EUFORIA - European Forest Research and Innovation Area

In September 2015 **the final EUFORINNO conference** on *"Excellence in Forestry: a cutting-edge scientific meeting organised by the Slovenian Forestry Institute"*, named EUFORIA, was organised by Slovenian Forestry Institute together with eight excellent scientific partners in Rogla, Slovenia. The conference venue hosted over 130 participants from the EU and overseas, who contributed top scientific discoveries in forest science and progress to key EUFORINNO research topics: Climate change and biodiversity, Forest genetic diversity, Carbon dynamics in time and space, Modelling in forests and forestry, and Forest disturbance and management.

(Photo: M. Rupel)

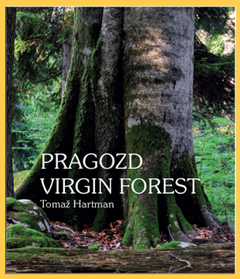
The EUFORIA conference featured a **round table**, the aim of which was to disclose and discuss main problems in regional and EU forest science and policies. Representatives from national and EU research and political bodies, including the Slovenian Academy of Science and Art, contributed ideas and future prospects for bringing quality, visibility, better connections within the sector and a higher competitiveness of the sector at regional and EU level.

Distinguished guests at round table (Photo: M. Rupel)

The conference was a success and the participants agreed that the take-aways from the conference and the round table will have a significant impact for forest science and policies.

http://euforinno.gozdis.si/euforia-2015/

One of the main outputs of the capacity building within the EUFORINNO project (RID objective A) is the LIFE LIFEGENMON project. It aims to implement forest science and policy in practice (forest managers and policy makers) in the form of the European Forest Genetic Monitoring System. It means a new opportunity for the researchers of Slovenian Forestry Institute to implement their research. Find out more at **www.lifegenmon.si**.



The book **Virgin Forest** was made over many decades the authors spent in the embrace of virgin forests of Slovenia. It is one of the most recent and iconic monographic editions of the Silva Slovenica publishing centre. The book is available for sale at various Slovenian bookstores, on the Internet and through direct contact with Silva Slovenica (silva.slovenica@gozdis.si).

Silva Slovenica

Building up SFI laboratory quality performance with Standard Operational Procedures

One of the EUFORINNO goals was to equip newly built SFI laboratories with modern research equipment for genetic monitoring, biodiversity and functional diversity, belowground complexity, and net ecosystem carbon exchange in time and space.
The Standard Operational Procedures preparation followed three elaboration levels:

- **Drafts:** The description of the SOP objectives and results, safety measures during operation, tools and consumables needed, detailed protocol description and relevant references were prepared for all SOPs using a uniform template.
- **Proposals:** The EUFORINNO Technical Board and Advisory Board members selected SOPs for further elaboration taking into account their highest comparative advantage for scientific excellence and future research.
- **Evaluated proposals:** Four of seven proposed SOPs were selected for an evaluation in a preliminary accreditation process.

SOPs were prepared on that basis for maintenance procedures and operational manuals, which were evaluated by collaborative partners and tested at their laboratories.

Research Centre of Excellence PLECO Department of Biology, University of Antwerp, Belgium
Bavarian Institution for Forest Seeding and Planting, Germany
Helmholtz Zentrum München, Germany
Institute for Landscape Biogeochemistry, Leibniz Centre for Agricultural Landscape Research, Germany
Department of Geography, Swansea University, UK
Institute Of Agroenvironmental and Forest Biology Institute -National Research Council, Italy
Forestry Department, University of Helsinki, Finland
Faculty of Science, Lund University, Sweden

List of evaluated Standard Operational Procedures for EUFORINNO equipment

No.	Name of SOP	Related EUFORINNO equipment
01	**Laser microdissection service**	**Microscope with microdissection and sample collection, comp. workstation**
02	**Alpha -cellulose extraction from wood**	**Isotope Ratio Mass Spectrometer**
03	**Sample preparation for determination of elemental and stable isotopic composition of C and N in solid samples**	**Isotope Ratio Mass Spectrometer**
04	**Measuring isotopic composition of carbon dioxide in the air**	**Trace Gas Analyser System**
05	Microscopy rules	Motorised stereomicroscope, Motorised microscope with camera and image analysis, Microscope with microdissection and sample collection, comp. workstation
06	Paraffin embedding of root samples	All microscopes from No. 05
07	Preparation of permanent slides of mycorrhiza for light microscopy	All microscopes from No. 05

