China and CEEC FORESTRY

Beijing, 30. - 31.10.2017

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Why forest genetic resources matter?

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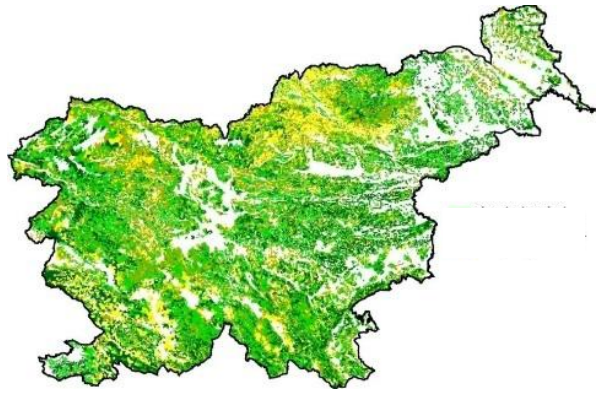


REPUBLIC OF SLOVENIA
MINISTRY OF AGRICULTURE, FORESTRY AND FOOD

LIFE GEN MON

REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING

Slovenian Research Agency

Rajhenavski Rog, est. 1892

„The Slovenian Forestry School“

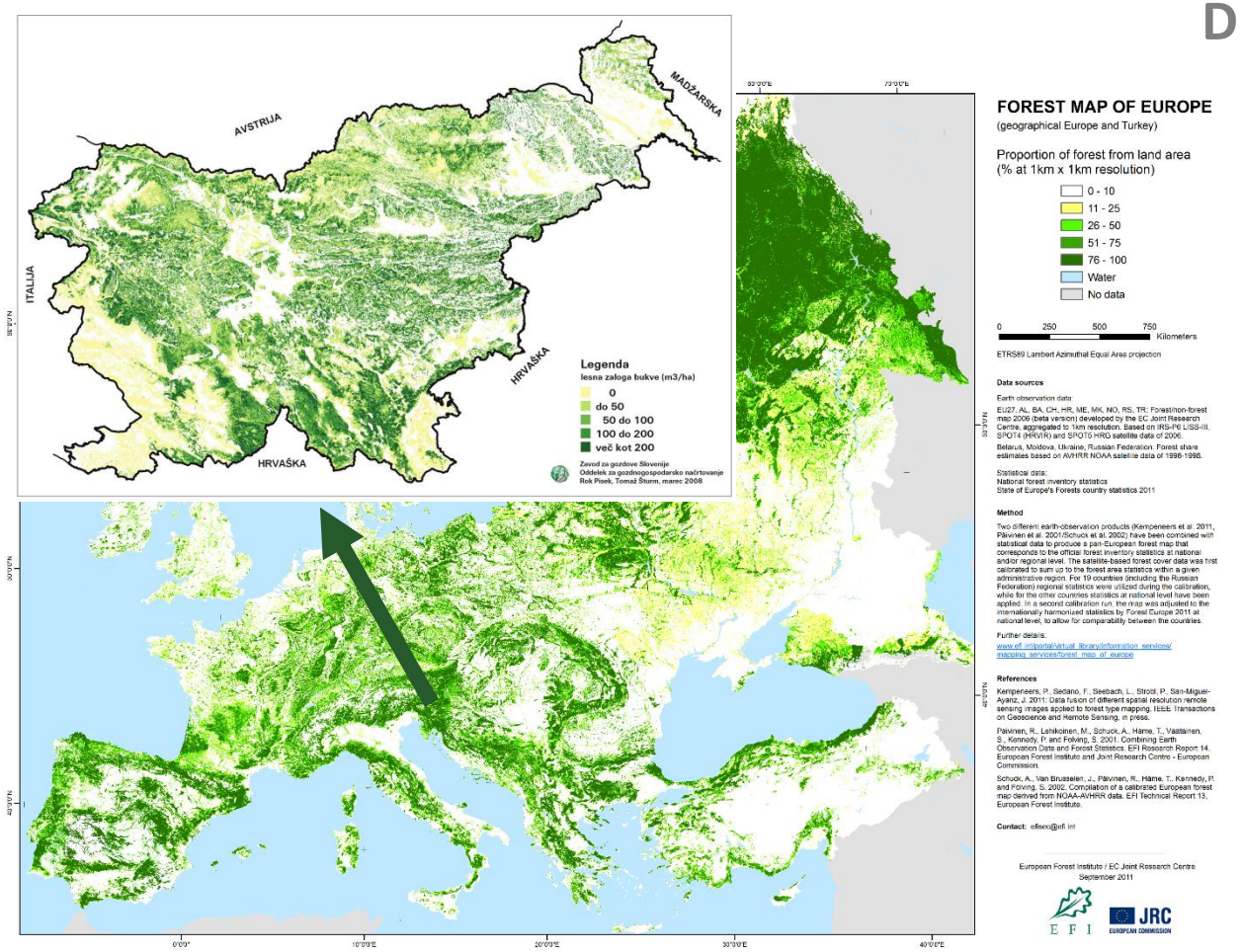
- Sustainable, close-to-nature, multifunctional forest management.
- Small-scale flexible forest management, adapted easily to site characteristics and natural development of forests.
- Active protection of natural populations of forest trees.
- Protection and conservation of biological diversity in forests.
- Support of the bio-ecological and economical stability of forests by improving the growing stock.
- Tending of all developmental stages and all forest forms for supporting of vital and high-quality forest trees, which could fulfil optimally all functions of forests.
- Natural regeneration is supported in all forests.
- If seedlings are used, they should derive from adequate seed sources / provenances, and only adequate species can be used.

