation Area) and plantation area nearby. In addition, to estimate whether there is genetic contamination from plantation to natural stand. Cones were collected from 97 mother trees (39 trees from natural stand and 58 trees from plantation) to obtain seeds which are produced by half-sib families. Genetic diversity parameters were estimated for both populations by using RAPD (Randomly Amplified Polymorphic DNA) markers. For detection of pollen contamination, isozymes were used by using 30 trees from each population. Eight RAPD primers generated 74 polymorphic loci. Genetic diversity parameters of the studied populations were generally similar. Percentage of polymorphic loci was 99 % for natural stand and 96 % for plantation. Mean number of observed alleles was 1.98 in natural stand and 1.96 in plantation. The mean number of effective alleles was about 1.62 in both populations. Observed heterozygosity values were estimated to be 0.42 and 0.39 for plantation and natural stand, respectively. Negative FIT (-0.11) and FIS (-0.15) values implied excess heterozygosity in the studied populations. Mean FST value (0.04) indicates that there was little differentiation between natural stand and plantation and vast majority (96 %) of genetic diversity was contained within populations. Studied 5 enzyme systems revealed 11 isozyme loci and 20 polymorphic alleles. Genetic (pollen) contamination was found to be 80.4 % in natural population.

OV S1

FOREST GENETIC MONITORING – DELINEATION OF MONITORING REGIONS ON A TRANSECT FROM BAVARIA TO GREECE

Marjana Westergren[1], Barbara Fussi[2], Filippos Aravanopoulos[3], Evangelia V. Avramidou[3], Roland Baier[2], Gregor Božič[1], Ioannis V. Ganopoulos[3], Darius Kavaliauskas[2], Monika Konnert[2], Ermioni S. Malliarou[3], Vladko Andonovski[4], Dalibor Ballian[5], Davorin Kajba6, Heino Konrad[7], Saša Orlović[8], Fotis Kiourtsis[9], Živan Veselič[10], Hojka Kraigher[1]

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Keywords: forest genetic monitoring, monitoring regions, forest genetic resources, LIFEGENMON, LIFE

Conservation and management of forest genetic resources for sustainable use is a crucial, but not an easy task and special tools, such as forest genetic monitoring are needed to recognise the state and changes in their composition in a timely manner. The six-year LIFE + implementation project LIFEGENMON, led by the Slovenian Forestry Institute, and supported by six partners from Germany, Greece and Slovenia, is intended to design, test and implement forest genetic monitoring on the transect from Germany to Greece. However, one of the elementary requirements needed for implementation of forest genetic monitoring is delineation of monitoring regions. Within the project, this has been done for seven tree species or species complexes differing in their biology and distribution (*Fagus sylvatica*, *Abies alba* / *A. borisii regis* complex, *Fraxinus excelsior*, *Populus nigra*, *Pinus nigra*, *Prunus avium*, *Quercus robur* / *Q. petraea* complex). Criteria for selecting and delineating monitoring regions were: (i) equal coverage of environmental zones, (ii) coverage of distinguished races or ecotypes as well as inclusion of marginal and peripheral populations at the (latitudinal and altitudinal) leading and rear edge of the species distribution range, (iii) each region should preferably include already defined dynamic gene conservation units (EUFGIS), (iv) known levels of standing genetic variation, (v) equal coverage of standing genetic structure and recolonisation routes, (vi) local expert knowledge regarding forest types, vitality and value (biodiversity, economic) of populations. Six to nine monitoring regions per species / species complex were recognised.

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OV S1

INTER AND INTRA-POPULATION VARIATION OF LEAF STOMATAL TRAITS OF *Populus nigra* L. IN VOJVODINA, NORTHERN SERBIA

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Keywords: *Populus nigra* L., stomatal traits, Vojvodina, interpopulation and intrapopulation variability

Black poplar (*Populus nigra* L.) as one of the most important riparian species is currently threatened by extinction across whole Europe. Since the middle of last century it has been faced with severe threats pertaining to its survival, mostly because of the serious loss of its natural habitat and the lack of natural regeneration.

The research was conducted in four *Populus nigra* L. natural populations located in the basin of three river valleys of Vojvodina region, northern Serbia. The research involved the examination of inter- and intra-population variation of stomatal traits: stomatal density, ratio adaxial / abaxial stomatal densities, stomatal dimensions (length and width of stomatal guard cells and stomatal aperture), potential conductance index and stomatal shape coefficient, in *Populus nigra* L. leaves. The stomatal characteristics were examined in fully expanded leaves, from two leaf positions - the sun-exposed and shaded side of the tree, and from both sides of leaf considering fact that this species is amphistomatous.

Results show that within and between studied populations exists considerable variability, with the variability much more pronounced within than between populations. According to CDA analysis traits that most contribute to the differences between these populations are: adaxial stomatal width, abaxial stomatal aperture width and shape coefficient of abaxial stomatal aperture.

OV S1

BIODIVERSITY-STABILITY RELATIONSHIPS UNDER CLIMATE EXTREMES

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Theoretical and empirical studies both suggest that high species diversity within ecosystems tends to increase plant community stability because the sensitivity to fluctuations in environmental conditions varies so that more diverse communities have a wider range of sensitivities. The ultimate result is that community functioning tends to be more stable under a range of conditions. While most evidence gathered to support this theory originates from studies focusing on year-to-year stability and moderate fluctuations in environmental conditions, we assessed whether the biodiversity-stability concept applies also to more extreme, sudden events such as severe droughts and heat waves. In literature, we found that studies simultaneously considering climate extremes and species richness differed in their conclusions. Some studies were supportive of the diversity-stability hypothesis, while others came to opposite conclusions or found no or inconclusive effects. We propose several reasons why the biodiversity-stability concept may not always apply under extreme event conditions. This relates to ambiguities in what exactly constitutes an "extreme" and how stability is measured, but also to community traits changing with changes in biodiversity. We subsequently suggest ways to improve mechanistic understanding of biodiversity-stability effects in order to facilitate comparison between studies and avoid making the right predictions for the wrong reasons.

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KN3 S1

EUROPEAN WHITE BIRCH AND RAGWEED: IMPACT OF AIR POLLUTIONS ON THE ALLERGENIC POLLEN, AN OVERVIEW

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Keywords: air pollution, allergenicity, birch, pollen, ragweed

Birch pollen is mainly responsible for allergenic diseases in Central and Northern Europe, whereas ragweed pollen is the main elicitor for such diseases in Northern America and the weed has become a spreading neophyte in Europe. Climate change and air pollution will affect the allergenic potential of pollen, either by changes of the pollen season, the pollen amount, or by directly increasing the transcripts and allergenic proteins.
Catkins of birch were collected in the area of Munich. High environmental O_3 concentrations showed a positive correlation to the allergen Bet v 1 content and a negative correlation was observed for NO_2 [1]. Skin prick tests showed larger wheals indicating an enhanced allergenicity in an O_3-enriched environment [1]. However, regional and year-to-year variations in Bet v 1 release were also observed [2]. Fumigation of birch pollen with O_3/NO_2 led to a pronounced increase of protein nitration, which might increase the allergenicity [3].
Regarding ragweed transcriptomic analyses showed changes in allergen-encoding ESTs upon elevated $O_3/CO_2/NO_2$ and drought stress [4, 5]. Increased amounts of allergenic proteins were found upon CO_2/NO_2-treatment [6], in addition nitrosylation of Amb a isoforms were also observed. CO_2-treated pollen or drought stress lead to higher IgE-levels in B cells of mice, and an increased pollen allergenicity was shown by immunoblotting with ragweed antisera.

Acknowledgements
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KN4 S2

BIO-ENERGY FROM BIOMASS: FULL GREENHOUSE GAS BALANCE, ENERGY BALANCE AND ENVIRONMENTAL LIFE CYCLE ASSESSMENT

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Keywords: POPFULL, yield, ecological balance, economic assessment, energy efficiency

With regard to efficacy of bioenergy as a viable renewable energy source three questions need to be answered. Q1: Is bioenergy from woody biomass energy efficient? Q2: Does bioenergy present a favourable greenhouse gas balance? Q3: Is bioenergy from woody biomass economically profitable? Answers to these three questions are provided in this lecture based on the first complet cradle-to-grave analysis of a renewable bioenergy source. Over five years (2009-2014) an operational plantation of fast-growing poplar (*Populus*) trees was managed as a short-rotation coppice in two-year rotation cycles. After each rotation the plantation was harvested and the coppice left to regrow as a multi-stem culture. The plantation was intensively monitored from establishment through to the production of bioenergy in combined heat-and-power plants. In answer to Q1 the bioenergy production was highly energy efficient, yielding nine times more energy than was put in. To answer Q2, the net fluxes of the five principal greenhouse gases between the plantation and the atmosphere were continuously monitored from a meteorological mast in the field. The plantation was a net carbon sink, i.e., absorbed more carbon from the atmosphere than was produced. But the non-CO_2 greenhouse gases (methane and nitrous oxide) represented an overall net emission to the atmosphere. In answer to Q3 the bioenergy culture was not economically viable. The total cost of producing bioenergy was five times higher than the benefit of the renewable energy produced. The unique results of POPFULL were presented by National Geographic (http://greenenergycleanenergy.com/behind-the-science-renewable-energy-national-geographic).

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KN5 S2

QUANTIFICATION OF LINKED CARBON AND WATER CYCLES IN A LOBLOLLY PINE-SWITCH GRASS INTERCROPPING SYSTEM FOR BIOENERGY AND WOOD PRODUCTS

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Keywords: bioenergy, climate change, forest intercropping, US Southeast, sustainability

Dependence on fossil fuel energy exposes the U.S. to potentially catastrophic climate change, economic instability, and risks to national security. The goal of the project is to assess sustainability of a novel pine-switch grass intercropping system for the production of bioenergy and traditional wood products based on regionally appropriate crops and indigenous biomass production practices. We hypothesize the asynchronous physiology and growth of the C3 trees and C4 grass along with the different soil horizons exploited by the respective root systems will allow for greater nutrient retention and more efficient utilization of site water. We also hypothesize that the additional soil volume exploited by switchgrass roots and associated fine root turnover will increase soil organic C, thus increasing C sequestration. The work is being done at a 32 ha replicated field experiment installed in the Lower Coastal Plain of North Carolina being implemented by Weyerhaeuser NR Company. The experiment consists of a randomized complete block design of traditional pine silviculture and switch grass intercropping treatments, deployed individually and together, in 0.8 ha plots sufficient for ecosystem analysis. Over the course of the five-year project we are carefully monitoring ecosystem productivity, soil carbon and nutrient dynamics, and water utilization. Measurements are being used to parameterize ecosystem models to scale results to the region and assess the effects of a changing climate.

OV S2

SUCCESSION INDUCED CHANGES IN ECOSYSTEM FUNCTIONING WITH EMPHASIS ON CARBON AND WATER EXCHANGE

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Keywords: drought effects, secondary forest, calcareous grassland, eddy-covariance, submediterranean Slovenia

Many marginal agricultural areas in Europe and elsewhere are being abandoned and subjected to spontaneous afforestation with shrub and tree species. Within ecosystem research this process is rarely studied (but see Stoy et al. 2008). Here, the functioning in terms of carbon and water vapour exchanges of a secondary forest developed on a former semi-dry calcareous grassland in the sub-Mediterranean region of Slovenia was investigated and compared with the nearby pasture still in use. Eddy covariance and other ancillary data was used on both plots to estimate fluxes of CO_2 and H_2O. Yearly and seasonal net ecosystem exchange and evapotranspiration of both ecosystems were examined together with their environmental controls (soil water content, air temperature, light availability, air humidity) during the period of 6 years. There were significant differences in yearly cumulatives, seasonal phenology of C assimilation and drought resistance between the investigated ecosystems. The occurrence of drought seemed to largely govern ecosystem functioning and productivity. By identifying the drought periods using the evapotranspiration response to soil water availability it was shown that more than the severity of drought the duration of the longest yearly drought affected the estimated yearly gross primary productivity. The functioning of ecosystems was also compared with respect to ecosystem-level water use efficiency, rain use efficiency and light use efficiency in different environmental conditions and phenological phases. The uncertainty in derived fluxes will also be discussed particularly with respect to spatial heterogeneity of the investigated ecosystems and possible abiotic (geological) sources of CO_2 stemming from carbonate dissolution / precipitation and subterranean storage in karst cavities (Kowalski et al. 2008; Serrano-Ortiz et al. 2010).

Acknowledgements
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KN6 S2

EFFECTS OF WARMING ON *Pinus sylvestris* IBERIAN FORESTS

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Keywords: Scots pine forests, Iberian Peninsula, warming, growth trends

Scots pine (*Pinus sylvestris* L.) is the conifer tree species with the widest distribution in the world reaching its southern distribution limit in Spain; it has a wide niche breadth, forming forests across a variety of climates and soil types in Europe and Asia. The Spanish Iberian Scots pine forests occupy a discontinuous area of 700,000 ha (Alía et al. 2001) and Studies on Scots pine responses to climate change (warming, climate variability and drought) have become abundant in the last 2 decades in Spain. Warming and drought have been causing an increased physiological stress (Poyatos et al. 2013) and tree growth decline and occasionally tree death in those more prone areas to drought stress (Martínez-Vilalta and Piñol 2002, Galiano et al. 2010, Heres et al. 2012). (e.g. Andreu-Hayles et al. 2011, Sanchez-Salguero et al. 2015). In this study, I review the main results of Scots pine responses to global climate change in Spain, and second, I will present results on Scots pine growth trends and distribution of resources at different temporal scales from locations with contrasting climate conditions.

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KN7 S2

STABLE ISOTOPES IN TREE RINGS

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Keywords: carbon, oxygen, climate change, dendrochronology

Tree rings provide perhaps the best natural archive of information on past climate change. Many trees produce a ring every year, so careful cross dating provides perfect annual resolution with no uncertainty. However, the measures of tree growth that are used as proxies for past climate, such as ring widths and densities, only respond strongly to climate when trees are growing under stress. The best records are obtained from high latitude or high altitudes or from places that are very dry. The result is that there is a strong spatial bias in tree-ring based climate reconstructions towards places where very few people live. Stable isotope ratios in tree rings are not measures of net tree growth but act rather as passive indicators of changing climate. They can thus provide reliable palaeoclimate proxies for tree that are not growing under strong climatic or environmental stress. I will present results of carbon and oxygen isotope analysis from British oak trees that are not growing under stress. The carbon isotope ratios record the balance between stomatal conductance and photosynthetic rate. In Britain the dominant control is photosynthetic rate and the isotope ratios correlate very strongly with summer sunshine and summer temperature. The oxygen isotope ratios record both the isotopic ratios of summer precipitation and evaporative enrichment. However, in Britain it seems that the isotopic ratios of summer rainfall are strongly dominant, providing a record of past changes in summer circulation and therefore of the amount of summer rainfall. Calibration and verification results suggest that these palaeoclimate proxies are very strong and temporally stable and that they record positive and negative extremes with equal skill. There would seem to be great potential for using stable isotope sin tree rings to redress the geographical bias in available palaeoclimate proxies.

KN8 S2

WHAT INFORMATION IS STORED IN PHLOEM STRUCTURE AND RELATIONSHIP BETWEEN PHLOEM AND XYLEM INCREMENTS?

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Structure and formation of phloem have generally earned less attention than the xylem. This could be partly explained by relatively low economic value of phloem. However, unlike xylem formation, annual formation of phloem is crucial for tree survival as it maintains the translocation pathways for photosynthates and signalling molecules.

Seasonal dynamics of xylem and phloem formation are not synchronous processes thus capturing different environmental information. Xylem formation has already proven to be influenced by environmental factors, whereas phloem formation is more stable and presumably less affected by changes in growing conditions. In addition to secondary changes in older phloem, this might be among the main reasons for excluding phloem from dendroecological studies so far.

