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## NATIONAL REPORTS

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### Summary

<b>BELGIUM</b> .....	<b>2</b>
<b>BOSNIA AND HERZEGOVINA</b> .....	<b>5</b>
<b>CROATIA</b> .....	<b>10</b>
<b>CYPRUS</b> .....	<b>16</b>
<b>CZECH REPUBLIC</b> .....	<b>22</b>
<b>FINLAND</b> .....	<b>30</b>
<b>FRANCE</b> .....	<b>34</b>
<b>GERMANY</b> .....	<b>38</b>
<b>GREECE</b> .....	<b>43</b>
<b>IRELAND</b> .....	<b>48</b>
<b>ITALY</b> .....	<b>52</b>
<b>NETHERLAND</b> .....	<b>58</b>
<b>POLAND</b> .....	<b>65</b>
<b>ROMANIA</b> .....	<b>70</b>
<b>REPUBLIC OF SERBIA</b> .....	<b>73</b>
<b>SLOVAKIA</b> .....	<b>78</b>
<b>SLOVENIA</b> .....	<b>83</b>
<b>SWITZERLAND</b> .....	<b>88</b>
<b>TURKEY</b> .....	<b>92</b>
<b>UKRAINE</b> .....	<b>97</b>
<b>REFERENCES</b> .....	<b>105</b>

## National Report on MaP FGR

**Country** Belgium

**Authors** Bart De Cuyper, Kristine Vander Mijnsbrugge

**Introduction** In Belgium, the forest cover amounts to 703'421 ha, being 23% of the total land area. Nearly all forests are managed as high forest. There is a clear difference between forests in Flanders and Wallonia.

### *Short description of the Country*

In Flanders (1'352'230 ha), forests cover merely 11% of the total area (136'500 ha). Forests often originate from plantations on former heathland and wet grasslands. Conifers account for nearly half of the forest cover (46%) while only 1/3 of the forest area consists of indigenous hardwoods, i.e. oak (8%), beech (4%) and mixed broadleaved stands (25%). Pine species together with poplar plantations account for almost half of the Flemish forest area (65'000 ha). Forests in Flanders are clearly part of an urbanized and industrialized region.

In Wallonia (1'684'430 ha), with a total forest cover of 477'800 ha (48%), forest are more prominent and play a more economic role compared to Flanders where forests are more related to socio-cultural and ecological services. Over 1/3 of the Walloon forest area consists of Norway spruce. Indigenous broadleaved forests account for about half (52%) of the forest cover, with pure oak and beech stands covering 51% of the broadleaf are.

Forests in Belgium are mainly threatened by destruction and fragmentation of natural habitats, pollution and eutrophication, high recreational pressure, use of unsuitable FRM, invasion of non-indigenous species and climate change.

### **Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

*Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios* Meteorological observations on an hourly/daily/monthly basis for Belgium:

- <http://eca.knmi.nl/>
- Climatic map of Belgium:
- <http://www.meteo.be/meteo/view/fr/16788784-Atlas+Climatique.html#navigate=1>

*Inventory of regional/national maps and/or links to web sites concerning* Soil and geomorphological map of Flanders:

- <https://dov.vlaanderen.be/dovweb/html/bodemloketten.html#bodemkaarten>

Soil map of Wallonia:

- <http://cartopro3.wallonie.be/CIGALE/viewer.htm>

*location of soil types and morphology*  
**Identification of pedo-climatic parameters characterizing species ranges**

Not available

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species**

In Belgium, very few indigenous species occur at the border of their natural distribution area. However, some ancient relict populations of widespread tree species (e.g. wild cherry, inland oak) can be considered as marginal when they are threatened by human interventions. Marginal populations also encompass populations of rare species (e.g. crab apple).

**Identification of skills and gaps in forest genetics research capacity**

In Flanders, research on forest genetic resources is mainly pursued at the Research Institute for Nature and Forest (INBO) being a governmental institution belonging to the Flemish Ministry of Environment, Nature and Agriculture. The main research objectives concern the study of genetic diversity of forest trees and shrub species using molecular and population genetic methods. A major tool, in view of the assessment of the adaptability to changing growing (climatic) conditions, is the establishment of common garden experiments. Greenhouse experiments are focusing on assessment of drought resistance and on epigenetics. Research gaps, more particularly the assessment of phenotypic plasticity, mainly concern the rather narrow spectrum of species studied.

**Survey and description of conservation and mitigation methods and actions with special reference to climate change**

- *Forest reserve network.* The total area of “Forest conservation areas”, established by law, amounts to 15'000 ha.
- *Natura 2000.* More than 30% of all forests in Flanders are included in the Natura 2000 network (58'000 ha), especially as Habitats Directive Areas.
- *Flemish Ecological Network (VEN).* Besides the Natura 2000 network, about 125'000 ha of the Flemish territory (about 10%) was selected to be included in a network where nature conservation is considered as a predominant function. This network includes 50'000 ha of forest.
- *Decree of the Flemish Government on the establishment of criteria for sustainable forest management (CSFM) in the Flemish region.* This regulation (2003) states that all forests (public and private) within the VEN are to be managed according to the CSFM, covering legal, socio-cultural, environmental and biodiversity aspects.

**Survey and**

Forest genetic resources of the most valuable tree and shrub species have been recorded. Their

*description of available FGR* importance not only evolves from their economic significance as they also constitute the gene pools for the restoration of the original, i.e. adapted, forest ecosystems. Apart from more common descriptors, offspring and molecular data are available for some species.

*Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.* Neutral molecular markers (AFLP, SSR, SNP) only have been developed and applied for a rather narrow spectrum of tree (6) and shrub (5) species. Assessment of internal genetic variability and differentiation was carried out. Based on this information, together with pedological, hydrological and climatic data, provenance regions were delimited for Belgium.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Although extreme climatic difference are not present in Belgium, considerable variation in growth conditions occur between the southern (Wallonia) and the northern (Flanders) part of the country. Consequently, the adaptability of forest genetic resources (at the level of provenances, seed stands, seed orchards) is assessed through establishment of common garden experiments throughout the country. Thus, recommendations concerning the appropriateness of FRM of different tree species can be made towards forest managers based on the identification of phenologically less stable genetic units.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

No actual networking activity is present in Belgium. Sharing and management of available databases on a pan-European level was accomplished through participation in several EU-funded projects/platforms (Treebreedex, Trees4Future, Valbro, EUFGIS, EUFORGEN). Regarding communication, several awareness-rising campaigns on the importance and the use of adapted FRM were organized during the past decades.

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## National Report on MaP FGR

**Country** Bosnia and Herzegovina

**Authors** Dalibor Ballian, Branislav Cvjetkovic

**Introduction Short description of the Country** Bosnia and Herzegovina has a total surface area of 51'209.2 km<sup>2</sup>, composed of 51'197 km<sup>2</sup> of land and 12.2 km<sup>2</sup> of sea. The land is mainly hilly to mountainous, with an average altitude of 500 meters. Of the total land area, 5% is lowlands, 24% hills, 42% mountains, and 29% karst region.

The climate of B&H varies from a temperate continental climate in the northern Pannonia lowlands along the Sava River and in the foothill zone, to an alpine climate in the mountain regions, and a Mediterranean climate in the coastal and lowland areas of the Herzegovina region in the south and southeast.

Forests and forest land occupy a surface area of about 27'100 km<sup>2</sup>, or about 53 percent of the territory of B&H - among the highest forest coverage in Europe. B&H forests mainly regenerate naturally and, as a result, show marked diversity. Due to activities such as illegal logging and mining, forest fires, etc., forested areas have been shrinking rapidly; furthermore, a significant part of the forest cover has been declared as mined (approximately 10%). However, three forest management public enterprises hold Forest Stewardship Council (FSC) certification, and currently around 50% of state-managed forests in B&H are FSC certified.

According to second data source, 2'501'000 ha are forests and forest lands, high value forest occupies 1'130'000 ha, and coppice forests and all kind of bush formations occupies 841'000 ha, and bare land occupies around 530'000 ha.

According to Ecological and vegetation distribution, there are 4 different areas: Pannonic, Inner Dinarides, Trans Iliric-Mesiac and Submediterranean and Mediterranean area. The most of interesting species concerning MaP FGR are in last mention area. The influence of human during history is significant. Process of deforestation was active for several centuries and climate become more arid.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventories of regional/national maps and/or links to web sites of climatic maps including future scenarios** Using the EH50M global model, the temperature in B&H is projected to increase from 0.7 to 1.6°C per 1°C of global increase during the period 2031-2060. It is clear that the average rise in temperature (the daily mean averaged over 30 years) is between 1 and 2°C along the coast, and between 2 and 3°C inland. The largest temperature increases would occur in summer, and in inland areas: T<sub>mean</sub> by 40°C and T<sub>max</sub> by 5 °C on average. Furthermore, T<sub>max</sub> is expected to rise more than T<sub>min</sub>. The increase in the number of summer days, defined as the number of days when T<sub>max</sub> exceeds 25°C, is from 2 to 6 weeks, or about one additional

month of summer days on average. Finally, the increase in the number of hot days in the Balkans, defined as the number of days with  $T_{max} > 30^{\circ}\text{C}$ , ranges from 2 weeks along the coast to 5-6 weeks inland. For precipitation, using the EH50M global model, the summer climate will be noticeably drier in Southern Europe.

This will be especially noticeable in summer (June-August), when already small amounts of rainfall could be halved. All parts of the Mediterranean (including the Balkans) are expected to see a decrease in summertime precipitation and a small decrease or no change in the other seasons during the period 2031-2060. On average, the Mediterranean region is expected to feature more dry days. The increase in dry days is likely to be lower along the coast but higher in the inland Balkans. Increasing variability in the weather has been noted in all seasons, with rapid changes of short periods (five to ten days) of extremely cold or warm weather - heat and cold waves - and periods with extremely high levels of rainfall, as well as droughts. It is expected that the duration of dry periods, the incidence of torrential flooding and the intensity of land erosion will increase over the next century. In addition, an increase is expected in the occurrence of hail, storms, lightning, and maximum wind velocity, which can represent threats to all forms of human activity.

<http://www.vladars.net/sr-SP->

[Cyrl/Vlada/Ministarstva/mgr/Servisi/Poslovanje/Documents/INC%20BH%20ENG%20FINA%20L%20DRAFT.pdf](http://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mgr/Servisi/Poslovanje/Documents/INC%20BH%20ENG%20FINA%20L%20DRAFT.pdf)

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology Identification of pedo-climatic parameters characterizing species ranges***

The data will be presented mostly for Submediterranean area which is southern area for many species. It occupies area from Adriatic sea on south to the high mountains on north. Whole area is karstified. There are also processes of karst erosion. Pattern rock is mostly limestone from Cretaceous and Jurassic period. Other sediments are rare.

Soils are mostly rocky. The kalkomelanosol and brown soils are dominated types of soils. On lower altitudes there is terra rossa (red soil).

The map in “.jpg” format will be provided.

The largest number of endangered species in Submediterranean area are on shallow and rocky soils. Mainly dominated by calcareous soils: kalkomelanosol (profile A-C) and kalkokambisol and terra rosa (profile A-(B)-C). Those soils are typical for areas with arid areas which provide process of humification but not for mineralization. The average annual rainfall is 1'300-1'500 mm, and annual temperature is in range 11, 1-15 °C. Vegetation period is in range 200 – 260 days. In vegetation period there are 33% of rainfalls.

Forest vegetation: The most common plant community is climazonal forest of Downy oak and hornbeam (*Quercus pubescentis* – *Carpinetum orientalis*) with regressive stadiums. There is also Macedonian oak (*Quercus trojana*), which occurs as single trees or in groups. The larger areas covered by this species are rare.

On the flat soils with a deeper soil, with often illimerised soils, forests of Italian oak took place. On the river bank are forests of willows and poplars.

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

At higher elevations, in extreme conditions, there are forests of oak and hornbeam and hornbeam forests with moor grass.

If we take into account same economically valuable species, tree species are important and some of characteristics will be mention. On the south, beech forests dominate on Mt. Orijen. That is the southernmost areal of European beech.

Silver fir ends its areal in B&H. The edge of spruce areal is on the border between Submediterranean area and Inner Dinarides.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species** The most important species: *Quercus pubescens*, *Quercus trojana*, *Quercus cerris*, *Quercus robur*, *Celtis turnefortii*, *Fagus sylvatica*, *Pinus nigra*, *Pinus heldreichii*, *Picea abies*, *Abies alba*, *Populus nigra caudina*, *Populus alba*.

**Identification of skills and gaps in forest genetics research capacity**

Skills:

- Team of researchers in B&H,
- Wealth of genetic diversity, large number of endemic species
- Field trail plots of several species (Provenance tests)
- Recognition of the need for conservation of forest genetic resources (Program of preservation FGR is in phase of validation)
- Recognition of potential value of population on edge of areal for process of adaptation due to climate changes

Gaps:

- There is no laboratory for genetic markers for forest species
- Small number of projects concerning research of genetic diversity

**Survey and description of conservation and mitigation methods and actions with special reference to climate change**

There are provenance test of several most valuable species established in Bosnia & Herzegovina. The significant conservation processes started around middle of the last century and usually contains material from all parts of country including the southernmost populations which are on the edge of their areal.

Seed stands and seed orchard are also method of conservation which took place.

According to spatial plans in B&H, several isolated populations will be included in new preservation areas such as reservations, parks of nature etc.

**Survey and description of available FGR**

- Natural populations on edge of their areal such as: *Pinus nigra*, *Pinus heldreichii*, *Abies alba*, *Picea abies*, *Fagus sylvatica*, etc.
- Several vulnerable oaks in Submediterranean and Mediterranean area: *Quercus troyana*, *Q. pubescens*, *Q. ilex*, *Q. cerris*, *Q. robur* etc.
- Seed stands: Almost all economically valuable species have their representatives as a seed

stands. Those forests are the most valuable forests and in future, the process of selection of seed stands will be with stress on climate change adaptive populations.

- Seed orchards: In several seed stands of first generation, all provenances are included. In next several year, we will obtained valuable results of adaptive potential of specific provenances and half-sib lines.

Endemic and subendemic species: There are many endemic species in B&H. The most significant are: *Picea omorika* and *Pinus heldreichii*. The second mention species is characterized by its areal which is in south part of country, not far away from sea.

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.**

- *Abies alba* – research of PhD Dalibor Ballian (morphological, biochemical and molecular markers, provenance test)
- *Picea omorika* - research of PhD Dalibor Ballian (molecular markers)
- *Pinus heldreichii* - research of PhD Dalibor Ballian (morphological markers)
- *Picea abies* - research of PhD Dalibor Ballian (biochemical (izozime) markers)
- *Fagus sylvatica* - research of PhD Dalibor Ballian (biochemical (izozime) markers, provenance test)
- *Quercus robur* - research of PhD Dalibor Ballian (molecular and morphological markers, provenance test)
- *Fraxinus excelsior* - research of PhD Dalibor Ballian (molecular markers)
- *Pinus nigra* - research of PhD Faruk Bogunić (cytological markers)
- *Pinus heldreichii* – research of PhD Faruk Bogunić (cytological markers)
- *Pinus mugo* - research of PhD Faruk Bogunić (cytological markers)
- *Pinus nigra* - research of PhD Milan Mataruga (Investigation of Austrian pine in extreme conditions mostly on border of its areal considering climate and soil conditions)
- *Picea abies* – research of PhD Milan Mataruga (molecular markers in realization)
- *Pinus sylvestris* – morphological parameters researched in provenance tests

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Bosnia and Herzegovina is a small state considering the surface, but it has variable environmental conditions. There is a large number of different types of forests and species. Genetic diversity is significant due to differences in environmental conditions. There are 4 types of climate: in the north, in the flat region is continental. Going south, the climate is temperate continental. In the mountains is the climate typical for mountainous areas (alpine) and Submediterranean and Mediterranean, climate is mainly Mediterranean. By varying the other topographic conditions, it can be concluded that the conditions for a very large variety of plant life at the level of ecosystems, species, populations and individuals.

A significant number of species that are found in Europe and B&H are located on the southern edge of its range.

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These are the populations that are affected by climate change and pernicious increase in temperature. Such populations are often in arid areas with shallow karst land. Species that occur in areas that are vulnerable climatic changes are: Downy oak, Turkish oak, Macedonian Oak, European nettle tree, and species such as pine, spruce and beech. B&H has the human capacity for researching population on the edge of species range. Interest in research has confirmed by the increasing number of offspring tests. Such tests include populations that are at the edge of areal. There is also interest in investigating these populations for finding individuals that are more tolerant of climate change impacts. Such individuals would be used in further breeding.

The problem is the lack of laboratories for the analysis of biochemical markers. Analyses which we carry out are mostly conducted abroad. Also, there are not a sufficient number of projects that support research, regarding to huge diversity of species. Research has mainly covered economic valuable species. Species that are not economically viable in terms of the use of timber, poorly researched.

In the last period, the program of conservation of forest genetic resources that should be adopted by the government. It provides more funds for research of genetic diversity. It is necessary that the people who make decisions in the field of forestry research identified the need for marginalized populations. To do so, they need to be familiar with the issues and to present the results of an affirmative way to get the research. In this way, they will be able to align management systems for forest conservation and use of genetic material of the species on the edge of areal.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

There are departments in Government at the level of entities (Bosnia and Herzegovina consist 2 entities) for agriculture, forestry and water management and departments for ecology. These departments provide information, projects and support for researches. There are two universities with forestry faculties with departments for forest genetic. Collaboration between government and Public Forest Enterprises which manage forests and with national parks in our country. Also, there are NGO organizations that take care about specific problems.

Several databases are available:

<http://www.florasrpske.webfactional.com/>

<http://arbormagna.webfactional.com/>

[http://nasljedje.org/index.php?option=com\\_content&view=article&id=64&Itemid=62](http://nasljedje.org/index.php?option=com_content&view=article&id=64&Itemid=62)

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## National Report on MaP FGR

**Country** Croatia

**Authors** Sanja Peric, Martina Tijardovic, Jasnica Medak

**Introduction** Total area of forests and forest land in Croatia amounts to 2'688'687 ha which is 47% of its total land area. Out of that, 2'106'917 ha is state-owned, whereas 581'770 ha are privately owned.

**Short description of the Country** Vast majority of state-owned forests is managed by Hrvatske šume (2'018'987ha). Except according to the ownership, forests are classified according to their purpose as well. The Forest Act states that according to their purpose, forests can be commercial, protective and those with a special purpose.

COMMERCIAL – used for the production of forest products, next to the preservation and improvement of their welfare functions

PROTECTIVE – serve for the protection of soil, waters, settlements etc.

FORESTS WITH SPECIAL PURPOSE – protected nature areas (reserves, national parks, nature parks, nature monuments, important landscapes, park forests)

- forests and parts of forests registered for production of forest seed (seed stands)
- forests for scientific research
- forests for defense of the state

The basic principles of the Croatian forestry are the sustainable management, aiming to preserve the natural structure and biodiversity of forests, and the continuous rise of the stability and quality of the commercial and welfare functions of the forest.

The Forest Act prescribes an integral forest-management area in the Republic of Croatia, which is further divided into management units.

Forests and forest land in Croatia is managed in line with the Forest management plan, adopted for the period of 10 years. The actual FMP has been adopted in 2006 and is valid until 2015.

The Forest management plan defines the ecological, commercial and social basis for the biological improvement of forests and the growth of forest production. The goal of the forest management in Croatia is a sustainable and harmonious usage of all the forest functions and the continuous improvement of their condition.

All managed forests are divided into management units, which are further divided into compartments and subcompartments. Management plan for each management unit is adopted for a period of 10 years. All measurements and planning in forestry are being carried out every ten years, when all data are up-to-dated.

By the valid Forest management plan it is has been defined that the growing stock in Croatia amounts to 398 million m<sup>3</sup>, whereof 302 million m<sup>3</sup> stems from the state forests, managed by Hrvatskešume; something more than 78 million m<sup>3</sup> stems from the privately-owned forests and 17 million m<sup>3</sup> from the state forests managed by other legal entities.

Croatian forestry is based on the principles of sustainable management for hundreds of years already. Significantly less wood is taken from the forest than it is growing every year, and as trees of lesser quality are constantly cut, it is clear that our forests are the more beautiful the longer they are managed.

Public enterprise 'Croatian forests' Ltd. in 2002 gained the right to carry the prestigious FSC certificate for the forest management.

According to Ecological and vegetation distribution, there are 3 different areas: Pannonic, Dinarides, and Submediterranean and Mediterranean area. The most of interesting species concerning MaP FGR are in last mention area.

The influence of human during history is significant. Process of deforestation was active in 19<sup>th</sup> century and forest area in Pannonian region significantly reduced.

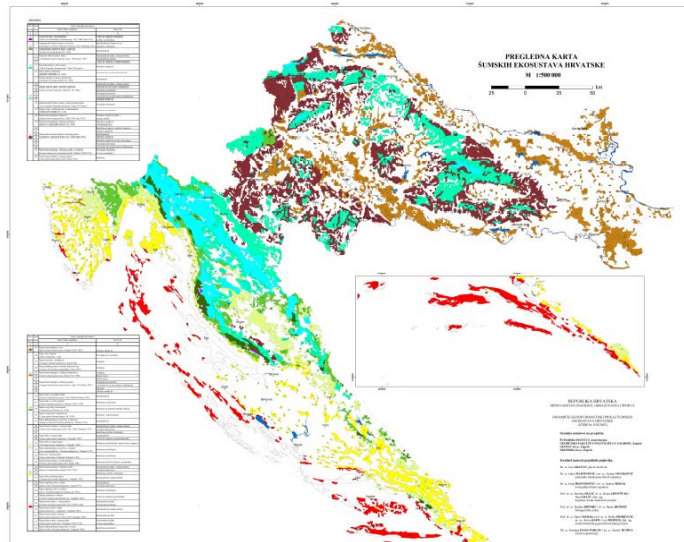
There are three major bioclimatic areas in Croatia: lowland area presented with poplars, willows, black alder, ash and pedunculate oak as major tree species; hilly and mountain area presented with sessile oak, beech, Silver fir, Norway spruce, Austrian black pine and Scots pine (*Pinus sylvestris*) and Mediterranean area presented with pines (*Pinus nigra*, *Pinus halepensis*, *Pinus pinaster*, *Pinus brutia*, etc.), Pubescent oak and Holm oak. It is safe to state that marginal populations can be found in all three bioclimates of the country. There is also evidence of impact of changed climatic conditions. Human impact is evident especially through regulation of river flows and application of different meliorative activities.

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

***Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios*** Meteorological and hydrological Service of Croatia is dealing with climate monitoring and climatic maps, so maps and climate history data are available on:  
<http://prognoza.hr/karte.php?id=ecmwf>  
[http://klima.hr/ocjene\\_arhiva.html](http://klima.hr/ocjene_arhiva.html)

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology*** Map of forest ecosystems in Croatia (soil types, forest communities and topography together with classification of forest ecosystems). Additional geological maps also available.

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**Identification of pedo-climatic parameters characterizing species ranges**

In the Pannonian region mainly dominated fertile soils: kalkomelanosol (crnica) (profile A-C). That soil is typical for areas within arid areas which provide process of humification but not for mineralization. The average annual rainfall is 1300-1500 mm, and annual temperature is in range 11,1-15 °C. Vegetation period is in range 200 – 260 days. In vegetation period there are 33% of rainfalls.

Forest vegetation: The most common plant community are clima zonal forests of oak (*Genisto elatae-Quercetum roboris*, *Carpino betuli-Quercetum roboris*), black alder (*Carici elongatae-Alnetum glutinosae*) and willow (*Galio-Salicetum albae*).

In mountain area, the Dinarides kambik soil dominate (profile A-(B)-C). In this area the most endangered species is silver fir (*Abies alba*). There are also common beech (*Fagus sylvatica*) and Norway Spruce (*Picea abies*).

Submediterranean and Mediterranean area main species are: downy oak (*Quercus pubescens*), holm oak (*Quercus ilex*), Aleppo Pine (*Pinus halepensis*), Dalmatian black pine (*Pinus nigra* subsp. *dalmatica*).

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species**

Pedunculate oak (small isolated areas in the karst area of Lika, *Premužno jezer* and *Crno jezero* localities and one locality in Istria (Motovun forest)).

Silver fir on *Biokovo* locality (Vukelić et al 2007- the forest community *Ostryo-Abietetum* (Fukarek 1963) Trinajstić 1983) and lower mountains in Pannonian lowland. On *Biokovo* locality *Abies alba* prevails in the dominant layer, *Ostrya carpinifolia* in the intermediate layer and thermophilic species of the order *Quercetalia pubescentis* in the shrub layer. The layer of herbaceous vegetation is dominated by the species of the order *Fagetalia* and the alliance *Aremonio-Fagion* and by the thermophilic species *Sesleria autumnalis*. The forest phytocoenosis of silver fir (*Abies alba*) with hop hornbeam (*Ostrya carpinifolia*) occurs over approximately

250 ha in the study area. Compared to phytocoenological relevés of this community from *Biokovo*, 54 new species have been registered. Those of mesophilic character and beech forests prevail, which completes the knowledge of the phytocoenosis *Ostryo-Abietetum*. In relation to the stands on *Biokovo*, 46 species of predominantly thermophilic character do not appear, including *Lonicera alpigena* and *Pulmonaria visianii*, which were initially classified as characteristic species of the association. The species *Hepatica nobilis*, with frequent presence of sessile oak (*Quercus petraea*) in the tree layer, occurs abundantly in Vinodol stands. Stands of the community *Ostryo-Abietetum* are mainly protective coppices with a permanently open canopy and density of about 50%.

European beech in *Spačva basin*. Pubescent oak. *Quercus cerris*.

The Italian oak (*Quercus frainetto* Ten.) grows in Slavonia and in several places in Dalmatia, but only on the southern slopes of Krndija and *Požeška kotlina* it occupies larger surfaces.

Sweet chestnut (*Castanea sativa* Mill.) grows in central part of Croatia, especially on *Zrinska gora*, *Petrova gora* and *Medvednica*.

Norway spruce

**Identification of skills and gaps in forest genetics research capacity**

Skills:

- Team of researchers in Croatia,
- Wealth of genetic diversity, large number of different significant species
- Field trial plots of several species (Provenance tests)
- Recognition of the need for conservation of forest genetic resources (Program of preservation FGR is in phase of validation)
- Recognition of potential value of population on edge of areal for process of adaptation due to climate changes

Gaps:

- High cost of laboratory work for genetic markers for forest species - small number of researches
- Small number of projects concerning research of genetic diversity

**Survey and description of conservation and mitigation methods and actions with special reference to climate change**

In Croatia there are provenance test established of several most valuable species. The significant conservation processes started around middle of the last century and usually contains material from all parts of country including some international provenance trials.