Toward Root Atlas – the fine root identification key

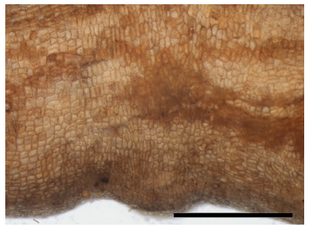
Objectives

- To develop the most effective approach for morphological – anatomical identification of tree species from roots with diameters less than 5mm
- To determine the most appropriate identifying features on the root morphological and anatomical level
- To present data in a user-friendly form
- To find out size limits for successful identification
- To gain insight into variability of roots less than 5mm in size

Pinus sylvestris L. morphological characteristics

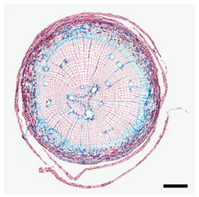
Colour of the roots orange-brown to ochre, more or less constant along the root up to the mycorrhizal tips. Shedding parts of the periderm give whitish appearance. Bar = 1 mm.

Surface of the roots smooth with large patches of shedding periderm layers. Root scars common. Bar = 1 mm.

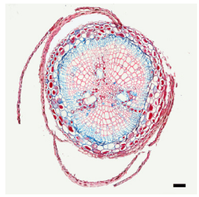


Cells of periderm large, easily observed even under low magnification. Bar = 1 mm.

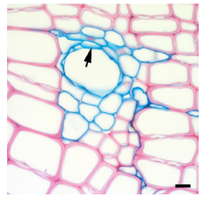
Pinus sylvestris L. anatomical characteristics



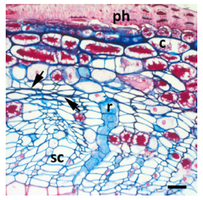
3 mm root, cross section (bar = 500 µm)



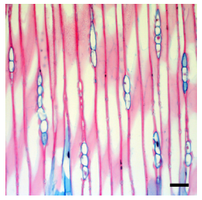
1 mm root, cross section (bar = 200 µm)



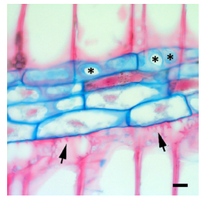
Resin duct, cross section: epithelial cells 5-7, thin walled (arrow), surrounded by parenchyma cells (bar = 20 µm



External tissues, cross section (sc: sieve cells, arrows: collapsed sieve cells, r: ray, c: cortex, ph: phellem) (bar = 50 µm)



Rays, tangential section (bar = 50 µm)



Cross field pits (asterisks) and ray tracheids (arrows), radial section: cross field pits large; end cell walls of ray cells thin and smooth; ray tracheids dentate (bar = 20 µm)

EUFORINNO

European Forest Research and Innovation

7th FP EU Capacities - Regional Potential Programme, RegPot, RegPot No. 315982, 100% financing from EU

Project coordinator: Prof. Dr. Hojka Kraigher

Project budget: 2,910,724.93 €

The project EUFORINNO - European Forest Research and Innovation – supports the Slovenian Forestry Institute to increase its scientific excellence and visibility as an innovative forest research centre, the Reference Centre for Central and South-East Europe, preserving the European 'biodiversity hotspot' in sustainably managed forests.

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GOZDARSKI INŠTITUT SLOVENIJE
SLOVENIAN FORESTRY INSTITUTE

This project is funded by the European Union

The project focuses on bridging the gaps that hinder the overall goal of increasing SFI excellence through 4 RID objectives and supportive transversal non-scientific actions:

A Development and standardisation of a system for **genetic monitoring** of forest trees aims to facilitate certification of forest reproductive material and implementation of concepts of dynamic conservation of forest genetic resources.