Simulations of CC effects on tree distribution ranges in European Forests

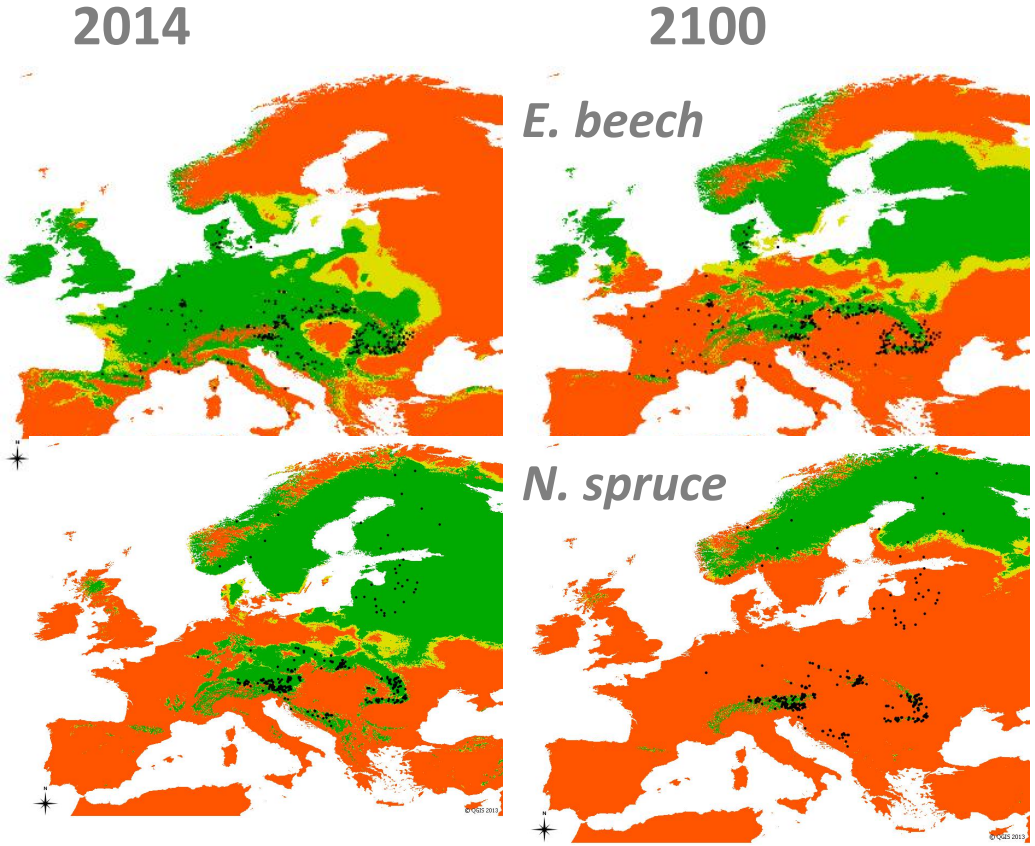
Global Change Biology
celebrating 20 years
Global Change Biology (2014) **20**, 1498–1511, doi: 10.1111/gcb.12476

Vulnerability of dynamic genetic conservation units of forest trees in Europe to climate change

SILVIO SCHUELER[1], WOLFGANG FALK[2], JARKKO KOSKELA[3], FRANÇOIS LEFÈVRE[4], MICHELE BOZZANO[3], JASON HUBERT[5], HOJKA KRAIGHER[6], ROMAN LONGAUER[7] and DITTE C. OLRIK[8]