Seed stands and seed orchard are also method of conservation which took place.

According to spatial plans several isolated populations will be included in new preservation areas such as reservations, parks of nature etc.

**Survey and description of available FGR**

The most valuable species also need the most monitoring and protection: *Q. robur*, *Q. pubescens*, *Q. ilex*, *Abies alba*, *Pinus nigra*, *Ulmus minor*.

- Seed stands: Almost all economically valuable species have their representatives as a seed stands. Today there are 3'924.01 ha of seed stands area in Croatia. Those forests are the most valuable forests and in future, the process of selection of seed stands will be with stress on climate change adaptive populations.
- Seed orchards: In Croatia there are 8 established seed orchards with *Quercus robur*, *Quercus petraea*, *Fraxinus angustifolia*, *Prunus avium* and *Pinus nigra* across the country in different provenance areas.
- Tested forest reproductive material of *Populus* sp. and *Salix* sp.

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.**

*Abies alba* – research of PhD Mladen Ivanković (morphological, molecular markers, provenance trial);

*Fagus sylvatica* - research of PhD Mladen Ivanković (provenance trial);

*Quercus robur* - research of PhD Ida Katičić Bogdan and Maja Popović, dipl.ing. (molecular and morphological markers, provenance test);

*Quercus robur* - research of PhD Sanja Perić, (provenance test, adaptive traits);

*Fraxinus angustifolia* – research of PhD Martina Temunović (molecular markers);

*Pinus sylvestris* - research of PhD Nevenka Čelepirović and PhD Mladen Ivanković (molecular markers);

*Pinus nigra* – research of PhD Saša Bogdan (provenance trials)

*Pseudotsuga menziesii* – research of PhD Sanja Perić, PhD Mladen Ivanković (provenance trial);

*Populus* and *Salix* sp. – Research of prof. PhD Davorin Kajba (provenance trials, tested forest reproductive material);

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Croatia has very variable environmental conditions and a lot of different types of vegetation in regard of small state size. There are a large number of different types of forests and species. Genetic diversity is significant due to differences in environmental conditions. There are 3 main types of climate: in the central and east part of the country is continental region. Going south-west, the climate becomes mountain and alpine. And in Submediterranean and Mediterranean, climate is mainly Mediterranean. By varying the other topographic conditions, it can be concluded that the conditions for a very large variety of plant life at the level of ecosystems, species, populations and individuals.

There are a large number of species populations that are affected by climate change and pernicious increase in temperature. Such species that are endangered with climatic changes are: common oak, silver fir, Downy oak, Field Elm and species such as pine, spruce and beech. Croatia has also the capacity for researching population on the edge of species range. Interest in research has confirmed by the increasing number of offspring tests. Such tests include

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populations that are at the edge of areal. There is also interest in investigating these populations to find out population potential for further information and in due time find individuals that are more tolerant of climate change impacts.

The problem is the high cost of laboratory work for the analysis of molecular and biochemical markers. Also, there are not a sufficient number of projects that support research, regarding to huge diversity of species. Research has mainly covered economic valuable species. Species that are not economically viable in terms of the use of timber, poorly researched.

In the last period, the program of conservation of forest genetic resources that should be adopted by the government. It provides more funds for research of genetic diversity. It is necessary that the people who make decisions in the field of forestry research identified the need for this kind of research. To do so, they need to be familiar with the issues and to present the results of an affirmative way to get the research. In this way, they will be able to align management systems for forest conservation and use of genetic material of the species.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

In Croatia the Government is the top level that provides information, projects and support for researches. There is one Forest Research Institute (Jastrebarsko) and one Faculty of Forestry (Zagreb) with departments for forest genetic. Collaboration between government and Public Forest Enterprise which manage forests and with national parks is satisfactory. Also, there are NGO organizations that take care about specific problems.

Several databases are available:

<http://portal.hrsume.hr/>

<http://jaska.sumins.hr/index.html>

<http://www.sumfak.unizg.hr/>

<http://www.mps.hr/>

**List of Experts/Contacts involved in FP 1202 MaP FGR**

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## National Report on MaP FGR

**Country** Cyprus

**Authors** Nicolas-George Eliades

### **Introduction Short description of the Country**

Cyprus is the third largest island of the Mediterranean covering an area of 9'251 Km<sup>2</sup>. It is situated at the north-eastern edge of the Mediterranean basin and lies across the boundary of the Euroasian and African continents. Two mountain ranges cross the island running from west to east; these are the Pentadactylos (northern) and Troodos (southern) mountain ranges, which are separated by the Mesaoria plain. The forest area in Cyprus is 386'718 ha (41.80% of the island area) and is classified into two major groups: forests land (188'388 ha) and other wooded land (198'330 ha). Out of the total forest area on the island, high forests comprise 84'209 ha and maquis and lower vegetation (scrub and phrygana) 104'179 ha. Forest areas in Cyprus are either natural forests (primary – undisturbed by man) or semi-natural. Nowadays the forest area (vegetation) is primarily found along the Troodos and Pentadaktylos ranges and along the coastal belt. Forests are absent in the Mesaoria which is characterized as semi-arid zone. Two major factors lead to the assumption that the populations of the core tree species on the island are marginal populations in the European level: (i) Cyprus is the southernmost part of Europe and (ii) the genesis of the island was the result of the Anatolian Plate collision with the African Plate, which has created the uplift of the Cyprus arc and Cyprus itself; hence, Cyprus has never been a part of mainland. Thus, the way in which different genetic aspects occur in the island's marginal populations, is of high genetic interest. However, the Department of Forests focuses on the conservation of the more restricted and narrowly distributed mountainous tree populations, such as: *Cedrus brevifolia*, *Pinus nigra spp pallasiana*, *Juniperus excels* and *Cupressus sempervirens*.

The fact that the earliest known human activity on the island dates around the 10<sup>th</sup> millennium BC, implies that human activity has had significant influence on the structure of nature in Cyprus. One could easily argue that the distribution of tree populations nowadays has resulted from intensive human impact, such as: forest fires, overgrazing, logging etc. Important negative impacts on the island's vegetation today are desertification and climate change. Both desertification and climate change have been affecting the viability of Cyprus flora, leading to dieback and secondary insect infestation of 6'000 ha of vegetation area.

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

***Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios***

The climatic map reflects the territorial distribution of climatic conditions based on the results of long-term observations. The climatic map of Cyprus is managed by the Meteorological Service (Ministry of Agriculture, Natural Resources and Environment, Cyprus). Such maps are available by the Meteorological Service (MS) upon request.

In general the climate in Cyprus is dry Mediterranean and is characterized by relatively short, mild and moist winter, which is followed by a long, hot and dry summer. The average rainfall is ~480 mm (varies between 300 mm at the central plain to 1'100 mm at Troodos' highest peak).

The temperature is concerned, during summer, and particularly in July and August, the average daily temperature varies between 29 °C at the Mesaoria plain and 22 °C at the highest peaks of Troodos. The respective temperatures during the winter (specifically January) are 10 °C and 3 °C. Snow is observed every year on the highest peaks of Troodos, mainly during the period of December - March.

Climatic maps including the future scenarios are available in two research studies by Giannakopoulos et al. 2010 and Hadjinicolaou et al. 2011. Besides, The Cyprus Institute has published the document entitled "Climate change and impacts in the Eastern Mediterranean and the Middle East" (<http://www.cyi.ac.cy/ewrc/general-information/downloads.html>). The future scenarios assume significant warming of 1 °C in winter to 2 °C in the summer for both maximum and minimum temperatures. Rainfall is projected to decrease by 2–8%, although this is not statistically significant (Giannakopoulos et al. 2010, Hadjinicolaou et al. 2011). Such results will lead to the shift of the mean climate to a warmer state, with a relatively strong increase in the warm extremes. Besides, the precipitation frequency is projected to decrease at the inland and at the coastal, while the mountainous could experience more frequent 5–15 mm/day rainfall (Giannakopoulos et al. 2010, Hadjinicolaou et al. 2011). The very hot days are expected to increase by more than 2 weeks/year and tropical nights by 1 month/year. The annual number of consecutive dry days shows a statistically significant increase (of 9 days) (Giannakopoulos et al. 2010, Hadjinicolaou et al. 2011).

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology***

The geological genesis of Cyprus took place through a series of tectonic episodes. It was initiated with the subduction of the African Plate beneath the Eurasian Plate and the formation of the Troodos Ophiolite (Upper Cretaceous, 90 Ma). An abrupt uplift of the area occurred during the Pleistocene (approximately the last 2,5 million years) when the Troodos and Pentadaktylos Ranges were uplifted to elevations even higher than today's. The island is divided into four geological Terranes, which are the: Keryneia Terrane, Troodos Terrane (or Troodos Ophiolite complex), Mamonia Terrane and Circum Troodos Sedimentary Succession. The geological structure of Cyprus has global scientific interest from the academic committee. Hence, the geological maps of Cyprus are being published by the Department of Geological Survey. Recently the Department of Geological Survey has also published the Geochemical Atlas of Cyprus (five-year project).

***Identification of pedo-climatic parameters characterizing species ranges***

The varied geomorphology of Cyprus and the intense fluctuations of temperature and rainfall in different areas have resulted in the creation of many different habitat types. There is not any specific investigation on pedo-climatic parameters characterizing species ranges. The species and/or habitat types range are described based on bioclimatic characterisation using climatic data (temperature and rainfall) and elevation. Based on bioclimatic characterization there are eight bioclimatic zones.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

***Identification of most relevant species***

The indirect role of forest genetic resources is of great importance for the ecology and economy sectors. The main commercial-value species of Cyprus forests is *Pinus brutia* (southern limits of the species), which constitutes about the 60% of the State forests and 90% of the growing stock. Nevertheless, there are additional species that are identified as priority by MaP FGR. Such species are two endemic tree species (*Cedrus brevifolia* and *Quercus alnifolia*), eight native tree species (*Pinus nigra* ssp. *pallasiana*, *Juniperus foetidissima*, *Juniperus excels*, *Juniperus phoenicea*, *Cupressus sempervirens*, *Quercus infectoria* ssp. *veneris*, *Platanus orientalis*, *Alnus orientalis*) and three exotic species (*Eucalyptus spp.*, *Ailanthus altissima*, *Acacia saligna*).

***Identification of skills and gaps in forest genetics research capacity***

In Cyprus the skills and facilities for research in forest genetics are very poor and only a very low proportion of the forestry budget goes to forest genetic resources. This is due to the lack of a national research institute or university school dealing with forestry. The few existing research studies in forest

genetics are carried out by young scientists through their postgraduate studies (MSc and/or PhD study) in Institutes abroad.

**Survey and description of conservation and mitigation methods and actions with special reference to climate change** Cyprus has endorsed numerous conventions and European directives, legislative or policy provisions, relevant to conservation and mitigation methods and actions with reference to climate change. The main issues arising from these methods will be adopted in the national strategy for adaptation to climate change entitled: “Development of a national strategy for adaptation to climate change adverse impacts in Cyprus”.

**Survey and description of available FGR** Most forest ecosystems on the island are under conservation programs, since they are characterised by vulnerability and fragility. Inventories and surveys are carried out for a number of plant species (i.e. *Pinus brutia*, *Cedrus brevifolia*, *Quercus alnifolia*, *Pinus nigra* ssp. *pallasiana*, *Juniperus foetidissima*, *Juniperus excels*, *Juniperus phoenicea*, *Cupressus sempervirens*, *Quercus infectoria* ssp. *veneris*, *Platanus orientalis*, *Alnus orientalis*, *Eucalyptus* spp., *Ailanthus altissima* and *Acacia saligna*), mostly for conservation and management purposes and not exclusively for in situ forest genetic resources conservation purposes. Additionally, surveys and monitoring are carried out for species included in EC Habitats Directive (92/43/EEC) and more specifically for the eight priority plant species of the directive that occur in Cyprus. *P. brutia* is the only species for which seed and clonal orchards have been established. Despite that these orchards are maintained, there is no collection of reproductive material and no testing has been applied. On the other hand ex situ conservation measures are applied for wild plant species following two main activities: storage of seed lots in Seed Banks and long-term survival of the targeted species outside their natural environment, through the establishment of particular sections within the Botanical Gardens and/or provenance trials. The National Seed Bank has been established in 1985 in the Agricultural Research Institute (ARI) of Cyprus and it hosts 970 seed lots from 220 taxa (30 taxa are cultivated and 190 taxa are wild plant species). The live collections of plants are maintained in three botanic gardens: Athalassa, Troodos and Paphos.

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive** The gap in forest genetics research in the academic and scientific communities in Cyprus is an important parameter for the low number of investigation of other species with relevant genetic parameters. Most of the studies that have been carried out focused on the main tree species of the island: *Pinus brutia* (isozyme, molecular markers, morphological traits), *Cedrus brevifolia* (isozyme, molecular markers, morphological traits), *Quercus alnifolia*

*traits.* (isozyme, molecular markers, morphological traits), *Quercus coccifera* (molecular markers, morphological traits) and *Quercus infectoria ssp. veneris* (molecular markers). Recently an investigation in four (*Arabis kennedyae*, *Astragalus macrocarpus subsp lefkerensis*, *Centaurea akamantis* and *Oprhys kotshyi*) out of the eight priority species according to the EU directive 92/43/ECC was carried out using anonymous molecular marker (AFLP). In addition, several samples of wild plant species from Cyprus have been included in phylogenetic studies.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

The forests of Cyprus are an important national resource which provides not only timber but also non-wood forest products. The Department of Forests (DF) is responsible for the management and protection of state forests, including National Park Forests and Forest Nature Reserves; it is also the legal body for implementing the national forests inventory. The high human impact on nature in Cyprus during the previous centuries (and decades) has led the DF to develop and apply sustainable management measures mainly focusing on the protection of state forests from biotic and abiotic factors. However, the lack of research and academic activity in Forest genetics, as well as the fact that a very low amount of the Forestry budget (DF) goes to forest genetic resources, lead to the absence of high-level science on forest genetics.

Nevertheless, the Ministry of Agriculture, Natural Resources and Environment, Cyprus, hosts several Departments that focus on sustainable management of the natural resources in Cyprus. These Departments (i.e. Department of Forests, Department of Environmental, Geological Survey Department and Meteorological Service) have informative databases. The data from these databases could be combined in order to create climate maps with future scenarios on species distribution. These maps must be supported by genetic information (derived from pure forest genetics researches through researcher projects). Also of great importance is the finalization and implementation of the national strategy for adaptation to the adverse impacts of climate change in Cyprus. The national strategy for adaptation to climatic change must include the need for the conservation of marginal forest tree populations' genetic resources. Besides, the seeds storage in Seed Banks must be continuous, but with the assumption that seedlots from different regions (forests) should be stored separately. Last but not least is the need for evaluating the existing provenance test of native species in different geographical locations.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

A networking activity in Italy on MaP does not exist: however some data can be found in the databases

*FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)*

compiled within European Projects to which several Italian Institutions take part (see above for details). MaP have been studied for many species and data are available.

The forest genetics area in Cyprus is very limited, and, hence, there is an absence of intra-island networking, training school and/or communication activities on Forest Genetics. The Cyprus Government has signed a number of conventions on the conservation and sustainable use of forest genetic resources (CBD, UNCCD, RAMSAR, CITES, BERN). Guidelines from the United Nations Convention to Combat Desertification (UNCCD) have contributed to the preparation of the national plan for combating desertification while all other conventions further support national measures for conserving biodiversity and sustainability of forest genetic resources. Additionally, the International collaboration representative from Cyprus has participated in European networking activities, such as: European Forest Genetic Resources Program (EUFORGEN) [Phase II and Phase III (2002-2010)], FPS COST Action FP1202. In electronic format, a database about the National Data Base is being managed by the Agricultural Research Institute (ARI) of Cyprus.

**List of Experts/Contacts involved in FP 1202 MaP FGR**

No expert available

## National Report on MaP FGR

**Country** Czech Republic

**Authors** Josef Frydl, Pavel Formanek, Pavlina Machova

**Introduction** The Czech Republic lies mostly between latitudes 48° and 51° N (a small area lies north of 51° N), and longitudes 12° and 19°E. Coniferous species dominate in forest stands (74%), Norway spruce (*Picea abies*) is dominant tree species followed by pine (*Pinus sylvestris*) and beech (*Fagus sylvatica*). Exceptional and rare forest types are floodplain and riparian forests and stands of watercourses. Cambisols are prevailing type of forest soils (67.3%) within the Czech Republic (UHUL 2007). Concentrations of SO<sub>2</sub> as main significant factor of forests damage (due to power plants using brown coal) in seventieth and eighties (also in 1996 in Ore Mountains) are reduced. Global change impact on forests via drought was most significant (in year 2011) in South-East and North-East part of the country; occurrence of Norway spruce needles yellowing on large areas was recorded in some parts of the country. Symptoms of needles damage by ozone were reported in ridge part of some mountain areas (Jeseníky and Eagle Mts). Informative maps and data surveys of coniferous and broadleaf forests distribution within the Czech Republic and individual regions of the country are on

**Short description of the Country**

<http://www.uhul.cz>.

- Regarding current time (2016), forest land covers 2'669'850 ha in the Czech Republic out of a total area of 7'887'015 ha. The composition of forest tree species has considerably changed in the past two and a half centuries as a result of intensive forest management. Replacement plantations of coniferous tree species have also been recommended since the 18<sup>th</sup> century.
- While the natural species composition included beech (40.2%), oaks (19.4%), fir (19.8%), spruce (11.2%) and pine (3.4%), the present species composition is rather different. The proportions of spruce (50.5%) and pine (16.4%) are higher. Oaks (7.2%), beech (8.3%) and fir (1.1%) are under-represented with regard to the original species distributions.

(Adapted according Report about Forest State and Management of the Czech Republic in 2016 – [www.uhul.cz](http://www.uhul.cz)).

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

**Rekonstruovaná přirozená a současná skladba lesů (v %) Natural and current of tree species (% of forest land area)**

Skladba lesů Composition	smrk spruce	jedle fir	borovice pine	modřín larch	ostatní jehličnaté other conif.	celkem jehličnaté total conifers	dub oak	buk beech	habr hornbeam
Natural	11,2	19,8	3,4	0,0	0,3	34,7	19,4	40,2	1,6
Current	50,5	1,1	16,4	3,8	0,3	72,1	7,2	8,3	1,3
Recommended	36,5	4,4	16,8	4,5	2,2	64,4	9,0	18,0	0,9

	jasan ash	javor maple	jilm elm	bříza birch	lipa linden	olše alder	ostatní listnaté other broadl.	celkem listnaté total broadl.	holina unstocked area
Natural	0,6	0,7	0,3	0,8	0,8	0,6	0,3	65,3	0,0
Current	1,4	1,4	0,0	2,8	1,1	1,6	1,6	26,7	1,2
Recommended	0,7	1,5	0,3	0,8	3,2	0,6	0,6	35,6	0,0

(Adapted according Report about Forest State and Management of the Czech Republic in 2016 – [www.uhul.cz](http://www.uhul.cz)).

**Species composition in ha and in % of total timber land**

Species	Year					
	2000	2010	2013	2014	2015	2016
	Timber land in ha and %					
Norway spruce	1 397 012	1 347 239	1 327 398	1 319 733	1 315 487	1 312 204
	54.1	51.9	51.1	50.7	50.6	50.5
Fir	23 138	25 869	27 509	28 251	28 699	29 086
	0.9	1.0	1.1	1.1	1.1	1.1
Pine	453 159	436 308	431 721	429 636	428 030	425 687
	17.6	16.8	16.6	16.5	16.5	16.4
Larch	97 170	100 761	100 917	100 749	100 283	99 917
	3.8	3.9	3.9	3.9	3.9	3.8
Other conifers	4 586	6 352	7 048	7 755	7 846	8 068
	0.2	0.2	0.3	0.3	0.3	0.3
Total conifers	1 975 065	1 916 529	1 894 593	1 886 124	1 880 344	1 874 961
	76.5	73.9	72.9	72.5	72.3	72.1
Oak	163 761	178 466	184 180	184 441	185 044	186 718
	6.3	6.9	7.1	7.1	7.1	7.2
Beech	154 791	189 998	202 638	207 595	211 835	215 535
	6.0	7.3	7.8	8.0	8.2	8.3
Birch	74 560	72 264	71 628	71 779	71 796	71 579
	2.9	2.8	2.8	2.8	2.8	2.8
Other broadleaves	183 696	209 559	215 602	219 363	219 207	221 243
	7.1	8.1	8.3	8.4	8.4	8.5
Total broadleaves	576 808	650 287	674 048	683 178	687 882	695 075
	22.3	25.1	25.9	26.3	26.5	26.7
Total excl. unstocked areas	2 551 873	2 566 816	2 568 641	2 569 302	2 568 227	2 570 036
	98.8	98.9	98.8	98.7	98.8	98.8

Source: FMI

(Adapted according Report about Forest State and Management of the Czech Republic in 2016 – [www.uhul.cz](http://www.uhul.cz)).

In the Czech Republic, among marginal tree species it is possible to mention some introduced (non-native) species, both coniferous and broadleaved, e.g. introduced species of genera *Abies*,

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

*Pinus, Larix, Juglans, Quercus*, and others.

Most common non-native tree species in the Czech Republic are black locust (*Robinia pseudoacacia*, 13'438 ha, 0.6% of forest land), red oak (*Quercus rubra*, 5586 ha, 0.2%), Douglas fir (*Pseudotsuga menziesii*, 5'335 ha, 0.2%) and grand fir (*Abies grandis*, 1'232 ha, 0.1%). Non-native spruce species from which is most common blue spruce (*Picea pungens*) covers 8'741 ha (0.4%) (UHUL 2007).

Less common species which were in the national forest inventory included into an aggregate category "other coniferous species (406 ha, 0.0%) and other broadleaved species (4'3704 ha, 1.8%) include from the non-native species *Acer negundo* (177 localities, 337 ha *Aesculus hippocastanum* (181 localities, 552 ha), *Castanea sativa* (25 ha), *Fraxinus americana*, *Juglans regia* (84 ha), *Pinus nigra* (3'689 ha), *Pinus strobus* (3'090 ha), *Populus x canadensis* (1934 ha), *Prunus serotina* (12,4 ha) (Mlíkovský et Stýblo 2006).

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

*Inventories of regional/national maps and/or links to web sites concerning location of soil types and morphology*

*Inventories of regional/national maps and/or links to web sites of climatic maps including future scenarios*

An initial screening allowed to find the following references:

- Maps produced by the Czech Geological Survey: <http://www.geology.cz/extranet-eng/maps/online/map-applications>
- Soils of Europe: <http://eusoiils.jrc.ec.europa.eu/>
- Status of Soil Surveys, Inventory and Soil Monitoring in the Czech Republic (NĚMEČEK et KOZÁK 2005)
- <http://www.eea.europa.eu/> (e.g. soil organic carbon: <https://www.eea.europa.eu/data-and-maps/indicators/soil-organic-carbon-1/assessment>)
- <http://isric.org/index.php/about>
- <http://www.cgiar-csi.org/>  
<http://www.jpl.nasa.gov/>

An initial screening allowed to find the following references:

- European Climate Assessment & Dataset project (<http://www.ecad.eu/>)
- Data concerning climate change scenarios: CzechGlobe - Global Change Research Institute of the Czech Academy of Sciences (<http://www.czechglobe.cz/en/>)
- <https://ec.europa.eu/jrc/en>
- <http://www.cgiar-csi.org/>
- Climate change: <http://www.zmenaklimatu.cz/cz/>

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

- (e.g. <http://www.zmenaklimatu.cz/cz/knihovna/studie/68-cesky/1133-zpresneni-dosavadnich-odhadu-dopadu-klimaticke-zmeny-a-navrhy-adaptacnich-opatreni-v-cr>)
- <http://r.fld.czu.cz/vyzkum/maps-kolm.html>
- Scenario of vegetation zone changes in the Czech Republic: ten years after (Buček et Vlčková 2009). Likely impact of a climate change on European Forests (Janouš 2006).

**Identification of pedo-climatic parameters characterizing species ranges**

Norway spruce (*Picea abies*) accepts precipitation limit 300 mm in period May - August and annual precipitation <600 mm causes drought stress. Lower temperature limit for irreversible damage of needles is -38 to -40 °C. Within climatic optimum is spruce indifferent to soil (Holuša et Liška 2002). Beech (*Fagus sylvatica*) occurs in Czech Republic within 220 – 1'200 m. above sea level and does not sustain dry sandy soils or clay wet soils. Pine (*Pinus sylvestris*) is adapted to annual precipitation range 200 -1780 mm with growth on sandy acidic sites. Silver fir (*Abies alba*) occurs in 300 – 1'100 m. above sea level and is sensitive to drought.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species**

The total area of main coniferous species, i.e. spruce, pine and larch, further declined, while the share of fir has been continuously showing a slight growth. In contrast, the share of broadleaves, particularly beech, has been augmenting. When assessing the species biodiversity of national forests, the overall proportion of individual tree species is the major indicator, along with the distribution of forest stand mixtures within individual units of spatial arrangement of forests. The proportion between individual tree species within a unit has been continuously increasing in favour of mixed forest stands and forest stands with prevailing broadleaves, which was also the case in the year 2014. This increasing trend is a result of foresters' permanent efforts to acquire an optimum species composition of forests, a practice that enjoys a long-term support under a goal-oriented national subsidy policy.

[http://eagri.cz/public/web/file/433136/ZZ2014AJ\\_16112015.pdf](http://eagri.cz/public/web/file/433136/ZZ2014AJ_16112015.pdf)

Especially, as absolute marginal tree species in the Czech Republic there are mentioned in the Law No. 395/1992 Coll. (Law on the Protection of Nature and Landscape). This legislative document regularly updates summary of specially protected organisms in the Czech Republic, including trees. Currently listed tree species are e.g.: *Sorbus sudetica*, *Sorbus aria*, *Taxus baccata*, *Quercus pubescens*, etc. In addition to the listed trees it is possible to mention various shrubs and low bushes - the full list can be found for example on the Arnika web page (<http://arnika.org/>; <http://english.arnika.org/>, respectively. ("Arnika" is a Czech non-governmental organization uniting people seeking better environment). Also, survey of such marginal tree species is possible to find in the § 49 Act no. 114/1992 Coll., Nature Conservation and landscape (<http://www.mzp.cz/ris/vis-legcz-en.nsf/0/363C50D843387F0BC>

[125746B0035E3A0/\\$file/19920114Sb.pdf](https://www.vulhm.cz/file/19920114Sb.pdf).