This presentation seeks to address the following questions: Which signals influence the structure of phloem? Do phloem structure and the relationship between phloem and xylem increments have potential to be used as sensitive stress indicators? Would information on phloem contribute to a more thorough understanding of radial growth of trees and their response to environmental changes? Examples of phloem in different tree species will be shown to discuss these questions.

Acknowledgements

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OV S2

STAND DYNAMICS AND DISTURBANCE HISTORY IN MIXED FOREST OF NORWAY SPRUCE AND CEMBRA PINE FROM EASTERN CARPATHIANS

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Keywords: dendroecology, boundary line, Carpathians, disturbance

Old-growth forest structure is the results of the interaction between internal competition and external natural disturbance regime. Scale and frequency of the disturbance strongly affect forest structure and functions. This study presents the main results concerning the stand structure dynamics and the disturbance history in a mixed forest of *Picea abies* and *Pinus cembra* from Calimani National Park, Eastern Carpathians (Romania). Three permanent plots (surface between 0.7 and 2.2 ha) were established in an altitudinal transect. The disturbance dynamics and stand regeneration history highlights an important advance of spruce limits in the last 50 years in case of timberline plot. The second plot targeted a forest out in late optimal development phase where the actual spatial structure is the effect of multiple wind disturbances. The first wave of regeneration is observed on 1850 with a maximum on 1890, following a high intensity wind damage dated by dendroecological methods around 1840. The second regeneration wave, dominated by spruce, start after 1940 with maximum in 1960-1970 and the intensity is 2-3 times higher that precedent period. The last plot was established in a forest regenerated after catastrophic wind damage (dated in 1840). The regeneration history, analyzed using dendroecological methods, highlights the stand establishing starting with 1850 until 1910 with a maximum in 1880. This type of stand developments is specific to a regeneration of open-field and the following stand structure, on dimensional level, is conditioned by competition processes specific to forest ecosystem. Based on millennium tree ring chronology of cembra pine from Calimani Mts. was possible to reconstruct the disturbance dynamics in the last eight century from this region. A significant increase of frequency of disturbance is observed the last century and the largest one been that from 1840 when over 70 % from the trees included in the datasets show a significant growth release.

OV S2

ENVIRONMENTAL SIGNALS IN *Quercus robur* L. TREE-RING WIDTHS AND $\delta^{13}C$

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Keywords: Pedunculated oak, earlywood, latewood, dendrohydrology, dendroecology

We analysed two groups of *Quercus robur*, growing at nearby plots with different micro-location condition (W-wet and D-dry) in the floodplain Krakovo forest, Slovenia. In the study we compared growth response of two different tree groups to environmental variables, the potential signal stored in earlywood structure and the potential difference of the information stored in carbon discrimination of earlywood and latewood. For that purpose earlywood and latewood widths and carbon discrimination have been measured. We found out that W oaks were growing significantly better over the whole analysed period. The difference between D and W oaks was significant in all analysed variables with the exception of stable carbon discrimination in latewood. In W oaks, latewood widths correlated with summer (June to August) climatic variables, while carbon discrimination was more connected to Krka River flow during the summer. Earlywood discrimination correlated with summer and autumn River Krka flow of the previous year, while latewood discrimination correlated with flow during the current year. In the case of D oaks, environmental signal appears to be vague most probably due to less favourable growth conditions resulting in markedly reduced increments. Our study reveals important differences in responses to environmental factors between the two oak groups of different physiological conditions that are preconditioned by environmental stress. Environmental information stored in tree-ring features may vary, even within the same forest stand, and largely depends on the micro-environment. Our analysis confirmed our assumptions that separate EW and LW analysis of widths and carbon isotope discrimination provides complementary information in *Quercus robur* dendroecology.

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OV S2

CLIMATE SIGNAL AND POTENTIAL OF BOSNIAN PINE (*Pinus heldreichii* CHRIST) FOR CLIMATE RECONSTRUCTION IN CENTRAL W BALKAN REGION

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Keywords: long chronologies, Bosnia and Herzegovina, temperature, precipitation

Bosnian pine (*Pinus heldreichii* Christ) - PIHE, is a species native to mountainous areas of the Balkans and southern Italy. PIHE is a tree species of the upper tree line in the Dinaric mountains and as such a promising source of valuable climate information. Due to its longevity it might have a good potential for long climate reconstructions based solely on living trees. Aim of our study was to investigate potential of PIHE (1) for construction of long PIHE chronologies for the region of the central W Balkan and (2) for long climate reconstructions based mostly on cores from living trees.
Preliminary PIHE chronology is 437 (1573-present) years long and has a sufficient sample depth for EPS>0.85 from 1659 onwards. Comparison with climate data show specific response of PIHE to climate – trees respond positively to above average temperature in March (Mt) and negatively to above average temperature in June and July (JJt). We found weak positive response to June and July precipitation (JJp). This is somehow expected since precipitation are abundant along the Dinaric mountain ridge and are not factor in minima. Running window statistics reveal a significant temporal change in the identified signals – JJt and JJp signals were significant before 1965, and Mt after 1965, both temperature and precipitation loose signal after 1965.
Although already quiet long, PIHE chronology can be extended by adding additional old trees from the studied region. Climate signal in tree rings is somehow specific comparing to other trees species in the region (e.g. Pinus nigra). JJt and JJp seems to play an important role in the formation of tree rings (see also Seim et al. 2012), however a clear positive March temperature signal in PIHE tree-rings after 1965 and almost complete disappearance of the JJt and JJp signal after 1965 deserves attention as well. The reasons for that are yet to be investigated.

Acknowledgment
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KN9 S3

THE IMPACT OF ENVIRONMENTAL FACTORS ON BIOGEOCHEMICAL CYCLES IN TREES AND FOREST ECOSYSTEMS - FROM MOLECULAR MECHANISMS TO ECOSYSTEM FUNCTIONING

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Trees are large global stores of carbon (C) that will be impacted by increased carbon dioxide levels and climate change. However, at present we cannot properly predict the carbon balance of forests in future as we lack knowledge on how plant physiological processes, the transfer of carbon within the plant, carbon storage, and remobilization in the plant tissues as well as the release of carbon from the roots to the soil interact with environmental drivers and ecosystem-scale processes.
Moreover, precipitation variability will increase in future and drought and rainfall periods will alternate. As a consequence, the ability of roots to utilise intermittent rainfall events will be crucial for tree performance and survival.
This talk will summarise how stable isotope techniques can give new insights in the fate of newly assimilated C in plants and ecosystems on the one hand and water uptake and use on the other hand.
The talk will span from the molecular to the ecosystem scale and will also highlight how physiological information can be transferred on larger spatio-temporal scale levels in order to predict the effects of environmental drivers and biotic interactions under future climatic conditions.

KN10 S3

DROUGHT AND HEAT STRESS EFFECTS ON THE PLANT-SOIL CARBON CONTINUUM AND BELOWGROUND MICROBIAL COMMUNITIES

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Important questions remain about the relevance of the plant-soil continuum in extreme climate event scenarios, such as, how might the plant-soil continuum benefit belowground systems? And, at which point is the connectivity severed? Furthermore, what do we stand to learn about microbial communities when pushed to their niche limits? We excavated soil monoliths, thus keeping the understory plant-microbe communities intact, from a Beech (*Fagus sylvatica L.*) forest and imposed an extreme climate event, consisting of drought and a single heat-pulse event, we then followed microbial community dynamics over a short time period of 28 days. During the treatment we labeled the canopy with $^{13}CO_2$ with the goal (1) of quantifying the different time delays of assimilate arrival to belowground plant tissues and microbial phospholipid fatty acids (PLFA). From this assessment we determined the strength of plant-microbe carbon linkages under control, drought, heat, and heat-drought treatments. Based on the ^{13}C labeled isotopic PLFAs we (2) characterized microbial groups that are tightly linked to the plant-soil carbon continuum during environmental stress. And, we used 16s rRNA sequencing of bacteria from the soil mineral horizon to determine (3) the short-term changes in the active microbial community structure.

In all treatments, root tissue tended to increase in ^{13}C, indicating that labeled carbon had been allocated belowground. None of the treatments were too severe to disrupt within-plant transport over the experiment, and the depletion of the aboveground signal with the concurrent enrichment of the belowground root tissue suggested that carbon sinks belowground were still dominant. If we consider only the general PLFA marker (c16: 0), which was the most enriched across all treatments, we observed that the heat-drought monoliths were the most severely affected. We also observed that the label increased over time in the PLFA markers under drought. We infer two pathways of carbon flow to belowground microbial communities based on the time delay of labeled carbon in the PLFAs. The first pathway is evidenced from the strong increase in ^{13}C excess directly after labeling and the second pathway delivers assimilates more slowly over time. Based on our high-throughput sequencing of the 16S rRNA, we observed multiple trajectories in the community shifts due to the stress treatments.

Heat in combination with drought had a clear negative effect on diversity (only in heat-drought we saw a significant decrease in diversity) and resulted in a distinct shift in relative abundances of various phylotypes.

KN11 S3/S5

RESPONDING TO CHALLENGES IN FOREST RESEARCH AND MONITORING: FROM PAST LEGACY TO INTEGRATION OF RESEARCH INFRASTRUCTURES

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Keywords: Forest ecosystems, Long Term, Climate change, Biodiversity, Sustainable Forest Management

Forests have been a "study and observation" object by humans since centuries.
In this long story, the way in which humans approached forests started to change significantly in the 19th century, when it started to become clearer the need for a long-term management view aimed at achieving a permanent and sustainable production. Forest inventories and growth and yield trials started to be implemented.
In the second half on the 20th century, concerns were on forest health and the impact of pollution and long-term forest monitoring programmes were initiated. In the last part of 20th and the beginning of 21st centuries, the overarching challenge is global change effects on forest ecosystems that were addressed through impact studies (Open-top-chamber and FACE experiments) and modelling. Furthermore, ecosystem scale fluxes of carbon and other gases started to be measured (currently on more than 400 sites on different ecosystems, many of those forests). In the same period, the development of remote sensing and modelling approaches opened the way in scaling up results in spatial (remote sensing) and temporal (modelling) scales.
This long history of monitoring and research has improved a lot our understanding of the functioning and long-term trends of forest ecosytems: however, it is now time to push for an integration in large-scale european infrastructure to provide renovated objectives for the future of forest monitoring and research schemes.
"Supersites (or Level III)" research / monitoring plots, measuring process-related parameters are needed to provide information on the effects of the driving forces on forest ecosystem dynamics and functioning (e.g. C and N cycles) and on the long term responses to global changes. As an example, considering carbon sequestration, the changes of carbon storage in European forests (including soils) and their response to climate impacts can only be assessed, if their variability, uncertainty and complete element cycles are known.

Other important issues for the future of forest research and monitoring is to expand the aims to the assessment of "ecosystem services" provided and granted by forests and to use data and results from research infrastructures to inform (and drive, if possible) forest management.
The presentation will address how basic and intensive monitoring networks should be coupled to research sites where process-based studies may provide deeper process understanding that can be used for addressing challenges for 21st century forest ecosystem research.

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KN12 S3

THE EFFECT OF FOREST TREES ON MICROBIAL PROCESSES INVOLVED IN CARBON CYCLING

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Keywords: decomposition, forest soil, litter, microbial ecology, plant-microbe interactions

Trees largely shape ecosystem processes in forest ecosystems, being the dominant primary producers responsible for the bulk of C fixation and its allocation belowground. The production of litter as well as root exudates affects the community of microbial decomposers in forest soils, most importantly the decomposers and root-associated symbionts. This is reflected by the facts that the seasonality of the composition of soil microbial communities and their activity in decomposition correspond to the seasonal changes in C allocation belowground and litter production (Voříšková et al. 2014) and demonstrated by the complex restructuralization of microbial community and pronounced alterations in decomposition patterns in the case of tree dieback, associated with the transition from soil fungal communities dominated by ectomycorrhizal root symbionts to those mainly composed of saprotrophic taxa (Štursová et al. 2014). Microbial community analysis and shotgun metatranscriptomics can help to explore the differences in microbial communities among various trees and their activity throughout the year. Fungi highly contribute to the total microbial transcription in litter and soil while the Proteobacteria, Acidobacteria and Actinobacteria are most transcriptionally active among bacteria in an acidic *Picea abies*-dominated forest. Notably, the share of fungal transcription decreases dramatically between summer and winter and the transcription of genes involved in mycorrhiza formation is most affected. In contrast, the relative activity of Acidobacteria increases in winter. The results show that both tree species composition and the seasonal changes of their physiology largely affect both community composition and processes involved in decomposition and C cycling.

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KN13 S3

TREE BIODIVERSITY AND ECOSYSTEM FUNCTION

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Keywords: mixed stands, elevated CO_2, drought

As a consequence of land-use change and the burning of fossil fuels, atmospheric concentrations of CO_2 are increasing which directly affects the carbon cycling in forests but also affects the climate. One of the consequences of climate change in Europe is an increase in long drought periods. Both the effect of elevated levels of CO_2 and drought has been extensively tested on monocultures. When modelling the effect of elevated CO_2 and climate change on mixed stands one often has to assume that the different tree species respond as they would have grown in monocultures due to the lack of data from mixed stands.

To investigate how mixed stands were affected by elevated CO_2, *Alnus glutinosa*, *Betula pendula* and *Fagus sylvatica* were planted in areas of single species and a three species polyculture. The trees were exposed to ambient or elevated CO_2 (580 µmol mol^{-1}) for 4 years. Plots at the same site and planting scheme were also used for a throughfall reduction experiment using sub canopy roofs, which removed 70 % of the throughfall. Hence soil water potential was reduced over two consecutive years. As expected biomass increase due to elevated CO_2 and decreased due to drought. But the response of the mixed stand and the individual tree species within the mixture could not be foreseen by the response in the monocultures.

During elevated CO_2 the overyelding in the mixed stands was lower than the control, whereas it remained the same under drought. In the controls *Alnus glutinosa* benefited the most from growing in mixture and overyielded with over 37 %. But under elevated CO_2 the over yielding was only 14 % whereas *Betula pendula* had the same overyielding (8 %) independent of CO_2 concentration. During drought experiment *Betula pendula* was over yielding the most in the control. Under drought however, the dominance of *Betula pendula* decreased and *Alnus glutinosa* started to contribute to the overyielding in the mixed stand.

KN14 S3

FINE-ROOT TRAITS AND SOIL PROCESSES IN BOREAL FORESTS

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Fine root traits and processes were studied during the last decade in Norway spruce and Scots pine forests on a climatic and soil fertility gradient in Finland. The overall aim was to understand the forest above- and belowground relationships and quantify carbon (C) allocation in relation to environmental factors, including site fertility. C allocation is one way for trees to cope with nutrient deficiencies. Both tree species responded to nitrogen (N) deficiency resulting from low fertility or a short growing season, or both, by maintaining more EcM root tips (Helmisaari et al., 2009; Ostonen et al. 2011) per unit foliage and basal area which may be associated with an increased share of N uptake in an organic form. Stand basal area predicted fine root biomass better than any other variable alone (Lehtonen et al. 2015). Fine root turnover rate was slower in the north, and the less productive sites produced relatively more litter belowground than aboveground (Leppälammi-Kujansuu et al. 2014). Increased partitioning to belowground in nutrient deficiency was recently indirectly shown in a pine stand in Sweden where N-fertilization-induced increase of aboveground net primary production was associated with a decreased partitioning to belowground (Lim et al., 2015). Needles and roots in the north vary in chemistry, containing more water-extractable compounds, especially phenols, than in the south (Hilli et al., in prep.). Polyphenols have been shown to regulate the formation of mor-humus by inhibiting N mineralisation. We conclude that coniferous roots may have a greater impact to soil humus formation in the north and / or less fertile sites.