Distribution areas of *Fagus sylvatica & Picea abies*



Selected examples of negative effects on forest & how to solve them – prepared by contacted national experts

The list prepared for/by:

- ***Croatia**, by Prof. Davorin Kajba, Dr. Mladen Ivanković, Dr. Nevenka Ćelepirović*
- ***Hungary**, by Dr. Sándor Bordács, nébih*
- ***Poland**, by Dr. Jan Kowalczyk*
- ***Serbia**, by Prof. Saša Orlović, Dr. Srdjan Stojnić,*
- *An **overview prepared for the LIFEGENMON project** and presented at 125th Anniversary IUFRO Congress in September 2017 by Stojnić S., Stevanov M., Alizoti P., Andonovski V., Avramidou E., Ballian D., Božič G., Ivanković M., Georgiadou M., Hasilidis P., Orlović S., Stijović A., Toromani E., Westergren M., Kraigher H.*

Threats to forest genetic resources

Albania	Bosnia	Croatia	Greece	Macedonia	Serbia	Slovenia
• forest fires • illegal logging • over-exploiting of forests	• forest fires • complicated state organization and overlapping of jurisdictions • no state level policy for protection of FGR and gaps • lack of public awareness about significance of FGR • illegal logging • pest and diseases	• natural disasters • ignorance of FGR diversity importance • tourism development in nature protection areas • Pests and diseases, alochtonous trees species • low level of underground water in lowland areas • Illegal logging • low investments in establishing of new forest and reforestation	• forest fires • pathogens and fungi diseases causing dieback of trees • human impact • climate change • policies inability to conserve in situ and ex-situ forest genetic resources	• forest fires • illegal logging, • diseases and pests • inappropriate past wood exploitation • specific natural conditions • lack of public awareness of the importance of forests and FGR	• negative forest practice • tree dieback in lowland region • neglected importance of FGR • fragmentation of natural forests • tourism development • poor state of private forests • invasive pest and diseases • forest fires • illegal logging	• climate change and associated biotic and abiotic disturbances • fragmentation in densely populated areas and prime agricultural areas • Forest fires • decline of forest seed and nurseries sector and subsequent insufficient supply of appropriate FRM

Hungary - Negative effects on forests and forest genetic resources (FGR)

1. **Climate change effects, extreme weather conditions**
2. **Invasive species, diseases and their high competitiveness**
3. **Increasing costs of handwork, less capacity of handicraft in silviculture**
4. **Increasing demand on industrial wood**