As mentioned above, in the Czech Republic, among marginal tree species it is possible to mention some introduced species, both coniferous and broadleaved, e.g. introduced species of genera *Abies* (e.g. Frýdl and Koblíha 2004, Frýdl 2005, Koblíha and Janeček 2001, 2003, 2005; Šindelář and Beran 2007a, 2007b, Šindelář et al. 2006) *Pinus* (e.g. Beran et Šindelář 2000, Fulín et al. 2017, Kaňák J. 1996, 1999, 2004; Kaňák K. 1971, Novotný et al. 2017), *Larix* (Frýdl and Šindelář 2003a, 2003b, Šindelář and Frýdl 2003), *Juglans*, *Quercus*, and others.

**Identification of skills and gaps in forest genetics research capacity**

Czech Republic has available some genetic information about population of tree species. The genetic characterization of selected tree species populations was processed using DNA analyses, mainly using SSR markers. On the base of obtained results, **genetic maps** (Čáp et al 2016; Fulín et al 2016a, 2016b; Novotný et al 2016a, 2016b) and **scientific papers** (Cvrčková et al 2013, 2015, 2017; Čurn et al 2014;) have been published for selected tree species – see following links.

**Genetic maps – Norway spruce:**

[http://www.vulhm.cz/sites/File/vydatelska\\_cinnost/lesnicky\\_pruvodce/LP\\_2\\_2017.pdf](http://www.vulhm.cz/sites/File/vydatelska_cinnost/lesnicky_pruvodce/LP_2_2017.pdf);

**Genetic maps – Scots pine:**

[http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP\\_19\\_2016.pdf](http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP_19_2016.pdf);

**Silver fir:** [http://www.vulhm.cz/sites/files/Informatika/LP\\_5\\_2016.pdf](http://www.vulhm.cz/sites/files/Informatika/LP_5_2016.pdf);

**Genetic maps – European beech:** [http://www.vulhm.cz/sites/files/Informatika/LP\\_4\\_2016.pdf](http://www.vulhm.cz/sites/files/Informatika/LP_4_2016.pdf);

**Genetic maps – Oaks:**

[http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP\\_16\\_2016.pdf](http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP_16_2016.pdf)

[http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP\\_12\\_2016b.pdf](http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP_12_2016b.pdf)

**Genetic maps – Elms:**

[http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP\\_6\\_2013.pdf](http://www.vulhm.cz/sites/files/Informatika/Metodiky/LP_6_2013.pdf).

From the viewpoint of forest practice measures, practically realized in long-term scale, classical methods of *in situ* and *ex situ* measures are currently prevailing.

As subject of research, there are biomolecular methods using with aim to identify genetic characteristics of tree populations, e.g. with the aim to verify level of polymorphism of some tree species populations. Research is aimed e.g. to identify genetic distance of the monitored populations in comparison with their geographic distance, etc.

**Survey and description of conservation and mitigation methods and**

**Genetic resources** - genetic material of plants, animals or micro—organisms of value as a resource for future generations of humanity;

**Forest genetic resources** or **forest tree genetic resources** are (according e.g. Wikipedia, LEFEVRE et al. 2013) genetic material of shrub and tree species of actual or future value, conserved *in situ*;

**actions with special reference to climate change**

**Forest genetic resources** are essential for forest-dependent communities who rely for a substantial part of their livelihoods on [timber](#) and [non-timber forest products](#) (for example fruits, gums and resins) for food security, domestic use and income generation.

**Forest genetic resources** are also the basis for large-scale wood production in planted forests to satisfy the worldwide need for timber and paper.

**Genetic resources** of several important timber, fruit and other non-timber tree species, incl. rare, threatened, etc., are conserved [ex situ](#) in gene banks or maintained in field collections.

Nevertheless [in situ conservation](#) in forests and on farms is in the case of most tree species the most important measure to protect their genetic resources.

In the Czech Republic, conservation methods are provided both as *in situ* and *ex situ* measures:

- **In situ measures:**
  - Selection, certification and registration of seed stands (certified for seed collection);
  - Selection, certification and registration of „plus trees“ (for seed orchards establishment);
  - Selection, preservation and conservation of forest tree species genetic resources;
  - Clonal collections (archives) established in original localities of selected clones;
  - Selection, certification and registration of GDCU (Genetic Dynamic Conservation Units).
- **Ex situ measures:**
  - Clonal collections (archives) established in *ex situ* localities;
  - Seed banks with samples of valuable, rare or threatened tree species;
  - Banks of valuable, rare or threatened tree species explants.

**Survey and description of available FGR**

In the Czech Republic, as one of the most important practical measure to conservation of forest genetic resources, it can be mentioned selection, certification and management of **Dynamic Genetic Conservation Units** (DGCU) – as considerable practical *in situ* treatment for preservation, conservation and reproduction of partial populations of valuable genetic resources of forest tree species.

Those sub-populations of significant and valuable forest tree genetic resources or their residues are in their continued existence more or less at risk.

In the last decades, there is paid still increasing attention to DGCUs not only in the European countries.

In the Czech Republic, as well as in other European and non-European countries, these sub-populations of significant and valuable forest tree genetic resources or their remnants retrieved, are registered and implemented measures to rescue their preservation and reproduction.

**Dynamic Genetic Conservation Units** (DGCU) are complexes of mostly original forest stands and their fragments (e.g. Buriánek et al 2014, Šindelář 2004, Frýdl 2012, Frýdl and Šindelář 2007, Frýdl et Novotný 2011, Novotný et al 2008, Novotný and Frýdl 2009a, 2009b; Pařízek

and Frýdl 2011).

**Importance DGCU from the forestry management point of view:**

- The original population of forest tree species have been growing at particular locations, under natural selection and are therefore well adapted to local environmental conditions.
- They are therefore of considerable importance for forestry, in particular with regard to their potential stability, adaptation to local conditions and the expected environment adaptability to any possible potential changes in the environment.
- Natural regeneration as the basic regeneration method is preferred (for tree species of DGCU's interest).
- In case of need of artificial renewal in DGCU - only reproductive material from this DGCU.
- In the Czech Republic, reasons for certification of DGCU's are also motivated by need to protect and manage forest genetic resources of some technically valuable ecotypes of forest tree species.

Among various discussed ways, how to adapt forest management in response to the challenges of expected environmental (climate) change, there used to be discussed also need to pay a bigger attention to provenance research aimed especially on such forest tree species, which are supposed to be more resistant e.g. to increased average site temperature, changes in site moisture regimes, etc.

In the Czech Republic, in frame of FGMRI research activities, there has been paid attention in long-term provenance research to testing of various „exotic“ introduced species, in that sense.

***Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.***

See also Part 2. (above), concerning the identification of skills and gaps in forest genetics research capacity in the Czech Republic.

In the Forestry and Game Management Research Institute (FGMRI), Department of Forest Tree Species Biology and Breeding, there used to be used also methods *ex situ* for valuable and threatened tree species genetic resources preservation and reproduction. As micropropagation techniques, somatic embryogenesis and organogenesis are realized. These micropropagation techniques used to be used for reproduction of valuable tree species populations, threatened tree species populations, endemic populations, improved breeding populations, incl. gene manipulations.

In FGMRI is established the Archive of Forest Tree Species Explants, which includes about 30 forest tree species of the Czech Republic forest ecosystems, including several critically

threatened species.

As for other activities, general strategy for preservation and reproduction of Noble Hardwoods gene sources have been worked out and presented by FGMRI specialists for practical use in the Czech Republic forest practice (management). Also, still inventory of red yew representation in forest stands, including other research activities with this species, is being realized in the Czech Republic, too.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

This analysis has not been synthetically worked out yet. Nevertheless, on several scientific and research work places, as Forestry and Game Management Research Institute (FGMRI), Faculty of Science on Charles University in Prague, Agricultural University in Prague, Mendel University in Brno, and others, there have been continuously realized various research projects, aimed to research of available ecological and genetic information both for main and marginal tree species populations.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

Similarly, as in case of other interviewed countries of COST Action FP1202, any networking activity in the Czech republic on MaP does not exist: however some data can be found in the databases compiled within European Projects in which the Czech Republic participated (TREEBREEDDEX, COST project with European beech, etc...

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## National Report on MaP FGR

**Country** Finland

**Authors** Matti Rousi, Mari Rusanen

**Introduction** Geographically, Finland lies in an intermediate zone between maritime and continental climates, belonging for the most part to the boreal vegetation zone. Finland is situated between the northern latitudes 60° and 70°, but because of the warming effect of the Gulf stream the climate is in many respects more favourable than in areas at similar latitudes in Canada and Russia, for instance. Conditions for growth vary considerably between the southern and northern parts of the country, which is also an important factor in the use of forest regeneration material. Towards the north, the climate gets increasingly colder and more humid, and the precipitation exceeds evaporation. The growth period is about five months in the south and three months in the north. The average increment of growing stock in southern Finland is 6.1 cubic meters per hectare, twice the increment in northern Finland. All native tree species in Finland have their northern margin somewhere within the country. The supply of well adapted forest reproductive material of high quality is essential for the Finnish forestry and consequently the whole forest sector.

**Short description of the Country**

In Finland some of the expected consequences of a possible general climate warming are that the occurrence of extreme events (gales, storms) will grow and humidity will increase especially wintertime. For the considerations of future forest regeneration material it has to be kept in mind that the present light conditions will not change.

Three fourths of the land area of Finland, total 338'432 km<sup>2</sup>, is covered by forests. The forest area, 22.2 million hectares, has remained almost unchanged over the last 50 years, whereas the volume of the growing stock has increased by more than 40% in the same period. Finland's forests represent the country's most significant renewable natural resource and they are managed and utilised in accordance with the principles of sustainable development.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventory of regional/national maps and/or links** [K. Ruosteenoja, J. Räisänen, P. Pirinen](#) 2011. Projected changes in thermal seasons and the growing season in Finland. Int J Climatol , 31:1473-1487. DOI: [10.1002/joc.2171](https://doi.org/10.1002/joc.2171).

**to web sites of climatic maps including future scenarios** Spangenberg, J., Carter, T., Fronzek, S., Jaeger, J., Jylhä, K., Kühn, I., Omann, I., Paul, A., Reginster, I., Rounsevell, M., Schweiger, O., Stocker, A., Sykes, M., Settele, 2012. J. Scenarios for investigating risks to biodiversity. Global Ecology and Biogeography, 21(1): 5–18. DOI: 10.1111/j.1466-8238.2010.00620.x

Ylhäisi, J.S., Tietäväinen, H., Peltonen-Sainio, P., Venäläinen, A., Eklund, J., Räisänen, J., and Jylhä, K., 2010: Growing season precipitation in Finland under recent and projected climate, Nat. Hazards Earth Syst. Sci., 10, 1563-1574, doi:10.5194/nhess-10-1563-2010.

Jylhä, K., Tuomenvirta, H., Ruosteenoja, K., Niemi-Hugaerts, H., Keisu, K. and Karhu, J.A., 2010. Observed and projected future shifts of climatic zones in Europe, and their use to visualize climate change information. Weather, Climate, and Society, 2:2, 148-167.

**Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology** International soil classifications seem to be relatively unsuitable for forest soils in Finland, because the important organic layer is not taken into account at all. Instead of many separate soil classes based on soil formation processes or associated properties, the use of continuous variables would be more useful for primary soil users. Traditionally, Finnish soil maps are based on soil texture and geomorphology

The World reference base soil classification system (WRB) was used in a study by Tamminen and Tomppo. The soil type was predicted on about 67'400 National forest inventory sample plots and a subsample of 285 plots were inventoried by the soil survey teams. The frequencies of soil types were estimated over the whole country. The most frequent soil types were Podzols (50%), Histosols (25%), Arenosols (11%) and Leptosols (9%). Finer-textured soils, Cambisols (1.9%), Gleysols (1.4%) and Regosols (1.2%), had only a small proportion.

Tamminen, P. and Tomppo, E. 2008. Finnish forest soils. Working Papers of the Finnish Forest Research Institute. <http://www.metla.fi/julkaisut/workingpapers/2008/mwp100.htm>

**Identification of pedo-climatic parameters characterizing species ranges** Pedo-climatic parameters are not generally used for characterization of species ranges in Finland. The main factors describing species range are climatic. For birches, excess of water limits growth of *Betula pendula* whereas *B. pubescens* is better adapted to wet conditions.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species** The economically most important species in Finland are *Pinus sylvestris*, *Picea abies* and *Betula pendula*. All three are widespread with continuous distribution and extensive gene-flow by both pollen and seed. Furthermore, they show pattern of clinal variation in adaptive traits. The northern distribution line of these species is in northern Finland.

Several rare broad-leaves grow in South Finland either mixed with other species or forming small stands. These species are *Acer platanoides*, *Fraxinus excelsior*, *Tilia cordata*, *Ulmus galbra*, *Ulmus laevis* and *Quercus robur*. Typically the gene flow between stands is limited and some populations also show slight inbreeding. A rare conifer is *Taxus baccata* which grows on

Åland islands.

**Identification of skills and gaps in forest genetics research capacity**

Not available

**Survey and description of conservation and mitigation methods and actions with special reference to climate change**

The National Plant Genetic Resources Programme (2001) lists 15 native tree species that are included in the genetic conservation strategy and for each species sets the main targets and measures, according to the priorities and the level of threat. The reasoning behind the selection of principal methods has been that *in situ* conservation is used for species that are fairly common, have continuous distribution and extensive gene flow. Therefore *in situ* conservation is used as the principal method for *Pinus sylvestris*, *Picea abies*, *Betula pendula* and *B. pubescens*. These species are also the main commercial species in Finland. For the rare and scattered broad leaved species the principal conservation method is *ex situ*, in living trees grown in extensively managed collections. Genetic conservation of forest tree species is listed as a measure for preparing for climate change in two important strategies, namely the Finland's national adaptation strategy to climate change and the Finnish National Forest Programme.

**Survey and description of available FGR**

The nurseries produce some 160 million seedlings (mostly *Picea abies* and *Pinus sylvestris*) every year. In the 2000's, the first-generation qualified seed orchards comprising phenotypically selected plustrees have produced 50%–60% of the seed used by forest nurseries. The amount of qualified orchard seed collected annually has varied from about 1500 to 6500 kgs in *P. sylvestris* and from zero to 1500 kgs in *Picea abies*. Most of the improved Scots pine seed is consumed in direct seeding. Nurseries use 500-600 kgs of qualified *P. sylvestris* and 1000 to 1300 kgs of seed qualified *P. abies* seed annually.

The production of the first-generation seed orchards is gradually diminishing, and they are being replaced by 1,5 generation elite seed orchards which comprise the 25-35 best progeny-tested plustrees of the region. In Finland, private companies and semi-private forestry organizations have established about 500 hectares of elite seed orchards since 1997. These have been clonal seed orchards except for 43 hectares of seedling seed orchards established in *P. abies*. According to the state-run forest seed procurement program, some 240 more hectares of elite seed orchards will be established until 2025.

For the major species, improved seed is available for commercial use on market-price basis and for research as part of domestic and international cooperation. For rare species there is very little reproductive material on the market. The material is mostly source identified although some seed orchards have been established.

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.**

University of Oulu, Outi Savolainen: genomic tools to resolve the genetic basis underlying genetic variation in adaptive traits, such as timing of growth in Scots pine, the evolution of reproductive isolation and genetics of speciation (also to some degree) with Scots pine <https://wiki.oulu.fi/display/PGG/Outi+Savolainen>

University of Helsinki, Jaakko Kangasjärvi, how plants sense and transmit stress signals at the cellular level, the primary focus is on understanding the signalling networks involving reactive oxygen species (ROS). <http://www.helsinki.fi/biosci/plantstress/>

University of Helsinki, Tapio Palva, a multidisciplinary approach including molecular, genetic, biochemical and physiological studies to understand the molecular mechanisms of this adaptation and to apply this knowledge to plant breeding. <http://f1000.com/prime/thefaculty/member/2776332463718640>

University of Eastern Finland, Elina Oksanen, Interactions of ozone, carbon dioxide, global warming, water stress, and other abiotic stress factors in plants and acclimation of birch to climate change <http://www.uef.fi/biologia/oksanen>

FFRI, Pertti Pulkkinen, acclimation of forest tree species/origins to “climate of 2050”

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Not available

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

Not available

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## National Report on MaP FGR

**Country** France

**Authors** B. Fady, B. Musch, C. Besacier, N. Picard, P. Bouillon

**Introduction** This description for France focuses on metropolitan France, i.e. in European France in the geographical sense. French overseas territories are outside of the scope of this report. France has a surface of 551'500 km<sup>2</sup>. Its forest area covers 16.7 million ha and occupies 30% of the land. The French forest is mostly temperate and can be subdivided into 11 ecological regions (GRECO) depending on the dominant climate (oceanic, continental, mountain, Mediterranean) (National Forest Inventory, <http://inventaire-forestier.ign.fr/spip/>). Broadleaves make up 61% of the total standing wood volume with over 1'200 m<sup>3</sup>. The number of autochthonous forest trees in metropolitan France is consequently quite large, with 16 conifers and 58 broadleaves. In addition, six conifers and three broadleaves of exotic origin can be considered as acclimatized, possibly as land-races. Finally, 35 exotic conifers and 19 exotic broadleaves can be regularly seen in French metropolitan forests. The three most abundant species are *Quercus robur* (12% of standing volume), *Quercus petraea* (12%) and *Fagus sylvatica* (11%), all broadleaves. The two most common conifers are *Abies alba* and *Picea abies*, both 8% of standing volume (French report to FAO state of the world Forest Genetic Resources, <http://agriculture.gouv.fr/inventaire-national-des-ressources-genetiques-forestieres>). Most autochthonous species in this list have marginal populations in France, either in the Mediterranean or in mountains. Forest cover increases by approx. 0.7% annually since 1980 and has doubled since the end of the XIX<sup>th</sup> century. Most of the increase in forest cover during the past 100 years has occurred in Mediterranean France, Brittany and the Loire Valley, and is due to land use change, away from grazing and agriculture (National Forest Inventory, <http://inventaire-forestier.ign.fr/spip/>). Climate change is affecting forests in the form of die-back at low elevation and on shallow soil. France has adopted a National Strategy for adapting to climate change which includes considerations on forest genetic resources.

**Short description of the Country**

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at northern limits of the species.**

**Inventories of regional/national maps and/or links to web sites of climatic maps including** The National Forest Inventory (<http://inventaire-forestier.ign.fr/spip/>) provides statistics on presence of species in forest habitats and can be used to produce maps. In addition, an inventory of ecological regions (GRECO, <http://inventaire-forestier.ign.fr/spip/spip.php?rubrique211>) can be used to map habitats. In terms of climate, the most relevant model is SAFRAN (<https://www.umr-cnrm.fr/spip.php?article788>), although climate estimates in

*future scenarios* mountain areas are less precise than in plains. SAFRAN produces hourly data on an 8x8 km grid.

*Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology* **France has a georeferenced soil database at a scale of 1/100'000** (<http://acklins.orleans.inra.fr/programme/bdgsf/bdgsf.php>).

*Identification of pedo-climatic parameters characterizing species ranges.* Not available

**Task 2 - Genetic information including adaptive traits of MaP populations at northern limits of the species.**

*Identification of most relevant species* Among the conifers native to France: *Abies alba*, *Juniperus thurifera*, *Larix decidua*, *Picea abies*, *Pinus cembra*, *Pinus halepensis*, *Pinus mugo* (*uncinata*), *Pinus nigra laricio*, *Pinus nigra salzmannii*, *Pinus pinaster*, *Pinus pinea*, *Pinus sylvestris*, *Taxus baccata*.  
Among the broadleaves native to France: *Acer* sp., *Alnus* sp., *Betula pendula*, *Betula pubescens*, *Castanea sativa*, *Fagus sylvatica*, *Fraxinus* sp., *Malus sylvestris*, *Populus* sp., *Prunus avium*, *Quercus robur*, *Quercus petraea*, *Quercus* sp., *Salix* sp., *Sorbus* sp., *Tillia* sp., *Ulmus* sp.

*Identification of skills and gaps in forest genetics research capacity* Many research institutes, including INRA, IRSTEA, FCBA, CNPF, ONF, AgroParisTech and several universities have research activities on forest genetic resources. Most of the time, the research activities are done after a concertation / consultation phase for harmonization. Funding is less than optimal to address all forest genetics research questions and call for proposals with short term span are not adequate for the long term research needed when addressing forest genetic resources. Forest genetic resources do not have high priority in research questions related to biodiversity, ecology or climate change.

*Survey and description of conservation and mitigation methods and actions with* As part of its activities, the French Commission on Forest Genetic Resources (CRGF) has set up a network of in-situ gene conservation units for the following species: *Abies alba*, *Fagus sylvatica*, *Picea abies*, *Pinus pinaster*, *Pinus sylvestris*, *Populus nigra*, *Quercus petraea*, *Ulmus laevis*. Ex situ conservation activities is ongoing for *Juglans regia*, *Pinus nigra salzmannii*, *Populus nigra*, *Prunus avium*, *Sorbus domestica*, *Ulmus glabra*, *U. laevis*, *U.*

*special reference to climate change* minor.

*Survey and description of available FGR*

French FGR are listed as conserved material at the following address: <http://agriculture.gouv.fr/la-politique-nationale-de-conservation-des-ressources-genetiques-forestieres>.

The Eufgis information portal also lists French FGR that are part of an in situ gene conservation unit: <http://portal.eufgis.org/search/simple/>. As for FGR used for afforestation and reforestation, regions of provenance can be found here:

<http://agriculture.gouv.fr/telecharger/82975?token=13ebc13bf2822b819dfab67abcba5884>.

The lists of basic materials are listed in different categories: tested ([http://agriculture.gouv.fr/sites/minagri/files/10-30-liste\\_registrenov2015materiel\\_base\\_admis\\_categorie\\_testee\\_08082016.pdf](http://agriculture.gouv.fr/sites/minagri/files/10-30-liste_registrenov2015materiel_base_admis_categorie_testee_08082016.pdf)), qualified (<http://agriculture.gouv.fr/telecharger/82728?token=34de01505243f59e33eeee981c211a64>), selected (<http://agriculture.gouv.fr/telecharger/82727?token=bfcb4bf7122a53d2f25a64b9bb693e60>), and identified material ([http://agriculture.gouv.fr/sites/minagri/files/10-31-liste\\_registre26avril2016materiel\\_base\\_admis\\_categorie\\_identifiee.pdf](http://agriculture.gouv.fr/sites/minagri/files/10-31-liste_registre26avril2016materiel_base_admis_categorie_identifiee.pdf)).

*Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.*

Species (data on morphological traits / data on adaptive traits / data on molecular markers)
<i>Abies alba</i> (Yes / yes / yes)
<i>Acer pseudoplatanus</i> (Yes / yes / no)
<i>Alnus glutinosa</i> (Yes / yes / yes)
<i>Betula pendula</i> (Yes / yes / in progress)
<i>Betula pubescens</i> (Yes / yes / no)
<i>Carpinus betulus</i> (Yes / yes / yes)
<i>Castanea sativa</i> (Yes / yes / yes)
<i>Fagus sylvatica</i> (Yes / yes / yes)
<i>Fraxinus excelsior</i> (Yes / yes / no)
<i>Larix decidua</i> (Yes / yes / yes)
<i>Picea abies</i> (Yes / yes / yes)
<i>Pinus halepensis</i> (Yes / yes / yes)
<i>Pinus nigra</i> (Yes / yes / in progress)
<i>Pinus pinaster</i> (Yes / yes / yes)
<i>Pinus sylvestris indigène</i> (Yes / yes / no)
<i>Populus nigra</i> and others (Yes / yes / incomplete)
<i>Prunus avium</i> (Yes / yes / yes)
<i>Quercus ilex indigène</i> (Yes / yes / yes)
<i>Quercus petraea</i> (Yes / yes / yes)

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

<i>Quercus pubescens</i> (Yes / no / yes)
<i>Quercus robur</i> (Yes / yes / no)
<i>Quercus suber</i> (Yes / no / yes)

Source: <http://agriculture.gouv.fr/linventaire-national-des-ressources-genetiques-forestieres>

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

There is no general analysis / synthesis available at national level on genetic and ecological information except that produced for the 2013 FAO State of the World Forest Genetic Resources (<http://agriculture.gouv.fr/linventaire-national-des-ressources-genetiques-forestieres>). There are syntheses at species level available in the scientific literature or syntheses done at much larger scales on how conservation units represent well the ecological and genetic diversity of species of interest and whether or not they are threatened by climate change. Marginal populations are not the main focus of these studies.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities**

Networking activity on in-situ and ex-situ gene conservation is coordinated by CRGF (the French Commission on Forest Genetic Resources) since 1991. Currently, the number of in situ gene conservation units listed in the national registry is 106 (<http://agriculture.gouv.fr/telecharger/85145?token=6dc01117f248de3d4268024e6607f688>).

Each conservation unit in the CRGF network is described and monitored on average once every five years. The national ex-situ registry lists over 1700 clones conserved in collections (<http://agriculture.gouv.fr/telecharger/85146?token=68db9491a8e302d04f4504f11a5388c5>).

**List of Experts/Contacts involved in FP 1202 MaP FGR**

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## National Report on MaP FGR

**Country** Germany

**Authors** Georg von Wühlisch

**Introduction** In 1987 (revised 2000 and 2010) a national concept for the conservation and sustainable use of forest genetic resources in the Federal Republic of Germany was elaborated and a working group (Bund-Länder-Arbeitsgruppe) was established to coordinate activities of evaluating the genetic resources, conservation measures *in situ* and *ex situ*, and research in this field.

**Short description of the Country**

Meanwhile the major forest tree species have been intensively dealt with and the minor forest tree and shrub species get more attention and special topics like monitoring, source identification, documentation and cooperation with international bodies gain importance.