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OV S3

CARBON INPUT INTO SOIL ORIGINATING FROM FINE ROOT AND FOLIAGE LITTER

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Keywords: fine root litter, foliage litter, root turnover, minirhizotron, carbon input

Carbon models require knowledge of litter inputs. Contrary to the foliage litter, the data quantifying the major belowground carbon input, fine root production, is very scarce, especially using comparable methods. The minirhizotron method, i.e. belowground digital filming of roots, is a method which is applied worldwide to study fine root turnover. An estimate of annually produced fine root litter can be calculated by multiplying the root standing crop (from soil cores) by the root turnover rate. In Finland the minirhizotron results have hitherto been reported only from three Norway spruce stands, of which in only two the foliage litter fall was also measured. Here we present the results from these two sites from Finland and one site from Sweden. Altogether in Sweden the respective results have been published from five Norway spruce sites, and one birch and pine sites. In a changing climate there is an urgent need, not least for the modellers, to have more data on root turnover, especially covering the whole ecosystem. Soil fertility or temperature changes will affect not only the aboveground tree growth but also the belowground parts which are tightly interconnected. Therefore, quantification of carbon input into the soil should always include both fine root and foliage litter.

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OV S3

FINE ROOT PHYSIOLOGICAL AND MORPHOLOGICAL TRAITS OF FINNISH BOREAL TREE SPECIES

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Keywords: boreal forest, Norway spruce, root respiration, Scots pine, Silver birch

Tree species have an impact on growth and survival of woody roots, with potential consequences for source and sink activities of root organ. However, the effects of different tree species on specific traits of fine roots are still unclear. We elucidated the magnitude of physiological and morphological traits of fine roots of different tree species and the relationships between specific respiration rates and morphological traits in a boreal forest in Kivalo, northern Finland. In this study, we used fine roots of Norway spruce (*Picea abies* (L.) Karst.), Scots pine (*Pinus sylvestris* L.), and Silver birch (*Betula pendula* Roth.), which are dominant tree species in Fennoscandia. The specific respiration rate of fine root segments was measured in the forest in July 2014. The N concentration and morphology, including root tissue density (RTD; g cm^{-3}) and specific root length (SRL; m g^{-1}) were then observed in the laboratory. Mass-based specific root respiration rates, the N concentration, and morphology differed among tree species. In all three species, the respiration rates were significantly positively correlated with root N and SRL, and negatively correlated with RTD. The regression slopes of respiration with root N and RTD were significantly higher in birch than in spruce and pine. Although no differences in slopes of root respiration with SRL were found across the species, there were significant shifts in intercept along the common slope. These results suggest that a contrasting pattern in interspecific relationships between root respiration and N, RTD, and SRL exists. Therefore, tree species influenced the magnitude of fine root physiological and morphological traits and their relationships. Boreal tree species also affected the trait-based root performance by covarying the root respiration, root N and morphology for optimizing potential nutrient and water uptake.

KN15 S4

DISTURBANCE AND RESILIENCE IN FORESTS: EXAMPLES FROM NEW JERSEY PINE BARRENS

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Keywords: pine barrens, prescribed burning, N-deposition, harvesting

The NJ pine barrens consists of pitch pine and oaks with an understory of ericaceous shrub species on marine sediment oligotrophic sandy soils. Historically, the forest has been cut for charcoal production. Although a protected area, disturbance comes from natural wildfires, prescribed burning, logging, recreational vehicle use and non-point source pollutants. Alternate stable states of graminoid and lichen understory vegetation are thought to be derived from disturbance factors. Here we will examine the impacts of experimental tree harvesting with soil disturbance, prescribed fire and nitrogen deposition, which appear to have only transitory effects on soil factors and understory vegetation. In a forest protected for its vulnerability to disturbance, we show that it has considerable resilience.

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Funds provided by National Science Foundation, United States Department of Agriculture, New Jersey Department of Environmental Protection.

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KN16 S4

IMPACTS OF INCREASED NITROGEN AVAILABILITY ON THE STRUCTURE AND FUNCTIONING OF A MEDITERRANEAN BASIN ECOSYSTEM

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Keywords: ammonium, biodiversity, impacts, nitrate, N cycling, N retention, plants, soil protection

Increased nitrogen (N) availability, resulting from agro-industrial activities, affects ecosystems' health and stability. Mediterranean Basin ecosystems are biodiversity hotspots threatened by N deposition, however, little or no information is available on their responses to increased N. We develop an integrated system-level approach to study the responses of an N limited Mediterranean Basin maquis to increased N availability. Since 2007, the form and dose of N available at the experimental site (ambient N deposition 5.2 kg ha^{-1} yr^{-1} and soil N 0.1 %) was modified by the addition of 40 kg NH_4^+-N ha^{-1} yr^{-1}, 40 and 80 kg NH_4NO_3-N ha^{-1} yr^{-1}. Control plots were not fertilized. Over the following years, the effects on plant and soil microbial diversity and ecosystem services were assessed: soil N retention, below and aboveground C sequestration, and soil protection.

Over the first year, the added N was retained by the system and detected in the autumn as soil inorganic N. The increased N promoted plant and soil microbial diversity.

On the fifth spring of N additions, plant richness increased with enhanced N and was more related to the cumulative ammonium than with the cumulative nitrate. Exposure to 40 kg NH_4^+-N ha^{-1} yr^{-1} (either alone or with nitrate) enhanced plant richness, but did not increase aboveground C sequestration or soil protection; soil N retention even decreased under 80 kg N ha^{-1} yr^{-1}. The treatment containing less ammonium, 40 kg NH_4NO_3-N ha^{-1} yr^1, did not enhance plant diversity but promoted aboveground C sequestration and soil protection. The dataset permitted the first estimation of an N critical load for this European habitat (20-30 kg N ha^{-1} yr^{-1}).

Data suggest that agriculture, the main source of NH_y, may affect the structure of the neighboring maquis, promoting soil erosion and N leakage. In contrast, industrial and urban activities that increase N availability as NO_x may increase fire risk. This is of significant importance for land-use management in biodiverse and fragmented ecosystems such as the Mediterranean ones.

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OV S4

FOREST – AGRICULTURE INTERFACE: A CASE OF BUCKWHEAT

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Keywords: buckwheat, environment, sustainability, project EUFORINNO, final conference

Buckwheat is in Bhutan, Japan, China and Korea used mostly to prepare noodles and other pasta products. In Italy, buckwheat flour is used to prepare a typical pasta and in Austria and Slovenia traditional dishes such as kasha and bread are made (Vombergar et al., 2014). In Asia (Japan, Korea, China, Nepal) buckwheat is cultivated in hight altitudes, sometimes above 3000 m. Humans used fire as an effective management tool to transform the evergreen forests into secondary vegetation, such as buckwheat cultivation (Shu et al., 2013). Buckwheat fields are often mixed with areas covered by forest. Such systems are traditional in Northern Italy, Slovenia and Bosnia and Herzegovina. Forest trees give to buckwheat fields protection from strong winds and are a shelter for propagation of polinators. In Japan, the abundance of the important polinator wild bee Apis cerana in the buckwheat fields show a stronger positive correlation with the total area of surrounding natural forests compared to that of surrounding plantation forests (Taki et al., 2011). Buckwheat fields are source not only for nectar for wild insects, but as well a food source for birds and wild animals. It is important that in buckwheat no spraying is needed, so buckwheat is a source of »organic« food for wildlife.

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OV S4

PROTECTION OF FORESTS UNDER INTERNATIONAL LAW

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Keywords: international law, forest protection, climate change, common concern of humanity

The presentation will address the lack of legally binding international regulation on forest protection and present the recognition of forests as a common concern of humanity as a possible solution for adoption of an international convention on forests. For centuries forests have been recognized as one of the most important natural resources. The fear of overexploitation of forest and loss of their ecosystem benefits has lead the process of negotiations for a binding international forest convention. However, after nearly forty years of negotiations, States have still not been able to reach an agreement on a legally binding international document. The majority of developing States oppose such a document out of fear that it would deprive them of their sovereign right to exploit their own natural resources in accordance with their development policies. On the contrary, developed States see such a document as the only means to prevent major deforestation in the fight against climate change. A solution to overcome this difference of opinion among States is the recognition of forests as a common concern of humanity. Legally, both climate change and biodiversity have already been recognized as common concern of humanity. However, international environmental law presents no definition of this concept. After the analysis of the common denominators of climate change and biodiversity, the author has developed a working definition of this concept that also enables its application to forests.

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KN17 S4

IMPACT OF FOREST HARVESTING PRACTICES ON BASE CATION BUDGETS – A SUSTAINABILITY STUDY USING MEASURED AND MODELLED DATA

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We simulated the impacts of harvestings on base cation (Ca, Mg, and K) budgets for Finnish forests under three harvesting practices: stem-only (SOH), whole-tree (WTH), and WTH + stump and coarse root harvesting (WTSR). The study included five Scots pine and five Norway spruce stands belonging to the UN-ECE ICP Forests Level II programme in Finland. A mass balance approach was used in which the base cation (BC) input fluxes total deposition (TD) and weathering (W) were balanced against the output fluxes leaching (L) and harvesting removals (H). The mean annual fluxes were estimated using a combination of measured and modelled data. The impact of harvesting practice evaluated in relation to soil BC stocks, stand tree species, and climate (latitude). Positive values of TD + W – L – H were considered to indicate sustainability while negative values were considered to indicate unsustainability. Spruce stand TD of BC correlated negatively with latitude, and was significantly higher than that for the pine stands. BC amounts in the hypothetically harvested removals of all three harvesting practices were larger for the spruce than for the pine stands. Harvesting removals of BC were significantly higher with WTH and WTSR than with SOH, but BC removals with WTH and WTSR did not significantly differ from each other. Harvesting intensity negatively impacted the sustainability of BC. WTH in the spruce stands had a more negative impact on soil BC stocks than in the pine stands. The mass balance for K in all stands and for Ca in the spruce stands were, on average, negative under WTH and WTSR scenarios. For Mg, the mass balances for both spruce and pine were, on average, positive under all harvesting scenarios.

OV S4

VARIANCE DECOMPOSITION OF STEM BIOMASS INCREMENT PREDICTIONS FOR EUROPEAN BEECH

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Keywords: empirical model, process-based model, climate scenario, forest management, forest modeling

Different sources of uncertainty in the results of forest model simulations were identified and quantified. The responses of annual stem biomass increment of European beech (*Fagus sylvatica* L.) to changes in climate and in forest management were simulated using two forest models, i.e. the empirical SIBYLA model and the process-based ANAFORE model. Both models were calibrated using experimental tree growth data from four plots in central Slovakia between 1989 and 2003. Three of these plots were subjected to different levels of thinning while one was left untouched as a control. Ten regional climate models (RCMs) based on the IPCC scenario A1B provided an ensemble of climate projections up to 2100. Simulations were made: (i) with the two forest models; (ii) for four thinning intensities; (iii) using the 10 RCMs; and (iv) for three time windows, each spanning 15 years. The contribution of these four components to the total variance in the simulated stem biomass increment was quantified. The forest model type explained most of the total variance in the simulation results, followed by forest management (i.e. thinning) and the time window. The effect of the RCMs on model uncertainty was limited. Stem biomass increment predictions obtained from both models used were different in absolute terms, but the models agreed well in their relative response to RCM, to forest management and to time window. The total variance of the predictions was 10 times higher for the process-based ANAFORE model than for the empirical SIBYLA model.

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OV S4

ADJUSTMENT CAPACITY OF MARITIME PINE CAMBIAL ACTIVITY IN DROUGHT-PRONE ENVIRONMENTS

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Keywords: cambial activity, anatomy, intra-annual density fluctuations, drought, Mediterranean

Intra-annual density fluctuations (IADFs) are anatomical features formed in response to changes in the environmental conditions within the growing season. These anatomical features are commonly observed in Mediterranean pines, being more frequent in younger and wider tree rings. However, the process behind IADF formation is still unknown. Weekly monitoring of cambial activity and wood formation would fill this void. Although studies describing cambial activity and wood formation have become frequent, this knowledge is still fragmentary in the Mediterranean region. Here we present data from the monitoring of cambial activity and wood formation in two diameter classes of maritime pine (*Pinus pinaster* Ait.) over two years in order to test: (i) whether the differences in stem diameter in an even-aged stand were due to timings and/or rates of xylogenesis; (ii) if IADFs were more common in large trees; and (iii) if their formation is triggered by cambial resumption after the summer drought. Larger trees showed higher rates of cell production and longer growing seasons, due to an earlier start and later end of xylogenesis. When a drier winter occurs, larger trees were more affected, probably limiting xylogenesis in the summer months. In both diameter classes a latewood IADF was formed in response to late-September precipitation, confirming that the timing of the precipitation event after the summer drought is crucial in determining the resumption of cambial activity and whether or not an IADF is formed. It was the first time that the formation of a latewood IADF was monitored at a weekly time scale in maritime pine. The capacity of maritime pine to adjust cambial activity to the current environmental conditions represents a valuable strategy under the future climate change conditions.

OV S4

ABOVE AND BELOWGROUND TREE BIOMASS ALLOCATIONS- AS INFLUENCED BY SPECIES COMPOSITION IN TEMPERATE DECIDUOUS PLANTATION FOREST

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Keywords: allometry, woody biomass, root biomass, polyculture

Afforestation and management of first growing tree species enhance the terrestrial carbon stocks by offsetting anthropogenic emissions of CO_2, and thus can be the potential tools for mitigation of climate change impacts. Effects of species polyculture on ecosystem C balance in plantation forest has been assessed by some authors. However, the mechanistic understanding of how stand composition affect the tree biomass in polyculture compare to monoculture is still unclear. We estimated above and belowground biomass by developing species specific allometric equations and sequential coring and subsequent litter flux and fine root turnover in mono and polyculture stands of *Betula pendula, Alnus glutinosa* and *Fagus sylvatica* in the temperate forest ecosystems of North Wales, UK. Significantly higher woody biomass was observed in the single stand of *B. pendula* and *A. glutinosa* then *F. sylvatica*. Fine root (<2 mm) biomass was higher in *A. glutinosa* whilst the root turnover rate was higher in *B. pendula*. At the stand level, clear additive mixture effects on above ground biomass was observed, however at the tree level, *B. pendula* tended to lower biomass in mixture presumably due to suppression by the faster growing *A. glutinosa.* Our results indicated that selection of tree species in polyculture can affect the biomass allocation through species interactions. The concentration of SOC at the top 20 cm of plantation plots increased following the order: *F. sylvatica* < species mixture < *A. glutinosa* < *B. pendula,* reflecting the impacts of species specific functional traits such as biomass inputs and litter quality. Over all, with judicious selection of species, tree polyculture might be the best option in plantation design.