Poland - Main challenges regarding FGR

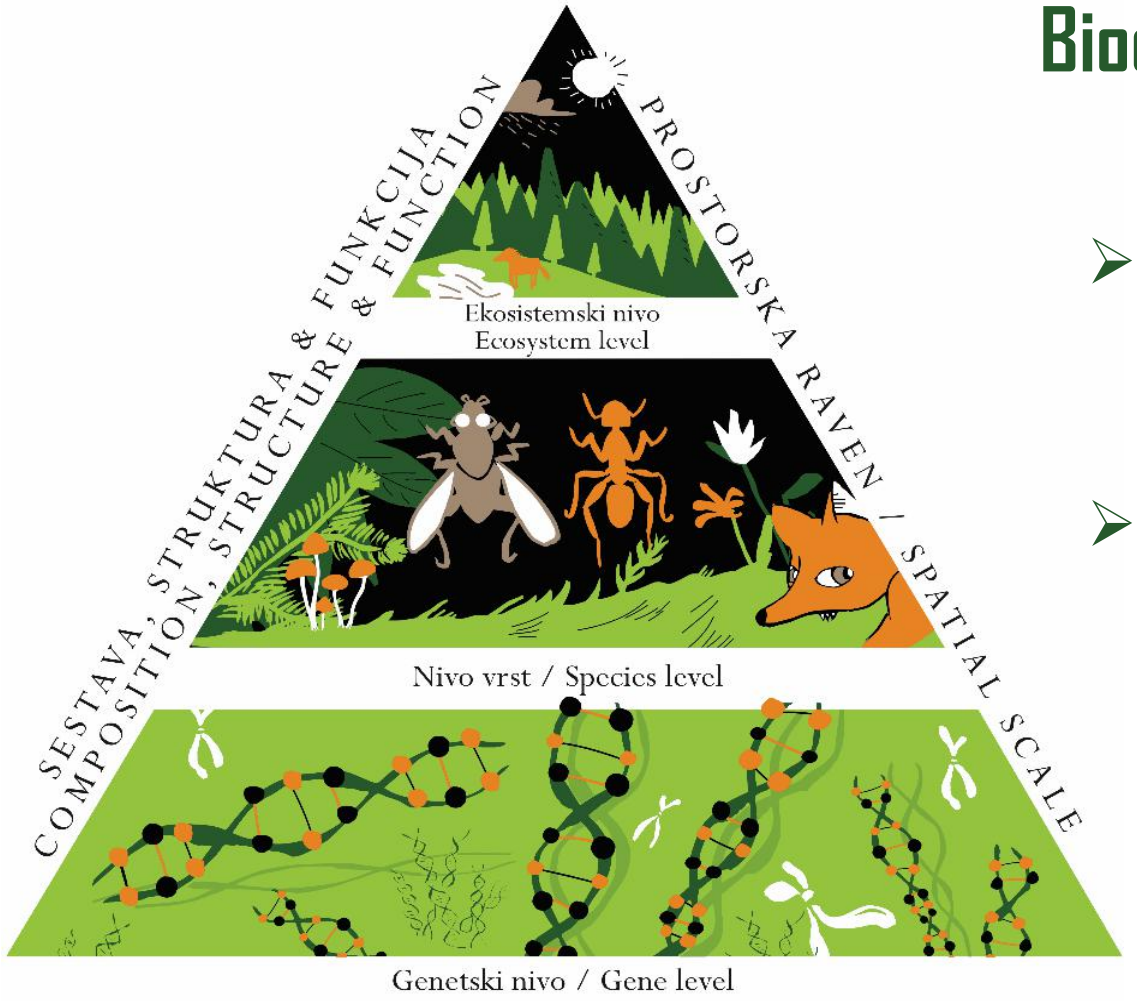
1. **Influence of climate change (windstorms, temperature increase)** on FGR management, utilisation and conservation
   [http://www.bbc.com/news/world-europe-40959863]
   →It is estimated the storms brought down over eight million cubic metres of lumber across 80.000 hectares of forest.
2. **Active protection of FGR through adaptive forest management practices and tree breeding**
3. **Social aspect and acceptance of management of forests including FGR**

Possible solutions to country-envisaged threats to FGR

Croatia	Hungary	Poland	Serbia
1. Preparation of **national strategies** on FGR 2. **Communication with forest owners** on quality of higher values seeds (bread for resistance), and/or subsidies from the State for their use. 3. **Raising awareness** about the conservation and economic value of these seeds 4. **Active search for FRM** that is adapted to climate change, before spp. become seriously endangered 5. Positive: policy makers already realise that FGR are important also from an economical point of view	1. **assisted migration, genetic monitoring, improvement on populations' adaptive plasticity** 2. **resistance breeding,** 3. **improvement of silvicultural methods,** 4. **breeding for plantations with intensive machinery**	1. **Strong forestry sector and possibility to incorporate decision at a wide scale** 2. **Good infrastructure and human capacity (including original, localy developed know-how, and introduced into the practice)** 3. **Cooperation at the country and international levels**	1. **increasing public awareness on the importance of FGR for SFM** 2. **integration of FGR into forestry and biodiversity legislation, strategies, programmes & action plans** 3. **promotion of inter-sectorial cooperation on FGR** 4. **application of more intensive *ex situ* conservation measures** 5. **improvement of research activities on within species genetic diversity** 6. **establishing of forest genetic monitoring** 7. **knowledge improvement on the effect of biotic and abiotic stresses on forests (drought, alien species etc.)**

Croatian seed orchard and collected improved seeds

Biodiversity at different scales



- **Ecosystem, species & functional diversity** can diminish the impacts of stress and disturbances
- **Genetic diversity (GD)** ensures that future populations of forest trees can survive, adapt & evolve in changing environmental conditions

Drawing by D. Finžgar

Food and Agriculture Organization of the United Nations

EUFGIS

EUFORGEN

Measures for Genetic Protection of forests

- *Every measure to be considered **with respect to its impact on genetic diversity** of the stand/population(s)*
- ***Support natural regeneration,***
- ***Assist regeneration** by co-planting and co-sawing of a high number of tree species based on site-matching (**enrichment planting**),*
- *Use adequate forest reproductive material **(FRM) of high genetic diversity**, through:*
  - ***i)Defining the minimum number of seed trees for FRM production,***
  - ***ii)Collection of FRM in full mast years,***
  - ***iii)Controlled & prescribed mixing of seed units,***
- *Use **advanced seed and seedling production systems,***
- ***Test provenances for transfer and mixing of FRM.***