B **Biodiversity & functional diversity** at gene, species and community level is focused on the development of standardised microscopy techniques as an essential prerequisite to visualize, compare and define taxa in combination with micro dissection, genomic and transcriptomic high-throughput sequencing approaches adapted to forest tree (roots, wood), fungal (mycorrhiza, pathogens) and other soil biota (bacteria, insects, etc.)

C **Belowground complexity and carbon dynamics** is focused on the development of protocols to quantify C fluxes in the soil, including mycelium and fine root turnover, development of C dynamics models including the complex belowground diversity, development of an automatic soil respiration measurement system and further development of fine root and mycelium turnover analysis devices with permanent temperature and moisture measurement.

D **Net Ecosystem Carbon Exchange in time and space** is focused on the development of a laboratory for stable isotopes analysis including laser-based in situ methodologies for forestry development of NCEE models, upgrading of a standardised LiDAR method for acquiring data relevant for forestry.

Supportive transversal non-scientific actions:
- Publishing
- Innovation
- IP management
- Networking.

Forest Genetics Laboratory

The Forest Genetics Laboratory benefited immensely from the EUFORINNO project and now boasts improved processivity and a higher level of quality of procedures performed. This was achieved through (1) purchase of new pieces of laboratory equipment; (2) changes to the layout of laboratory equipment in order to achieve a complete physical separation of cross-contamination sensitive processes; (3) implementation of new and improved standard operational procedures (SOPs); (4) training and secondments within the EUFORINNO which contributed greatly to the quality of analytical process in the Forest Genetics Laboratory.

We offer our services to the research and industrial community. For further information contact: **Marko Bajc** (marko.bajc@gozdis.si).

(Photo: D. Finžgar)

Recent development of laboratories at Slovenian Forestry Institute

SFI research laboratories were expanded and upgraded with modern analytical and research equipment with a substantial financial support of the EUFORINNO project. These facilities now provide high-quality service for research, teaching and commercial purposes in forestry and other environmental studies.
EUFORINNO supported laboratories now participate in developing timber tracking tools (anatomical, molecular and stable isotope tracers) and associated data libraries that help to define guidelines on technologies and policies to reduce illegal logging and associated trade worldwide all in scope of providing knowledge and scientific support to timber tracking global/regional platforms.

Impresum / Impressum

NEWSLETTER EUFORINNO
European Forest Research and Innovation No. 7
ISSN 2232-6677

Izdajatelj: **Založba *Silva Slovenica*, Gozdarski inštitut Slovenije**
Publisher: **The *Silva Slovenica* Publishing Centre, Slovenian Forestry Institute**
Glavna urednica / Editor-in-Chief: **prof. dr. Hojka Kraigher**
Tehnična urednika / Technical editors: **dr. Peter Železnik, dr. Tine Grebenc**
Lektor / Language editor: **Jean McCollister**
Oblikovanje / Design: **Tomaž Plečko**
Tisk / Print: **MEDIAPLAN 8 d.o.o.**
Naklada / Circulation: **1000 izvodov / copies**

Newsletter je v PDF-obliki objavljen na spletni strani projekta EUFORINNO
www.euforinno.gozdis.si / The newsletter is in PDF format published on web site **www.euforinno.gozdis.si**

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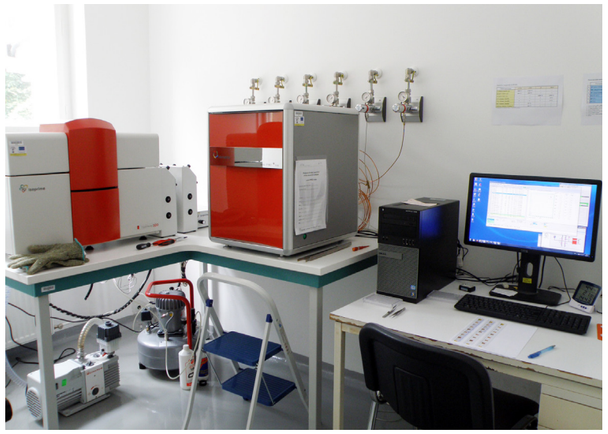
Stable Isotope Laboratory