Germany has 11.1 Mha forests, which amounts to 31% of land area. The forests have been regenerated artificially to a large extent favouring coniferous species. There are no virgin forests. Silviculture prefers high forest systems with high thinning and closed canopies, and natural regeneration to create stable stands able to withstand wind storms. Diversity with respect to age classes as well as a mix of species is aimed at 72 tree and 30 shrub species grow in German forests. Main species are *Picea abies* 28%, *Pinus sylvestris* 24%, *Fagus sylvatica* 14%, *Quercus robur* and *petraea* 10%, *Larix decidua* 3%, *Pseudotsuga m.* 1.7%, *Abies alba* 1.5%.

MaP of following species occur: *Abies alba*, *Acer pseudoplatanus*, *Castanea sativa*, *Picea abies*, *Pinus cembra*, *Populus nigra*, *Pyrus pyraister*, *Quercus petraea*, *Sorbus domestica*, *Sorbus torminalis*, *Tilia platyphyllos*, *Ulmus laevis* and more. In most species MaP of the leading edge of the species' distribution range are located in Germany. There are also species of high elevations, which have reached the altitudinal limit, e. g. *Pinus cembra*. Marginality is not considered a FGR conservation criterion as compared to endangerment, scarcity or uniqueness.

With its warm and mild regions Germany (> 10 °C average Temp.) is able to provide *ex situ* habitats for FGR of Mediterranean MaP, e.g. in the south-west along the Rhine river, where *Castanea sativa* has already been introduced widely.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventories of regional/national maps and/or links to web sites of climatic maps including future** Very little information is available since in most species MaPs of the leading edge of a species' distribution range are located in Germany.

*scenarios*

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology*** The climatic warming endangers low elevation populations and favors those at higher elevations. In some cases species have already reached the highest elevations and can therefore not evade further, e. g. *Pinus cembra*.

***Identification of pedo-climatic parameters characterizing species ranges*** Information on pedo-climatic parameters characterizing species ranges is not available.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

***Identification of most relevant species*** A relevant species with respect to climate change is *Picea abies*, in which low elevation populations are effected in warm summers and become susceptible to attacks by bark beetles. Norway spruce is replaced in such situations by better adapted tree species, e. g. Douglas fir. Other relevant species are *Fagus sylvatica* and *Abies alba*.

***Identification of skills and gaps in forest genetics research capacity*** Relevant skills and research capacities in forest genetics are available in Germany.

***Survey and description of conservation and mitigation methods and actions with special reference to climate change*** Both, surveys as well as a genetic monitoring for several species are undertaken. Measures and methods are available and are employed to conserve FGR according to the national concept.

**Survey and description of available FGR** A survey and description of FGR is available for each of the Bundesländer.

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.** In a monitoring program the existing information on variability of relevant genetic parameters by species *Fagus sylvatica*, *Quercus spp.*, *Abies alba*, *Picea abies*, *Tilia cordata*, *Prunus avium*, *Populus nigra*, *Ulmus spp.* are planned. Molecular markers and adaptive traits were determined so far in *Fagus sylvatica* and *Prunus avium*.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

An inventory of FGR has been established at the Länder-level making up a national inventory. The endangerment of the FGR by climatic factors is constantly monitored and evaluated. The preferred conservation mode is *in situ* conservation. For many GCU data is available, also at the molecular level.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

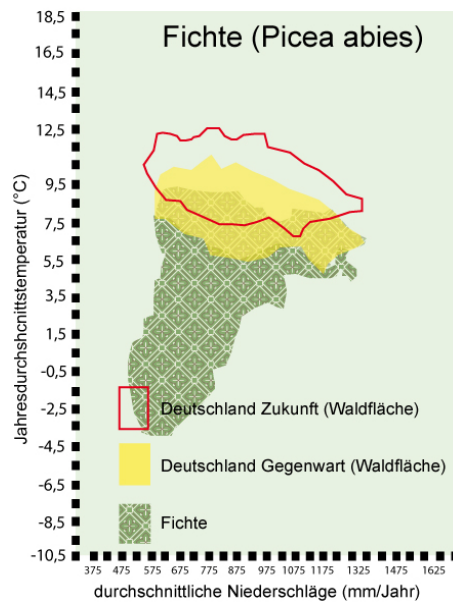
At national level, a federal and länder working group is established which coordinates activities and research among the 10 governmental bodies and research organizations involved. Information is available on the website <http://blag-fgr.genres.de>). Data has been provided for the EUFGIS-database.

**Relevant literature to MaP FGR**

Due to the fact MaP in Germany are mostly leading edge populations there is no specific literature among the 60 publications focusing specifically on MaP FGR.

**Figure**

<http://www.hamburger-bildungsserver.de/klima/klimafolgen/poster/>



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FOR Martin Rogge  
FOR Wolfgang Voth  
FD Dr. Heino Wolf

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populations of forest tree to climate change in Europe  
(MaP-FGR)

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## National Report on MaP FGR

<b>Country</b>	Greece
<b>Authors</b>	P.G. Alizoti, I. Gitas, A.C. Papageorgiou, F.A. Aravanopoulos

### Introduction

#### *Short description of the Country*

Greek forests represent 4.06% of European forests and cover almost 3'300'000 m ha, corresponding to the 25.4% of the country's total land area. The country is characterized by an intense terrain and a climate of pronounced bio-seasonality and large year to year variability. Greece is a biodiversity hotspot due to the almost 6'500 plant species harbored in its natural ecosystems, out of which 400 are forest tree species. The forest tree species form pure or mixed forests out of which, 48.5% are evergreen broadleaved, 22% noble broadleaved and 40% coniferous. Marginal populations potentially containing genetic resources adapted to stressful environment can be recognized for all forest tree species naturally distributed in Greece. They can be rear edge marginal populations or populations growing in ecologically marginal conditions. There are species that meet their natural distribution limits in Greece, such as *Pinus halepensis* meeting its easternmost limits, *Pinus brutia* its westernmost limits, *Fagus sylvatica*, *Abies alba* and *Picea abies* meeting their southern limits in Greece, and *Castanea sativa*, *Prunus avium* and *Pinus sylvestris* meeting their southern-eastern limits in Greece. Human activity is affecting forest ecosystems of Greece since antiquity, given the long history of ancient civilizations, the turbulent history of the country and the consequent exploitation of forests. Major challenges include population decline and structure changes due to forest fragmentation, forestry practices, wild fires, pests, disease and especially climate change. Defoliation, dieback, lack of flowering synchronization and lack of sound seed production can be recognized as global warming consequences for certain forest tree species up to this point.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species

<i>Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios</i>	<p>Climatic data:</p> <ul style="list-style-type: none"> <li>• Digital weather data of Greece at weather stations [on-line, real time point weather data and climatic statistics for temperature, precipitation, wind, cloud cover, humidity), source: Hellenic National Meteorological Service/104 georeferenced stations]</li> <li>• <a href="http://www.hnms.gr/hnms/english/climatology/climatology.html">http://www.hnms.gr/hnms/english/climatology/climatology.html</a></li> <li>• Surface wind, Rainfall, Snowfall, Cloudiness, Air temperature, Atmospheric</li> </ul>
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FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

pressure [on-line surfaces, 3-hour step, source: Hellenic Center for Marine Research/POSEIDON system]

- [http://poseidon.hcmr.gr/weather\\_forecast.php?area\\_id=gr](http://poseidon.hcmr.gr/weather_forecast.php?area_id=gr)

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology***

Sources for soil and topography regional/national maps:

Soil:

- European Soil Data Base (ESDB) [polygon vector data of soil attributes, source: JRC\_ESDAC, scale 1:1000000, also in raster and Google maps].
- Land Use/Cover Area Frame Statistical Survey (LUCAS) Soil dataset [vector data of 732 points in Greece/7819 panned, source: JRC\_ESDAC]
- Soil Threat Maps (Erosion risk/PESERA, Topsoil Organic Carbon Content, Natural susceptibility of soils to compaction, Saline and sodic soils) [raster data, source: JRC\_ESDAC, scale 1:1,000,000]
- Soil Map of Greece (Edafologikos Xartis Ellados) [image, source: Institute of Geology and Mineral Exploration (I.G.M.E), scale 1:1,000,000, year: 1967]
- Physiographic map of Greece ('Nakos' map) [image, source: Forest Research Institute in Athens/Soil Science Laboratory, scale 1:50,000, year: 1982]
- Soil Map of East Macedonia - Thrace Region (Soil Taxonomy Classification Map) [Aristotle University of Thessaloniki, School of Agriculture, Lab of Applied Soil Sciences, scale: 1:200,000, year:2010]
- Soil Map of Crete [source/publisher: ADK Plot, scale: 1:1,000,000, year: 1986]
- [http://eusoils.jrc.ec.europa.eu/library/maps/country\\_maps/metadata.cfm?mycountry=GR](http://eusoils.jrc.ec.europa.eu/library/maps/country_maps/metadata.cfm?mycountry=GR)

Topographic:

- Slope and aspect derivatives from ASTER\* satellite Digital Elevation Model (DEM) [grid raster, cell-size: 30 m, source: NASA/Jet Propulsion Laboratory, year: 2008-2009] \*Advanced Spaceborne Thermal Emission and Reflection Radiometer
- <http://asterweb.jpl.nasa.gov/gdem.asp>
- Slope and aspect from Physiographic map of Greece ('Nakos' map) [image, source: Forest Research Institute in Athens/Soil Science Laboratory, scale 1:50,000, year: 1982]

***Identification of pedo-climatic parameters characterizing species ranges.***

Geospatial data and maps of Greece are mainly provided by Greek Public Services. Information concerning the forest cover in Greece is also provided by several European (Joint Research Centre-JRC) and International organizations (Food and Agriculture Organization-FAO). Current methods for GeoData distribution and sharing on the web rely on the use of either metadata and/or map publishing. Numerous map products could also be available upon request by several services/authorities. The map products which are currently available for

Greece are:

- The Corine Land Cover provided by Environmental European Agency (EEA)
- The Forest/NonForest Maps (for two dates-2000 and 2006-) and Forest Type Maps (for two dates-2000 and 2006-) provided by JRC
- The Forest Maps provided by FAO upon request
- The Geological Maps (scale-1:50.000) provided by Institute of Geology and Mineral Exploration upon request
- The Land Cover Maps (for two dates-1987 and 2007-) provided by WWF Hellas
- Forest Service Products produced in the framework of the research project Geoland 2 6) (<http://www.gmes-geoland.info/service-portfolio/land-cover-and-land-use-monitoring-products.html>)
- Land Cover and Land Use Monitoring Products: European Land Monitoring (EUROLAND) (<http://www.gmes-geoland.info/service-portfolio/land-cover-and-land-use-monitoring-products.html>)
- The Land Parcel Information System-LPIS provided by OKXE (Hellenic Mapping and Cadastral Organisation)
- Digital Elevation Model (<http://gdex.cr.usgs.gov/gdex/>)

Geospatial data for Greece can also be viewed and downloaded from the following links:

<http://www.geodata.gov.gr/maps/>

[http://portal.igme.gr/portal/page?\\_pageid=33,80043&\\_dad=portal&\\_schema=PORTAL](http://portal.igme.gr/portal/page?_pageid=33,80043&_dad=portal&_schema=PORTAL)

<http://213.16.130.14:6578/geonetwork/srv/en/main.home>

<http://www.ktimatologio.gr/ktima/>

## **Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

### ***Identification of most relevant species***

Marginal populations can be identified in most of the forest tree species naturally distributed in Greece. The most relevant species for which the level of genetic variation based on molecular markers and on adaptive traits has been studied up to now are the following: *Abies* sp., *Pinus halepensis*, *Pinus brutia*, *Pinus nigra*, *Pinus sylvestris*, *Castanea sativa*, *Cupressus sempervirens*, *Fagus* sp., *Picea abies*, *Prunus avium*, *Populus* sp., *Quercus petraea* and *Quercus robur*. For most of the above mentioned species, experimental trials have been established and populations of the species, including marginal ones, has been evaluated for adaptive and growth traits.

### ***Identification of skills and gaps in forest genetics research***

Skills:

Research on forest genetics is currently carried out in: 1. Aristotle University of Thessaloniki, Faculty of Forestry and Natural Environment, Laboratory of Forest Genetics and Tree

<b>capacity</b>	<p>Improvement. Six faculty members are carrying out research on forest genetics. Two faculty members are also heavily involved in international activities and research related to conservation of genetic resources. 2. Democritus University of Thrace, Department of Forestry and Management of the Environment and Natural Resources, Laboratory of Forest Genetics and Forest Tree Breeding. Research is carried out by one faculty member. 3. National Agricultural Research Foundation (N.AG.RE.F), Institute of Mediterranean Forest Ecosystems and Technology of Forest Products, Laboratory of Genetics - Sylviculture and Biotechnology. One researcher is currently involved in forest genetics research. 4. National Agricultural Research Foundation (N.AG.RE.F), Forest Research Institute of Thessaloniki, Laboratory of Forest Genetics. One researcher is involved in forest genetics research.</p> <p>Gaps:</p> <p>Organizations 2, 3, and 4, as mentioned above, are currently understaffed. Moreover: (1) the Technological Educational Institute of Kavala - Department of Forestry and Natural Environment Management is understaffed, and (2) the Technological Educational Institute of Larissa - Department of Forestry and Management of Natural Environment and (3) the Technological Educational Institute of Lamia - Department of Forestry, are currently unmanned.</p>
<b>Survey and description of conservation and mitigation methods and actions with special reference to climate change</b>	<p>The Central Bank of Forest Seeds - Ministry of Environment, Energy and Climate Change, has undertaken the tasks of collection, quality control and transfer of forest reproductive material. Greece is participating in the IPGRI/Bioversity - EUFORGEN Programme and in the framework of the EUFGIS Project genetic conservation units (GCU) have been designated for several species. Extensive forested areas are currently protected in the framework of European Networks (Natura 2000 sites, Corine and Corine 2000 sites) and on a national level (i.e. National Parks, Biogenetic Reserves).</p>
<b>Survey and description of available FGR</b>	<p>Partially covered in the course of preparatory actions for EUFORGEN activities. Not addressed at national level.</p>
<b>Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.</b>	<p>Results have been published on genetic variation based on molecular markers for the following species: <i>Abies</i> sp., <i>Pinus halepensis</i>, <i>Pinus brutia</i>, <i>Pinus sylvestris</i>, <i>Pinus nigra</i>, <i>Cupressus sempervirens</i>, <i>Fagus</i> sp., <i>Fraxinus</i> sp., <i>Quercus</i> sp., <i>Castanea sativa</i>, <i>Prunus avium</i>, <i>Juglans regia</i>, <i>Picea abies</i>. Results from the analysis of adaptive traits measured in experimental trials have been published for <i>Abies</i> sp., <i>Pinus halepensis</i>, <i>Pinus brutia</i>, <i>Pinus nigra</i>, <i>Pinus sylvestris</i> and <i>Castanea sativa</i>, <i>Populus</i> sp., <i>Fagus</i> sp.,</p> <p>Populations studied for all the above mentioned studies include populations of the core distribution of the species in the country and marginal populations.</p>

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**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers**

Scattered information addressed on a species by species basis or as problem solving activity. Not coordinated at national level.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities**

- At the national level, databases exist on Natura 2000 and Corine sites as well as on Nationally Protected Areas and Natural Parks. In the framework of the IPGRI/Biodiversity International EUFGIS Project, Genetic Conservation Units (GCU) of several species are included in the EUFGIS Database.
- (Relevant web-sites: <http://www.ypeka.gr/Default.aspx?tabid=433&language=el-GR>; <http://filotis.itia.ntua.gr/>; <http://www.eufgis.org/>.)
- A National network of FGR experts is interacting and handles issues regarding conservation of forest genetic resources.
- Training: Courses are taught at graduate and post-graduate level on Conservation of FGRs and Climate Change (A.U.Th. School of Forestry and Natural Environment - <http://www.for.auth.gr/> and D.U.Th. Department of Forestry and Management of the Environment and Natural Resources - <http://www.fmenr.duth.gr/index.en.shtml> )
- Organization of Conferences: Biennial Conferences are organized by the Hellenic Scientific Society of Plant Genetics and Breeding and the Hellenic Forestry Society (Websites: <http://www.plantbreeding.gr>, <http://www.forestry.gr>)
- Short term Scientific Missions: Exchange of students among Universities and Laboratories on a case by case basis.

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## National Report on MaP FGR

**Country** Ireland

**Authors** Colin T. Kelleher, John Coll, Rowan Fealy

**Introduction Short description of the Country** Ireland is an island on the western fringe of Europe. The total area for the island of Ireland is 84,421 km<sup>2</sup>, with the Republic of Ireland in the south accounting for over 80% of this (70'273 km<sup>2</sup>). The information in this report relates to the Republic of Ireland. The climate is temperate oceanic. It is mild and moist with significant rainfall and a lack of extreme temperatures. Woodland cover is low, with approximately 10% of the land area being forested. Native woodland is extremely scarce and it is estimated that less than 1% of the land surface is composed of native woodland. The majority of forestry cover is composed of non-native stock such as *Picea sitchensis*. The major semi-natural forest types are mixed broadleaf woodlands dominated by *Quercus petraea*, *Q. robur* and *Fraxinus excelsior*. Another important habitat for maintaining forest trees are the hedgerows, which are very well developed across Ireland. As Ireland lies on the western extreme of Europe, the Irish populations of forest trees are important in terms of peripheral populations but not so much for climatic marginality. Most of the land that was previously forested is now being used for agriculture. Climate change is of concern, although no detailed studies have been conducted to date to specifically assess the potential threats to native woodland in Ireland.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios** There are various research groups/government organizations investigating the effects of climate change on agriculture and biodiversity. Organizations of note include the Environmental Protection Agency, Teagasc, the Department of Agriculture, Food and the Marine, ICARUS (Irish Climate Analysis and Research Units) in the National University of Ireland Maynooth and Met Éireann – the Irish Meteorological Service. Below are some relevant links. No study has specifically targeted MaP populations.

- Climate Change Impacts for Ireland  
<http://eprints.maynoothuniversity.ie/2682/1/sweeney-report-strive-12-for-web-low-res.pdf>
- Climate Change Impacts on Biodiversity in Ireland  
[https://www.epa.ie/pubs/reports/research/climate/CCRP\\_19.pdf](https://www.epa.ie/pubs/reports/research/climate/CCRP_19.pdf)
- Climate model information for a European domain (including Ireland) at both 0.44 and 0.11 resolutions  
<http://www.euro-cordex.net/060378/index.php.en>

	<ul style="list-style-type: none"> <li>• Hendrick E, and Black K (2009) Climate change and Irish forestry. <i>COFORD Connects</i>, Environment No. 9.</li> </ul>
<b><i>Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology</i></b>	<p>A National Soils map has been created by Teagasc, the national Agriculture and Food Development Authority.</p> <p><a href="http://gis.teagasc.ie/soils/map.php">http://gis.teagasc.ie/soils/map.php</a></p>
<b><i>Identification of pedo-climatic parameters characterizing species ranges</i></b>	<p>A limited amount of work has been undertaken on assessing soil and climate interactions of native species. More work has been undertaken on exotic forestry species, e.g. Black et al. (2010) Climate Change Impacts and Adaptive Strategies. <i>Journal of Irish Forestry</i> 67 125:139.</p>
<b>Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.</b>	
<b><i>Identification of most relevant species</i></b>	<p>Two species of tree are of particular relevance to MaP-FGR in Ireland:</p> <ul style="list-style-type: none"> <li>• <i>Arbutus unedo</i>. This is primarily a Mediterranean species although the range does extend as far north as Ireland. The Irish populations are the most northerly within the putative natural range.</li> <li>• <i>Salix phylicifolia</i>. This is not a forest tree but the populations in Ireland represent the southern edge of the range. The populations are extremely small.</li> </ul>
<b><i>Identification of skills and gaps in forest genetics research capacity</i></b>	<p>The laboratory in the National Botanic Gardens has undertaken a number of projects on characterisation of Forest Genetic Resources. Teagasc laboratories also undertake research on FGR. Currently there are no specialist personnel working exclusively in FGR in any Irish third level institution, but there are a number of active projects in the area of FGR.</p>
<b><i>Survey and description of conservation and mitigation methods and actions with special reference to climate change</i></b>	<p>Ireland is a member of EUFORGEN and as such has utilized EUFGIS to record populations of interest in terms of conservation. A recent report by Kelleher 2015 (<i>Developing a National Forest Tree Gene Conservation Strategy</i>) has put forward suggestions for FGR conservation in the context of climate change.</p>
<b><i>Survey and</i></b>	<p>A survey of FGR capacity was undertaken during the FAO “The State of the World’s Forest</p>

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

*description of available FGR*

Genetic Resources” report in 2012. The Irish report is available at <http://www.fao.org/3/a-i3825e/i3825e35.pdf>

*Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.*

The FAO 2012 report contains a list of the work already complete on characterizing FGR in Irish populations – a synopsis is given below.

Species	Molecular Study for Ireland	Type of molecular marker
<i>Alnus glutinosa</i>	Cubry et al. in 2015 <i>Tree Genetics and Genomes</i> 11:99.	cpDNA, SSRs
<i>Betula pendula</i>	Cubry et al. in prep	cpDNA
<i>Betula pubescens</i>	Cubry et al. in prep	cpDNA
<i>Fraxinus excelsior</i>	Heuretz et al. 2004 <i>Molecular Ecology</i> 13:3437–3452.	cpDNA
<i>Pinus sylvestris</i>	Cubry et al. in prep	mtDNA, SSR
<i>Populus nigra</i>	Keary et al. 2005. <i>Irish Forestry</i> 62 (1 &2): 6-18.	SSRs
<i>Quercus petraea</i>	Kelleher et al. 2004 <i>Forest Ecology and Management</i> 189: 123-131; Kelleher et al. 2006 <i>Annals of Botany</i> 96(7):1237-1246.	cpDNA, SSRs
<i>Quercus robur</i>	Kelleher et al. 2004 <i>Forest Ecology and Management</i> 189: 123-131; Kelleher et al. 2006 <i>Annals of Botany</i> 96(7):1237-1246.	cpDNA, SSRs
<i>Salix caprea</i>	Perdereau et al. 2014 <i>BMC Plant Biology</i> 14:202.	cpDNA, SSRs
<i>Salix viminalis</i>	Perdereau et al. in prep	cpDNA, SSRs, SNPs

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

To date, very little work has been undertaken to combine ecological and genetic information in forest tree species in Ireland. A recent project involving herbaceous species (saxifrages) showed the potential effects of climate change on species distributions (Beatty et al. 2014 *Annals of Botany* 115 (2): 179-186). Further work on forest species is dependent on funding.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

A national Forest Genetic Resources Group was established in 2015 under the COFORD council within the Department of Agriculture, Food and the Marine. This committee meets regularly and aims to help realize a strategy for the development, conservation, and deployment of forest genetic resource material.

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## National Report on MaP FGR

**Country** Italy

**Authors** P. Belletti, F. Bagnoli, S. Bajocco, S. Fineschi, G. Di Matteo, M.E. Malvolti, G.G. Vendramin

### **Introduction Short description of the Country**

Mediterranean basin is a well-known hot-spot of biodiversity, that includes about 25'000 specie, half of which are endemic. Italy is a sort of bridge, located just in the middle of the basin, so acting as a connection between central Europe and northern Africa, as well as between eastern and western Europe.

In Italy the land covered by forest is 10'467'533 ha, that is the 34.7% of national total surface. 83.7% of the area is covered by forest *sensu stricto* and 16.3% by Mediterranean scrub, shrub, etc. Most of forests are located in hilly and mountain areas (only 17% are at altitude lower than 300 m a.s.l.). Concerning forest types, the most representative are: white oaks (1'084'000 ha), beech (1'035'000), other oaks (1'010'000), *Carpinus* and *Ostrya* (852'000), chestnut (788'000), *Q. ilex* (620'000), other deciduous species (994'000), Norway spruce (586'000), other mountain conifers (838'000), Mediterranean pines (226'000). Italian forests are threatened by many factors, the most important being deforestation and urbanization, habitat fragmentation, pollution, climate change, forest fire, inappropriate forest management, use of unsuitable reproductive material, introduction of alien species

Italy represents the southern geographical border of diffusion for many forest species, mainly conifers, but also broadleaves and species with diffusion highly influenced by human.