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 (2015) 51–59

Marjana Westergren *, Gregor Bozic, Andreja Ferreira, Hojka Kraigher

LIFEGENMON - LIFE for European forest genetic monitoring system (2014 – 2020, LIFE Environmental fund, 5,4 M€)

⇒ *FOREST GENETIC MONITORING (FGM) = an early warning system to aid the assessment of a species response to environmental change at a long-term temporal scale*

⇒ *Monitor changes in GD in time*

⇒ *following forest management & operations*

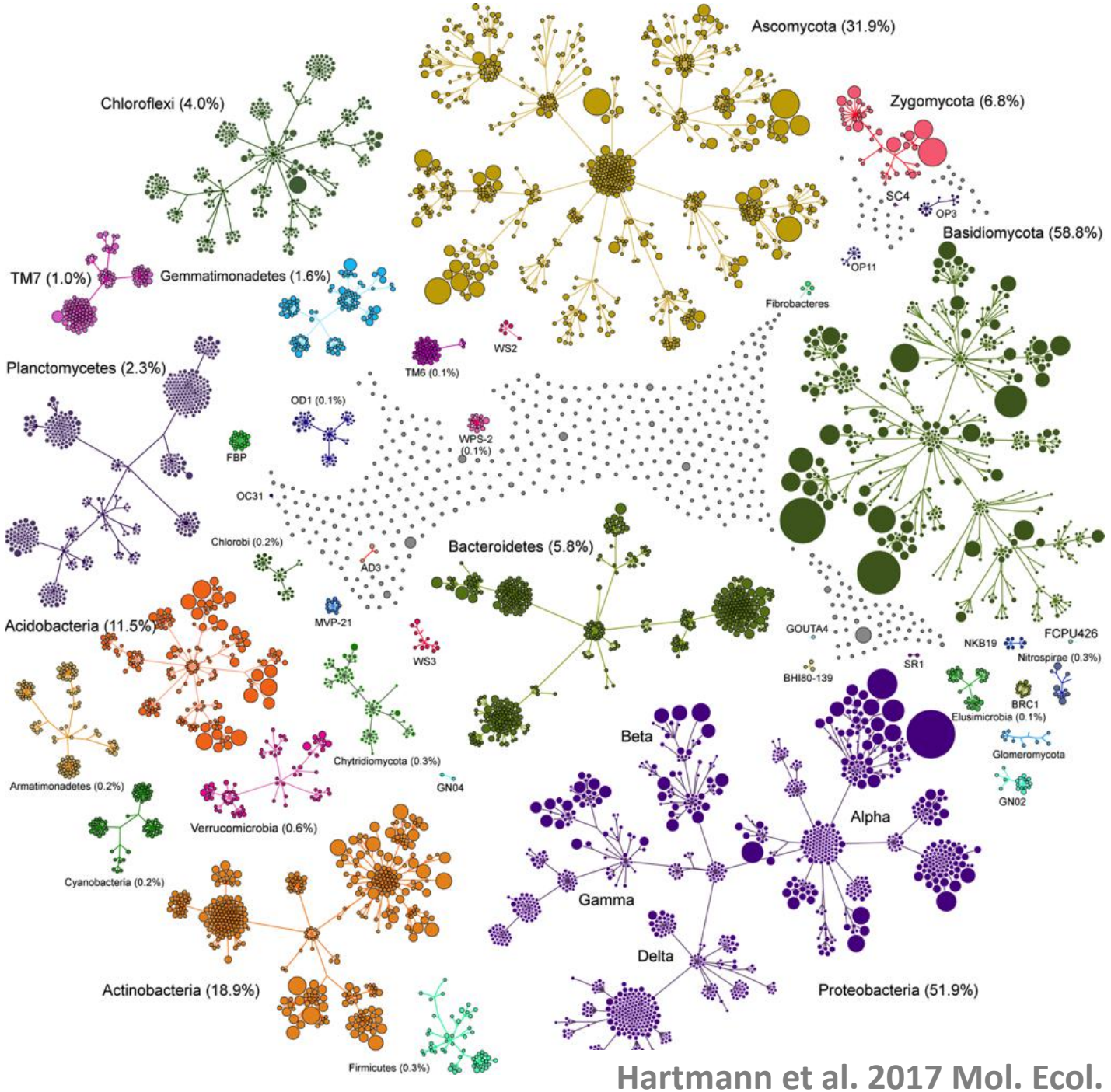
⇒ *to observe consequencies of changing environment before visual deterioration*