KN18 S4

CARBON CYCLING IN LOWLAND OAK FOREST ECOSYSTEMS

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Keywords: forest productivity, eddy covariance, dendrometers, NPP, MODIS

Lowland oak forests are among the most productive forest ecosystems in the region of SE Europe, with high ecological and commercial value. Monitoring and quantifying carbon fluxes in them is necessary to meet the reporting requirements of UNFCCC and Kyoto protocol, but even more so it is needed in our efforts to understand carbon dynamics and underlying processes and key drivers.
Our study is conducted in Jastrebarsko forest, which is a part of 12 kHa of lowland forests of Kupa river basin. Forests within the basin are managed with continuous cover, even-aged management system. Eight stands dominated by Pedunculate oak (*Quercus robur* L.), aged 5 to 168 years, were selected in spring 2010 to represent an oak chronosequence, and in one of them (the 37 year old) an eddy covariance flux tower was already installed in September 2007.
Carbon stocks and fluxes are monitored using classical dendrometric techniques, eddy covariance (EC), and soil respiration measurements (SR). Decomposition fluxes from fine woody debris are assessed with decomposition experiment, while fine root and soil carbon stocks are measured with soil core sampling. Depth to the ground water was also recorded during vegetation season.
Carbon pool stocks change during stand development with soil as a dominant carbon pool in young age, while live biomass carbon pool dominates in older age. Carbon stocks in soil organic layer increase with stand age, but in mineral soil layer no statistically significant age-dependent trend was observed. When successfully regenerated, as in our case, oak stand becomes carbon sink very early in a development phase, between the age of 5 and 13 years and remains a carbon sink even after the age of 160 years, or until final harvest.
Weekly and annual productivity (GPP and NPP) estimates from EC were compared with MODIS NPP and GPP (MOD17, col. 5.5) products from NASA's TERRA satellite, and validated with weekly NPP estimated with dendrometer measurements and SR for years 2008-2012. Results indicate good agreement in "average" years, but poor agreement with MODIS after prolonged dry period when MODIS underestimates the productivity. Ground water, i.e. soil moisture seems to be the key element, as MODIS routines do not consider soil water availability in calculations of GPP and NPP.

Acknowledgments
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KN19 S4/S5

ACCELERATING FOREST MORTALITY

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Keywords: project EUFORINNO, final conference, 7FP, programme, topics

Forest mortality is rising throughout the northern hemisphere and may be driven in part by rising temperature and increasing frequency or intensity of droughts. The EUFORINO effort has enabled improved technical, computational, and theoretical abilities to investigate the patterns, physiology, and predictions of forest mortality in temperate forests. Evidence thus far suggests that rising temperature is the primary culprit driving rising mortality via increasing vapor pressure deficit (VPD), which forces increasing vulnerability to carbon starvation and hydraulic failure. Predictions suggest that rising VPD will cause a shift in forest structure from tall trees to shorter shrubs and weeds, and will particularly impact gymnosperms more than angiosperms. Global evidence suggests that increasing droughts will also impact angiosperms as well, however, and the bulk of evidence points to increasing vulnerability of forests to climate change throughout the Earth. We review the evidence underlying these predictions.

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OZONE RESEARCH, *QUO VADIS*? LESSONS FROM THE FREE-AIR CANOPY FUMIGATION EXPERIMENT AT KRANZBERG FOREST

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Keywords: ozone, climate change, Supersite network, integrative research, hemispheric scope

Enhanced ground-level ozone (O_3) has gained awareness worldwide as an agent of climate change. Forest ecosystem response to O_3 has remained uncertain, though, aside from scarcely validated modelling predictions. The 8-year free-air O_3 canopy fumigation experiment at Kranzberg Forest (Germany) was the first to examine adult forest trees of climax species (evergreen *Picea abies*, deciduous *Fagus sylvatica*). What was learnt, and what is to be strived for?

Key findings will be highlighted from the tree-soil system as a starting point for defining upcoming conceptual and methodological challenges. Amongst such, perception of O_3 as part of multi-factorial, abiotic and biotic interaction networks and effective dose-related tree and stand-level risk assessment are ultimate requirements. Rationales must be both mechanistic and holistic, and ecosystem-level O_3 research must reach out for hemispheric scopes.

Integrated empirical and modelling approaches are to be conducted within a global "Supersites for Forest Research" network, for which a concept is outlined that unifies mechanistic clarification, process scaling and modelling-guided risk assessment. Will O_3 studies remain a "non-topic" within climate change research?

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EI S5

OVERVIEW OF EUFORINNO PROJECT

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Keywords: Capacities, support action, scientific excellence, research infrastructure, visiblity

EUFORINNO: European Forest Research and Innovation is an FP7 CAPACITIES project (RegPot No. 315982) coordinated by the Slovenian Forestry Institute (SFI). It provides a mean for SFI to raise its scientific excellence and infrastructure, and better exploit its innovative outputs. The project focuses on filling the gaps in four research areas: i) genetic monitoring; ii) biodiversity and functional diversity; iii) belowground complexity; and iv) ecosystem carbon exchange in time and space; and in transversal activities: publishing, innovation and IP management, and networking, contributing to the exploitation of innovation.

EUFORINNO relies on 8 excellent research partners who support SFI in building its long-term strategy, welcome researchers from SFI during their secondments abroad, provide on-site training on new methodologies, data interpretation and publishing.

The project has so far proven to be of unprecedented importance for SFI, as well as for the role of forest science in the national, regional and in the European research and innovation area. The number of international projects coordinated or participated by SFI has accelerated, and a number of common project proposals have been submitted to the H2020 calls. The purchase and operationalization of research equipment, realizations of secondments, trainings at SFI and workshops abroad have mostly been finalized, in which 75 % of all SFI researchers participated and benefited from. However, we have also faced several problems, including lower financing rates of recruits due to internal systemization regulations and due to a restrictive law on salaries accepted after the project negotiation has been finalized. Therefore a prolongation of time for financing the core project activities was accepted, finishing in January 2016, while the project ends on March 31st 2016.

Selected EUFORINNO impacts shall be presented in the session of the conference dedicated to the procedures aimed at accreditation of selected equipment applications, and publishing.

Acknowledgements

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EI S5

MODERN LABORATORIES AND STANDARDISATION OF PROTOCOLS

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Keywords: project EUFORINNO, laboratory equipment, laboratory protocols, modernisation, standardisation, accreditation, scientific excellence

EUFORINNO Work Package 1 (WP1) activities focused on procurement of nineteen different types of modern laboratory equipment. The acquired equipment included both state-of-the-art core research instruments as well as general laboratory equipment. Initial list of equipment was formulated during the preparation of project application and was later refined and updated by incorporation of project partner expert suggestions. According to Public procurement regulations eighteen out of nineteen pieces of equipment were acquired through public tendering by 'bidding process after prior publication' and one by 'the best of three offers' selection process. Six public tenders were issued from December 2012 to July 2013 and successfully finalized with all equipment delivered and installed between May and December 2013.

Following the delivery, installation, basic user training and familiarization with equipment use and maintenance, SFI operators began preparing Installation and Maintenance Protocols (IMP), Operational Manuals (OM) and Standard Operational Protocols (SOP) for the new equipment. Major contributing factor for development of high quality SOPs and their standardization were trainings and secondments at project partner institutions (EUFORINNO WP2).

Based on their state-of-the-art nature, operator expertise and interest of the research community it was established that SFI would benefit the most if (1) Isotope Ratio Mass Spectrometer (EA/TC-IRMS) and (2) PALM Laser Microdissection Microscope System were selected for bringing analytical procedures performed on these two systems to accreditation-ready level. Efforts are currently underway to make all procedures and documents pertaining to the use of these two instruments compliant with SIST EN ISO/IEC 17025:2005 standard which forms the basis for accreditation. During project prolongation at least one of the selected SOPs will be subjected to audit by an external accreditation authority.

The newly acquired research equipment, combined with implementation of new and optimized SOPs and know-how acquired during trainings into research practice, has had an immensely positive impact on SFI research capabilities and an overall increase in the level of scientific excellence. New state-of-the-art core research equipment enables SFI to perform cutting edge analyses and produce highly relevant and publishable results as well as to venture into new areas of forest research. New general laboratory equipment has also contributed to a general increase in quality of laboratory work by enabling separation of processes where cross contamination is a major concern and also increased the processing capacity (throughput). The modernization of SFI laboratories and implementation/standardization of new SOPs have made SFI more competent, recognizable and attractive as a potential project partner and as a provider of analytical services for outside customers. During EUFORINNO WP1 activities SFI personnel have also gained invaluable experience in successful preparation and issuing of complex public tenders, which will undoubtedly have a beneficial impact on future public procurement activities at SFI.

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EUFORINNO METHODS TOWARDS FORMAL ACCREDITATION

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Keywords: project EUFORINNO, final conference, accreditation, infrastructure

The value of the testing laboratory depends very much on its working procedures, structure, reliability and results. With all these words we are describing the quality of the laboratory. Laboratory quality systems were established with the idea that when testing the same sample all laboratories following such a quality system should produce the same results, within the defined precision interval. The accreditation is the process in which certification of competency, authority, or credibility is presented. The procedure for achieving accreditation is very comprehensive, labour-intensive, involves all organisational levels of the laboratory and has to be accepted and recognized by the laboratory personnel and the entire institution as a means for constantly achieving improvement and maintaining a high level of scientific excellence. During the audit an accreditation body checks the laboratory if it meets all requirements of the corresponding standard, in our case SIST EN ISO/IEC 17025. At the Slovenian Forestry Institute we formally started with the processes in January 2015 with an education seminar for a wider audience focusing on most important aspects of the standard SIST EN ISO/IEC 17025 and its implementation, followed by a workshop for a smaller group of laboratory personnel with the aim to obtain education and certification for internal auditor. All participants had successfully absolved the internal audit workshop and received an official certificate of competence to perform internal audit according to SIST EN ISO/IEC 17025. Standard operational procedures (SOP's) for EUFORINNO equipment were built upon the 16 operational manuals and know-how transfer form CP (collaborative partners). Altogether 7 SOP drafts were upgraded to proposals and four of them were harmonised following the principles of SIST EN ISO/IEC 17025 laboratory standard. Steps of internal audit and external audit by an independent body will follow.

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EI S5

PROGRESS OF MICROSCOPY FACILITIES WITHIN EUFORINNO PROJECT

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Keywords: laboratory equipment, research infrastructure, operating manual, installation and maintenance protocol, standard operating procedures, applications of light microscopy in forestry

Within Euforinno project, the outdated equipment of microscopy room was upgraded with modern and high quality microscopes Zeiss Stereo Lumar motorized dissecting microscope, Zeiss Axio Imager Z2 semi-motorized upright research microscope and PALM laser microdissection system in conjunction with Zeiss Axio Observer Z1 motorized inverted research microscope. All the instruments are operated on Zeiss ZEN software platform, while for laser microdissection special user-friendly PALM Robo software is available. For all the microscopes, operating manuals, as well as installation and maintenance protocols were prepared, and selected standard operating procedures for house rules in microscopy room, laser microdissection service, paraffin embedding of root samples, preparation of permanent semi-thin sections of mycorrhiza and measurements with ZEN software developed. The main study subjects of the facility are a) conservation biology and biotic diversity of mycorrhizal fungi, b) identification of ectomycorrhizal morphotypes, tree fine roots and lichens, c) identification and taxonomy of mycorrhizal and saprotrophic fungi, d) bioindication with ectomycorrhizal fungi, e) responses of root symbioses to environmental factors (ozone, temperature, water availability,…), f) dynamics and extent of lignification of cell walls, g) growth rings formation (on microscopy level) in dependence on environmental factors. During the project, microscopy facilities were extensively used for development of identification key for tree roots (atlas of tree roots) that encompass twelve common European temperate tree species, for which morphological and anatomical features of roots, measuring 5, 3 and 1 mm in diameter, and the most distal fine roots were studied. Based on the findings of this pilot study we will be able to expand the identification key on further tree and shrub species.

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EI S5

USE OF STABLE ISOTOPES IN FOREST ECOSYSTEM STUDIES: ON THE PROGRESS OF STABLE ISOTOPE LABORATORY AT THE SFI

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Keywords: stable isotopes, forest ecosystem, TC/EA-IRMS, IsoPrime100, vario Pyro cube

In the past three decades, the use of stable isotope techniques in forest research has greatly contributed to the understanding of biochemical, physiological and ecological processes on a spatial and time scale. Stable isotopes of light elements (i.e. hydrogen, carbon, nitrogen oxygen and sulphur) are often used as integrative tools in different fields related to forestry; from forest ecology to managements through genetics and palaeoclimatology (Ferrio et al., 2005). Natural biogeochemical processes which regulate the uptake and flow of matter cause differences in the isotopic signature of nutrient compounds due to isotopic fractionation. Thus, tracing these processes in ecosystems and determining the amount of isotopic fractionation can help identify transfer pathways and capacities (Bauer et al., 2000) important for the understanding of the dynamics of forest ecosystems responding to ever-changing environmental conditions.

The abundance of stable isotopes in samples is typically measured by an (stable) isotope ratio mass spectrometry technique (IRMS) coupled to a peripheral unit, e.g. elemental analyser, that converts a samples to a gaseous compound (CO_2, N_2, CO or H_2). In 2013, in the frame of the EUFORINNO project (RegPot No. 315982), a continuous flow *IsoPrime100* IRMS (Isoprime, UK) coupled with a *vario Pyro cube* high-temperature elemental analyser (Elementar, Germany) was installed in the newly founded Stable Isotope Laboratory at the Slovenian Forestry Institute. The analysing system enables simultaneous elemental and stable isotope ratio determination of H, C, N, O and S in solid and liquid samples. The elemental analyser can be operated in a CNS mode (for C, N and S analyses) or in high-temperature pyrolysis mode (for H and O analyses) in a temperature range between 950 and 1450 °C. The gaseous compounds are then analysed with the IRMS for the isotope ratio determination.

Following successful installation of the analysing instruments, necessary equipment (weighing balance, reference and He gas tanks etc.), personnel training and purchase of selected certified reference materials, a variety of internal research projects were initiated to (1) calibrate the analysing instruments and test their performance, and (2) to introduce the usefulness of isotope tracer techniques to the interested research community within the institute and others. Around 3500 analyses of samples were performed so far, mainly of α-cellulose isolated from tree rings, plant leaves, mosses, fungi and soil materials. The stable C and O isotopes of tree rings of oaks, spruce, chestnut tree, catalpa and wisteria helped us constrain the influence of anthropogenic pollution by burning fossil fuels, urban impacts on tree growth and the ability to survive drought period, diminished groundwater levels, and to reconstruct past climate changes. To understand the dynamics of Slovenian forests more thoroughly, isotope ratio analyses of C and N in soil profiles, roots and fungi of mixed forest stands growing in different climate areas (as an upgrade of data collected within the ManFor C.BD project) were used to reveal impacts of forest management on the soil biogeochemical processes. Additionally, along with actual elemental and isotope ratio measurements in samples, a good laboratory practice is constantly being implemented by developing standard operating procedures on the sample preparation and TC/EA-IRMS use and maintenance.

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EI S5

MEASURING ISOTOPIC COMPOSITION OF CARBON DIOXIDE IN THE AIR

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The stable carbon dioxide isotopologues analyzer – model CCIA-46 – is the latest product of Los Gatos Research, Inc. The instrument outputs $^{13}CO_2$, $^{12}CO_2$, $^{12}CO^{17}O$, $^{12}CO^{18}O$ in ppm and thus the isotopic ratios of $\delta^{13}C$, $\delta^{17}O$, $\delta^{18}O$ in real time. The main unit for performing acurate and reliable measurements is a midinfrared quantum cascade laser using. All LGR analyzers utilize a unique laser absorption technology called Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS). This LGR-patented technique offers superior performance, value and reliability compared to Laser Absorption Spectroscopy (LAS) or cavity ringdown spectroscopy (CRDS). Features of the instrument are fast response (5Hz), portability for field measurements and insensitivity to methane and other hydrocarbons. The instrument also alow high concentration measurements via dynamic dilution system and manual sample injection via syringe. Carbon dioxide isotopologues measurements allow determination of uptake, residence time and sequestration of carbon dioxide in it's cycle in the ecosystems. The instrument could be used in net ecosystem exchange measurements via Eddy covarance method or connected to an automated soil respiration system. Instrument could also be used in labeling experiments with CO2 isotopologues.