### **Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

#### ***Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios***

In order to realize a climatic geodatabase, characterize the climatic conditions of the selected MaP populations and derive scenarios map, the WG1 will lead an intensive research of the available datasets at regional/national coverage, taking into account both the accessibility and the costs. An initial screening allowed to find the following references:

- Observational 2000-2010 (ECAD project) and provisional 2020-2030 (Agroscenari project) data on hourly/daily basis for Italy/Europe (10 km): Dott. M. Pasqui – CNR IBIMET
- Observational data 1950-today on hourly/daily/monthly basis for Italy (30 km): SIAN [www.cra-cma.it](http://www.cra-cma.it); SCIA [www.scia.sinanet.apat.it](http://www.scia.sinanet.apat.it)

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

- Observational data 1975-today on daily basis for Europe (25 km): <http://mars.jrc.ec.europa.eu/mars/About-us/AGRI4CAST/Data-distribution/AGRI4CAST-Interpolated-Meteorological-Data>
- Observational 1901-2000 and provisional 2010-2100 data on yearly basis for Europe 1 km): <http://afoludata.jrc.ec.europa.eu/index.php/dataset/detail/238>
- Precipitation observational data 1950-2012 on monthly basis for the Globe (0.25°, 0.5°, 1.0°): <http://climatedataguide.ucar.edu/guidance/gpcc-global-precipitation-climatology-centre>
- [ftp://ftp.dwd.de/pub/data/gpcc/html/download\\_gate.html](ftp://ftp.dwd.de/pub/data/gpcc/html/download_gate.html)
- Evapotranspiration and aridity data 1950-2000 on monthly basis for the Globe (1 km): <http://csi.cgiar.org/Aridity/>

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology***

In order to realize a thematic map integrating different environmental aspects, both biophysical and socioecological, and characterize the background of the selected MaP populations map, the WG1 will lead an intensive research of the available datasets at regional/national coverage, taking into account both the accessibility and the costs. An attempt will be also done to have available land use/land cover scenarios. An initial screening allowed to find the following references:

- Land use/land cover CORINE 1990-2000-2006 and changes for Europe (rst 100 m or vec 1:100.000): [http://www.eea.europa.eu/data-and-maps/data#c11=&c17=&c5=all&c0=5&b\\_start=0&c12=corine+land+cover](http://www.eea.europa.eu/data-and-maps/data#c11=&c17=&c5=all&c0=5&b_start=0&c12=corine+land+cover)
- Digital elevation model for the Globe:  
1 km <http://www.eea.europa.eu/data-and-maps/data/digital-elevation-model-of-europe>;  
90 m <http://srtm.cgiar.org/>;  
30 m <http://asterweb.jpl.nasa.gov/gdem.asp>
- Soils of Europe (different resolutions) in terms of: soil threats data <http://eussoils.jrc.ec.europa.eu/library/themes/ThreatsData.html>; soil profile data <http://eussoils.jrc.ec.europa.eu/projects/spade/>; European soil database [http://eussoils.jrc.ec.europa.eu/ESDB\\_Archive/ESDB/index.htm](http://eussoils.jrc.ec.europa.eu/ESDB_Archive/ESDB/index.htm); soil projects <http://eussoils.jrc.ec.europa.eu/projects/ProjectsData.html>
- Protected sites Natura 2000 of Europe: <http://www.eea.europa.eu/data-and-maps/data/natura-2>
- Desertification map of Europe (1 km): <http://www.eea.europa.eu/data-and-maps/data/sensitivity-to-desertification-and-drought-in-europe>
- Phytoclimatic map of Italy: prof. C. Blasi – University of Rome “La Sapienza”
- Naturalistic maps of Italy GIS NATURA: prof. M. Gatto – Italian Ministry of Environment

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

- Environmentally sensitive area of Italy (Climagri project) (1 km): CRA-CMA [www.cra-cma.it](http://www.cra-cma.it)
- Soil quality, vegetation quality and climate quality maps of Italy (Climagri project) (1km): CRA-CMA [www.cra-cma.it](http://www.cra-cma.it)
- Free satellite data for environmental applications: MODIS 250-500-1000 m [https://lpdaac.usgs.gov/get\\_data](https://lpdaac.usgs.gov/get_data); SPOT VGT 1 km <http://free.vgt.vito.be>

**Identification of pedo-climatic parameters characterizing species ranges**

Once selected the MaP populations to be investigated, on the basis of raw and processed geodatabases, the WG1 will be able to identify the pedo-climatic and environmental parameters useful to characterize the species ranges and niches.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species**

The Italian territory, from Alps to Sicily, represents a peculiar combination of different environmental situations, from the most fertile to the marginal ones. Forest species are adapted to the above conditions so that some of them, widely distributed in the rest of Europe, are marginal in Italy. Within the long list of these species we could consider conifers (*Picea abies*, *Abies alba*, *A. nebrodensis*, *Pinus halepensis*, *P. pinea*, *P. pinaster*, *P. brutia*, *P. heldreichii*, *P. nigra*, *P. mugo*, *P. cembra*, *P. sylvestris*, *Larix decidua*, *Taxus baccata*), but also broadleaves (*Quercus trojana*, *Q. suber*, *Q. cerris*, *Q. ilex*, *Q. petraea*, *Q. pubescens*, *Q. robur*, *Alnus cordata*, *Platanus orientalis*, *Fagus sylvatica*) and species with diffusion highly influenced by human (*Prunus avium*, *Juglans regia*).

**Identification of skills and gaps in forest genetics research capacity**

The State Forest Service, Ministry for Agriculture and Forestry and Ministry for Environment are the main institutions actively engaged in the conservation of forest genetic resources. Forest genetic research in Italy is mainly conducted by public Academic (Universities) and Research (CNR, CRA) institutions, partly supported by local governments. The main research objective is the study of neutral and adaptive genetic diversity in forest species using molecular and population genetic methods to establish guidelines for management and conservation strategies. In the framework of EU-funded projects (Walnut3, WBrains, FairOak, Oakflow, Dynabeech, SeedSource, Evoltree, Noveltree, Trees4future, etc.) and international cooperation projects founded by MAE and CNR, forest genetic diversity in natural and naturalized populations have been studied within the species oak, walnut, alder, cherries, beech, pines, fir, spruce. CNR and Universities are currently members of the European Technology Platform (ETP) 'Plants for the Future', a forum for the plant sector, including plant genomics and biotechnology. Among EU-funded projects presently active FORGER and TreeBridex are focused on the sustainable management of forest genetic resources in Europe, and ProCoGen which

promotes a functional and comparative understanding of the conifer genome implementing applied aspects for more productive and adapted forests. In spite of the above efforts, not all species have been studied with the same traits. If neutral molecular markers have been almost applied, markers for adaptation are still in progress or are not available. These gaps should be evidenced and then filled up.

***Survey and description of conservation and mitigation methods and actions with special reference to climate change***

In recent years in Italy there has been a notable increase of protected territory, thanks especially to a law on protected areas that has enabled the creation of new national parks and numerous nature reserves. Italy recently adopted the resolution "National Strategy for Biodiversity" and supported the international initiative against deforestation "Partnership REDDplus" (*Reducing Emissions from Deforestation and Degradation in Developing Countries*).

***Survey and description of available FGR***

Marginal populations of widespread species are present in Italy, as well as species with limited distribution. Southernmost populations of central and northern species are at the border of environmental and climatic conditions, thus representing locally adapted ecotypes. Nevertheless, these populations might not withstand climate and global change. On the other hand, southern populations are valid candidate for northwards migration and colonization as consequence of global warming, replacing more drought and temperature sensitive species and/or populations. Local populations of native species are often present as isolated stands and might suffer intensively climate change and pollution. In addition these populations are threatened by unsustainable human disturbance (selection, and cutting), and new diseases. The Italian marginal populations represent reservoirs of genetic resources and at the same time cultural and landscape heritage.

***Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.***

Maps of neutral (chloroplast and/or mitochondrial) genetic diversity available for most indicated species, providing phylogenetic and phylogeographic information. Several species have also been analysed for neutral nuclear markers, indicating populations harboring significant genetic diversity. Thanks to EUproject Evoltree currently are available many genetic resources that are routinely used in tree genomic research, genetic mapping and association studies within the tree families of *Pinaceae*, *Fagaceae* and *Salicaceae*.

A survey of existing data does not allow us to identify patterns of common genetic variation. For instance, MaP of Scots pine from Apennines showed low internal genetic variability and high differentiation towards populations from the Alps, while in wild cherry the situation was reversed (high internal genetic variability and low differentiation). Still different the case of silver fir (high genetic variability and high differentiation).

*FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)*

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Climate predictions indicate drying trends associated with higher evaporative demand and lower precipitation amounts in many regions with current evidence in the Mediterranean. Impacts of warming and drying on Mediterranean forests are already accumulating in an alarming pace. In 2008 alone at least 5 distinct drought-induced regional forest mortalities were published in the scientific literature.

The selection of ecotypes based on performance data (e.g. height, trunk straightness, root/shoot ratio, etc.) alone can be problematic, due to hidden interactions between tree function and climate. Such interactions are not necessarily expressed until times of climate instability and their existence reject the extrapolation of data from one site to another. The observation of ecotypes which were transferred into environments very different from their seed sources being able to grow and even compete with the native, local populations is a further complication of this unsafe inference.

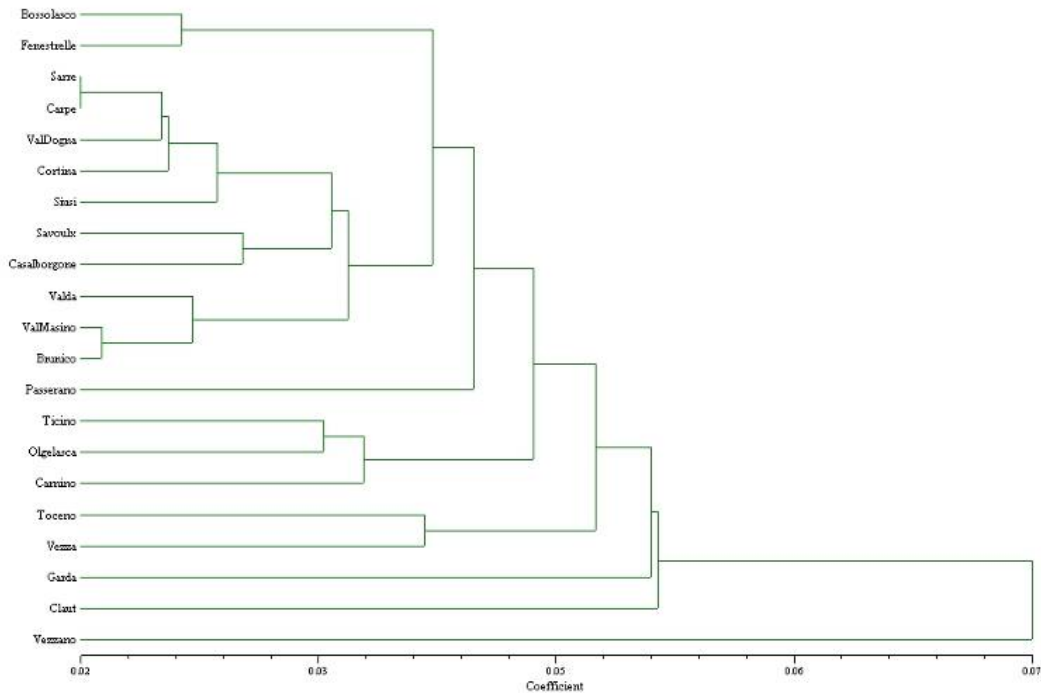
The high genetic variability which exists in tree populations has considerably promoted a high level of adaptability, allowing trees to withstand a variety of environmental changes. Today forests around the world are challenged by an increasingly faster rate of changes in environmental conditions, already severely affecting vulnerable populations. In many cases, these include trees that grow near the limit of their natural distribution, such as the dry timberline cases affecting the Southern Mediterranean forests. Recommendations and suggests for forestry implications are: (i) Considering the adjustments in key traits across a range of available provenances and climates could provide a powerful management tool to address the dangers of reduced forest distribution with warming and drying climate trends, such as predicted for the entire Mediterranean and other regions. (ii) A single advantageous trait may be insufficient for sustainability. For example, selection of the provenance Otricoli based on high WUEi (intrinsic water-use efficiency) or Senalba based on low water use in currently favorable conditions would fail under extreme conditions. A recent study on Aleppo Pine along a climatic gradient (including Italy) indicates the existing gap between plant adaptability and the changing environment could be closed by ecophysiological response at the species and provenance level, as well as by exploiting the range of performance offered by provenances of different seed sources. Such an approach, in turn, will potentially permit sustained forest productivity and distribution even under relatively severe climate change scenarios across the Mediterranean region. Future forest planning should consider testing for ecophysiological adjustment in key traits in candidate tree species and genotypes selected for planting today, whose growth should be ensured in the future.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

A networking activity in Italy on MaP does not exist: however some data can be found in the databases compiled within European Projects to which several Italian Institutions take part (see above for details). MaP have been studied for many species and data are available.

**Figure**

Dendrogram of genetic distances among 21 native populations of Scot pine from Italy. Populations Vezzano (the only one from Apennines) clearly differentiates from the others.



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## National Report on MaP FGR

**Country** Netherland

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**Introduction** The Netherlands is situated in Western Europe, in the delta of the Rhine and Meuse rivers. It has a temperate climate as a result of the influence of the Gulf Stream, with even rainfall throughout the year (approx. 800 mm per year). The total area of the Netherlands is 41'526 km<sup>2</sup>. About 18% of this area is water. The main land use types are agriculture and human habitation and infrastructure, which occupy about 60% and 30% of the total land area (34'000 km<sup>2</sup>) respectively. Forest occupies 360'000 ha, which is equivalent to 10.6% of the total land area of the country.

**Short description of the Country** Compared to other European countries the forest area of the Netherlands is small and highly fragmented. About 85% of all forest areas are smaller than five hectares. Only 12 tree species form the main species in Dutch forests. Of the total forest dominated by broadleaved species, 21% consists of one tree species, 15% is mixed with other broadleaved species and some 8% is mixed with coniferous species. A comparable pattern is observed in the coniferous forest area, where a majority (32%) consists of one tree species. Some 7% of the coniferous forest contains more than one coniferous species, whereas 13% is classified as mixed coniferous-broadleaved. The remaining 4% of the forest area is categorized as open or young forest.

Surveys have shown that many of the native tree and shrub species are now rare or threatened. Among these are *Daphne mezereum*, *Juniperus communis*, *Rhamnus cathartica*, *Ulmus spp*, *Taxus baccata*. Other species appear to be so rare that only a few specimens can be found, such as *Viburnum lantana* and *Malus sylvestris*. The autochthonous genetic material of a few species has completely disappeared (e.g. *Pinus sylvestris*). For an overview of Forest genetic resources to be threatened in all or part of their range see the Dutch country report for the first FAO SoW-FGR. (the report is available at <https://www.wur.nl/en/Expertise-Services/Statutory-research-tasks/Centre-for-Genetic-Resources-the-Netherlands-1/Expertise-areas/Forest-Genetic-Resources/Show-FGR/First-National-Report-on-Forest-Genetic-Resources-for-Food-and-Agriculture-The-Netherlands.htm> )

Dutch forests have a long history of human intervention and excessive exploitation. Therefore ancient woods are extremely rare in the Netherlands. By the beginning of the 19th century the area of forest had been drastically reduced to only 4% of the total land area. The main current human-induced changes that impact on the genetic diversity of the forests, include forest management, fragmentation through road construction, urbanization, introduction of foreign forest reproductive material. Furthermore, forest genetic resources are threatened by logging, inappropriate thinning in old woodlands and hedges, and the use of herbicides and fertilizers that end up at the forest edges. Even non-intervention management in forests intended primarily as

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

nature conservation can be disastrous for the survival of autochthonous genetic resources, especially for light-demanding rare species.

Signs of global change impact may be earlier budburst (see also [www.natuurkalender.nl](http://www.natuurkalender.nl), the phenological observation network in relation to climate), increase of precipitation, extreme events, increased frequency of storms.

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

*Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios* Alterra makes use of the climate change scenarios compiled in the ISI-MIP Inter-Sectoral Impact Model Intercomparison Project (<http://www.pik-potsdam.de/research/climate-impacts-and-vulnerabilities/research/rd2-cross-cutting-activities/isi-mip>). This is available in standardized format (Netcdf v4) for all climate parameters

Alterra can provide, (under conditions of non-commercial use, and for scientific purposes only, with due referencing) the environmental data that is compiled for the Environmental Stratification (EnS) of Europe (Metzger 2012; Metzger 2005). This data entails the following data at a 1 km<sup>2</sup> resolution (Table 1 from {Metzger, 2005 #10923}):

- Altitude
- Slope
- Northing (latitude)
- Oceanicity
- Minimum temperature (in January, April, July and October)
- Maximum temperature (in January, April, July and October)
- Precipitation (in January, April, July, October and November)
- Percentage sunshine (in January, April, July and October)

*Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology* Alterra has access to much soil, climate, land use (change), and air pollution data. A brief overview is presented below

data source variable ID	data source	variable	unit	description
1	MOTIVE scenarios	temperature - maximum	degree Celcius	maximum daily temperature per scenario
2	MOTIVE scenarios	temperature - minimum	degree Celcius	minimum daily temperature per scenario
3	MOTIVE scenarios	radiation	J m-2 d-1	incoming daily shortwave radiation per scenario
4	MOTIVE scenarios	precipitation	kg m-2 d-1	daily total precipitation per scenario

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

5	MOTIVE scenarios	vapor pressure	Pa	averaged daily vapor pressure per scenario
6	MOTIVE scenarios	windspeed	m s-1	average daily windspeed measured at 2 m height
9	EFISCEN space	height	m	tree height per dbh class and species
10	EFISCEN space	density	# ha-1	tree density per dbh class and species
11	EMEP	SO2	eq.-1.ha-1.yr-1	annual deposition and concentration
12	EMEP	Nox	eq.-1.ha-1.yr-1	annual deposition and concentration
13	EMEP	NH3	eq.-1.ha-1.yr-1	annual deposition and concentration
14	EMEP	O3		concentration of ozone
15	ESDB soil map	Soil type		soil mapping units consisting of soil types
17	ESDB soil map	texture		texture classes
18	ESDB soil map	slope		slope class
20	ESDB soil map	parent material		derived class
21	ESDB soil map	drainage		derived class
22	ESDB soil map	rooting depth		derived class
23	REMO data NEU	T minimum	degrees K	minimum temperature
24	REMO data NEU	T maximum	degrees K	maximum temperature
25	REMO data NEU	precipitation	mm/d	precipitation
26	GLC 2000	Land cover class		
27	CLUE	Land cover class		
28	CORINE	Land cover class		
29	NEU SPADE/WISE	pH		
30	NEU SPADE/WISE	Organic carbon	g/kg	
31	NEU SPADE/WISE	N total	g/kg	
32	NEU SPADE/WISE	bulkdensity	kg/m3	

**Identification of pedo-climatic parameters characterizing species ranges**

Alterra has access to much soil, climate, land use (change), and air pollution data.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species**

The Netherlands is home to approximately 101 native woody species, including 78 trees, 3 conifers, 4 climbers and 16 dwarf shrubs. For an overview of tree and other woody species considered to be threatened in all or part of their range from a genetic point of view, including information on their distribution in the Netherlands and the type of threat see table 7 in the country report for the first FAO SoW-FGR. Most relevant species might be *Acer campestre*, *Berberis vulgaris*, *Cornus mas*, *Crataegus spp.*, *Daphne mezereum*, *Malus sylvestris*, *Populus*

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

*nigra*, *Rhamnus cathartica*, *Taxus baccata*, *Juniperus communis*, *Tilia ssp.*, *Ulmus spp.*, *Viburnum lantana*.

**Identification of skills and gaps in forest genetics research capacity** The Centre for Genetic Resources, the Netherlands (CGN, [www.wur.nl/cgn](http://www.wur.nl/cgn)) and the State Forest Service are the main institutions actively engaged in the conservation of forest genetic resources. Forest genetic research in the Netherlands is mainly conducted by CGN and Alterra in order to study genetic diversity in autochthonous tree and shrub species using molecular and population genetic methods. Insight into the genetic diversity of the ex situ collections and the natural populations is used to support the main nature conservation organizations' management and conservation strategies. In the framework of EU-funded projects (Fairoak, Oakflow, Europop, Dynabeech and Evoltree), genetic diversity and the processes involved in maintaining genetic variation in natural populations have been studied within the species oak, poplar and beech. Alterra is currently coordinating the EU-funded project FORGER, which is focused on the sustainable management of forest genetic resources in Europe.

**Survey and description of conservation and mitigation methods and actions with special reference to climate change** No conservation or mitigation methods or actions with special reference to climate change are carried out. However, the Netherlands has established a number of in situ dynamic gene conservation units in line with the strategy of EUFGIS for in situ conservation of forest trees (see also <http://portal.eufgis.org/>). In 2011 a total of 10 gene conservation units for 11 target species were established. Together they comprise an area of about 340.6 hectares. These gene conservation units consist mainly of one or two stands of rare species. The type and function of the conservation units differ. All are used as a gene reserve forest and registered seed stand ('Source identified' category) and function for biodiversity conservation. Nine of the conservation units (except the *Fagus sylvatica* unit) are located in protected areas (e.g. the Natura 2000 protected area Geuldal).

Target forest species included within *in situ* conservation programmes/units.

Species	Purpose of establishing conservation unit	Number of populations or stands conserved	Total area (ha)
<i>Fagus sylvatica</i>	Long-term gene conservation	1	250
<i>Quercus robur</i>	Long-term gene conservation	1	23
<i>Quercus petraea</i>	Long-term gene conservation	2	26
<i>Populus nigra</i>	Long-term gene	1	0.6

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	conservation		
<i>Ulmus laevis</i>	Long-term gene conservation	1	30
<i>Prunus avium</i>	Long-term gene conservation	1	7
<i>Fraxinus excelsior</i>	Long-term gene conservation	1	7
<i>Taxus baccata</i>	Long-term gene conservation	1	4
<i>Juniperus communis</i>	Long-term gene conservation	1	3
<i>Carpinus betulus</i>	Long-term gene conservation	1	20
<i>Acer campestre</i>	Long-term gene conservation	1	2

**Survey and description of available FGR**

Between 1991 and 2012 an extensive survey of the distribution of this autochthonous genetic material was carried out across the entire country, commissioned by the Dutch government. The outcome of this survey revealed that half of the Dutch tree and shrub species of autochthonous origin are extremely rare or partly threatened with extinction. Currently, about 60% of all in situ locations of Dutch trees and shrubs have been inventoried.

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.**

See table for the tree and shrub species for which adaptive and production traits are assessed or genetic variability has been investigated using molecular markers (not exhaustive).

Forest species for which genetic variability has been evaluated.

Species		Morphological traits	Adaptive and production traits	Molecular characterization
Scientific name	Native (N) or exotic (E)			
<i>Pinus sylvestris</i>	N	n.d.	+	—
<i>Pseudotsuga menziesii</i>	E	+	+	—
<i>Larix</i> spp.	E	n.d.	+	—
<i>Pinus nigra</i>	E	n.d.	+	—
<i>Picea abies</i>	E	n.d.	+	—
<i>Fagus sylvatica</i>	N	n.d.	+	+
<i>Quercus robur</i>	N	+	+	+
<i>Quercus petraea</i>	N	+	—	+
<i>Populus</i> spp.	N/E	+	+	+
<i>Salix</i> spp.	N	n.d.	+	—

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

<i>Castanea sativa</i>	E	n.d.	–	–
<i>Prunus avium</i>	N	n.d.	+	+
<i>Malus sylvestris</i>	N	n.d.	–	+
<i>Alnus glutinosa</i>	N	n.d.	+	–
<i>Acer pseudoplatanus</i>	N	n.d.	+	–
<i>Crataegus laevigata</i>	N	n.d.	–	+
<i>Crataegus monogyna</i>	N	n.d.	–	+
<i>Juniperus communis</i>	N	n.d.	–	+
<i>Ulmus laevis</i>	N	n.d.	–	+
<i>Ulmus minor</i>	N	n.d.	–	+

n.d. = no data available

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Over the past ten years in particular, knowledge of the intraspecific variation in a number of forest species present in the Netherlands has increased by assessing production characteristics and molecular genetic diversity. However no analysis of genetic information at national level has been performed. In general knowledge of rare species is lacking.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

The Netherlands has not established a formal national coordination mechanism or networking activity for conservation of forest genetic resources. The various actors actively engaged in conservation of forest genetic resources are listed in the Country report for the FAO SoW-FGR. However, CGN functions as the National Focal Point for genetic resources in general within the CBD framework.

Concerning Forest Genetic resources CGN manages a database of field experimental trials including information on the locality and type of trial, the genetic resources tested and raw data on a range of traits measured for internal use. In this context, CGN has contributed to the EU-wide Treebreedex database ([www.treebreedex.eu](http://www.treebreedex.eu)). CGN also compiles the ‘Catalogue of recommended varieties and provenances of trees’, which includes the national list of basic material of species subject to Directive 1999/105/EC and the recommended list of basic material of so-called non-EU species. This database can be accessed through a website ([www.rassenlijstbomen.nl](http://www.rassenlijstbomen.nl)). A national ex situ collection of trees and shrubs with over 5000 accessions is maintained by the State Forest Service. Information on these accessions is accessible through a website ([www.genenbankbomenenstruiken.nl](http://www.genenbankbomenenstruiken.nl)).

At the EU-level, Alterra – Wageningen UR participated in the *EUFORGEN*, *TREES4FUTURE* and *EVOLTREE* networks, and was project coördinator of the FP7-project *FORGER* (Towards the Sustainable Management of Forest Genetic Resources in Europe; [www.fp7-forger.eu](http://www.fp7-forger.eu)).

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*FPS COST Action FP1202* Strengthening conservation: a  
key issue for adaptation of marginal/peripheral  
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(MaP-FGR)

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## National Report on MaP FGR

**Country** Poland

**Authors** Piotr Markiewicz, Jarosław Socha, Małgorzata Sułkowska, Justyna Nowakowska, Dorota Dobrowolska, Jan Kowalczyk, Szymon Jastrzębowski

**Introduction** The total surface area of Poland is 31'188'900 ha. Forest land is 9'350'700 ha what gives forest cover equal 29.2%. Poland has retained forests mostly on the poorest soils which is reflected in the structure of forest habitat types. Coniferous forest habitats predominate in the habitat structure, accounting for 52.6% of the total forest area, while broadleaved forest habitats – for 47.4%. In both groups upland habitats additionally occupy 5.4% of the forest area and mountain habitats 8.7%. The geographical distribution of habitats is, to a great extent, reflected in the spatial structure of dominant tree species. While in the mountains spruce (west) and spruce and beech (east) are the main species in stand composition, and in a few locations stands have diversified species structure, stands with pine as the dominant species prevail in the major part of the country. Coniferous species dominate in Polish forests accounting for 70.8% of the total forest area.

**Short description of the Country**

The area of Poland is influenced by many climatic factors which causes existence of natural distribution borders of many forest tree species i.e. Scots pine, Norway spruce, silver fir, European larch, European beech, sessile oak, gray alder, wild service tree, wild cherry, yew tree, sycamore, large-leaved lime, European white elm, field maple, Swiss stone pine.

At the end of 18<sup>th</sup> century forest covered about 40% territory of Poland. In 19<sup>th</sup> to the mid of the 20<sup>th</sup> century deforestation and depletion of the stand species structure occurred. Moreover forest management was concentrated on forest productivity. Foresters have introduced even-aged regulated forest, creating habitat for game species with as short as possible rotation period. As one of the results of such forest management was the depletion of the stand species structure to artificial even-aged monoculture stand resulted in a decrease in biological diversity in forest, soil erosion and disturbance of water balance in large part of Polish forests. At the second part of the 20<sup>th</sup> century in accordance with growing ecological knowledge, foresters in Poland started with its conversion to uneven-aged mixed forests. As the result of conversion of species structure the share of coniferous trees was changed from 87% in 1945 to 70% in 2011. This process was parallel with increasing forest cover from 20.8% in 1945 to 29.2% in 2012. As the sign of the global change impact are the problems with the stability of even-aged Norway spruce monocultures in mountain areas. In recent years the condition of spruce stands in Beskid Śląski and Żywiecki (South Poland) has decreased drastically. As the result there was observed large scale forest disturbances. This process consists of many factors. One of them are strong summer droughts in 2006 and heavy wind event.