⇒ *Implement forest genetic monitoring - locally, nationally & accross borders*

⇒ *Supports measures for Genetic Protection of forests*

The contribution of tree-soil metagenomes to forest resilience – IPBES & Global Soil Biodiversity Initiative

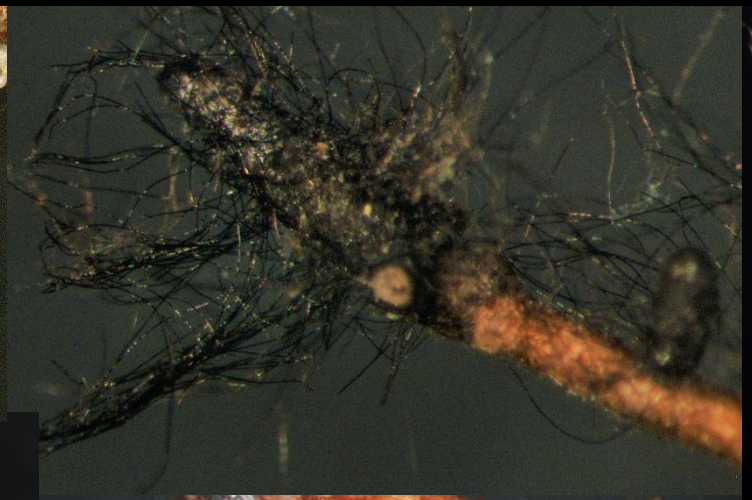
- *Mechanisms that facilitate species coexistence in complex communities*
- *Metagenomics in Forest Genetic Monitoring offers a better understanding of ecosystem functioning, stability and evolution of a natural population*

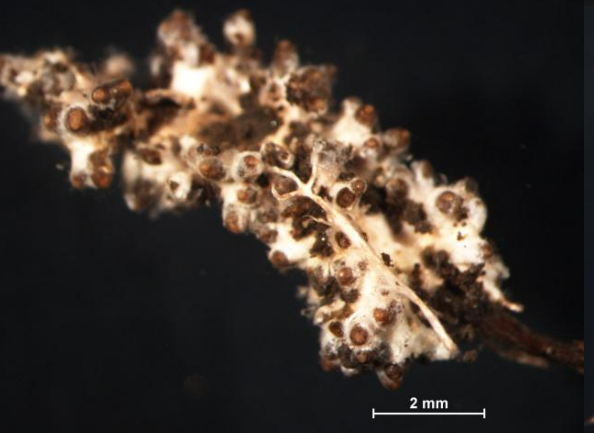


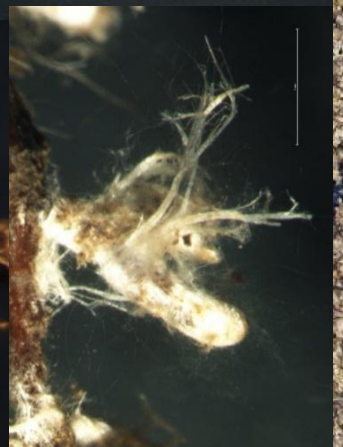
Hartmann et al. 2017 Mol. Ecol.

DIVERSITY OF ECTOMYCORRHIZA

(Photos M.Hrenko, T.Grebenc, T.Mrak, I.Štraus, H.Kraigher)