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THE PUBLISHING CENTER *SILVA SLOVENICA* AND MONOGRAPH SERIES *STUDIA FORESTALIA SLOVENICA*

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Keywords: Project EUFORINNO, scientific series, publishing centre, scientific communication

Silva Slovenica is the publishing centre of the Slovenian Forestry Institute (SFI), founded in 1949. The publishing centre concentrates its efforts in publishing scientific monographs and co-publishes the main Slovenian scientific journal in the field of forestry, wood science and paper, but it also publishes professional publications, leaflets and brochures for promotion of certain applied and implementation results important for the civil forest service, forests and forest ecosystems.

Through the project EUFORINNO, SFI gained resources, needed for the internationalization and professionalization of its publishing centre and the monographs series. Its activities have been intensified in the last three years in several activities:

- development of a publishing system from author through technical preparation of texts with proofreading and print, which rationalises all costs of the publishing process;
- preparation of documents according to the Slovenian and international copyright law (Declaration of authorship and publication);
- set-up of the open access repository *SciVie*, which authors can use as their home repository;
- activities concerning obtaining DOI for published e-material (e.g. membership in a specific DOI organization).

Since its establishment the scientific outputs of the Slovenian forest and wood science were published in a scientific and professional monograph series Strokovna in znanstvena dela. With no. 122 in the year 2005 the series was renamed into *Studia Forestalia Slovenica* (ISSN 0353-6025). It is published in cooperation with the Department of Forestry and Renewable Forest Resources and Department of Wood Science and Technology at Biotechnical Faculty of the University of Ljubljana. By now 146 titles have been published, and among most prominent monographs the photo-monograph The Virgin Forest was published in 2014.

As a small publishing centre we are flexible, cost effective and adaptable to needs of authors, and expect to proliferate as such also after the project EUFORINNO reaches its end.

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ACTA SILVAE ET LIGNI

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Keywords: project EUFORINNO, *Acta Silvae et Ligni*, scientific publishing, academic journals, digitalisation, open access

The scientific publications were always the key way of disseminating the research outputs and also an important stage in their evaluation and putting in frame of international importance. Recently changes in scientific communication due to European Commission activities and worldwide are encouraging researches to open science, in particular publications and available data to all communities. These shifts are also reflected in publishing activities of the Slovenian Forestry Institute (SFI). The European project EUFORINNO has offered a financial support to publishers of *Acta Silvae et Ligni* to focus and intensify activities for improvement of the journal.
Acta Silvae et Ligni is the only Slovenian scientific journal dedicated to publish original or review scientific and professional contributions from the fields of forests, forestry, wood science and technology, forested landscape, nature and the environment. Journal in particular supports the development of scientific and professional terminology in Slovenian language. The journal is published in cooperation of three institutions: the Slovenian Forestry Institute, Department of Forestry and Renewable Forest Resources and Department of Wood Science and Technology at Biotechnical Faculty of the University of Ljubljana. In 2013, with no. 100, its current title has been introduced with the purpose of boosting the internationalization of the journal. Several other changes have also been done on graphical design, home page, policy strategy, open access to bring the journal closer to all levels of readers, and a fully electronic submission system. The journal is under evaluation within two major databases, Web of Science and Scopus. Also the process of obtaining DOI for all articles has been lounged (e.g. membership in a specific DOI organization).
In addition the digitalization process of 643 articles from the Zbornik gozdarstva in lesarstva was conducted and entered into the repository *SciVie*.
With all these activities we try to enable use and re-use of new and old materials that might otherwise not be readily accessible, and we thus support the advancement of forest research and development.

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SCIVIE – SCIENCES *DE LA VIE* FROM THE PAST AND FOR THE FUTURE

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Keywords: project EUFORINNO, repository, *SciVie*, digitalisation, open access, life sciences

Changes in scientific communication due to European Commission activities and worldwide are facing directions to open science, in particular publications and available data to all communities. These shifts are reflecting also in publishing activities of the Slovenian Forestry Institute (SFI). With the financial support of the project EUFORINNO we have started the open access repository *SciVie*.
The repository *SciVie* (deriving from 'Science de la Vie') with its open access materials provides more efficient re-use of past research, promotion of research results, researchers and the institution itself including the possibility of increased citations and recognition of scientific works, training future scientists for open access, increasing the number of potential users and giving the general public the opportunity of improving their lives resulting from the research findings. The repository *SciVie* was launched on a base of the EPrints 3 software as multi-institutional repository in the fields of natural and life sciences. It is intended for storage of articles, monographs, databases and other works, with the aim of meeting the requirements of EU co-financers. Therefore it has been entered in the databases OpenDOAR, RAOR and OpenAir. Currently several institutions already contribute to *SciVie*, including the Slovenian Forestry Institute, Agricultural Institute of Slovenia, National Institute of Biology and Biotechnical Faculty of the University of Ljubljana, Department of Wood Science and Technology. Big efforts were put into developing the policy strategy and copyright requirements that meet the Slovenian and EU policy, into its graphical design and home page.
Activities concerning promotion of open access have been organized at all participating institutions as well as in the southeast Europe.
In addition the three stage digitalization process for already published works (dating from the establishing SFI in 1950') was set up. Firstly 643 articles from the Zbornik gozdarstva in lesarstva (now *Acta Silvae et Ligni*) were digitalized and entered into *SciVie*. In the second stage 324 study reports were digitalised which were considered as grey literature and the only copy (usually) only exists in the Forestry library. That task has been a challenge even for the chosen digitalizing company, since materials were on a different paper formats, old or damaged paper and printed or typed in a diverse quality. Special challenge has been the digitalization of supplementary maps and other outsized material and finding a way to disseminate digitalized copies to public (via *SciVie*) as not too large files. The third stage, the digitalization of a set of study reports and other similar material published by SFI, is under way.
With all these activities we try to enable use and re-use of new and old materials that might otherwise not be readily accessible, and we thus support the advancement of forest research and development.

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POSTERS

in alphabetical order of first authors

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LEAF UNFOLDING VARIABILITY IN CLONAL SEED ORCHARD OF *Fraxinus angustifolia* Vahl

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Keywords: narrow leaf ash, flushing phases, phenoform group

In Croatia, narrow-leaved ash (*Fraxinus angustifolia*) is distributed in the Pannonian lowland area, along the rivers with pedunculate oak (*Quercus robur*) in mixed stands. Greatest portion of its genetic variability is localized in the region of Sava river (area of 30 000 ha) where in 2005 established clonal seed orchard with 56 clones (Forest Range Office Nova Gradiška). The grafts were planted with 4 × 4 m spacing in the area of 3.50 ha. Clonal seed orchard have been regularly maintained by pruning and with other agrotechnical treatments from the moment of establishment. Pomotechnical treatments are used and successful pomology techniques is maintaining the balance between the vegetative and generative activity.

Phenological seasonal rhythm has recently receives importance and with better understanding of leaf phenophases we will be able to more precisely define response to climate change. Through the period of three years (2012, 2014, 2015) it was observed phenological clonal differences in monitoring of flushing phases on four ramets per clone on which we based our strategy to determine interclonal and intraclonal variability. The start date of the leaf unfolding stage is defined as the point at which the entire leaf blade and leaf stalk were visible (Phase 2). Each year, observation began before any buds began to break (10th of March), and was made every seven days until the 1st of June.

Analysis of variance showed statistically significant difference between the studied genotypes for each year of investigation for the parameters period of leaf development and beginning of leafing ($F = 6.89$, $F = 7.15$, $F = 4.91$, $Pr < 0.0001$). There is a statistically significant difference over the years ($F = 539.21$) and for the interaction clone × year ($F = 2.44$, $Pr < 0.0001$). The results of k-means clustering of the clones according to their leaf unfolding clearly classified clones into three groups (early, intermediate and late flushing). Each of the phenoform groups are also an important characteristic related to the pests and insects and to the occurrence of the late spring frost. For the early flushing group, the mean value for the period of leaf development were in average from 24 days in 2012, 25 days in 2014 and 20 days in 2015. The intermediate group required an average of 27 days in 2012, 26 days in 2014 and 19 days in 2015. For the late flushing group, the mean value were in average from 31 days in 2012, 26 days in 2014 and 21 days in 2015. Among early, intermediate and late flushing group of clones due to the time to complete the leaf development for each year of observation there was no statistically significant difference ($p = 0.238$) but it was between the years ($p = 0.017$). In this period seed orchard was also continuously monitored and checked for the presence of *Chalara fraxinea*. The presence of *Chalara fraxinea* was not confirmed, and on the clones there were no simptoms that would indicate it.

Statistically significant differences were obtained between genotypes in clonal seed orchards for period of leaf development and leaf unfolding. There is a statistically significant difference over the years and significant differences in the interaction between the clones × years, which means that analyse variable for phenoform group over the year do not behave the same. Investigated 54 clones were divided into three groups depending on the beginning of leafing. With the results gathered from this monitoring we are able to determine and classify clones into early, intermediate and late flushing groups, which has a high practical value not only for clonal seed orchard managing and maintaning, but also for the production of quality forest reproductive material and their distribution as very important adaptive trait for the future.

Acknowledgments

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P S1

PHENOLOGICAL VARIABILITY OF EUROPEAN BEECH (*Fagus sylvatica* L.) IN THE INTERNATIONAL PROVENANCE TRIAL

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Keywords: European Beech, provenance trial, phenology, coloration and winter leaf retention

Common beech is the most important species of forest trees in Bosnia and Herzegovina. This research provides the results of investigation into the phenological variability of 22 common beech provenances in the international trial near Kakanj, both for the properties of autumn coloration and winter leaf retention. The experiment included eight provenances from Bosnia and Herzegovina, four from Germany, three from Serbia, two from Croatia, Romania and Switzerland each and one from Hungary. The experiment was established in a randomized block system with three repetitions.

The goal of this research was to establish whether there were differences in variability between the investigated provenances and what features would be important for future management and regeneration of beech forests, as well as for increased production and adaptability.

Based on the investigated phenological properties, statistically significant variability was found between all the studied provenances. The established differences included the beginning, duration and end of particular phenophases. There are considerable statistically significant differences in flushing among the studied provenances. Provenances from Croatia and Bosnia as a rule flush earlier than foreign provenances. April 10 can be considered as the beginning of common beech vegetation in this international trial, because this is the date on which bud opening occurred in twelve out of 22 provenances.

The analysis of leaf colour of different common beech provenances revealed variations in the presence of different groups of colours with varying shades in a particular period. Current differences in winter leaf retention indicate that 65.92 % of the plants in the entire experiment do not retain the leaves. The highest proportion of leaf non-retention, amounting to 91.05 %, was manifested by the provenance from Germany (Hoellerbach). It can be concluded that common beech is genetically differentiated according to ecological and vegetation areas and that it shows different morphological and physiological characteristics from different provenance areas. This proves that morphological and physiological properties of common beech are influenced by a number of factors and that each of the investigated properties is determined by a large number of genes.

P S4

THE IMPACTS OF FOREST FIRES IN THE CURRENT STATE OF FOREST RESOURCES IN KOSOVO

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Keywords: forest fires, economic damages, vulnerability, preventing measures

Kosovo is situated in the central Balkan peninsula. It has an area of 10,887 square kilometer and an overall forest area of 481,000 hectare. Forests and pastures in Kosovo occupy around 50 % of the whole Kosovo territory. Based on the National Forest Inventory carried out on 2012, the total standing volume is 46.3 Million m^3. Natural broadleaves forests cover 90 % of the whole forest area, while conifer forests cover about 7 % represented by silver fir (*Abies alba* Mill.), norway spruce (*Picea abies* H. Karst.) and pine species. More than 60 % of the forests are located in various altitudes ranging from 600 m to 1000 m.
The aim of the study is to assess the vulnerability of forest fires, their causes as well as measures to prevent them. Kosovo forests during last years have been affected by severe forest fires causing many damages with a high economic bill. The most severe fire's years were 2000, 2004, 2007 and 2012, burning about 10,955 ha, with an economic damage about 4.65 Million €.

P S4

RETREATING SESSILE OAK FOREST WITH IMPROVING VITALITY – INCLUDING TREE MORTALITY IN VITALITY ASSESSMENT

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Keywords: *Quercus petraea*, drought, mortality, stand density, forest monitoring

The drought induced vitality loss of sessile oak (*Quercus petraea*) has been continuously observed in Hungary for more than three decades. Although stand density is an important indicator of the stand stability, the decreasing stand density as a consequence of drought induced mortality is not considered in most of the monitoring methods (e.g. ICP forest monitoring network). We introduced a novel health assessment method based on the vitality of the living trees and on the relative stand density, expressed as the ratio of the current density to the fully stocked density. Stands for the assessment were selected along a climatic transect from the humid region in SW-Hungary to the continental-semiarid region in NE-Hungary where no forest intervention was applied at least during the last three decades. The results showed that the calculated health status of the sessile oak stands are considerably below the ones measured by the ICP, lying between 70-90 % in SW Hungary and below 50 % close to its xeric limit.

P S1

GENETIC ANALYSIS OF NATIVE EUROPEAN BLACK POPLAR (*~~populus~~ nigra* L.) POPULATIONS IN SLOVENIA AND CROATIA BY USING SSR MARKERS

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Keywords: *Populus nigra*, genetic resources, genetic diversity, introgression, microsatellite loci

The European black poplar (*Populus nigra* L.) is one of the most important tree species of alluvial forests in Europe. In Slovenia and northern Croatia, ecosystems, where European black poplar is the keystone species, are fragmented and endangered mostly because of river regulations, pollution, urbanisation and felling of vital trees for wood. European black poplar is also an indicator species for the vitality and intactness of alluvial ecosystems. To inventory genetic diversity and structure of the remaining natural populations, a study using nuclear microsatellites was conducted.

We analysed genetic diversity and structure of 10 native black poplar populations (200 trees) along the main river systems across Slovenia and Croatia (rivers Soča, Sava and Mura) and in the submediterranean using 6 microsatellite loci (WPMS16, WPMS20, WPMS14, PMGC14, WPMS09, WPMS18). Eleven common cultivated clones of *Populus* x *canadensis* were also included in the analysis in order to assess the level of introgression of genes of the American Eastern cottonwood, *P. deltoides,* into the gene pool of native black poplar. Standard methods using programmes GenAlEx, SpaGeDi and Structure were used to obtain estimates of genetic diversity and genetic structure including presence of hybrids.

Three genepools were observed for our dataset, mainly following the river systems (Soca, Mura, Sava with two genepools). No clear accumulation of allelic richness nor gene diversity downstream neither for Sava nor Mura was observed. In natural populations, the introgression of *P. deltoides* genes was very low. The results indicate that the gene pool of the remaining *P. nigra* populations maintains high genetic connectivity along rivers even if fragmented today. The obtained results can be used to further develop dynamic *P. nigra* conservation in endangered forest ecosystems at regional and national levels.

Acknowledgments
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P S1

IMPLEMENTING FOREST GENETIC MONITORING PLOTS

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Keywords: forest genetic resources, genetic diversity, monitoring, Smolarjevo, Pri studencu

Within the LIFEGENMON project, two forest genetic monitoring (FGM) plots were installed in Slovenia in 2015. Such monitoring might be a possible tool for gathering information, whether the forest ecosystem can adapt to the future changes of its environment (Namkoong et al. 1996, Konnert et al. 2011). FGM is going to be conducted for two species - *Fagus sylvatica* L. and *Abies alba* Mill. The sites were considered based on the pre-prepared LIFEGENMON protocol drafts, meteorological and environmental data availability, site conditions, local forestry initiative, legal status of selected forests and ownership. Upon several candidate plots, two seed stands: "Smolarjevo" and "Pri studencu" were chosen. The poster presents main reasons for this decision, as well as rich history of forest management on both FGM plots. The pre-prepared LIFEGENMON protocol drafts for FGM seem to be well considered so far and only minor changes need to be discussed within LIFEGENMON partners when preparing the final protocol.