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

***Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios*** National climatic maps including future scenarios for Poland are available from website of ICM (Interdisciplinary Center for Mathematical and Computational Modeling): <http://klimat.icm.edu.pl/>  
Available climatic maps include proposed future scenarios according to: IPCC. Local predictions for a part of Carpathians geo-referenced in GIS are also available in University of Agriculture in Krakow, Dept. of Biometry and Forest Productivity.  
The land cover maps for Poland in the frame of Pan-European CORINE Land Cover 2006 (CLC2006) Project are available on the website of Chief Inspectorate of Environmental Protection (<http://clc.gios.gov.pl/>).

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology*** The inventory of *aqua regia* extracted soil elements and their exchangeable cations were conducted in the stands within natural range in Poland of the following species: 9 populations of beech, 20 populations of wild service-tree and 27 populations of wild cherry. All analysis were performed by the Laboratory of Forest Environment Chemistry in Forest Research Institute. It has a fully-documented quality management system in strict accordance with ISO 17025:2005 standard: “General requirements for the competence of testing and calibration laboratories”, which possess 18 years of experience in environmental analysis; highly qualified staff, modern testing equipment as well as the use of the most up-to-date methods and analytical techniques makes our Laboratory rank among the top European laboratories studying forest ecosystems.  
The BioSoil-project, a demonstration project on forest soils and forest biodiversity was a part of the Laboratory activities. The project was financed under the Forest Focus-Scheme (Regulation EC No 2152/2003), concerning the monitoring of forests and environmental interactions in the Community and aimed to broaden the scope of previous forest monitoring activities to the fields of soil characteristics and biodiversity indicators.  
Geo-referenced in GIS maps of soils are available for each of 434 Forest Districts in Poland. It is possible to prepare more generalized map of soil types. Maps of aspect, slopes and topographic indices are also available for Poland. Aspect, slopes and topographic indices maps are based on SRTM Digital Terrain Model, however in nearest future it will be possible to obtain more precise soil maps and DTM for Poland; such projects are in progress.

***Identification of pedo-climatic parameters characterizing species ranges*** Information about pedo-climatic parameters characterizing species ranges are rather dispersed. However, we have large databases from our research and combined data from NFI and information system of State Forests National Holding. For most of main forest forming tree species in Poland occurs northern limits of species range.  
The results concerning ecotype diversity of European beech obtained on the basis of mentioned

above 9 population's analysis of genetic markers and soil condition can be an object for further elaborations. The single tree provenance plot for 5 of 9 provenances, representing about 180 families was established; it enables observations of progeny variations of different traits.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species** The most relevant forest tree species in Poland are: Scots pine, Norway spruce, silver fir, European larch, European beech, pedunculate oak and sessile oak. All of them, except pedunculate oak, has in Poland the natural distribution border, mostly the northern one.

**Identification of skills and gaps in forest genetics research capacity** The genetic knowledge in case of most Polish forest tree species is generally not fully documented. Up to now, 90 stands of Scots pine, 70 stands of Norway spruce, 46 populations of oaks (pedunculate and sessile oak), 12 populations of European larch and 9 populations of European beech were investigated at the level of the genetic structure of DNA with nuclear (SSR), mitochondrial (STS) and chloroplast markers. The study of genetic variation of silver fir based on isozyme analysis were conducted so far only in one region of the Sudety Mts. Additional genotyping of some populations (mainly located in vicinity of the distribution border) for Norway spruce, sessile oak, silver fir, beech and Scots pine is still needed. Also genetic investigations regarding yew tree, hornbeam and lime are missing.

**Survey and description of conservation and mitigation methods and actions with special reference to climate change** At present, there is a project realised by Forest Research Institute concerning identification of the genetic diversity and silviculture potential of 8 forest tree species in Poland: Scots pine, Norway spruce, silver fir, European larch, beech, sessile oak, grey alder and Douglas fir to verify their natural borders. The research will cover silviculture aspects of these species stands in terms of breeding, genetics, climate, habitat and paleobotanical data. The project is financed by the State Forests. The tasks of the project are between others:

- silviculture studies on growth, quality and natural regeneration of trees made on experimental plots chosen in stands within natural range, on the border and outside the natural range of these species,
- studies on wood growth rings,
- genetic studies of selected species to determine the genetic diversity and migration paths,
- analysis of climate change,
- analysis of soil and habitat changes,
- analysis of water balance and changes.

The project started in 2010 and will finish in 2014.

There is a 'Program of conserving forest genetic resources and breeding of trees in Poland for the years 2011-2035', which is a continuation of the previous program, started in 1992. The strategic aims of this program are: conservation and enrichment of the genetic diversity in the

forests, breeding of forest trees, finding and maintaining at an appropriate quantitative and qualitative level the Forest Basic Material (FBM) for the needs of reforestation and afforestation. There is also the 'Program for testing of forest reproductive material' which aims to estimate in field tests the genetic and breeding value of Forest Reproductive Material (FRM) and to verify existing division of Poland into seed transfer zones.

***Survey and description of available FGR***

The Forest Genetic Resources rely on Forest Based Material according to the EU Council Directive 1999/105/EC of 22 December 1999 and Polish the Forest Reproductive Material Act of 7 June 2001. At the day of 1 January 2009 there were: 2'567 seed sources of 18 species, 219'100 ha of stands of known origin of 13 species, 1'185 selected stand of 15 species (16'933 ha), 9'775 maternal trees (plus trees) of 22 species, 200 clonal seed orchards of 19 species (1'259 ha), 103 seedling seed orchards of 13 species (699 ha), 62'384 ha of progeny plantations in blocks of 12 species, 210 conservation stands of 10 species (3'156 ha), 865 ha of conservation plantations of 6 species and 115 conservation stands of 13 species in national parks (2'518 ha). The National Register of Forest Genetic Resources is conducted by Forest Research Institute as well as the State Forests and Forest Reproductive Material Office.

***Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.***

Genetic studies based on the isozyme analysis of European beech populations as well as their progeny covered approximately 60 populations within the natural range, 18 populations on the border and 15 populations outside the natural range. The parameter of heterozygosity can indicate the potential stability of genetic resources of future populations. The molecular data on the basis of DNA markers are available for about 40 populations mentioned above. There are some provenance and progeny trials established in Poland, where adaptive trait (growth, survival, phenology) of forest trees (Scots pine, Norway spruce, European larch, European beech, pedunculate oak) are investigated. Some of these experimental plots are included in international series of research, e.g. IUFRO 72 experiment for Norway spruce, IUFRO 82 experiment for Scots pine, International beech experiment 93/95.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Some ecological and genetic investigations were carried out in European beech stands growing at the border of natural distribution of this species in Poland. 18 plots were established in different stands from the north-east to south-east part of Poland. The genetic investigation was based on the isozymes analysis of mature trees and their progenies from the natural regeneration. Following ecological features were measured: crown area, light conditions, air temperature and humidity, soil enzymes and soil characteristics, ground cover, quantity and quality of natural regeneration. The study finished in 2008 (final report).

Some research concerning influence of 3 weather factors (air temperature, precipitation and solar radiation) on flowering of European larch were carried out in 10-year-old clonal seed orchard and 9-year-old seedling seed

orchard.

In Poland today, there is no separate recommendations or guidelines for forest tree species and provenances under different climatic conditions. Seed transfer rules are still elaborated based on the current climate influence and forest reproductive material (FRM) performance in field tests. The research project concerning elaboration of guidelines how to use the forest reproductive material in changing environmental conditions is now realised in Forest Research Institute. The aim of the project is to compare adaptability and genetic diversity of Scots pine, Norway spruce, European larch, pedunculate oak and European beech based on DNA markers with information about the variability on phenotypic level. To provide scientific data about the growth potential and adaptability, some measurements and observations are carried out in existing trials (common gardens). Regression models are used to express survival, growth and quality traits of studied populations in relation to the differences in climate variables between the original location of a provenance and the location of a common garden experiment. Comparison of meteorological and climate data with the growth and survival of the populations and the results of dendrochronological analysis of trees in selected populations will allow to define the likely responses of forest tree species to environmental changes and elaborate guidelines for Polish conditions.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

The scientific consortium called DENDROGEN, including University with Forestry Faculty in Warsaw, Krakow and Poznan, Forest Research Institute in Sekocin Stary, Institute of Dendrology in Kornik, Kazimierz Wielki University in Bydgoszcz and Adam Mickiewicz University in Poznan, has been set up and a joint research project, concerning Scots pine, European larch and pedunculate oak breeding, has started in 2013.

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## National Report on MaP FGR

**Country** Romania

**Authors** Marin Tudoroiu, Ecaterina Nicoleta Apostol, Alexandru Lucian Curtu

**Introduction** Romania has a total surface area of 238'400 square kilometres. The forest area covers 6.65 million ha which corresponds to 27% of the Romanian territory. In the past it is estimated that forests occupied about 80% of the national territory. The forests are unevenly distributed across the territory, being concentrated mainly in the Carpathian Mountains and the adjacent hilly regions (90%). Only about 10% of the forests can be still found in the lowlands. The main forest tree species is European beech (30%), followed by Norway spruce (22%), oak species (18%) and silver fir (4%). Several forest tree species reach the north-eastern margin of their natural distribution range in Romania (e.g. *Q. cerris*, *Q. pubescens*, and *Q. frainetto*). Especially in the south of the country the climate is arid and the tree species are gradually replaced by herbaceous species (a transition from forest area towards steppe). Under a global warming scenario the steppe is expected to expand its area and continue to gradually replace the marginal forest of xerophyllous oaks (*Q. pedunculiflora*, *Q. pubescens*). A tendency of forest tree species migration towards higher elevations, above the current timber line has also been observed (e.g. for Norway spruce, European larch)

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios** Several climate change scenarios have been developed for Romania as for example those issued by the National Meteorological Administration for the time period up to 2030 (Busuioc et al. 2012) or based on simulations of forest microclimate (Zoran M. et al. 2008). According to their predictions mean monthly temperature will increase for each month, with the maximum increase estimated for July (+1.31 °C). The mean precipitation amount will decrease during the summer and autumn months, with the highest reduction estimated for July (about 6%). However, it will slightly increase in March (by approximately 4%). No significant changes were predicted during the winter months (BUSUIOC *et al.* 2012). More information is available on the site of the Ministry of Environment and Climate Change [www.mmediu.ro/beta/wp-content/uploads/2012/04/2012-04-23\\_schimbari\\_climatice\\_schimbareregimclimatic2001\\_2030.pdf](http://www.mmediu.ro/beta/wp-content/uploads/2012/04/2012-04-23_schimbari_climatice_schimbareregimclimatic2001_2030.pdf)

**Inventory of regional/national maps and/or links to web sites concerning** The Map of soils in Romania was realized by the NATIONAL RESEARCH AND DEVELOPMENT INSTITUTE FOR SOIL SCIENCE AGRO-CHEMISTRY AND ENVIRONMENT - ICPA București. It is available in GIS format at a reference scale of 1:200'000. Currently the map is under updating procedures in order to be in accordance with FAO nomenclature.

*location of soil types and morphology* Different types of soil maps are also available on the EU site: [https://esdac.jrc.ec.europa.eu/resource-type/national-soil-maps-eudasm?field\\_data\\_continent\\_tid\\_selective=All&field\\_data\\_country\\_country\\_selective=RO&field\\_data\\_cont\\_coverage\\_value=](https://esdac.jrc.ec.europa.eu/resource-type/national-soil-maps-eudasm?field_data_continent_tid_selective=All&field_data_country_country_selective=RO&field_data_cont_coverage_value=)

*Identification of pedo-climatic parameters characterizing species ranges* de Martonne aridity index defined as the ratio of the annual precipitation sum in mm and the annual mean Temperature in °C +10

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

*Identification of most relevant species* The oak species from the south-eastern Romanian lowlands: *Q. pedunculiflora*, *Q. robur* and *Q. pubescens* and the associated species, isolated populations of European beech, high altitude Norway spruce populations, Cembra pine and European larch populations.

*Identification of skills and gaps in forest genetics research capacity* Romania has a National Register of Forest Genetic Resources (Pârnuță et al. 2011), which is the result of domestic research funding between 2005 and 2008. The main specialists are enrolled at the National Institute for Research and Development in Forestry “Marin Dracea” (INCDS) and at the Dept. of Forest Sciences, Transylvania University of Brasov. The overall expertise in the field of Forest genetics and tree breeding can be synthesized in: over 30 years of experience in tree breeding, very good comparative field trials and seed orchards network, very good experience and knowhow in selection and description of forest genetic resources and a good research infrastructure in terms of laboratories with basic devices and machines. The Master students in Brasov (study program Forest Ecosystem Management) have the opportunity to attend a specialized course on Conservation of forest genetic resources. Domestic research funds are scarce in the last years due to the economic crisis and it is getting more difficult to attract young people to work in this field.

*Survey and description of conservation and mitigation methods and actions with special reference to climate change* Establishment of ex situ collections. Introduction of tree species in adjacent ecological zones. There were selected Forest Genetic Resources adapted to extreme site conditions. Within forest genetic resources the silvicultural interventions are restricted (e.g. only sanitary cuttings).

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

**Survey and description of available FGR** The description of the FGR is shown in the National register of forest genetic resources (Pârnuță et al. 2011) which contains 698 FGR conservation units for 45 forest tree species. The survey is to be done every 5 years. The local forest districts are responsible for the sustainable management of these conservation unit and the regional forest inspectorates are responsible for the control of the management measures.

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.** There are studies based on molecular markers mainly on oak marginal populations. Adaptive traits were measured in field trials for the most important tree species across Romania (Sofletea et al. 2012, Mihai G. 2009)

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

The National Register of Forest Genetic Resources was published in 2011 (Pârnuță et al. 2011). Together with its publication, guidelines and technical norms for the management of forest genetic resources have been implemented by an Order of the Ministry of Environment and Forests on March 1, 2012. All state and private forest administrations across the country must comply with those regulations. There are also numerous experimental trials, seed orchards and forest genetic resources

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

At present there is no networking. This is to be created in the frame of this Cost action.

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## National Report on MaP FGR

**Country** Republic of Serbia

**Authors** Srđan Stojnić, Saša Orlović, Dejan B. Stojanović

**Introduction** Republic of Serbia is located at the Balkan Peninsula and characterize with the temperate continental climate.

### *Short description of the Country*

Serbia contains 2.3 million ha of forests which cover approximately 29.1% of the total state area. The dominant growing stock in Serbia are coppice forests with 64.7% of the total forest area, whereas natural high stands and artificially established stands (with plantations) cover 27.5% and 7.8%, respectively. The dominant tree species is European beech and its percentage in total volume is 40.5%, and in volume increment 30.6%. The most abundant coniferous species is Norway spruce. Its percentage accounts for 5.2% of volume and 6.7% of volume increment (National Forest Inventory, 2009).

With regards to the aims and objectives of COST Action MaP-FGR, Serbia is southern border for many forest tree species (e.g. European beech, Norway spruce, Silver fir, Scots pine, etc.), as well as habitat for some of endemic tree species (Bosnian pine, Macedonian pine and Serbian spruce). Likewise, discontinuous natural range of certain species led to the separation of marginal populations (e.g. European beech, Pedunculate oak, Sessile oak, etc.). Forest genetic resources in Serbia are threatened by many factors, such as fragmentation of natural forests, tourism development, poor state of private forests, forest fires, illegal logging, invasive pest and diseases, etc.

Climate change is projected to negatively affect forest ecosystems in Serbia. The most endangered tree species will be Pedunculate oak, Sessile oak, Turkey oak, European beech, Silver fir and Norway spruce (Stojanović et al. 2014).

### **Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

**Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios** **Temperature.** Climate projections have been made for two periods and two SRES scenarios. For the period 2001 to 2030 (SRES A1B scenario) temperature is projected to rise by about 1 °C, compared with 1961-1990. For 2071 to 2100, projected temperature rise is between 2.4 and 3.8 °C, depending on the climate change scenario and part of Serbia.

**Precipitation.** Climate projections for the periods 2001 to 2030 (SRES A1B scenario) and 2071 to 2100 (A2 scenario), indicate an increase of precipitation for Serbia of 20 to 30 mm/year for 2001 – 2030 and a decrease of precipitation of up to 30 mm/year for 2071 – 2100, compared with 1961-1990. For the end of the century projected precipitation change strongly varies over Serbia for the A2-scenario. Model results indicate precipitation increases (5–10%) in AP Vojvodina (Northern Serbia), whilst it decreases in other parts of Serbia. Projected precipitation

change has a large gradient increasing from north–east towards south–west, namely between 0 and –5% in the Sava and the Danube valleys; from –5 to –10% in the most parts of the central and east Serbia and on the border with Montenegro; and from –10 and –15% in the west and southwest parts of the country, as well as on the most of Kosovo and Metohija. For the A1B-scenario precipitation at the end of the century is projected to decrease relatively uniform over the entire country.

Climate data might be find online at the official web page of the Republic Hydrometeorological Service of Serbia ([http://www.hidmet.gov.rs/index\\_eng.php](http://www.hidmet.gov.rs/index_eng.php)).

Climate data projections could be found at South East European Virtual Climate Change Centre (SEEVCCC - <http://www.seevccc.rs/>). SEEVCCC provides results of climate projections obtained with coupled atmosphere-ocean Regional Climate Model (RCM-SEEVCCC). Results obtained by INGV/CMCC’s model, SINTEX-G, are used as initial and lateral boundary conditions for this climate projection integrations, as a part of projects SINTA and ADRICOSM-STAR.

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology***

As a non-EU member country, Serbia does not need to implement *INSPIRE* (Infrastructure for SPatial InfoRmation in Europe initiative) Directive. At the moment, digital soil map of Serbia is under construction, thereby there are no available digital soil maps at the moment. GeoSrbija (<http://www.geosrbija.rs/>) is national project designed to support such kind of public database in the future. The best soil data map concerning territory of Serbia is Harmonized World Soil Database (HWSD) and the best available maps of aspects and slopes are derived from DEM maps.

***Identification of pedo-climatic parameters characterizing species ranges***

All forest types in Serbia belong to some of forest complexes listed below. In the northern part of Serbia (lowland part of country), forest complexes are differentiated under the influence of temperature and soil moisture. In the mountain region, beside these factors, forest complexes are differentiated under the influence of altitude, as well. In that sense, there is seven forest areas in Serbia: 1) complex of alluvial-higrophilic types of forest, 2) complex of xero thermophilic Hungarian oak and Turkey oak types of forests, 3) complex of xero-mesophilic forest types of Sessile oak, Turkey oak and Hornbeam, 4) complex of mesophilic pure beech and mixed beech and coniferous types of forests, 5) complex of thermophilic forests types of pines, 6) complex of coniferous forest types and 7) sub-alpine complex consisting of different forms of woody shrubs.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

***Identification of most relevant species***

European beech, Penduculate oak, Sessile oak, Norway spruce, Silver fir, Scots pine, Serbian spruce.

**Identification of skills and gaps in forest genetics research capacity** In the recent years, significant progress has been made in studying of genetic diversity using molecular and population genetic methods. These researches are mainly oriented toward establishing of programmes aimed to conservation of forest genetic resources. Due to projected negative impact of climatic changes on forest ecosystems in Southern Europe, a number of research activities is also focused on evaluation of adaptation potential of certain tree species and populations to adjust to local environmental conditions.

In general, Serbia has a good basis for studying of genetic diversity of core and marginal/peripheral populations due to Balkan Peninsula is one of the genetically most diverse regions in Europe.

The major challenges in the future will be improvement of forest genetics research capacities, continuous funding of research activities, as well as modification and adjustment of traditional breeding strategies to the ongoing climatic changes to address rising demands in a rapidly changing environments.

**Survey and description of conservation and mitigation methods and actions with special reference to climate change** Predominant form of FGR conservation in Serbia is *in situ*, mainly through the establishment of seed stands. Selected reproductive material is produced at the area of 1'815.18 ha. In addition, a number of *ex situ* objects, such as provenance trials (douglas fir, norway spruce, silver fir, european beech), seed orchards (pedunculate oak, serbian spruce, balkan mapple, austrian pine) and clonal archives (poplars, willows and black locust) are established during last decades. The National Programme of Conservation and Directed Utilization of Forest Genetic Resources of the Republic of Serbia for the period between 2016-2025 defines conservation and mitigation methods and actions that should be conducted in the mentioned period to improve adaptability and sustainability of forest ecosystems in the light of climatic changes. Likewise, Forestry Development Strategy for the Republic of Serbia defines conservation and sustainable utilization of forest genetic resources as one of the principal objectives of Serbian forestry in the future. In addition to these documents, a few more forest laws (Law on forests and Law on reproductive material of forest trees) and regulations (Regulation on quality of poplar and willow reproductive material, Regulation on small quantities of forest seeds and seedlings, Regulation on approval of the basic material and control of forest reproductive material production, and Regulation on forest reproductive material balance) tackle the issue of sustainable use of forest genetic resources either directly or indirectly.

**Survey and description of available FGR** In the frame of EUFORGEN activities on EUFGIS database several Gene Conservation Units (GCU) were determined for the following tree species: *Abies alba*, *Picea abies*, *Quercus petraea*, *Quercus robur*, *Castanea sativa*, *Pinus nigra*, *Fagus sylvatica*, *Pinus sylvestris*, *Fraxinus angustifolia* and *Quercus frainetto* (source: <http://portal.eufgis.org/>). The lists of seed objects for the production of qualified, selected and source identified reproductive material are available online.

<b>Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.</b>	Assessment of genetic diversity and population genetic structure of sessile oak (Šijačić-Nikolić et al. 2009), black poplar (Čortan et al. 2016), beech (Ivetić et al. 2012; Nonić et al. 2015), austrian and scots pine (Isajev et al. 2008; Lučić et al. 2008, 2011a, 2011b), serbian spruce (Milovanović and Šijačić-Nikolić, 2010; Aleksić et al. 2017), and norway spruce (Galović et al., 2015; Trudić et al. 2016) in Serbia have been conducted using different molecular markers. Information on variability of different adaptive traits assessed in natural population and common garden experiments are available for european beech (Stojnić et al. 2012, 2013, 2015a, 2015b, 2015c, 2016; Štajner et al. 2013; Šijačić-Nikolić et al. 2013), pedunculate oak (Batos et al. 2010a, 2010b; Bojović et al. 2017), norway spruce (Ivetić et al. 2005; Šijačić-Nikolić et al. 2000), wild cherry (Orlović et al. 2014), black poplar (Čortan et al. 2015, 2017), etc.
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**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Forests in Serbia cover about 29.1% of total area. Beech is the most abundant species (37% of forest area), followed by oaks (35%), other deciduous species (20%) and conifers (8%). Wealth of forest genetic resources is reflected throughout the large number of autochthonous forest tree species (49), as well as presence of endemic tree species (e.g. Serbian spruce) (National Forest Inventory, 2009). Genetic diversity of different forest tree species in Serbia is conserved throughout various *in situ* and *ex situ* conservation forms. Predominant form of FGR conservation in Serbia is *in situ*, whereas *ex situ* objects have been established for the certain species only. Climate change will negatively affects forest ecosystems in Serbia. Pedunculate oak is projected to be the most endangered tree species in Serbia due to global warming and expected habitat changes (Stojanović et al., 2014). Similarly, it was predicted that until the end of the century almost 90% of present beech forests might fall outside their bioclimatic niche, whereas approximately 50% of these forests may experience mass mortality (Stojanović et al., 2013). Besides these two species, highly endangered will be also sessile oak, turkey oak, silver fir and norway spruce (Stojanović et al. 2014). Forest genetic resources are not specifically mentioned neither in forest legislations nor nature conservation policies. Rather the term genetic resources or genetic diversity is used, often in the definition of biodiversity.

Sustainable use of FGR should be improved through the close-to-nature forest management, increasing of forest area, conversion of coppice forests into high, prevention of illegal logging and forest fires, etc. Future activities on *ex situ* conservation should be directed towards the establishment of new field objects of the most important tree species for Serbian forestry, as well as species that are projected to be the most endangered by climatic change.

The forest legislations should explicitly mention FGR, and consider different activities that contribute to the preservation of them. Likewise, the conventional breeding strategies, based on selection for dominantly stem quality and vigorous growth rate, will need to be revised and adjusted to the new climate requirements (e.g. selection for improved water-use efficiency, drought resistance, etc.).

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

Coordination of majority of activities related to forestry science is organized by three scientific institutions: (1) University of Novi Sad, Institute of Lowland Forestry and Environment, (2) Forest Research Institute, Belgrade, and

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(3) University of Belgrade, Faculty of Forestry. These activities are dominantly financed by three state authorities: (1) Ministry of Education, Science and Technological Development, (2) Ministry of Agriculture, Forestry and Water Economy, Forests Directorate, and (3) Republic Serbia, Republic of Serbia, Autonomous Province of Vojvodina, Provincial Secretariat for Science and Technological Development.

Networking at the pan-European level is mostly based on the sharing of available databases throughout EUFORGEN and EVOLTREE programs, as well as participation in IPA projects and COST actions.

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## National Report on MaP FGR

**Country** Slovakia

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**Introduction** Basic facts: country area 49'035 km<sup>2</sup>, forest area 19'336 km<sup>2</sup> + approx. 2 750 km<sup>2</sup> of agricultural land covered by forest trees (data from the National inventory and monitoring of forests), forest cover 40.9%, total growing stock 452.1 mill. m<sup>3</sup>.

**Short description of the Country**

Tree species composition: conifers 40.3% (Norway spruce 25.7, Scots pine 7.7, silver fir 4.0, European larch 2.4, dwarf pine 1.1), broadleaves 59.7% (common beech 31.4, sessile and pedunculate oak 10.8, Turkey oak 2.5, hornbeam 5.8, maples 2.1, ashes 1.5, other 5.6).

Forest functions: commercial 68.9%, ecological 11.7%, social 14.0%.