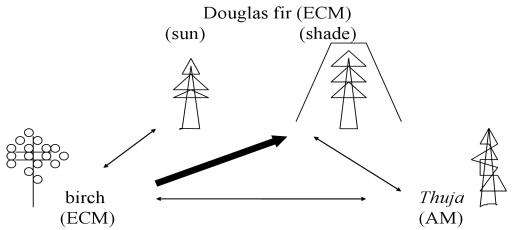


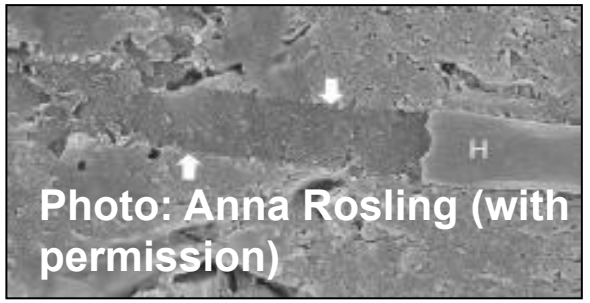


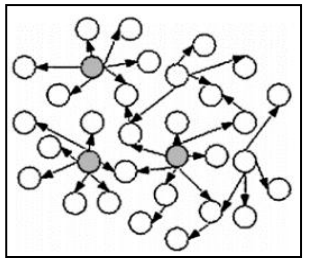


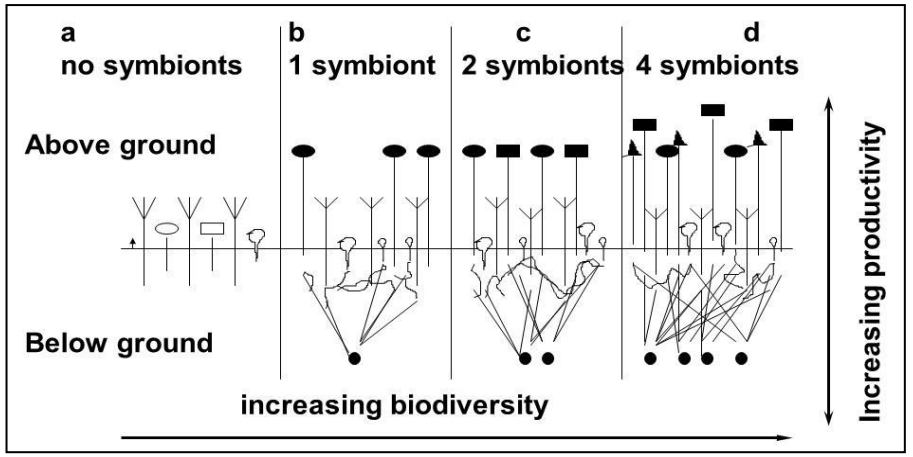
Common Mycelial Networks (CMN)

- **Translocation of C, N, P** between plants through CMN:
  - **C** (Simard et al 1996 – ^{13}C from birch into shaded Douglas fir),
  - **N** (Arnebrant et al 1993 – ^{15}N through *Frankia* to *Alnus* and through *Paxillus* to *Pinus*,
  - **P** (Lindahl et al 2001 – ^{32}P from *Hypholoma* through *Suillus* to *Pinus*)
- **Mineralisation:**
  - **‚Rock-eating' fungi** (Jongmans et al 1997)
- **Biodiversity belowground supports diversity above ground:**
  - **Increasing site productivity** (Read 1998 & van der Heijden et al 1998)
- **Water relations:**
  - **Hydraulic lift & retranlocation of water** within hubs from old to small trees (Simard et al group 2014)
- **Mycorrhiza induced resistance** (Cameron et al 2013)









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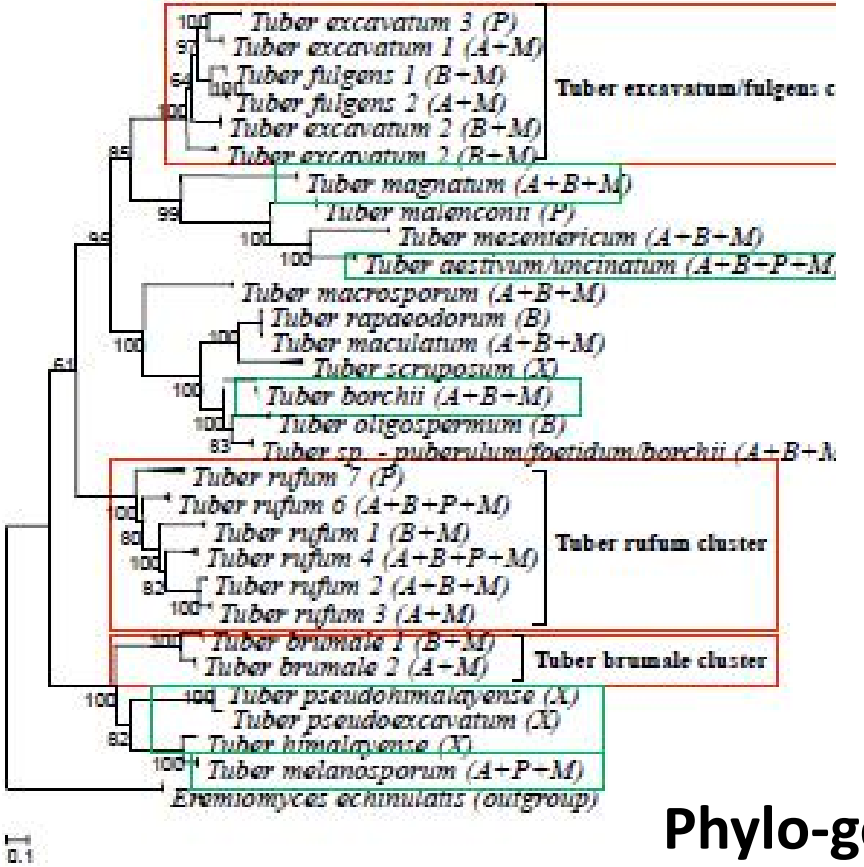
This project is funded by the European Union