Acknowledgements
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P S1

TESTING OF SALT TOLERANCE ASSOCIATED GENES IN SERBIAN POPLAR CLONES

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Keywords: poplar, gene expression, stress inducible genes, quantitative RT-PCR

Trees from Pannonian region are exposed to a combination of environmental stress conditions, especially high salinity. Poplar is extensively used for forestation in this region due to its importance in carbon sequestration, bioremediation, nutrient cycling and wood production. Rapid growth, facile transformation and small genome size makes poplar an ideal model for basic and applied research targeting stress responses in woody plants.
This research work employs functional genomics strategies to analyze oxidative stress responses of poplar woody plant species in order to improve its tolerance to extreme environmental conditions. The experiment was stetted with two poplar clones (*P. deltoides* and *P.* x *euramericana*), with different tolerance level, exposed to salt stress where different concentration of NaCl as a stress agent with a different time point of stress were monitored. Transcript levels of stress-induced marker genes, transcription factors and other regulatory genes were analyzed. In order to test several stress inducible genes of different biosynthetic pathways on particular poplar clones quantitative RT-PCR was used. The isolation of total RNA from poplar tissue, derived from control and stress samples was done using TRIzol method, followed with first strand DNA synthesis. Successful cDNA synthesis was confirmed by amplification of actin gene (PtACTIN9 *Populus trichocarpa* homolog) for both species as endogenous gene of choice (internal standard). The Ct value of the genes of interest were tested on sampled cDNA by quantitative RT-PCR using SYBR green. Different level of expression has been occurred for different stress induced genes. The best induction was detected in the gene belonging to the dehydrin protein family with lysine rich segments in its sequence. It is a regulatory gene which amino acid sequence shows homology with group II LEA (late embryogenesis abundant) proteins. Also responds to osmotic stress, ABA, dehydration and inhibits E.coli growth while overexpressed. The most important segment of this work represents getting successful strategy for approaching the climate change problem with functional genomic tools using qPCR for testing gene expression in order to obtain the first applicable insights into the future protection of poplar species in the area of Srem, Vojvodina region, Serbia.

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P S3

MOLECULAR ANALYSES OF ITS rDNA OF THREE AUTOCHTHONOUS FUNGAL SPECIES FROM MOUNTAIN FORESTS IN SERBIA

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Keywords: mountin forest, macrofungi, diversity, molecular taxonomy, molecular phylogeny

Fungi and mushrooms represent an essential structural element of forests ecosystems. In the frame of national project of biodiversity examination in mountain forests of Serbia during three investigation years (2011-2013), autochthonous macrofungal diversity have been examined on the following areas: Tara Mt (Mitrovac), Kopaonik Mt (Metođe) and Stara planina Mt (Vidlič). The most frequently 3 species found in all three areas were chosen for analyses, including selected isolates of each, namely 6 isolates of *Fomitopsis pinicola* (Sw.) P. Karst., 8 isolates of *Polyporus varius* (Pers.) Fr. and 3 isolates of *Hymenopellis radicata* (Relhan) R.H. Petersen.

Since molecular methods have been contributed to a great extent to the taxonomic and phylogenetic studies of fungi in the last decades and DNA barcoding has become a standard method in species identification, the aims of this study were: 1) confirmation of selected taxa, previously determined by classical morphological procedures, using molecular methods; 2) evaluation of their phylogenetic origin using sequence analysis of the ITS1-5.8S-ITS2 region rDNA, by comparing it with sequences from the GenBank® database using BLAST. UNITE sequences from databases, that upon BLAST search showed concordance of over 97 %, were used for the formation of the cluster tree dendrogram constructed using RAxML (Randomized Axelerated Maximum Likelihood) software.

Based on the results obtained, the ITS rDNA region proved to be adequate bar-coding marker for molecular determination of tested fungal species and construction of phylogenetic trees.

According to sequence-based analysis from dendrogram constructed for *F. pinicola* clade, autochthonous mushrooms species have a common origin with European species. Based on the sequences of *P. varius* two distinct clades can be singled out, of which one consists of species *Polyporus varius, Polyporus melanopus* and *Royoporus badius* what is in correspondence with morphologically defined group *Melanopus*. Since all three sequences of autochthonous *H. radicata* grouped in one of two distinct subclasters, phylogenetic relatedness of the isolates can be concluded as well as the separation from European species sequences of the same fungal species.

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P S3

HYPOGEOUS FUNGI DIVERSITY AND ECOLOGY IN SE EUROPE

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Keywords: truffles, distribution, species concept, cultivation perspectives

In Europe there is over 50 genera of hypogeous fungi with best known genus *Tuber* (true truffles), represented with over 30 species published for central and western Europe. Truffles were only recently popularised in the SE Europe, namely in the Balkan Peninsula and their presence, diversity and ecology in the region remains understudied. We aimed to analyse the diversity of true truffles and to certain level also false truffles (all non-*Tuber* hypogeous fungi) in selected countris in the SE Europe and compare it with the rest of Europe and globally.
Using specialised purposive oriented tracing approaches we collected over 2000 collections of hypogeous fungi, all ecologically and morphologically analysed. The less known genera were also characterised using molecular markers.
The diversity of hypogeous fungi in the SE Europe is comparable to other parts of Europe (Marjanović et al. 2010) with a high number of endemic genotypes, among which at lease some can be identified as separate taxa following the Species hypothesis approach (Kõljalg et al., 2013). The distribution and ecology of selected species is pointed out, so as the importance of commercial truffle species in the region.

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P S3

TYPES OF ECTOMYCORRHIZA IN THE 34 YEARS OLD *Pinus sylvestris* L. SEED PLANTATION IN THE LOWLAND FOREST SITE "MURSKA ŠUMA"

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Keywords: *Pinus sylvestris*, *Qurecus robur*, forest plantation, ectomycorrhiza, monitoring

The objective of this study was to evaluate the types of ectomycorrhiza of *Pinus* sylvestris L. seed plantation in SE part of Slovenia at 158 m a.s.l. and establish a longterm monitoring of ectomycorrhizal types in new developing forest plantation of *Quercus robur* L.. Samples were taken in April 2015. *Quercus robur* was sampled in forest nursery Polana in Banuta site and *Pinus sylvestris* in its former plantation in the Murska šuma site. At each of two sites soil cores were taken and the soil structure was analysed. Roots from the both species were sampled in different sites. After washing, all roots were differentiated into non-woody-plant roots, non-ectomycorrhizal, non-turgescent and different vital ectomycorrhizal morphotypes. Morphological and anatomical characteristics of mycorrhiza is under study. Ectomycorrhizal roots will be identified by using classical ITS-PCR and sequencing.

Acknowledgments
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P S4

SOIL PROPERTIES IN RELATION TO SELECTIVE LOGGING IN BEECH AND FIR FOREST STANDS - CASE STUDY AT BJELAŠNICA MOUNTAIN

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Keywords: SOM, topsoil, site factors measurements, Mt Bjelašnica

Quality of forest soils is associated with the range of stand disturbance due to applied forest management practice. Selective logging, which is characteristic for mixed beech and fir forests (*Abieti-fagetum dinaricum s. lat*.), rises globally in it intensity in regard to the growing needs for wood products and energy resources. Understanding how the soil quality alters relative to selective logginging operations in a successional cycle will help determine sustainability of forest management system. Mixed beech and fir forests are covering large areas along the Dinaric mountain range where limestone and dolomites occur as predominant geological substrates. In Bosnia and Herzegovina, they comprise more than 50 % of all high forests and they are therefore considered as the most important forest types. In addition to the principles of the forest management strategy which imply maintenance of their structural elements, we are investigating soil chemical and microbiological properties associated with alternations in forest structure, micrometrological parameters, and light conditions in a different choronosequences after logging. Regarding the intensity and temporal premises, the results should answer the question of indirect influence of logging on forest soil organic matter quality, storage ability for the organic carbon and nitrogen, nutrient ability, microbial properties etc. Soil organic matter is vitally important for ecosystem functions on shallow calcareous soils and further critical for maintaining natural regrowth and forest ecosystem sustainability. In that view the study attempts to valorize the forest management system using soil quality parameters.

P S3

SEASONAL VARIATION OF ECTOMYCORRHIZAL COMMUNITY FROM MATURE POPLAR PLANTATION

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Keywords: *Populus alba* L., ectomycorrhizal diversity, anatomophic characterization, molecular identification, seasonal dynamics

Ectomycorrhizal communities are rarely studied at the seasonal basis. For this reason we analysed the seasonal variation of the ectomycorrhizal community from mature twenty years old white poplar plantation growing on native poplar site. Using anatomical and morphological identification in combination with molecular approach, 29 distinct ectomycorrhizal types mainly belonging to Basidiomycota were identified. The seasonal differences were most profound between winter and spring on one side and summer and autumn on the other side. Number of ectomycorrhizal types and percentage of vital ectomycorrhizal roots were the highest in winter and spring. The diversity indices of ectomycorrhizae and number of fine roots from the studied poplar plantation were similar to other studies on poplars. Persistent dominance of types from familiy Inocybaceae was observed at studied site. While short distance exploration type dominated overall ectomycorrhizal community in all seasons, the abundance of ectomycorrhizal root tips belonging to the medium distance exploration type was significantly higher in spring in comparison with autumn and winter.

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P S5

POSSIBILITIES FOR THE USE OF LASER VIBROMETRY IN THE MANAGEMENT OF INSECT PESTS

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Keywords: project EUFORINNO, final conference, 7FP, invasive insect pests, Laser vibrometry

Nowadays, invasive alien species present one of the main threats to natural and semi-natural ecosystems worldwide. In addition to global trade and tourism, which have escalated the spread of alien species to unprecedented levels, climate change is becoming an increasingly important factor as it further facilitates expansion of species´ natural ranges and their spread to new areas. Until recently, control of pests was based mainly on the use of chemical pesticides. Since these often present risk to non-target organisms, researchers seek alternative methods for pest management. Among these, biological control through the use of the species´s natural enemies has attracted considerable attention, and currently shows potential to play a pivotal role in the sustainable management of invasive species in the future.
Among insects, some of the most important pests come from the family of plant-dwelling stink bugs (Heteroptera, Pentatomidae), which feed on a wide variety of host-plants. Given the high amount of damage that these species cause mainly in agriculture, it is not suprising that they are subject to extensive research. Additionally, the family Pentatomidae is important also for certain predatory species that it includes. However, these are less well known and have drawn attention of the scientific community only recently, namely because they show high potential as biocontrol agents. It is now well established that in Pentatomidae species vibrational communication represents a communication channel that is vital for successful reproduction for it enables sexual partners to recognise each other, to meet and to mate. Studies have shown that males and females emit species- and sex-specific substrate-borne vibrational signals, which are produced by dorso-ventral vibrations of the abdomen and have distinct temporal, frequency and amplitude characteristics. Vibrations of the abdomen are transmitted through legs and induce vibrations of the substrate. In addition to this, research have shown that vibrational signals play an important role also in interspecific interactions, such as interactions between prey and their natural enemies. It has been shown that certain parasitoids exploit vibrations produced by their prey as cues for localization of the prey. Similarly, in some prey species vibrations produced by predators evoke escape reactions. Given the importance of vibrational communication in a variety of economically important insects and implication of vibrationals signals in predator – prey interactions, a wide variety of research has focused on vibrational communication within and between species, trying to better understand their biology and gain new insights, which would help in obtaining new tools for effective control of insect pests.
Detection and measurement of vibrational signals is possible by different bioacoustic detection methods. However, Laser vibrometry has proven especially suitable for registration of vibrational signals of small insects. This is a novel, non-contact method based on the frequency shift of the laser beam due to the motion of the surface (Doppler effect). The amplitude and frequency of vibrational signals are calculated from the frequency change of the test beam, which is obtained from the intereference of the test and reference beams. The main advantages of this method are that it does not load the substrate, has a wide range of frequency sensitivity, and enables measurement of vibrational signals on small and delicate natural as well as artificial substrates. Laser vibrometry has significantly extended the area of possible

research of insect pests. Current research focus on vibrational repertoires of pest species and their potential predators, signal transmission and the nature of vibrational signals on different substrates, and the effect of heterospecific vibrational signals on insect development and behaviour. Together with the latest study showing that Laser vibrometry could be used also as a diagnostic tool for detection of wood-boring insect pests, this method shows high potential in the development of novel approaches to the management of insect pests.

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P S4

FOREST PHENOLOGY IN CENTRAL-EUROPE BASED ON MODIS DATA

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Keywords: MODIS, EVI, NDVI, forest activity, forest phenology

Forest phenology and productivity is intimately linked with the actual weather conditions, and in the long term with the local climate. Our current understanding on the environmental control on spring leaf-out and autumn senescence is incomplete. Causes of the interannual variability of tree growth and forest carbon balance are not well understood as well. Satellite remote provides a feasible way to monitor and study the changes of forest activity in general and to understand its relationship with the climate fluctuations.
In this study the Enhanced Vegetation Index (EVI) and the Normalized Difference Vegetation Index (NDVI) calculated from measurements of the MODIS sensor onboard the NASA Terra satellites are used to characterize forest activity in Central Europe (Hungary and Croatia). The applied EVI and NDVI dataset is part of the so-called MOD13 product of NASA and covers the 20002014 time period. Based on long term climatologies and data availability we selected a few forest sites in Hungary and Croatia that represent contrasting climatic conditions in the temperature-precipitation space. The selected two Croatian sites are data-rich in terms of information on management, productivity and groundwater level. Using the FORESEE climatological database as archive meteorological data the effects of drought is studied on the NDVI variations. Possible lagged effect of severe drought on NDVI variability during the consecutive years is studied at the selected sites. The effect of water availability in the form of groundwater during dry periods is studied as well as a possible mechanism to mitigate the negative effect of the dry periods. The presented methodology might be used to identify forested regions which are susceptible to climate variations in terms of forest health and production.

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P S4

THE IMPORTANCE OF SEEDLINGS QUALITY IN TIMBER AND BIO-ENERGY PRODUCTION

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Keywords: Seedlings, genetic resources, timber, bio-energy**,** wood production

One of the main issues that the forest sector is facing is to achieve a balance between the demand for wood production and the need to preserve the sustainability and biodiversity of forest ecosystems. The purposes of the new approaches are to ensure more efficient management of ecosystems and implement intensive forestry that will increase timber yields. To achieve this, we need to determine the macroeconomic potential of the various options available, including the use of biotechnology and genetics. The degradation of the forests natural regeneration capacity may be solved through forest certification, as described below: a) Conservation of biodiversity and stabilization of the forests structure. b) Hierarchy of timber production in the forest's management process. c) Organization and implementation of effective reforestation. d) Maintenance or increase of forest productivity by introducing new items as and when they are required. e) Prevention of the properties that reduce the basic parameters of the trees in seed production stands. It is important to evaluate of the influence of factors such as the quality of reforestation areas, the utilization of the genetic resources and the management of forest operations with the environmental economic criteria such as net present value of benefits (N.P.V) and the corresponding flow annuities (E.A.C.F).The existing evaluations studies showed that the quality of the reforestation areas has the most influence and through validated quality seed production can generate an increase in the NPV up to 73%. The importance of seedlings quality in timber and bio-energy production based on the literature it is estimated according to the heredity of the characteristics of the wood structure (except shrinkage) and it was always higher than that on the characteristics of growth and shape. This clearly indicate that seedlings with the appropriate morphological characteristics can significantly improve the growth performance and help to support the development of reforestation oriented in tailor-made timber and bio-energy production.