Human impacts and associated risks: In the recent decade, Slovak forests have been affected by extreme weather events including droughts, flooding, and windstorms. In 2008 and 2010 abnormally high temperatures and precipitations were recorded, in 2011 and 2012 extreme whole-year droughts appeared; along with a disastrous windstorm in spruce forests of High Tatra Mts. in 2004 they probably contributed to persisting bark-beetle outbreak heavily damaging especially montane and subalpine spruce forests. The emissions of all major solid and gaseous pollutants considerably decreased since the early 1990s and nowadays they are either stabilized or further fall. Recent reduction of air pollution has been reflected in improved pH of precipitation in Slovakia. However, the widespread acidification of soils in mountain zones and industrial regions appears to be a long-term problem now: approx. 25% of forest soils have pH < 4.5, 40% pH 4.5–5.5. Tropospheric ozone concentrations continue to rise, particularly at higher altitudes. Concern still persists over the local and regional contamination of soils by heavy metals and alkaline pollutants, especially around large industrial sources.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios** Most climatic variables of interest as well as data on soil properties, geology, geomorphology etc. can be found at the online enviroportal of the Slovak Agency of Environment <http://globus.sazp.sk/atlassr/>

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*Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology* <http://globus.sazp.sk/atlassr/>

*Identification of pedo-climatic parameters characterizing species ranges* <http://globus.sazp.sk/atlassr/>

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

*Identification of most relevant species* *Fagus sylvatica*  
*Picea abies*  
*Abies* sp. (Mediterranean firs)  
Rare species endangered by warming (*Picea omorika*, *Pinus leucodermis*, *P. cembra*, *Aesculus hippocastanum*)

*Identification of skills and gaps in forest genetics research capacity* There are several institutions in Slovakia dealing with genetic research on forest trees. The Faculty of Forestry of the Technical University in Zvolen (TUZVO) has been occupied since the late 1980s by regional and rangewide genetic surveys of forest trees, first using allozymes, now using various kinds of uniparental and biparental DNA markers. The National Forestry Center (NLC) manages a quite extensive research infrastructure of field trials, mainly local or international provenance tests. Institute of Plant Genetics and Biotechnology of the Slovak Academy of Science (UGBR) has also been involved in marker studies on forest trees and biotechnology studies (*in vitro* cultures, somatic embryogenesis, cryopreservation) and also in functional genomics and gene expression studies. In spite of this, there is a significant lack of experience with tree genomics and adaptive-marker studies.

*Survey and description of conservation and mitigation methods and actions with* Nature conservation: 219 National Nature Reserves with an area of 84'189 ha, most of which on forest land, 390 other reserves 13'398 ha. In general, no human intervention is allowed in such reserves, which also means that gene reserves contained in them are hardly exploitable in forestry practice. Forestry: gene reserves

*special reference to climate change*

<i>Survey and description of available FGR</i>	Gene reserves: 112 Approved seed stands: 15'227/69'555 ha Plus trees 4'541 Clonal archives: central clonal archive for European larch at Ostrá Lúka, clonal archives of poplars (130) and willows (60). Seed orchards: 64/134 ha
<i>Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.</i>	TUZVO: rangewide allozyme study on <i>Fagus sylvatica/orientalis</i> including Balkan and other southern populations, rangewide cpDNA study on <i>Taxus baccata</i> , regional mtDNA/nSSR studies on eastern-Mediterranean <i>Abies</i> species, regional cpDNA/nSSR study on <i>Fraxinus excelsior</i> , minor studies on other species ( <i>Quercus robur/petraea/pubescens</i> , <i>Prunus avium</i> , <i>Picea omorika</i> , <i>Alnus glutinosa</i> , <i>Sorbus</i> sp.), international provenance experiments on <i>F. sylvatica</i> (growth, phenology, tree architecture data), local/regional experiments with <i>A. alba</i> , <i>Picea abies</i> NLC: East-Europe-wide allozyme study on <i>A. alba</i> , local and regional provenance experiments on <i>Picea abies</i> , <i>Pinus sylvestris</i> , <i>Larix decidua</i> , <i>Quercus</i> sp. UGBR: local allozyme and cp/mtDNA studies on <i>P. sylvestris/mugo</i> complex

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Several analyses have been made concerning mitigation of climate change effects on forest ecosystems (see below), which included reviews of the effects on gene pools of forest tree species. More detailed regional scenarios and mitigation proposals were developed for 3 areas where most severe impact of climate change on forests is expected: Western Beskydy Mts., Tatra Mts and Slovak Ore Mts. A new synthesis of current research in the field is under development, including the effects on gene pools and recommendations for forestry practice (expected to be published in the first quarter 2013). No specific recommendations or regulation concerning forest reproductive material procurement, use and transfer have been issued. Nevertheless, new knowledge on altitudinal patterns of adaptive variation was taken into account during the preparation of the new legislation on FRM in Slovakia (act no. 138/2010 and executive regulation 501/2010).

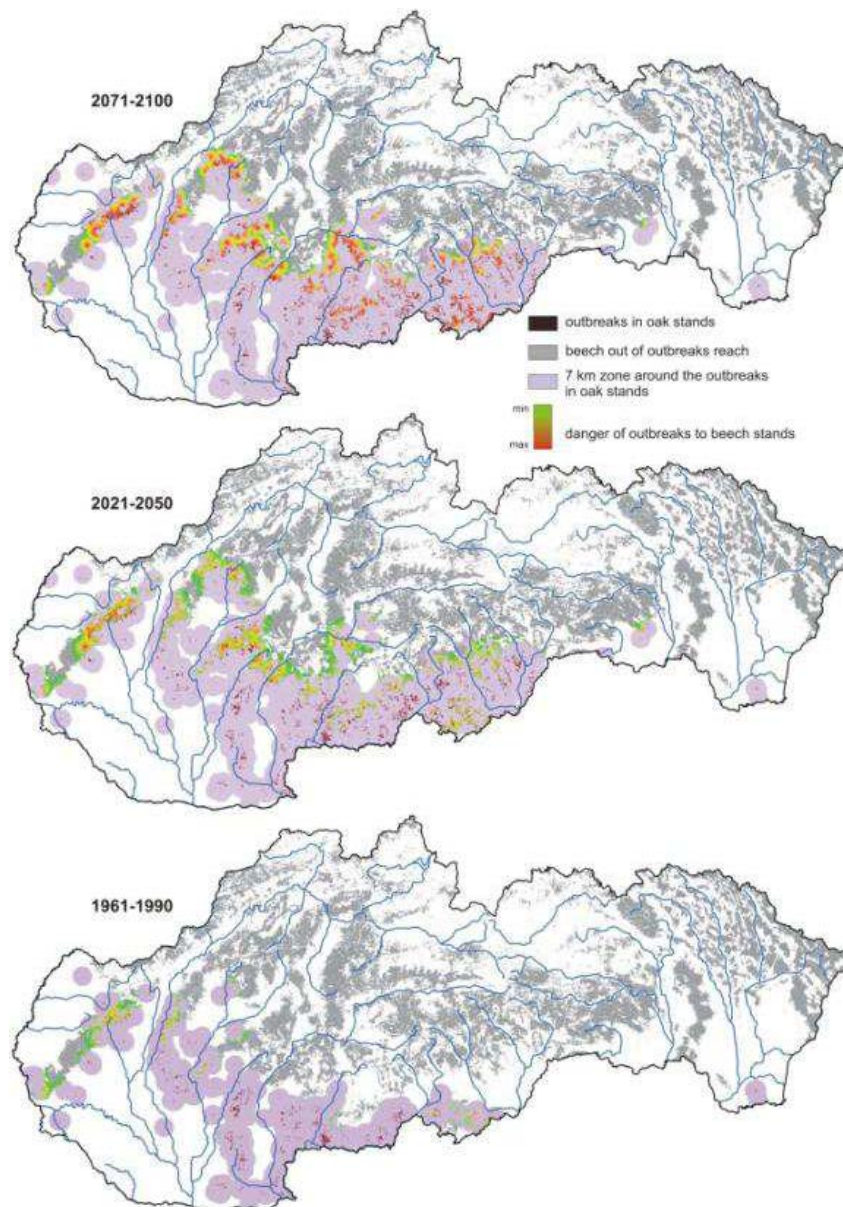
**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

At the national level, there is at present only one official mechanism for networking or coordination of activities associated with gene conservation in forest trees (except those associated with the Euforgen), namely the Commission for Conservation of Forest Genetic Resources of the state forest enterprise Lesy SR (which manages

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

48% of forest land), which meets once-twice a year and takes decisions and recommendations concerning forest reproductive material and its use, and standpoints to the legislation in this area. Moreover, there is an intense informal cooperation within research projects, mainly between TUZVO and NLC.

**Figure** Prediction of the risk of *Lymantria dispar* outbreak in *Quercus cerris* stands and the risk of spread into neighbouring *Fagus sylvatica* stands (Hlasny et al. 2013)



*FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)*

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## National Report on MaP FGR

**Country** Slovenia

**Authors** Gregor Božič, Marjana Westergren, Lado Kutnar, Igor Dakskobler, Andrej Kobler, Robert Brus, Tina Drolc, Franc Batič, Hojka Kraigher

**Introduction Short description of the Country** Slovenia is small size country situated in Central Europe. In territory of Slovenia 4 European landscape macroregions meet: the Alps (the SE part of Alps), the Pannonian Basin (the western margin), the Dinaric Mountains (NW part), the Mediterranean (the northern margin) and 3 types of the climate: alpine, Mediterranean and continental. In spite of its small size, Slovenia is characterised with its great natural diversity, variability and transitional character. From the perspective of climate units, Slovenia has a warm humid temperate climate, with exception of its mountain regions (OGRIN 2004).

Total surface: 20'273 km<sup>2</sup>, forest area: 62% (12'569 km<sup>2</sup>) according to FRA (2010). 70% of the forests grow on potential beech, fir-beech and beech-oak sites (Perko 2007).

Growing stock: 332 m<sup>3</sup> per hectare; Broadleaves/Conifers=55%/45%, Number of naturally growing forest tree species: 71.

Tree species with the highest growing stock share: *Fagus sylvatica* L. (32%), *Picea abies* (L.) Karst. (32 %), *Abies alba* Mill. (8 %) and several species of *Quercus* spp. L. (7 %).

Forest vegetation types & distribution according to Kutnar and Kobler (2011):

- 1 - Acidophilic *Fagus sylvatica* forests;
- 2 - Acidophilic *Pinus sylvestris* forests;
- 3 - Submontane *Fagus sylvatica* forests;
- 4 - Montane *Fagus sylvatica* forests; Alti-) montane *Fagus sylvatica* forest in (Pre-)Alpine region;
- 5 - (Alti-) montane *Fagus sylvatica* forest in (Pre-) Dinaric region;
- 6 - Thermophile *Fagus sylvatica* forests;
- 7 - Collinar forests of *Quercus petraea* and *Carpinus betulus*;
- 8 - Lowland forests of *Salix* species,
- 9 - *Alnus glutinosa* and *Quercus rubur*;
- 10 - Thermophile forests of *Ostrya carpinifolia*, *Quercus* species, *Pinus sylvestris* and *P. nigra*;
- 11 - *Abies alba* forests;
- 12 - *Picea abies* forests;
- 13 - *Pinus mugo* woodlands; ([http://hrcak.srce.hr/index.php?show=clanak&id\\_clanak](http://hrcak.srce.hr/index.php?show=clanak&id_clanak))

[jezik=100952](#)).

No. of tree species with northern distribution limit in Slovenia: 15 (*Acer monspessulanum* L., *Acer obtusatum* L., *Arbutus unedo* L., *Carpinus orientalis* Mill., *Castanea sativa* Mill., *Celtis australis* L., *Cercis siliquastrum* L., *Fraxinus angustifolia* Vahl, *Juniperus oxycedrus* L., *Laurus nobilis* L., *Pistacia terebinthus* L., *Phyllirea latifolia* L., *Pyrus spinosa* Forsk., *Quercus crenata* Lam., *Quercus ilex* L.)

No. of tree species with southern distribution limit in Slovenia: 4 (*Betula pubescens* Ehrh., *Larix decidua* Mill., *Pinus cembra* L., *Salix daphnoides* Vill).

Current impact of human activities in forests: moderate

Signs of global change: spread of pests and diseases from warmer regions (Jurc et al 2006, Ogris et al 2007, 2009, 2010, Jurc and Jurc 2010a, 2010b, Piškur et al 2011, santini et al 2012).

Forestry in Slovenia is traditionally co-nature-based and oriented in sustainable and multifunctional management regardless of the ownership. Clear-cuts are forbidden since 1947. Natural regeneration is promoted wherever it is possible. If seedlings are used, they should originate from known seed sources in Slovenian forests and from adequate tree species and provenances. Replanting with sowing and planting is carried out on ca 500 ha annually, mainly for implementation of the long-term ecological improvement (conversion) from spruce monocultures growing in natural beech or beech-silver fir sites to broadleaf forests. Conservation of FGR in Slovenia is traditionally an integral part of close-to-nature and sustainability forest managements and linked to the Forest Act (1993). Conservation of locally adapted races is ensured by officially approved forest seed objects, through protection of natural parks, natural monuments and forest reserves.

**Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

- Forecasts of tree species distribution and potential forest-site conditions in Slovenia are generated from models (explaining relationships between present climate and distribution of tree-growing stock/vegetation) and scenarios of altered climate (prepared by climatologists).
- The forecasts based on currently observed spatial relationships between climate and vegetation/species distribution accounting also for some ancillary influences: soil, relief (Kutnar et al 2009, Kutnar and Kobler 2011).
- The simulations showed that the spatial pattern of the tree species share/distribution and forest vegetation will be altered under impacts of climate change. The currently dominant mesic beech forests may be affected by changing climatic conditions in the future and potentially replaced by thermophilous forests.
- Significant alterations in potential forest stand species composition in Slovenia are predicted even under the Optimistic scenario.

- In year 2100 MaP populations of *Larix decidua* from the southern distribution limit of the species in Slovenia could potentially be reduced by 59% and 88% under the Optimistic and the Pessimistic scenario, respectively.

*Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios* Not available

*Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology* Not available

*Identification of pedo-climatic parameters characterizing species ranges* Not available

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

*Identification of most relevant species* *Larix decidua, Pinus cembra, Salix daphnoides, Betula pubescens*

*Identification of skills and gaps in forest genetics research capacity* Skills:  
population genetic studies using neutral markers (SSR, sequences, isoenzymes)(laboratory and interpretation), experience with DGGE, experience with morphological variation, experience in provenance research  
Gaps:  
limited sample throughput, lacking experience for analysis of adaptive traits.

*Survey and description of conservation and mitigation methods and actions with special reference to climate change* Storage of seed in a seed bank.  
Genetic conservation units established.

<b>Survey and description of available FGR</b>	<p>The national list of basic FRM is established and published by Slovenian Forestry Institute (SFI) each year in the official gazette and on SFI web page.</p> <p>Genetic conservation unites are entered into the EUFGIS database.</p> <p>Seed bank.</p> <p>Extracted DNA for number of managed forest stands/seed stands for different tree species (however non MaP FGR).</p> <p>International provenance trial – <i>Fagus sylvatica</i>.</p>
<b>Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.</b>	<p>None for MaP (however information on variability of genetic variability available for <i>Picea abies</i> ( isoenzymes, nuclear SSR), <i>Abies alba</i> (isoenzymes), <i>Populus nigra</i> (nuclear SSR), <i>Prunus avium</i> (nuclear SSR), <i>Fraxinus excelsior</i> (nuclear SSR), <i>Fraxinus angustifolia</i> (nuclear SSR), <i>Fagus sylvatica</i> (isozymes, nuclear SSR, international provenance trial with 38 provenances / BU2012).</p>

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

- Maps of current vegetation and the distribution of individual tree species exist.
- Ecological information exists but scattered amongst different institutions and sometimes difficult to access.
- Model-based forecasting maps of potential vegetation in 2040, 2070, 2100 exist for three (non-IPCC) climate-warming scenarios. The spatial resolution of the models/maps is 1 sq. km. They include potential growing stocks of the 16 most frequent tree species and potential percentages of 13 forest types. The predictive accuracy of the models was estimated as correlation between the actual present values and the modeled present values. The correlation values range between 0.92 and 0.66, for the forest types and 0.88 and 0.64 for the tree species. The model correlation mainly depends on the spatial predominance of a species / type. Therefore the predictions for less frequent species / types are less accurate.
- Population size and condition is being under study in several marginal populatins lately (*Arbutus unedo*, *Juniperus oxycedrus*)
- A new modeling / mapping effort is underway, this time taking into account IPCC scenarios AiB and B1.
- Genetic information for MaP /marginal species except for some marginal azonal Norway spruce populations lacking.
- Recommendations for forestry managers for some species exist in the form of translated EUFORGEN technical guidelines with country specific addition.
- Most species that include MaP are included in the Rules on the list of forest tree species and hybrids and therefore subjected to Act of Forest Reproductive Material (FRM).

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**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

- Work regarding MaP and/or FGR is / has been carried out within the following international and national projects EUFORGEN, EUFGIS, COST E52, SIFORGEN (Slovenian Forest Genetic Resources Programme), within Public Forest Service Programme (the aim is to transfer knowledge to forest managers), national projects Development of molecular databases in forestry and Designation of measures to ensure genetic based forest protection.
- Within EUFORINNO project, purchase of laboratory equipment, networking, laboratory trainings, organization of conferences in the field of FGR are managed.
- No project so far has specifically addressed MaP.

Databases are managed by scientists employed at SFI and are as follows:

- Seed stands for forestry and non-forestry purposes with metadata are entered into a local (not available on internet) database.
- Molecular data (nuclear SSR, Isoenzymes) including metadata on populations are entered into a local access database.
- Growth and spring phenology data obtained in international beech provenance trial Straža (BU2012) are entered into a local and international access databases.
- Genetic conservation units have been identified during the duration of EUFGIS project and are entered into the EUFGIS database.

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## National Report on MaP FGR

**Country** Switzerland

**Authors** Mühlethaler U., Pluess A. R., Heiri C., Weber P., Moser B., Arend M.

**Introduction** Approximately 31% of Switzerland or 12'786 km<sup>2</sup> are covered by forests and, according to the National Forest Inventory NFI (Brändli 2010), the forest area grows by 0.4 % every year. Forest cover varies between regions, with a minimum in the central lowlands (25%) and a maximum in the Southern Alps (51%). The growing stock of 346 m<sup>3</sup>/ha is very high. Annual growth (9.5 m<sup>3</sup>/ha) is slightly higher than annual harvest and mortality (8.6 m<sup>3</sup>/ha). *Picea abies* is still the dominant tree species, with a 45% share. The second most frequent tree species is *Fagus sylvatica* (18%) followed by *Abies alba* (15%). Due to Switzerland's vivid topography, many ecological marginal populations MaP are present. The Central-Europe southern distribution limit of *Pinus sylvestris*, *P. cembra*, *Picea abies*, and *Larix decidua* may be identified here. Many tree species are present with MaP at the natural northern distribution limit, e.g. *Quercus pubescens*, *Q. cerris*, *Sorbus domestica*, *Acer opalus*, *Castanea sativa*, *Fraxinus ornus*. Impacts of human activities are still important by silvicultural measures. However, more than 90% of mature timber is established by natural seeding – a peak value in Europe. But nowadays natural rejuvenation of *Abies alba*, and of many other tree species, is endangered by game damage. On the other hand, damage to forests by people looking for recreation has increased. Climate change impacts are well investigated on *Pinus sylvestris* forests in the dry inner-alpine valleys (Rigling et al. 2013). A set of more than 130 permanent observation plots shows impacts of climate change and other environmental parameters on forest ecosystems in Switzerland (<http://www.wsl.ch/info/organisation/fpo/lwf>; Braun & Flückiger 2009).

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios** The climate in Switzerland is highly variable, covering a wide range of temperature and precipitation conditions. A network of 117 ground-based automatic weather stations operated by MeteoSwiss (<http://www.meteoschweiz.admin.ch>) provides data on several meteorological variables, e.g. precipitation, temperature, wind and solar radiation. Climate maps displaying monthly and annual patterns of temperature, precipitation sum and sunshine duration are available for the 30 year averaging periods 1961-1990 and 1981-2010, with notable regional climate change data, recorded during this last period. Additionally, the Federal Institute for Forest, Snow and Landscape Research WSL operates 19 forest research plots equipped with automated weather stations providing information on several meteorological variables in different forest areas of Switzerland (<http://www.wsl.ch/lwf>). Scenarios predicting future climate

conditions were recently developed for Switzerland, pointing to an increase in temperature by 2.7-4.0 °C and a reduction in summer precipitation by 21-28% until the end of 2100 (CH2011).

**Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology** A digitized soil map covering all parts of Switzerland is available with a scale of 1:200.000 (Frei et al. 1980), and more detailed maps showing soil conditions at larger scales are available for selected regions. Furthermore, a database including around 1000 soil samples was recently developed by the Federal Institute for Forest, Snow and Landscape Research WSL, providing detailed information on soil conditions in Swiss forests. The digital height model DHM25 provided by the Swiss Federal Office of Topography can be used for computing topographic information, e.g. elevation, aspect, slope and profiles.

**Identification of pedo-climatic parameters characterizing species ranges** Some past/current research activities focus(ed) on pedo-climatic factors limiting tree species ranges in Switzerland. Dendro-ecological approaches and analysis of soil moisture conditions are/were applied for studying tree growth in marginal beech stands at the inner-alpine drought limit (Weber et al. 2013). Assessments of pine mortality/regeneration together with an analysis of forest vegetation data provided by the Swiss National Forest Inventory NFI indicated increased climatic drought as a driving factor of the vegetation shift from *Pinus sylvestris* to *Quercus pubescens* in dry alpine forests (Rigling et al. 2013).

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

**Identification of most relevant species** Many woody species are present in Switzerland with marginal populations due to ecological limits and/or northern/southern distribution edges. The most relevant species forming marginal populations are *Fagus sylvatica*, *Picea abies*, *Abies alba*, *Pinus sylvestris*, *Larix decidua*, *Pinus cembra* and *Quercus pubescens*.

**Identification of skills and gaps in forest genetics research capacity** **Molecular:** Genetic research at the molecular level is conducted in most Swiss universities, including the Genetic Diversity Center at ETHZ ([www.gdc.ethz.ch](http://www.gdc.ethz.ch)), and the Federal Research institute for Forest, Snow and Landscape Research WSL. Research focuses mainly on neutral molecular diversity (AFLP, nSSR, cpSSR, allozyme, etc.) though analyses of markers in genes under selection (SNP) has recently started. To date, countrywide molecular analyses of tree species are missing despite of an ongoing *Fagus sylvatica* project (A.R. Pluess; ETHZ).

**Genecological:** Resources for common garden experiments are available at WSL and BFH-HAFL, including specific research facilities for drought, warming and CO<sub>2</sub> treatments, e.g. the WSL model ecosystem facility MODOEK or the WSL climate manipulation facility. Switzerland is not involved in pan-European provenance trials, except a contribution to the IUFRO fir provenance trial.

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

**Survey and description of conservation and mitigation methods and actions with special reference to climate change**

The ETHZ and WSL monitor and conduct research on a set of over 50 small forest reserves at different stages and altitudes (Brang et al. 2011). Many of them concern marginal populations of above mentioned tree species. Human activities are strongly restricted within these perimeters to avoid un-natural disturbance. Mitigation is not foreseen as a priority of forest management in our country, but the focus lies more on adaptation to climate change, e.g. selection of adapted tree species/provenances for forest regeneration/afforestation. Recent research, for instance, suggests adaptational potential of *Fagus sylvatica* to local drought that might foster future viability of beech forests in Switzerland (Pluess & Weber 2012). Experiments with *Pinus sylvestris* seedlings suggest that autochthonous provenances have a high potential to adapt to increasing drought and rising temperatures, while low growth plasticity might limit the competitive ability of Mediterranean provenances in continental Alpine forests (Richter et al. 2012).

**Survey and description of available FGR**

The Swiss Federal Office for the Environment FOEN has published a report on forests of particular genetic interest BGI. A conceptual framework for identifying and managing BGI's was formerly developed by the organization of the cantonal forestry heads (OKOK-Gruppe Genreservate, 1988) but has not been implemented so far. A national register of recognized seed harvest stands for forest regeneration is provided by the Swiss Federal Office for the Environment FOEN (<http://www.nks.admin.ch>). Forest genetic resources FGR's are currently studied in *Fagus sylvatica*, *Picea abies* and *Abies alba*, with special emphasis on the adaptability of Swiss provenances/ecotypes to climate change (C. Heiri, ADAPT and M. Arend, BuKlim).

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.**

**Molecular:** So far, primarily small scale molecular analyses were done in Switzerland. For *Larix decidua*, one expanding population in the Canton Valais was investigated using nSSR to understand how genetic diversity is shaped during the colonization process (Pluess 2011). For *Fagus sylvatica*, trees in three regions containing a mesic and a nearby dry site were investigated using AFLP (Pluess & Weber 2012). Inbreeding and inbreeding depression in core and peripheral stands of *Pinus cembra* were studied using molecular markers and a common garden experiment (Salzer & Gugerli 2012). **Genecological:** Although one of the first genecological studies was conducted in Switzerland (Engler, 1905; *Picea abies* and *Abies alba*), this field of research is only marginally represented in our country today. Provenance trials, including 86 Swiss *Picea abies* provenances, were conducted by Bossel (1983) and Fouvy & Jeantet (1997). Response to drought stress was investigated for four *Abies alba* provenances by Herzog & Rotach (1990). Drought and temperature manipulation experiments revealed high phenotypic plasticity of autochthonous marginal *Pinus sylvestris* seedlings compared to low plasticity of Spanish seedlings (Richter et al. 2012). In 2009, a genecological study was launched with 80 provenances of *Picea abies*, *Abies alba* and *Fagus sylvatica* to map the patterns of genetic variation in adaptive traits (C. Heiri; ADAPT). Drought experiments with *Fagus sylvatica* saplings (M. Arend; BuKlim) taken from ecologically different provenance sites and *Pinus*

*sylvestris* seedlings from several continental and Mediterranean provenances (B. Moser) were recently started.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

The Swiss Federal Office for the Environment FOEN has published a report on forests of particular genetic interest BGI, including a guideline of how to identify and to protect them (Bonfils & Bolliger 2003). The BGI report is intended to help forest managers and owners to fulfill legislation regarding forest genetics. It links ecological aspects with genetic knowledge. However, the responsibility is delegated at the level of cantonal forest authorities. The main objective is to guarantee local provenances and genetic diversity of BGI in the long-term, mainly by only allowing natural regeneration of desired tree species. Consulting of concerned forest managers plays a major role in the context of BGI management. Genetic manipulation on plants is strictly forbidden. Therefore, interest in genetic research is rather poor so far. In the light of climate change, policy makers need to get aware of the important lack of precise and systematic information. However, within the federal research program “Forest and Climate Change” some of the above mentioned projects and case studies on FGR are receiving funds.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

Swiss research activities dealing with marginal forest populations, forest genetic resources and impacts of climate change are conducted by many different research groups at the Swiss Federal Institute of Technology Zurich ETHZ, the Bern University of Applied Sciences BFH-HAFL, and the Swiss Federal Institute for Forest, Snow and Landscape Research WSL. To date, networking among these research groups as well as international collaboration was mostly informal without any structured organization. A coordinated and more intense national/international networking is developing within the frame of COST FP1202, linking national/international research activities and facilitating knowledge transfer.