The Stable Isotope Laboratory was established to support and assist research studies in the field of forest ecology, climatology with emphasis on climate reconstruction from tree rings and tree physiology. Beside sample preparation units, the laboratory is equipped with Isoprime's **IsoPrime100** continuous-flow IRMS (Isotope Ratio Mass Spectrometer) coupled with Elementar's **vario Pyro cube** elemental analyser (both purchased through the EUFORINNO project), allowing us to rapidly process solid and liquid samples with high precision. We provide high-quality stable isotope ratio measurements of C, N, S, O and H for a variety of sample types, specialising in wood, plant, moss, fungi and soil substrates.

We offer our services to the research and industrial community. For further information contact: **Prof. Dr. Tom Levanič** (tom.levanic@gozdis.si).

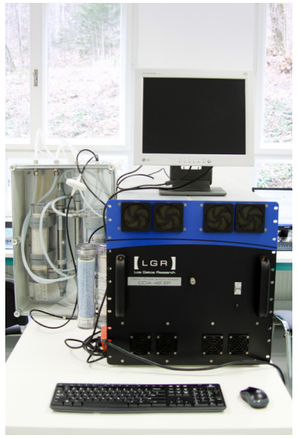


(Photo: Saša Zavadlav)

Carbon Dioxide Isotope Analyzer CCIA-46

Stable carbon and oxygen isotopes are interesting in environmental research. They are widely used to investigate both natural and anthropogenic carbon sources in the atmosphere, hydrosphere and geosphere, as well as the exchanges between these reservoirs. Analysis of stable carbon and oxygen isotopes, which is based on laser technology, represents a new approach as it provides continuous measurement at high temporal resolution. Our latest research equipment acquisition - Carbon Dioxide Isotope Analyzer CCIA-46 (obtained from Los Gatos Research) - allows us to monitor CO_2 trace gas isotopes. At the Slovenian Forestry Institute we currently have a work in progress to analyse a CO_2 trace gas isotope transfer in one of many Slovenian Karst caves.

The equipment is available for research cooperation. The person responsible for the equipment: **Dr. Mitja Ferlan** (mitja.ferlan@gozdis.si).

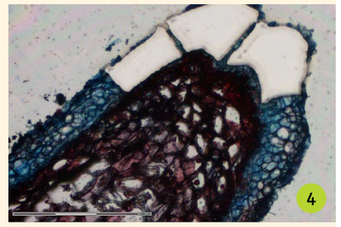


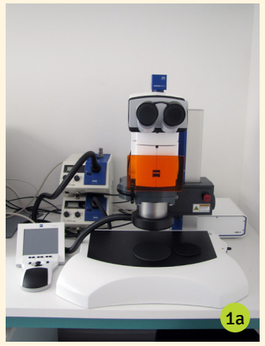
(Photo: Grega Voglar)

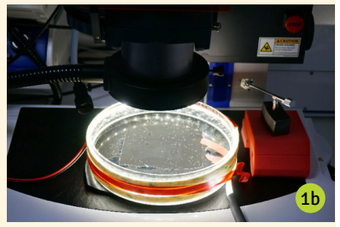
Microscopy centre

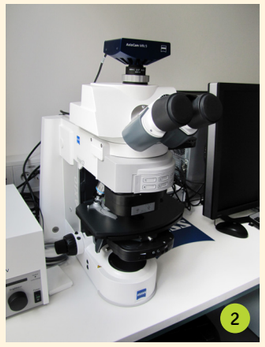
The microscopy room at SFI was modernised with three key microscope systems: Zeiss Stereo LUMAR steremicroscope, Zeiss Axio Imager Z2 Microscope, and PALM laser microdissection system. Crucial technical performances for biodiversity, function and ecology studies are:

1 **Stereo LUMAR** (Picture 1a, 1b) is a motorised stereomicroscope suitable for fluorescence, transmitted and reflected light observations yielding high resolution images with magnifications of up to 80 x.
2 **Microscope AxioImager.Z2** (Picture 2) is suitable for contrast techniques bright field, dark field, differential interferential contrast, polarisation and fluorescence microscopy at high magnifications. It has a motorised objective turret, reflector turret filters and automatic objective recognition system. Motorised Z-axis drive allows for the precision of focusing step up to 10 nm.
3 The main components of the **Zeiss PALM laser microdissection system** (picture 3) are invert microscope and laser beam source (wavelength 355 nm) suitable for cutting samples on common object slides and membrane slides, but also microdissection of samples on certain types of filters and forensic adhesive tapes. We have good experience with native, stained, formalin fixed paraffin embedded or prepared with cryomicrotome. The laser beam is precise enough to cut single cells or single chromosomes (Picture 4). Dissected elements are contact free catapulted by laser beam pulse into a collection cap situated above the object. Microdissected samples can be directly used for DNA, RNA and protein isolation.









(Photo: Tanja Mrak)

The equipment is available for research cooperation and as a samples analysis service. The person responsible for the equipment: **Dr. Tanja Mrak** (tanja.mrak@gozdis.si).

Highlighted publications as a result of EUFORINNO boost of scientific excellence and publishing

Kraigher H., Bajc M., Grebenc T. 2013. Chapter 8 – Mycorrhizosphere Complexity. Developments in Environmental Science 13: 151–177.

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Hansen K., Thimonier A., Clarke N., Staelens J., **Žlindra D.**, Waldner P., Marchetto A. 2013. Atmospheric deposition to forest ecosystems. In: Ferreti M., Fischer R. (Eds.) Forest monitoring: methods for terrestrial investigations in Europe with an overview of North America and Asia. Elsevier, Amsterdam, pp. 337-374.

Eler K., Plestenjak G., **Ferlan M., Čater M., Simončič P.**, Vodnik D. 2013. Soil respiration of karst grasslands subjected to woody-plant encroachment. *European journal of soil science*, ISSN 1351-0754. [Print ed.], 2013, vol. 64, issue 2, str. 210-218, ilustr. doi: 10.1111/ejss.12020.

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Deckmyn G. I., Mayer A., Smits M. M., Ekblad A., **Grebenc T.**, Komarov A. S., **Kraigher H.** 2014. Simulating ectomycorrhizal fungi and their role in carbon and nitrogen cycling in forest ecosystems. Canadian journal of forest research, ISSN 0045-5067, 2014, vol. 44, iss. 6, str. 535-553, ilustr. http://eprints.gozdis.si/484/, doi: 10.1139/cjfr-2013-0496.

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Štraus I., Mrak T., Ferlan M., Železnik P., Kraigher H. Influence of soil temperature on growth traits of European beech seedlings. Canadian journal of forest research, ISSN 0045-5067, 2015, vol. 45, iss. 3, str. 246-250. doi: 10.1139/cjfr-2014-0332.

Železnik P., Vilhar U., Starr, M., de Groot M., Kraigher H., 2015. Fine root dynamics in Slovenian beech forests in relation to soil temperature and water availability. Trees, doi:1-10. 10.1007/s00468-015-1218-z

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Gričar J., Eler K. 2015. The frequency of ray and axial parenchyma versus tree-ring width in silver fir (Abies alba Mill.). *Trees*, ISSN 0931-1890, 2015, vol. 29, iss. 4, str.

Vončina A., **Ferlan M., Eler K.**, Batič F., Vodnik D. 2015. Effects of fire on carbon fluxes of a calcareous grassland. *The International journal of wildland fire*, ISSN 1049-8001, 2015, vol. 23, iss. 3, str. 425-434, doi: 10.1071/WF12195.

Westergren M., Bozic G., Ferreira A., Kraigher H. 2015. Insignificant effect of management using irregular shelterwood system on the genetic diversity of European beech (*Fagus sylvatica L.*): A case study of managed stand and old growth forest in Slovenia. Forest Ecology and Management 335, 51-59.

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