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P S4/S5

ROCKFALL MONITORING BY THE COMBINATION OF LIDAR AND UNMANNED AERIAL VEHICLE TECHNOLOGY

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In recent years, the application of unmanned aerial vehicles (UAVs) in disaster monitoring and management operations has become more common due to its advantages, such as low-cost, great mobility and high-resolution acquisitions of real-time aerial photos. Additionally, the areas, relevant for rockfall activity are often difficult to access due to their typical morphology, since the concept of manual controlled quad-rotor systems have been proved to be well suited for terrain changes monitoring in difficult alpine terrain.

In this study, a combination of lidar technology and remote sensing approach, based on UAVs and digital compact cameras, will be presented in the context of rockfall, which occurred in 17. 2. 2014 in the main road Kobarid – Drežnica (Slovenian Alps). In addition to previously existing airborne laser scanning (ALS) data from 2007, significant numbers of airborne photographs of rockfall have been acquired. These images were used for dense point cloud generation, using the structure from motion approach (SfM). By using the original point clouds of both technology, the digital terrain model (DTM) of 0.5 × 0.5 m before and after the rockfall event were derived and different raster maps processing were done to analyses rockfall activation areas.

The results of our analyses provide important perspectives for rockfall activity research: a) detailed geomorphological analyses of rockfall activation areas, b) estimation of the total volume of the rockfall event by a reconstruction of the pre-event surface at the detachment zone and c) for monitoring rockfall activity in time.

P S3

Leotia cf. *lubrica* FORMS ARBUTOID MYCORRHIZA WITH *Comarostaphylis arbutoides* (ERICACEAE)

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Keywords: cloud forest, Costa Rica, description of mycorrhiza

Arbutoid mycorrhizal plants are commonly found as understory vegetation in forests worldwide where ectomycorrhiza-forming trees occur. *Comarostaphylis arbutoides* (Ericaceae) is a tropical woody plant and common in tropical Central America. This plant forms arbutoid mycorrhiza, whereas only associations with *Leccinum monticola* (Osmundson et al. 2007) as well as *Sebacina* sp. (Kühdorf et al. 2014) are described so far. We collected arbutoid mycorrhizas of *C. arbutoides* from the Cerro de la Muerte (Cordillera de Talamanca), Costa Rica, where this plant species grows together with *Quercus costaricensis*. We provide here the first evidence of mycorrhizal status for the Ascomycete *Leotia* cf. *lubrica* (Helotiales) that was so far under discussion as saprophyte or mycorrhizal. This fungus formed arbutoid mycorrhiza with *C. arbutoides*. The morphotype was described morphologically and anatomically. *Leotia* cf. *lubrica* was identified using molecular methods, such as sequencing the internal-transcribed spacer (ITS) and the large subunit (LSU) ribosomal DNA regions, as well as phylogenetic analyses. Specific plant primers were used to confirm *C. arbutoides* as the host plant of the leotioid mycorrhiza.

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P S4

EFFECTS OF DIFFERENT FOREST MANAGEMENT INTENSITIES ON BIODIVERSITY IN NATURA 2000 FOREST HABITATS

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Keywords: forest management, nature conservation, plant diversity, species turnover, gap colonization, Illyrian *Fagus sylvatica* habitat type

In Slovenia, the Natura 2000 network covers more than 37 % of the country. Forests dominate more than 70 % of this area, and forest management is a significant driver of diversity. Depending on the options applied, forest management may enhance or decrease forest biodiversity. Dinaric fir-beech forests (part of Natura 2000 Illyrian *Fagus sylvatica* habitat type) with significant nature-conservation interest and timber production functions were selected for this study. With the aim of testing the effects of different forest management measures on plant diversity in these forests, and consequently on biodiversity in a broader sense, three sites in the Slovenian part of a Dinaric fir-beech forest range were studied. The plant species diversity was assessed before and after the implementation of forest management measures of three intensities: 1. control plots – no logging; 2. logging of 50 % of the growing stock; and 3. logging of 100 % of the growing stock. Before the implementation of the management measures, the mean number of plant species per 400 m² vegetation plots was 48.8, and the mean value of the Shannon diversity index was 2.41. Two years after the measures were implemented, different magnitudes of plant species turnover were observed. There were no significant changes in plant diversity status and vegetation composition in the control plots. Two years after 50 % of the growing stock was logged, the mean number of species was 73.3, and the mean value of the Shannon index was 3.21. In the plots where all the trees were removed, the mean number of species was 87.4, and the mean value of the Shannon index was 3.42. In parallel with the increases in the diversity parameters, the cover of the herbaceous layer increased significantly with an increase in the management intensity, indicating that short-term species turnover can mostly be attributed to herbaceous plant species. As a result of changed stand and ecological conditions, in addition to the increased plant diversity, greater biodiversity in a broader sense and improved habitat suitability for different animal species could be expected.

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P S2

XYLEM SAP FLOW AND RADIAL GROWTH IN *QUERCUS PUBESCENS* WILLD. FROM ABANDONED GRASSLANDS IN SLOVENIAN KARST REGION

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Keywords: pubescent oak, karst, xylem sap flow, radial growth, phenology

Karst region, which is located in SW part of Slovenia, has been significantly changed during the last decades due to the abandonment of marginal agricultural lands, mostly dry calcareous grasslands. In sub-Mediterranean climate, characterized by rather harsh winter and dry and hot summer drought periods frequently occur leading to a great impact on plant and ecosystem functioning.
Pubescent oak (*Quercus pubescens* Willd.), hophornbeam (*Ostrya carpinifolia* Scop.) and manna ash (*Fraxinus ornus*) are the dominant native tree species of the Slovenian Karst region. To survive in such environment, pubescent oak has developed various mechanisms and adaptations, such as conservative water use, tolerance of plant water potential drop, deep and extensive root system, narrow xylem increment etc.
Research was conducted in abandoned karst grassland that is being overgrown with different tree species among which pubescent oak dominates. In the current study we evaluated intra-annual regulation of water of pubescent oak with eco-physiological and wood-anatomical analysis. In the growing season of 2014 (i.e., in the period April–October), we performed the following measurements and analyses: 1) xylem sap flow measurements according to the Heat Ratio Method, 2) micro-core sampling at weekly intervals using Trephor to study the timing of xylem and phloem formation, and the widths and structure of completed xylem and phloem increments, 3) leaf phenological observations, 4) collection of weather data.
Preliminary results show that xylem sap flow is closely related to the climate factors and to internal tree factors. With the development of new shoots and with leaf unfolding at the beginning of May xylem sap flow increased. Cambial cell production and, consequently, xylem and phloem formation started in the third week of March 2014. By the second half of April, the first ring of the earlywood vessels was fully developed and thus ready for water transport. In mid-May the second ring of earlywood vessels was forming in wider xylem growth rings, while latewood formation began in the third week of May. The transition between early and late phloem occurred at the end of May.
In order to get a better insight into tree water relations and radial growth of *Quercus pubescens*, we have to extend measurement period over several years, which will include dry and wet periods.

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P S3

WILD EDIBLE MUSHROOMS AND MEDICAL HERBS ON MONTENEGRIN MOUNTAINS AND KATUNS

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Keywords: mountain regions, inventory, protection, commercial use, rural communities

Mountain regions of Montenegro are rich in forests and biodiversity, including rare and European red listed plant and fungal species. The inventory and protection of them are among the highest priorities. On the other hand, collection of wild edible mushrooms, berries, medical and aromatic herbs could be important sources of income for rural communities. In order to provide a balance between commercial usage and needs for protection, best management practice is necessary to be established.
Ongoing KATUN project is focused on Kuči mountains (SE Montenegro) and Mt. Durmitor (NW Montenegro), where identification of the most valuable medical herbs and wild edible mushrooms are under study. Electronic database with GIS positioning are created for inventory of forests, plants and diversity of fungi.
Raising the public awareness and social responsibility on sustainable use of the resources currently are the highest priority. Hence the workshops and trainings on their sustainable use will be organized for farmers and wider public as well as the manual for collectors will be prepared.

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P 4

APPLICATION OF AUTOCHTONOUS FUNGI FOR MYCORRHIZATION OF CONIFERS –TRIALS IN MONTENEGRO

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Keywords: *Pisolithus arhizus*, *Suillus granulatus*, forest nurseries, *Pinus nigra*

Mycorrhiza improves water uptake, mineral nutrition, growth and adaptation of forest trees, and provides a protection of seedlings against pathogens. Seedling mycorrhization could be of importance for South-eastern Europe, due to unfavorable environmental conditions: prevailing high summer temperatures of air and soil, low humidity and low precipitation during growing season.

Several thousands of fungi are thought to form ectomycorrhizas (ECM) globay. More than 250 putative ECM species have been recorded in Montenegro until now. Value of fungal species in seedling mycorrization is different. Compatibility of fungus-host combinations for nursery inoculation and source of inoculums adapted to the environmental conditions of the transplantation site are among the most important criteria for selection.

Possibilities for involvement of different techniques for ECM inoculation of containerized *Pinus nigra* seedlings in nursery production in open field were studied. Ten native ECM fungi were examined as vegetative and spore inoculums. Effect of inoculations on ECM formation and seedling growth characteristics were tested.

The utilization of spore (10^6, 10^7, 10^8) and vegetative (1:4, 1:8, 1:16) inoculums of *Pisolithus arhizus* and *Suillus granulatus* proved to be an effective method for obtaining containerized ECM *P. nigra* seedlings in open field conditions.

Additional trials also included: use of the soils from four unmanaged forests for coniferous myccorization, as well as the use of vegetative inoculums of *Sclerodermatace* in mycorrhization of oaks.

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P S1

STUDENTS' ATTITUDE TOWARDS COMMERCIALIZATION OF TRANSGENIC FOREST TREES IN SLOVENIA

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Keywords: *questionnaire, students' towards, transgenic, forest tree*

Genetically modified organisms (GMOs) are organisms that have been transformed by the insertion of one or more isolated genes. Genetic modification in forestry is much more than a technical issue; sociocultural values and the multiple uses of forests need to be taken into account and public acceptance is necessary if genetically modified forest trees are to be deployed (El-Lakany, 2004). In Slovenia, information on public attitudes towards the use of transgenic forest trees is lacking. To address this issue, a pilot survey was organized using as sampling subjects university students. Specifically students were selected from three different disciplines: forestry, agriculture and biotechnology. The Slovenian survey was conducted in the frame of a cross country pilot survey through the working program of the EU COST Action FP0905. The survey attempted to provide information about the young peoples' attitude regarding: 1) the their knowledge about the use of transgenic forest trees in forest plantations, 2) whether they would agree with the use of transgenic forest trees in forest plantations, and 3) issues related to concerns about using transgenic forest trees in forest plantations. The questionnaires were delivered to selected classes of students. The students completed the questionnaires on site; 180 questionnaires were collected and subject to statistical analysis. Most respondents (86 %) knew what forest transgenic trees are, 70 % did not know whether transgenic forest plantations are grown for commercial purposes in Slovenia and 68 % did not know whether final products of transgenic plantations are sold on the market. About a third of the respondents were highly positive towards the transgenic changes that concern the greater resistance of forest trees and the altered lignin content. The majority of respondents (81 %) would approve funding of transgenic forest plantations for commercial purposes and 86 % appeared willing to purchase products originating from transgenic forest plantations. Most respondents (82 %) agreed that the final products derived from transgenic forest plantations should be labelled and 80 % of respondents agree that labelling such products should be legally mandatory. In terms of the potential benefits of transgenic forest plantations, 66 % of the respondents stated as very important for Slovenia the potential use of fewer pesticides, 63 % the potential better quality wood, 54 % the use of less chemicals and energy for cellulose pulping and 52 % the need for fewer treatments with herbicides of the forest plantations, as well as the increased stress resistance. In relation to the safety of adopting transgenic forest crops: the potential loss of biodiversity due to genetic flows between transgenic and wild trees was the main concern of the great majority of the respondents (72 %), followed by the potential adverse effects of bio-trophic processes of host ecosystems. New genetic traits entering these ecosystems was considered by 46 % of the respondents to be the most potentially serious hazard in Slovenia in relation to adoption of transgenic forest trees.

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P S3

FUNGAL AND BACTERIAL COMMUNITIES IN SPRUCE WOOD SAMPLES EXPOSED TO OUTDOORS ENVIRONMENTAL CONDITIONS

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Keywords: wood degradation, construction wood, fungi, bacteria, community structure

The problem of industrial wood biodegradation is still an up-to-date topic. Scarcity of more resistant tree species is a limiting factor in most parts of Europe, thus one of the commonly used tree species in building industry is Norway spruce (*Picea abies*). Our aim was to evaluate the differences in fungal and bacterial communities of spruce samples that were treated differently prior to environmental exposure. The first treatment was thermal wood modification and the second one was based on the biocides - alkaline copper quaternary (ACQ, Silvanolin©) for limiting microbial growth. Collected samples were processed mechanically and wood meal was used for DNA extraction. The target regions of the ribosomal operon were amplified in polymerase chain reaction (PCR): ribosomal ITS1 region for fungal communities and 16S rRNA for bacterial communities. The communities were profiled using denaturing gradient gel electrophoresis (DGGE) method and the profiles were analyzed in BioNumerics© program. Representative bands from fungal profiles were processed for sequencing by Sanger method. DGGE profiles showed considerable differences between treated samples and the untreated control for both fungi and bacteria. However, preliminary sequencing results for fungi revealed that most of the sequences do not represent typical biodegrading fungi and the profiles could not be distinguished based on these sequences. Sequences were compared against Unite and INSD databases. Out of 30 sequences in total, roughly 35% corresponded to uncultured fungi from family Herpotrichielaceae (genus *Phaeococcomyces*), 14% family Tremellaceae (genera *Tremella* and *Dioszegia*), 10% family Coniochaetaceae (genus *Coniochaeta*) and 10% family Dothioraceae (genus *Aureobasidium*). There were some representatives of the order Helotiales, as well as genus *Peniophora* and species *Rhodotorulla lamellibrachiae* and *Cryptococcus dimennae*. Most of the identified fungal genera do not belong to the extremely degrading fungi, but predominately to wood-staining fungal species. It should be noted that a number of the sequences recovered in this study exhibited a low level of identity with sequences of known fungi, thus making determination of their identity and biological function within the community impossible. Based on the DGGE profiles of bacterial communities we can speculate about the community shift, especially in case of ACQ treatment, but this needs further validation. In order to improve the results, we plan on prolonging the environmental exposure period and analyzing the samples using next generation sequencing approach (Illumina MiSeq platform).

Acknowledgements
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P S4

COMPARISON OF STAND STRUCTURE IN MANAGED AND VIRGIN EUROPEAN BEECH FORESTS IN SERBIA

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Keywords: beech, stand structure, managed forest, virgin forest, Serbia

This study is presenting results of the research of structural and production characteristics of European beech forests in Serbia. Analysed were five managed and three virgin stands. The aim of this study was to perform a comparison of structural and production characteristics of managed and virgin beech forests on the most productive sites in Serbia.
The observed stands are located in the mountainous range of 400 to 1200 meters above sea level. For the gathering and processing of data in the managed stands systematic sample was applied. Sample plots 0.05 ha in size, circled shaped, which are spaced at a distance of 100 x 100 m were set. In all test areas diameter at breast height and height of all trees were measured. In two virgin forests stands total survey of diameters and tree heights were performed, while in the third virgin forest set of seven experimental fields of different sizes approximately square and rectangular shapes where measured. In all stands trees with dbh>10 cm were measured. For comparison of structural characteristics following parameters were used: height curves, diameter distribution, Lorenz index, Gini index, Coefficient of variation, ratio of the height and diameter at breast height and maximum dimensions of trees. Density and production of stands are analysed with taxation elements: number of trees, basal area, volume, biomass, carbon stock, stand quadratic mean diameter and Lorey's mean height.
Height curves of managed and virgin type stands differ to a diameter of 30 cm because the slope of the curve is higher in virgin stands, while the average height of medium thick and thick trees are without significant difference. Diameter distribution of managed type stands can be roughly identified with the selective managed stands. Diameter distribution of virgin type stands Danilova kosa and Vinatovača approximately can be described as the virgin forest stand structure, while diameter distribution of Kukavica stand has a shape that is characteristic of two-story stands. Diameter and height diversity in stands of managed and virgin type in Serbia are similar, which is diametrically different to the most of the managed beech forest in Europe. For all taxation elements there is a statistically significant difference between the average values for managed and virgin forest stands. General conclusion of this research is that the structural characteristics of managed beech forests in Serbia are much closer to their primeval state in comparison to the most of managed beech forests in Europe.