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## National Report on MaP FGR

**Country** Turkey

**Authors** Y. Serengil & S. Ayan

**Introduction** The surface area of Turkey is around 780'000 km<sup>2</sup>. 22.3 million hectares are forestland, and this comprises some 27% of national territory. However, only 53% percent is productive forest.

**Short description of the Country** There are various forest types in the country. We can distinguish three phyto-geographical regions namely: Euro-Siberian, Irano-Turanian and Mediterranean. Turkey has approximately 12 000 plant species. 3'708 of these species are endemic to the country. Classified by the species type and the area covered, oaks (*Quercus* spp.) takes the lead with about 20 species and 6'476'277 hectares, Calabrian pine seconded oaks with 5'420'524 hectares followed by Anatolian black pine with 4'202'298 hectares. Beeches (*Fagus orientalis* and *F. sylvatica*), Scotch pine, and firs (*Abies nordmanniana* and *A. cilicica*) also take up a considerable share in the country's overall forest resources. The forest ecosystems in the country potentially under risk of multiple stressors including climate change. However, due to in the county migration the pressure on forest resources is getting down every year and forest areas are increasing. The climate change can be considered as a significant driver as a large portion of the country. In addition, desertification is a serious issue as a large portion of the country land experience semiarid region of the country. The adaptation of marginal/peripheral populations of forest trees, such as *Cedrus libani*, *Corylus colurna*, endemic *Abies* taxa, *Fagus orientalis*, some *Quercus* taxa with narrowed distributioned etc., is a significant research subject considering this spatially variable climatic conditions and also rough topography.

### Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

**Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios** It can be accessed some forest inventories as to regional, forest enterprise and district chief via the web site of Turkish Forest General Directorate:

[http://www.ogm.gov.tr/Sayfalar/Ormanlarimiz/T%C3%BCrkiye-Orman-](http://www.ogm.gov.tr/Sayfalar/Ormanlarimiz/T%C3%BCrkiye-Orman-Varl%C4%B1%C4%9F%C4%B1-Haritas%C4%B1.aspx)

[Varl%C4%B1%C4%9F%C4%B1-Haritas%C4%B1.aspx;](http://www.ogm.gov.tr/Sayfalar/OrmanHaritasi.aspx)

<http://www.ogm.gov.tr/Sayfalar/OrmanHaritasi.aspx>

There are some climatic data for every city (Example: Çorum; <http://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=CORUM#sfb>).

Also, it can be found some academic studies related to climate change scenarios as to national and river basin level (Supplement B and C). In addition it can be reach some studies regarding scenario of temperature and precipitation for Turkey (Supp. A).

There are studies in Turkey to understand the ecologic conditions of various forest tree species

and communities but these are not towards understanding the impacts of climate change. There is a coarse scale climate change projection study in Turkey but vegetation response is not worked on a regional or national scale.

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology*** Soil, climate and topographical maps exist at various government agencies but may not be readily available. At universities we generally have our own collection of GIS layers on soil, vegetation, topography and some other parameters that we use in our studies.

***Identification of pedo-climatic parameters characterizing species ranges*** We are quite confident that we do not have such a map or database.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

***Identification of most relevant species*** *Cedrus libani*, *Corylus colurna*, endemic *Abies* taxa, *Fagus orientalis*, some *Quercus* taxa with narrowed distributioned, are concerned by MaP FGR.

***Identification of skills and gaps in forest genetics research capacity*** Forest Tree Seeds and Tree Breeding Research Institute Directorate that is under “General Directorate of Forestry” and “General Directorate of Nature Conservation and National Parks” are responsible for selection, protection and management of forest genetic resources. Gene conservation forests, seed stands, national parks, nature protection areas, biosphere reserve areas, natural monuments, protection forests, nature parks, specially protected areas are in situ conservation areas in Turkey. In situ gene conservation activities major on gene conservation forests and seed stands, since other units are selected for different purposes together with gene conservation function. There are 308 gene conservation forests as in situ conservation areas. They consist 42 species (162 coniferous and 76 broadleaved), which covers 35'000 ha. Seed stands are also important as other in situ conservation areas. There are 321 (260 is coniferous and 61 is broad leaved) seed stands in 35 species across the country. Almost all of the seed stands are natural, and they cover 42'227,5 ha.

***Survey and*** There are several conservation status and conservation forests in Turkey but the conservation is

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***description of conservation and mitigation methods and actions with special reference to climate change*** not towards the effects of Climate Change. It is mostly for conserving the significant forest communities. "Protected Areas and Climate Change Turkey's National Strategy" (October 2011), Ministry of Forestry and Water Affairs, UNDP-Turkey and WWF-Turkey carried out in collaboration with the Global Environment Facility (GEF) funded "Forest Protected Areas Strengthening Management Project" on 15-16 February 2010 as a result of the "Protected Areas and Climate Change Workshop" organized as a strategy compatible with the Granada Summit Strategy. The world's first national strategy "Turkey's National Protected Areas and Climate Change Strategy", the global climate change risk management and defines activities needed for Turkey to reach the desired goals.

***Survey and description of available FGR*** Not available

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.

Scientific name	(N) (E)	Morphological traits	Adaptive and production traits	Molecular characterization
<i>Abies equitrojani</i>	N	Seedling characteristics		Isoenzyme, SSR, ITS
<i>Abies bornmulleriana</i>	N	Seed characteristics		
<i>Abies cilicica</i>				Isoenzyme
<i>Abies normaniana</i>		Seed and seedling characteristics,		Isoenzyme
<i>Castanea sativa</i>	N	Seedling characteristics,		
<i>Cedrus libani</i>	N	Seed and seedling characteristics,	Drought tolerance	RAPD Isoenzyme
<i>Fagus orientalis</i>	N	Seed and seedling characteristics,	Wood density	SSR
<i>Liquidambar orientalis</i>	N	Seedling characteristics		RAPD, mtDNA, isoenzyme
<i>Laurocerasus officinalis</i>	N			RAPD
<i>Picea orientalis</i>	N			Isoenzyme, SSR
<i>Populus alba</i>	N	Seedling characteristics	Volumediameter, wood density	DNA fingerprinting
<i>Populus nigra</i>	N	Seedling characteristics	Volume, diameter, wood density	DNA fingerprinting
<i>Pinus brutia</i>	N	Seed and seedling characteristics,	Volume, diameter, drought tolerance, cold tolerance, wood density	Isoenzyme, SSR, RAPD
<i>Pinus nigra</i>	N	Seed and seedling characteristics	Volume, diameter, drought tolerance, cold tolerance, density, pollen characteristics	Isoenzyme, RAPD
<i>Pinus sylvestris</i>	N	Seed and seedling characteristics	Volume, diameter, density	Isoenzyme, RAPD
<i>Pinus halepensis</i>	N	Seed and seedling characteristics		RAPD, ITS
<i>Pinus pinea</i>	N			RAPD
<i>Pinus pinaster</i>	N			RAPD
<i>Prunus mahaleb</i>	N			RAPD
<i>Quercus vulcanica</i>	N	Seed and seedling characteristics		
<i>Taxus baccata</i>	N			RAPD

Resource: The state of the World's Forest Genetic Resources, Country Report by compiled GAYE KANDEMİR (2013), Ankara.

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

The main constraints to improving in situ genetic conservation activities in Turkey comprise (1) limited numbers of researchers and technical staff specialized about forest genetics, (2) inadequate knowledge about the biology, ecology and genetics of species (3) insufficient research and inventory studies. All these constraints are related mainly with high species diversity. The major restriction on in situ genetic conservation studies in Turkey is the lack of research and inventory studies because of the great deal of species diversity. Genetic diversity studies are being carried out by

a limited number of scientists working in this field (Kandemir 2013).

We believe that another one of the major issue that can be considered as a research gap is a research study to put forward the species distribution and its relevance with soil and climate parameters. If this gap is filled then it would be possible to integrate this with climate change scenarios. Another point is the ecosystem services have not been mapped in Turkey at the national level. Therefore the relationship between the services and climate change impacts cannot be identified.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

Turkey is a member of EUFORGEN (European Forest Genetic Resources Programme) (<http://www.euforgen.org/associated-countries/turkey/>). In years 1994, 2000 and 2009, three meetings of this programme were held in Turkey. In the context of this programme, common action plans are determined concerning protection and sustainability of forest gene resources. Furthermore, Turkey provides data regarding in situ conservation areas in the database of EUFGIS (Establishment of a European Information System on Forest Genetic Resources) ([http://portal.eufgis.org/search/simple/list/?tx\\_wfqbe\\_pi1\[country\\_name\]=Turkey](http://portal.eufgis.org/search/simple/list/?tx_wfqbe_pi1[country_name]=Turkey)). Turkey has signed a number of legally binding agreements on the conservation and sustainable use of forest genetic resources as a United Nations (UN) country. Apart from EUFORGEN and EUFGIS, we do not think that there is a networking activity beyond conferences in Turkey. The networking takes place during the scientific meetings or in case of a project application.

**List of Experts/Contacts involved in FP 1202 MaP FGR**

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## National Report on MaP FGR

**Country** Ukraine

**Authors** Taras Parpan

### **Introduction Short description of the Country**

Ukraine lies in the central portion of Europe, occupying the Southwestern and Southern parts of the East European Plain. The total area of Ukraine is 603'550 km<sup>2</sup> (with the Crimea) and is one of the least wooded countries in Europe (forest cover is only 15.9% of the whole territory, or 9.7 million ha). Today in Ukraine, about 20 native woody species are used in economy.

The portion of the forest cover greatly varies from region to region, ranging from 34% in the Carpathian region to an average of 4% on the steppe. The most forested areas are concentrated in two main regions: the Carpathian Mountains (mainly covered by Common spruce, European beech and highly less by Silver fir stands) and the Northern territories (which are largely represented by Scots pine plantation).

The main physiographical zones can be recognized within the flatland portion of Ukraine: mixed forests (Ukrainian Polissya), forest-steppe, and steppe. The highland and mountain regions include only the Ukrainian Carpathians. All of the territory (without Crimea) extends within the temperate climatic zone, where the climate is continental.

According to ecological and vegetation distribution, there are 4 different areas: Carpathians, Polissya, Forest Steppe and Steppe regions. The most of interesting species concerning MaP FGR are on the border between Carpathians and Forest Steppe area. The influence of human during history is not so significant compared with Western Europe but process of deforestation was active particularly for last 150 years and climate become more arid.

Due to activities such as illegal logging, forest fires, etc., forested areas have been shrinking rapidly.

However, on 1 January 2015 the area of forest that hold Forest Stewardship Council (FSC) certification make 2'787 million ha, what sum 26.8% state-managed forests in Ukraine. The FSC, certified forests are uneven and mostly concentrated in the western and northern regions of Ukraine.

### **Task 1 – Short description of existing information on scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.**

#### ***Inventories of regional/national maps and/or links to web sites of climatic maps including future***

*The climatic changes that have occurred*

According to the data of Ukrainian research Institute of hydrometeorology (URIHM) the effects of climate change are increasingly felt in Ukraine. Over the past 20 years the average annual temperature has risen by 0,8°C, and the average temperature in January and February

*scenarios*

– on 1-2°C. This led to a change in the rhythm of seasonal events - spring floods, beginning of the early trees flowering, light frosts and snow falling. Due to climate change the weather in our region become more extreme. Droughts and floods are not only becoming more and their devastating effects increases as the consequences for the economy (floods along the Danube in 2005, on the Dniester river and in Transcarpathia in August 2008, drought across whole Ukraine in 2007, a record snowfall in western and central part of the country in March 2013 and in December 2009 in the south regions of country).

*Future climatic scenarios*

The Ukrainian research Institute of hydrometeorology (URIHM) developed forecasts of climate change in Ukraine until 2050. The maximum and minimum temperatures for the year will continue to increase. Winter will be milder and shorter and the summers will be hotter. Redistribution of precipitation throughout the country may increase by 20% rainfall in January, March and April and will decrease during summer together with rising temperatures in summer. This will lead especially in the south to a lack of moisture. Forest fires will become more frequent and more devastating; it is expected that snow cover and winter period will be shorter.

Since 1971, the average annual temperature in the Carpathians and the area adjacent to the Carpathians (Precarpathians) where mostly silver fir and beech marginal population are situated increased by 0,6°-1,65°C, depending on the height and location. Rainfall in the Ukrainian Carpathians increased, and in Romanian - decreased. Heavy showers have become more frequent, which increases the risk of landslides.

In the next 20-30 years warming will continue, summers become drier and winters more humid. For trees, this means an early spring and lack of moisture in the summer.

[http://wwf.panda.org/uk/wwf\\_ukraine\\_ukr/climatechange/climate\\_impacts\\_ua/](http://wwf.panda.org/uk/wwf_ukraine_ukr/climatechange/climate_impacts_ua/)

<http://uhmi.org.ua/>

***Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology***

The data will be presented with focus for the eastern part of the Ukrainian Carpathians and Precarpathians which is an ecological site for several marginal population.

The soils of mountain areas characterized by zonal altitude. Typical Carpathian soils are brown, but there are also other types of soils.

The intensity of brown soil formation process depends on parent rock and type of forest. It is more evident in soils that formed on carbonaceous rocks than without carbonaceous, and under beech and hornbeam forest than under conifers stand.

In hilly areas Precarpathians up to 450 m a.s.l. (Chernivtsi, Ivano-Frankivsk, Lviv, Ternopil region) in more warm temperate zone brown-podzolic soils are more common. This soil profiles are clearly visible whit eluvial horizons.

Soil are mostly formed on magmatic and volcanic rocks as well as on Carpathian flysch.

In geological structure dominate a Cretaceous-Paleogenetic flysch, there exists of Jurassic

limestone and Paleozoic crystalline schist. Neogene volcanic formations are represented by andesite, basalts and their tuffs.

The maps in “jpg” format will be provided: map of geomorphology with natural distribution of beech, fir and spruce, simple map of geomorphology for whole Ukraine, geographical range of three species.

Soil types 50-km-fao-7, geomorphologie.shp.zip.

<http://www.ex.ua/348916284329>

<http://ukrmap.su/program2009/g8/Maps/12.jpg>

***Identification of pedo-climatic parameters characterizing species ranges***

The one of most important criteria to determine the chorological and distribution structure specially of European beech and Silver fir trees population in a complex of ecological factors is the hydrothermal coefficient which is determined on the basis of correlation between atmospheric precipitation and evaporation. It was established that these marginal populations grow in the range of hydrothermal coefficient 1.5-1.8; in the more humid region of the Carpathians, those species spread in the range of hydrothermal coefficient from 1.5 to 3.76.

European beech and a marginal Silver fir population are peripheral populations which are growing at one of the six Carpathians vertical thermal zones, namely the warm temperate zone. This zone is found in the Precarpathians area at an altitude of 250-400 m a.s.l. with a total annual temperature of 2'200-2'800°C. The average temperature in June about 18-20°C, and in January about - 3°C. The average annual rainfall is 600-700 mm.

The climatic conditions, geological structure, lithological base is defined by various types of forests soils under marginal trees population. In the Carpathians, beech forests on flysch lithological base tend to grow on light-brown and brown forest soils. Hornbeam-spruce-beech and oak-beech forest of the foothills are associated with podzol soils on alluvial and deluvial sediments. In the Precarpathians area, the subformations of oak-hornbeam-beech and hornbeam-beech as well as pure beech forests are ecologically associated with light-grey, grey and dark-gray podzolized soils on carbonate and non-carbonate loess.

**Task 2 - Genetic information including adaptive traits of MaP populations at southern limits of the species.**

***Identification of most relevant species*** The most important species: European beech (*Fagus sylvatica L.*), Common silver fir (*Abies alba Mill.*) and Norway spruce (*Picea abies L.*).

***Identification of skills and gaps in forest genetics research capacity*** *Skills:*

- Team of researchers in Ukraine
- Wealth of genetic diversity large number of endemic species (especially in Carpathian Mountains)
- Field trial plots of several species (Provenance tests)
- Recognition of the need for conservation of forest genetic resources (The gene resources)

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

conservation in Ukraine is regulated by many legislative and standardized documents. The Forest Code of Ukraine of 08.02.2006 is the basic legislative document on forest management. Other legislative documents adopted for the forest sector in elaboration of provisions of the Forest Code regulate various aspects of the process of forest genetic resources conservation).

*Gaps:*

- There is no laboratory for genetic study for forest species
- Absence of projects concerning research of genetic diversity
- Till now lack of recognition the potential value of trees population on edge of areal for process of adaptation due to climate changes
- At the level The State Forest Resources Agency of Ukraine and the State Forest Seed Inspection, there are no contracts concluded with foreign countries in fields associated with the genetic conservation or with an extended access to forest genetic resources that are located outside Ukraine
- Lack of explained information on the necessity of conserving genetic resources and an inadequate level of public awareness
- Lack of financial resources and state-run programs.

***Survey and description of conservation and mitigation methods and actions with special reference to climate change***

Methods of forest management that have been used over the last years contribute to a certain extent to the conservation of the genepool of forest tree species. When making a forest inventory, tree mensuration descriptions of stands in most cases contain a conservation status of each forest plot (a seed orchard, a plus stand, a genetic reserve, a protected area of local significance, etc.). Besides, a tree mensuration description contains information on the presence of plus trees. At regular intervals, a State forest-seed inspection makes an inventory of the status of seed-growing objects which are units of genetic conservation.

The first steps towards the conservation of the genetic diversity of forest woody species in Ukraine were taken in the framework of creating provenance test plantations for basic forest-forming species (almost 100 years ago) and during the progress of work on selection of forest species over 50 years ago (plus trees and plus stands were selected). In Ukraine, altogether 478 genetic reserves of 30 species with the total area of 24.05 thousand ha were allocated at that time. In the western region of Ukraine, the use of a multiple-factor index of functionality was suggested and approved to assess genetic reserves. It was found out that 5 to 15 % of different genetic reserves do not fit for criteria set for units of genetic conservation related to the valuable genepool. A tendency to degradation of condition of genetic conservation units was observed. At the same time there is evidence that forest enterprises are increasing their activities towards depriving these units of their protective status. On the other hand, the forest-seed inspection and scientific institutions do not support the reduction of units of genetic conservation in area. The selection of new units of genetic

conservation *in situ* is often problematical due to considerable reduction of area of natural forests.

At the moment, a work is nearing completion on the refinement and co-ordination of the document entitled “Regulations on the allocation, conservation and sustainable use of the genepool of forest woody species in Ukraine” which regulates differentiated approach to the conservation of forest genetic resources of basic forest-forming species and less-common autochthonal and introduced tree species.

**Survey and description of available FGR**

Natural populations on edge of their areal such as: European beech (*Fagus sylvatica L.*), Common silver fir (*Abies alba Mill.*) and Norway spruce (*Picea abies L.*).

- Seed stands: almost all economically valuable species have their representatives as seed stands. Those forests are the most valuable forests and in future, the process of selection of seed stands will be with stress on climate change adaptive populations.

- Plus stands - units selected for genepool conservation and tree improvement: from 11 tree species 141 number of population. From theirs total 2'093.3 ha on 2010-2011 was selected 78.1 ha.

- According to the “Program on the development of the forest seed-growing management for the years of 2010 to 2015”, it is planned to select additionally 1260 plus trees of 9 species. Over the years of 2010-2011, 688 trees of 6 economically significant species were selected.

- About 100 years ago, the first work on the *ex situ* conservation of forest genetic resources was started in connection with creating provenance test plots and studying the geographic variability. The most promising provenances have been selected. 7 population breeds have been suggested to create forest plantations artificial stands.

- In today's Ukraine, there are 146.8 ha of progeny tests of 4 species. More than a thousand progenies of plus trees are being tested.

Endemic species: In Ukraine there are 12 endemic species of trees and bushes grow in natural way. The most significant are: *Larix polonica Racib* with a disjunctive area and *Betula klokovii Zaverucha akin to Betula pubescens Ehrh.*

**Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.**

*Abies alba* – research of Nadija Pirko, Ivan Korshykov, Serhij Pryvalikhin, Taras Parpan (biochemical (izozime), molecular markers, provenance test)

*Picea pungens* - research of Inna Makohon, Ivan Korshykov (pollen morphology)

*Quercus robur* - research of Andrij Demkovich, Ivan Korshykov (molecular markers)

*Pinus cembra* - research of Jaroslav Pirko, Nadija Pirko (biochemical (izozime), molecular markers)

*Pinus mugo* - research of Ivan Korshykov, Nadija Pirko, Taras Parpan (biochemical (izozime), molecular markers)

*Picea abies* – research of Ivan Korshykov, Serhij Privalikhin, Inna Makohon, (biochemical (izozime), molecular markers)

FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

*Pinus sylvestris* – research of Anton Lisnichuk, Ivan Korshykov, Jaroslav Pirko, Inna Makohon, Roman Hut, Taras Parpan, Roman Yatsik, Roman Volosjanchyk (biochemical (izozime), molecular markers), morphological parameters researched in provenance tests  
*Fagus sylvatica* – research of Roman Hut (molecular markers).

**Task 3 - Analysis and synthesis of available ecological and genetic information and knowledge gaps highlighted in Task 1 and Task 2 and recommendations for forest managers and for national policy makers.**

Ukraine is a huge state considering the surface and has variable environmental conditions. There is a number of forest formations, a large number of different types of forests and species. Genetic diversity is significant due to differences in environmental conditions. The predominant part of Ukraine's territory is situated in conditions of temperate continental climate, except for the south coast of the Crimea with its Mediterranean type of climate. The degree of continentality goes up in the direction of the west and north-west to the east and south-east. In Ukraine, one can single out the following natural zones:

- Temperate forest zone (Polissya).
- Temperate forest-steppe zone.
- Temperate steppe zone.
- Zone of subtropical dry forests (The south coast of Crimea).
- Vertical zoning in the Carpathians and Crimean mountains.

The species composition of Ukrainian forests is rich and various. Over 30 forest-forming woody species grow in these forests. A significant number of species that are found in Europe and Ukraine are located on the eastern edge of its range. These are the populations that grow on the line separating Precarpathian area and the west forest-steppe as well as Transdnistria. Those two last mentioned ecological zones are droughtier, therefore more affected by climate change and harmful increase in temperature. Species that occur in areas that are vulnerable climatic changes are: Norway spruce, European beech and common silver fir.

Besides, there is scientific evidence that spruce and beech have expanded their distribution because of warmer climate and land use change especially in tree line ecosystem (in the Ukrainian and Romanian Carpathians). Our last studies show that there are real prospects for increasing beech forests in the Carpathians, Precarpathian, Opillya and partially Podillya regions. It is facilitated by the intense generative regeneration of beech, its high vitality and successful cultivation. Considering the global warming ways are discussed to increase the area of beech forests. The necessity of protection of the marginal beech forest is substantial.

The problem is the lack of laboratories for the analysis of biochemical markers. In Ukraine there is only one such laboratory in Donetsk (Botanic Garden of Donetsk). Analyses which we carry out are mostly conducted abroad. For the conservation of the genepool of forest species in Ukraine (rare and disappearing species; targeted commercially valuable forms and varieties, etc.), the Ukrainian Research Institute of Forestry and Forest Melioration, National Forestry Engineering University of Ukraine, National University of Bioresources and Nature Management of Ukraine, and National Botanic Garden are using the micropropagation simultaneously with classical methods of reproduction. For economic or ecological expectations to be achieved, the use of micropropagation technologies must be supported by the government. What is more, it is necessary to recruit high-skilled specialists and to ensure an

appropriate level of the financing of fundamental research work and a proper collaboration between science and production operations.

The informational support to measures on the rational use, development and conservation of genetic resources of Ukraine should be effected through discussions concerning the most important issues of the above directions by a collegiate organ of the State Agency for Forest Resources of Ukraine, with the issuance of appropriate orders, or by permanent/provisional advisory organs (a Scientific and Technical Council). At present, informational systems of the State Agency for Forest Resources of Ukraine and of the State Forest-Seed Inspection concerned with the rational use, development and conservation of genetic resources of Ukraine are still only partially computerized. Comprehensive computerization of these systems will allow keeping the electronic documentation in standard formats (Word, Excel) and provide free exchange of data. A unified state-run system of electronic registration of data of forest genetic resources units in Ukraine is developing now.

Besides, there are no strategies of conserving the genepool. Only some approaches have been recently suggested for the development of such strategies. For example, the following documents have been developed: “A Concept of the Conservation and Sustainable Using of Forest Genetic Resources in Ukraine”, “Guidelines on the Allotment, Conservation, and Reproduction of the Valuable Genepool of Forest Tree Species in Ukraine”, and “Regulations on the Allotment, Conservation and Sustainable Use of the Genepool of Forest Tree Species in Ukraine”.

**Task 4 Coordination and organization of all networking, databases management, training and communication activities: web-site, organization of conferences, training schools, short term scientific missions.**

The state-run program “Forests of Ukraine for the years of 2010-2015” is now in force in Ukraine. This program provides for the conservation of biodiversity of forests and is based on principles of sustainable forest management and rational use of forests. Also there are some multinational programs involving individual regions as exemplified by “The framework convention on protection and sustainable development of the Carpathians”.

An active participation in the conservation of forest genetic resources is taken by the Ukrainian State Forest-Seed Inspection, Ukrainian Research Institute of Forestry and Forest Melioration, Ukrainian Research Institute of Mountain Forestry, National Ukrainian University of Forestry Engineering, National University of Bioresources and Nature Management of Ukraine and other research institutions and higher educational institutions. All this activity is under the general supervision of the State Agency of Forest Resources of Ukraine.

Investigations on the conservation of genetic resources are annually financed by the State Agency of Forest Resources of Ukraine to the extent of UAH 1 million (ca. 35.000 EU).

No special financial provisions are made for the conservation of genetic resources.

The most important higher educational institutions in the sphere of forestry are the National Forestry Engineering University of Ukraine, National University of Bioresources and Nature Management of Ukraine. Besides, 20 universities of general and agrarian profile have forestry faculties or departments that teach subjects related to forest genetic resources and their conservation. There is collaboration between government and Public Forest Enterprises which manage forests and with national parks in our country.

Ukraine has participated in works on the conservation of forest genetic resources within the EUFORGEN network.

No web-site regarding FGR exists in Ukraine.

*FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)*

**List of Experts/Contacts involved in FP 1202 MaP FGR**

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FPS COST Action FP1202 Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

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