CASIROZ 3

Co-migrations of mycorrhizal fungi and forest tree species in Europe



Phylo-geography of *Tuber & Quercus* (Dr. Tine Grebenc *et al* 2010)

RESEARCH INFRASTRUCTURE - SLOVENIAN FORESTRY INSTITUTE

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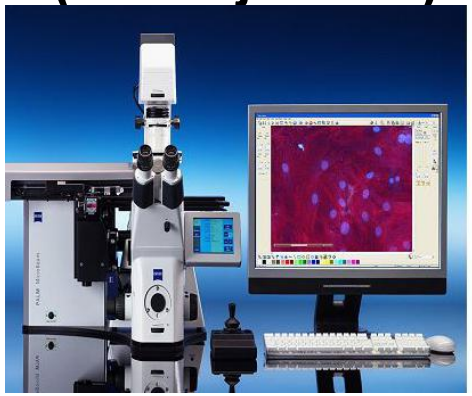
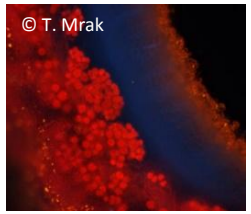
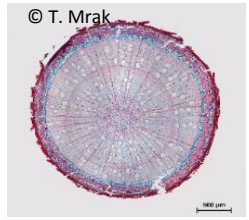
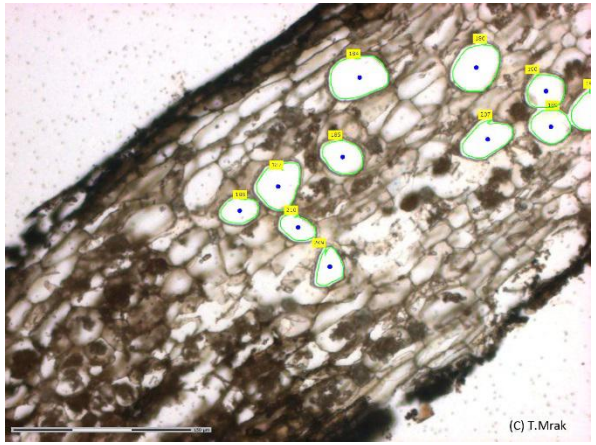
Microscopy with ***ZEISS StereoLUMAR.V12, AxioImager.Z2 & AxioObserver.Z1*** with the ***PALM Microbeam laser microdissection system*** **(Dr. Tanja Mrak)**







Forest physiology and genetics: fully equipped **labs for molecular genetics** (molecular databases for European tree spp spruce, beech, fir, oaks, ash; & fungi), **physiology** of seed & seedlings, and an **underpressurized clean room** with growth chambers (for GMOs, quarantine pests & diseases) **(Marko Bajc)**

Collections:

The Slovenian Forest Gene Bank (with the National list of FRM – as the **State authority** for approval of seed objects and certification of FRM) **(Prof. dr. Hojka Kraigher),**

Living collection of ectomycorrhizal fungi (Dr. Tine Grebenc), with reference samples included in **Mycotheca & Herbarium SFI**, **Living archives, clonal collections** *(Populus nigra &* hybrids) **and provenance tests** (the International trial with 38 provenances of *Fagus sylvatica*) **(Dr. Gregor Božič)**

Cooperation within the Global Timber Tracking Network
(Prepared by Dr. Marjana Westergren, SFI member of the IUFRO WP 7.01.02)

Aim: develop scientific standards & laboratories to fight illegal logging

- ***First WG*** *group meeting in Washington DC (October 2017):* ***standardization of methods and protocols***
- *Needs for* ***Wood anatomy, Genetics, Stable isotopes & Chemistry*** *(chemical composition of wood) laboratories*
- ***Forensic*** *vs.* ***solid and transparent science approach***
- ***Validation of laboratories*** *in development: certification possible*
- *Next step for developing harmonized methods: case studies on tree spp for which samples for all 4 types of analysis are already available; participation of SFI*

SFI as service provider

SFI as methods developer & validator

We are hoping for development of common research strategies among 16 + 1 countries for sustainable future forests, forestry and forest science!