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P S2

ECTOMYCORRHIZA BETWEEN *Scleroderma Areolatum* EHRENB. AND *Fagus sylvatica* L.

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Keywords: description of mycorrhiza, morphotyping of mycorrhiza

Scleroderma is a genus of widely distributed gasteromyceous species (Sims et al. 1995), many of them are reported to persist in extreme habitats, withstand drought and increased temperatures and being a competitive primary colonizer (Jeffries 1999). They have a potential application as inoculants for forest plantations in areas with poor mycorrhizal status (Chen et al. 2014). *Scleroderma* ectomycorrhizas were obtained on fine roots of beech (*Fagus sylvatica* L.) seedlings from tree nursery and peristed for several years in conditions of increased soil temperatures on seedlings grown in rhizotrons under controlled conditions. The morphotype collected from rhizotrons was described morphologically and anatomically and identified using molecular methods, namely sequencing of the internal-transcribed spacer followed by a genus-based phylogenetic analyses. Based on phylogenetic outcome, the morphotype was asigned to *Scleroderma areolatum* Ehrenb. morphological species which forms a subcluster in SH005470.07FU species hypothesis according to criteria set up by Kõljalg et al. (2013).

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P S2

TOTAL AMOUNT OF CARBON HOLD UNDER DIFFERENT AGES EUCALYPTUS TREES, PLANTS WITH DIFFERENT SOIL AND CROP MANAGEMENT SYSTEMS IN COST OF THE MEDITERRANEAN CONDITIONS

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The biggest soil carbon (C) sink and C sequestration sources in terrestrial ecosystems is mainly coming from forestry area. Forest ecosystems store C as lignin and other relatively resistant C compounds. The forest C is sequestered not only in the harvestable timber and other branched. It is important to keep the atmospheric CO_2 in the plant tissue for long term sequestration. Recently fiber forest farming and agro forestry also getting more used. One of the fiber forestry is eucalyptus. Eucalyptus is a common plantation in Mediterranean cost conditions. Since eucalyptus timbers are used for ecological and economical it is sound to calculate effect of several years old tree on total biomass and total C sequestration.

The experiment was carried out on three age's groups eucalyptus plantation in the Regional Forest and Forestry Management area which is located in Mersin-Tarsus, Southern of Turkey.

The eucalyptus (*E. camaldulensis*) tree in the experimental plan for each age group was harvested from the soil surface with motorized saws. There were three different treatments such as (SI) shaved the three trees from soil surface and ploughed, (SII) Shaved trees without plowing (SIII) Control without shaved the trees.

Research areas that are connected to three different age groups 5, 7 and 10 years old which have different diameter at breast height of trees high and mass. Branch and leaf, fresh and dry weight and total moisture content were also determined by calculating the total biomass. For each age group all the tree diameters and height taken into consideration with the *E. camaldulensis* of double-entry volume tables by utilizing a single tree volume calculating on hectare.

According to the research findings in five years old eucalyptus total biomass weighing for SI, shaved was 82 tons ha^{-1} and shaved and plowed was 105 ton ha^{-1} respectively. In the 7 age group SI was 107 ton ha^{-1}, and the SII was 125 ton ha^{-1} biomass produced. In the 10 age group in SI was 151 ton ha^{-1} and SII was 150 ton ha^{-1} bio-mass production was obtained.

Also the soil organic carbon (SOC) stock was calculated for each ages and management systems. Apart from SOC, total soil nitrogen was calculated as well. Soils have collected at 5 years old eucalyptus plantation total 40.46 ton ha^{-1} SOC, and respectively to 7 and 10 years old plantation they have accumulated 56.04 and 82.66 ton ha^{-1} SOC. The SOC accumulation is strongly depends on plantation ages and their duration on the soil.

P S1

INFLUENCE OF HEAVY FOREST MACHINERY ON FINE ROOTS: OBSERVATIONS ON MINIRHIZOTRON DATA

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Keywords: Fine root turnover, *Picea abies,* heavy forest machinery

Between 10% and 20% of the total roots in forest are fine roots (Jackson et al. 1997), therefore the amount of carbon (C) stored in fine roots is significant and relevant in forest C cycle. Fine roots play important role in long-term changes in soil organic matter and ecosystem carbon balance.
In a managed forest, the influence of soil compaction by heavy forest machinery on fine roots dynamics is not well measured, but still observed in some research (Železnik et al. 2015). We observed impact of logging activities on fine root dynamics with minirhizotrons. Fine root turnover and longevity of Norway spruce (*Picea abies* (L.) H.Karst), situated on mountain region Pohorje (NE Slovenia), was analyzed.
Minirhizotron tubes were installed on two different locations. On each site, tubes were placed in and beside wheel rut and in undisturbed soil profiles. Under the most adverse conditions (in the wheel ruts made by harvester and forwarder) fine roots were almost absent. In average, the highest fine root longevity was observed by wheel rut and the lowest in undisturbed soils.

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P S3

VISIBILITY AND DISSEMINATION IN FOREST GENETIC MONITORING

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Keywords: Communications, dissemination, forest, genetic, monitoring

Communication skills are very important for scientists and practitioners in the field of forest genetic monitoring (FGM). In the past, communication and dissemination activities were often avoided by scientists, experts and professionals because they were perceived as difficult, time consuming, stressful and tiresome. Today, the best path to achieve the implementation and ensure long-lasting results of FGM is through good communication and appropriate dissemination. It is the duty of any FGM scientist, expert or professional to disseminate their knowledge in an ethical way, because: (i) FGM research is mostly publicly funded; (ii) the public deserves an understandable presentation of FGM; (iii) feedback from different stakeholder groups allows FGM knowledge and future research to be suited to its practical users and therefore more relevant; (iv) new opportunities and synergies can be fostered through communication activities and channels. The willingness to communicate and personal communication skills of FGM scientists, experts and professionals will be a crucial factor in the evolution and implementation of FGM systems in the future.

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P/M S5

OZONE IN URBAN FORESTS

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Ozone is still the important air pollutant, dangerous for plants, animals and humans.
The Slovenian Forestry Institute (SFI) have more than ten years experiences (2003 – 2015), assessing ozone visible injury on forest vegetation in Slovenia, observed as foliage damage on the forest trees and shrubs species. Our first observations of negative impacts of ozone on forest tress were in year 2003. During these years the visible ozone damages were observing at 5 to 11 intensive monitoring plots (ICP Forests Level II) and in the years 2013 and 2014 also in Ljubljana urban and peri-urban forests**.**
In the same time span the SFI has been monitoring ozone concentrations in the air with passive samplers. In 2013, we expanded air monitoring to three other pollutant gases: sulphur dioxide, nitrogen dioxide and ammonia. We monitor air pollution with passive samplers also in the capital of Slovenia – Ljubljana. We perform measurements in urban areas and urban and peri-urban forests (city parks, nature park Tivoli, Rožnik, Šišenski hrib, forest covered hill Golovec, riparian forests).
Identification of visible ozone or visible ozone like symptoms in small trees and shrubs in Ljubljana urban forests was performed. Visible foliar injury by ozone we surveyed on 3 *off-plots*, on light-exposed sampling sites at urban forest edge according to the ICP Forests manual. We looked at 34 different species.
Different species show different sensibility to the same ozone dose.
Due to the environment pollution and impacts on the forest, urban and peri-urban forests and vegetation, we present the acquired conclusions to the wider public.

P S2

SOIL RESPIRATION VARIABILITY IN BOREAL PINE FOREST IN VÄRRIÖ, FINLAND

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Keywords: soil respiration, carbon dioxide, Boreal forest, weather

Soil respiration stands for carbon dioxide (CO_2) emissions from soil to atmosphere. It is a sum of CO_2 that is emitted by soil microbes, soil animals and plant roots. During summer days, forest floor vegetation photosynthesizes and takes up CO_2 from the atmosphere. Then the observed net exchange at the forest floor can be much less than the soil respiration only since the canopy especially in northern forest is open providing considerably light also on the forest floor. The influx and efflux ratio is driven by various factors i.e. atmospheric and soil conditions, daylight as well as flora, fauna and disturbances caused by human or animals. In high latitude Boreal forests, where ecosystem productivity, decomposition and accumulation of organic matters are low, high spatial diversity in soil conditions and weather variability significantly affect the amount of released carbon dioxide into the atmosphere. During the summer and autumn 2014, we conducted a periodical chamber measurements of carbon dioxide emissions on twelve collars, distributed in two transects inside the fence of SMEAR I research site using close-path system with portable chambers. The measurements are repeated in ambient light conditions and in darkness with transparent and opaque chamber, respectively. The site is located 220 km northeast from Rovaniemi, Finland, at the top of hill Kotovaara (390 m a.s.l., 67.75516° N, 29.60997° E), inside of uneven-aged Scots pine (*Pinus sylvestris* L.) stand and with some mountain birch (*Betula pubescens subsp. Czerepanovii*). The measurement site is fenced in order to protect from reindeer grazing. We analyzed readings of eight measuring campaigns from June to October 2014 with sample rate of fifteen days and dataset of continuous close-path measuring system using two chambers. The analyses showed significant differences between collars and pointing out effects of (under) ground variability as well as weather conditions.

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P S2

RADIAL GROWTH RESPONSES OF PINUS HALEPENSIS MILL. AND *Pinus Pinea* L. FORESTS TO CLIMATE VARIABILITY IN WESTERN ALBANIA

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In this study are presented chronologies of earlywood (EW), latewood (LW) and tree-ring widths (RW) of a *Pinus halepensis* (*P. halepensis*) and *Pinus pinea* (*P. pinea*) natural forest stand growing in western Albania. Bootstrapped correlations and pointer year analysis were combined in a dendroclimatological study to evaluate climate-growth relationships in both pine species as well as to assess the spatial outreach of our chronologies evaluating them with those of the same species from other Mediterranean countries. We found that both species responded positively to precipitation and Indexed Percentage Average Precipitation (% AvP) in late summer-early autumn, particularly the LW, whereas summer temperatures constrained the growth of *P. halepensis* tree-ring features. Current January temperature and Potential Evapotranspiration (PET) showed positive relationship with *P.pinea* LW and RW. The same association was observed when considering PET in spring and *P.halepensis* LW and RW. Pointer year analysis showed that inhibitory climatic drivers of radial growth for both species were low precipitation from previous winter and current summer, associated with low temperatures during autumn. Our *P. halepensis* chronology showed a wider spatial outreach than that of *P. pinea* when compared to those from other Mediterranean countries. We conclude that current January temperatures and September precipitation are very important for *P. pinea* growth influencing both EW and LW growth whereas *P. halepensis* is mostly affected by the summer-early autumn climate conditions.

P S3

LINKAGES OF PLANT MORPHOLOGICAL-FUNCTIONAL TRAITS TO SOIL PROPERTIES ON EXTENSIVELY USED GRASSLANDS OF POHORJE MOUNTAINS

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Keywords: plant functional types, soil analysis, matgrass grasslands, species richness, multivariate analysis

In our research we used functional approach to determine relation between soil properties (chemical reaction – pH, phosphorus, potassium, nitrogen, calcium carbonate, C : N proportion, organic carbon and humus), species richness and *morphological-functional plant traits* (MFT) on extensively used oligotrophic grasslands of Rogla (Pohorje, NE Slovenia).
Our research was based on 60 vegetation relevés (plots) of extensively used grasslands. In this vegetation plots we recorded 60 plants species, for which we collected MFT. The research was devided into two parts; in the first part we used all 60 vegatation plots - 29 vegetation plots were from typical matgrass (*Nardus stricta*) grasslands and 31 vegetation plots were from ski trail Mašinžaga. Those areas/grasslands were compared, based on floristical composition, species richness and MFT. In the second part of the research we included only those 23 vegatation samples/plots, on which soil analyses were made.
We found that typical matgrass (*Nardus stricta*) grasslands and grassland Mašinžaga vary floristically as well as in species richness and occurance of MFT. Those findings can be result of the variation of environmental conditions on those grasslands. Due to those results we decided to do further analyses of MFT and environmental variables. We analysed our data with two seperate RDA analyses. Results of the first RDA analysis divide plant species into the three groups.
The first group is linked to the higher soil pH values and lower values for phosphorus, potassium and nitrogen. Those areas were found on deeper soil on ski trail Mašinžaga, where plant communities from association *Arrhenatherion* were developed. The second group of plant species can be found on areas with higher P, K and N, although they can not be absorbed because of low soil pH. Species are typical acidophilic plants (such as *Arnica montana*). The third group of species can be found on extreme areas – soils are acidic, very shallow and at the same time poor with nutrients. Here we can found pioneer species from genus of moss *Polytrichum*. MFT was also divided due to environmental data on those grasslands. On areas of ski trail Mašinžaga where are soils with higher pH and lower values of P, K and N, we found higher plants height, higher values of SLA, more tussock plants and plants with rosettes and life strategies CSR_R and CSR_C. On typical matgrass grasslands, where soil is acidic with higher values of P, K and N, we found more phanerophytes, geophytes and life strategies CSR_S with higher values of LDMC.
Occurrence of small plant height on nutrient-rich soil can be explained with lower values of soil pH, because plants on such soil are not so efficient in absorbing nutrients. Similar explanation was offered for findings that in conditions where pH values are higher and at the same time values of P, K and N are lower, plants have higher values of SLA.

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P S3

FINE ROOT DYNAMICS IN SLOVENIAN BEECH FORESTS IN RELATION TO SOIL TEMPERATURE AND WATER AVAILABILITY

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Keywords: fine root ingrowth, fine root mortality, environmental factors, forest floor precipitation, evapotranspiration

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ROOT GROWTH DYNAMICS OF THREE BEECH (*Fagus sylvatica* L.) PROVENANCES

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European beech (*Fagus sylvatica* L.) is commercially and ecologically important tree species in Central European forests but its intra-specific variability in drought and temperature tolerance might endanger its future distribution in Europe. Beech phenological and growth traits have been studied in large-scale international beech provenance trials, yet the growth and turnover of its fine roots (FR) has not been included among the observations. FR growth dynamics of three beech provenances in the international beech provenance trial Straza / Kamenski hrib, established in Slovenia in 1998, and from a natural beech regeneration site growing at its border, were studied from 2007 to 2010. We studied FR biomass using soil cores (SC), root production using ingrowth soil cores (IC), and root longevity using minirhizotrons (MR). There were no significant differences in total FR biomass (live and dead) among the tested provenances but live FR biomass differed between two of three tested provenances in the trial from seedlings in the natural regeneration site. Values of specific root length (SRL) in IC varied significantly among sampling periods, except for the natural regeneration. The turnover rates in IC were at the end of the experiment close to MR results. Median MR-based longevities of fine roots varied between 625 and 934 days. Survival curve of the slowest growing provenance (considering its aboveground characteristics) was significantly different from the other two, median longevities of later being higher. Death of FR, older than two years, occurred most likely in the winter. Our results suggest that there are significant differences in FR longevity among provenances, which might contribute to their adaptation to future environmental conditions. Furthermore, the calculated annual C investment into FR growth per ha differs up to twofold between provenances, contributing to different C dynamics of their future stands.

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