Joint GenTree/LIFEGENNMON

Stakeholders' event on genetic monitoring

Stakeholders' event

Date of the event: 24-25 October 2017
Location: Porto Palace Hotel, Thessaloniki (Greece)

Executive summary

A stakeholders' event on forest genetic monitoring (FGM) was organized jointly between the projects GenTree and LIFEGENMON in order to exchange scientific knowledge and harmonize approaches developed by the two different EU-funded initiatives. The event brought together more than 60 participants from 13 countries. The key points that emerged from the meeting were the following:

- forest genetic monitoring (FGM) should work as early warning tool applied within the framework of a conservation strategy for forest genetic resources, implemented across the network of genetic conservation units (GCUs) identified across European countries. It should also support decisions about the inclusion among the GCUs of additional forest stands that are particularly valuable and exposed to environmental changes, based on a spatial assessment of threats.
- According to some workshop's participants, applying FGM to daily forest management may be difficult for various reason, in particular because there are no standards to define if the changes observed through the genetic monitoring are going to have positive or negative consequences in terms of resilience of the forest cover. In addition, the costs for FMG may be too high. On the other side, there are ongoing attempts (e.g., in Germany) to incorporate genetic monitoring into forest

management on a pilot basis, for a few species, by screening a large number of trees in managed plots and combining phenotypic and genetic data. It will be important to track this experience.

- It is true that in the short-term, forester practitioners do not expect forest genetic diversity to be changing considerably, but the implementation of FGM as part of close-to-nature forest management may become useful in light of the increasing rate of environmental changes and their effects on forests.
- The questions about what indicators to use in FGM, and what should be the frequency of monitoring, are still open. Clarity about the scale (spatial and temporal) of adoption of FGM is necessary in order to select the appropriate set of indicators to be used in the implementation of FGM.
- A priority setting exercise to identify a set of critical indicators to be adopted should be carried out, by linking indicators to the processes and threats they associate with and to be able to interpret the changes detected. This priority setting will enable to define the threats to be monitored, the indicators that relate to these particular threats and the time scale to be addressed. It was observed that sometimes monitoring could be more necessary after disturbance, for example to assess, the trajectory of a forest ecosystem after fire or after implementing forest restoration activities. According to some participants, for what concerns priorities in FGM, it is crucial to focus monitoring on seeds and demographic aspects, which are very informative. Sometimes, this may be sufficient without adding genetic information. Other participants reminded that it is necessary to use not only state indicators but also response indicators; response indicators enable to identify the responses that need to follow up on particular signals detected through FGM.
- An important aspect to take into account is whether indicators can be practically applied and used by foresters for monitoring purposes, without excessive investment of resources in training.
- In order to be effective in a dialogue with policy-makers, scientists should explain the purpose of genetic monitoring, a tool that works as an insurance; the return for the investment is a greater capacity to cope with extremely critical situations that cannot be foreseen. Genetic monitoring should help anticipating what cannot be detected early enough through simple standard observations carried out within monitoring plots (though keeping in mind that some catastrophic events cannot be monitored).
- It was clear to all participants that FGM is still at a research stage. The effectiveness of the tool in detecting early signs of changes due to climate change in GCUs requires a thorough assessment before upscaling. Case studies are also needed to highlight the benefits of genetic monitoring. A dialogue between LIFEGENMON and GenTree will be established to collaboratively advance the discussion around a set of meaningful indicators for FGM within the GCUs network. The modelling work foreseen within GenTree could also provide inputs to LIFEGENMON, assisting in the selection of indicators, by implementing simulations under different climate change and management scenarios.

Meeting report

A stakeholders' event on forest genetic monitoring (FGM) was organized jointly between the projects GenTree and LIFEGENMON in order to exchange scientific knowledge and harmonize approaches developed by the two different EU-funded initiatives.

Part of the research carried out within the GenTree project, and implemented within the LIFEGENMON project, is addressing the challenging task of FGM applied to a large number of tree species across Europe. The LIFEGENMON project, financed by an EU environmental fund, aims at producing a manual for FGM, guidelines for practice, and a science-policy communication action plan for the long-term conservation of forest genetic resources and FGM. The first objective was to define optimal indicators and verifiers for monitoring changes in genetic diversity over time. Six plots of two selected target tree species (*Fagus sylvatica* and the *Abies alba / A. borisii-regis* complex) are used as model across a transect from Greece to Bavaria in South Germany. The project LIFEGENMON has reached an advanced stage of discussion about the feasibility on the ground of FGM approaches based on scientific findings.

Within the GenTree project, FGM strategies are considered central to the conservation of forest genetic resources in *in-situ* collections (genetic conservation units) in Europe. The optimal selection of indicators and verifiers for forest genetic monitoring will be an output of modelling activities that will generate process-based forest adaptation models and forest dynamics scenarios under climate change.

The main objectives of the meeting were:

from a GenTree perspective to

- Understand how FGM is carried out and what are the main challenges in its implementation;
- Understand how FGM indicators and data can be incorporated into modelling.

from a LIFEGENMON perspective to

- Discuss methodological issues related to FGM plots selection, sampling design and further implementation;
- Discuss problems encountered with the identified indicators;
- Define a minimum set of indicators that would be valid in the long run and would define the baseline for long-term monitoring, regardless of scientific advances;
- Discuss how to raise awareness about genetic monitoring and explain the necessity to fund it in the long-term as part of regular management activities.
- Create an opportunity for networking and communication between the Greek and Slovenian forest services and forest geneticists from the two countries.

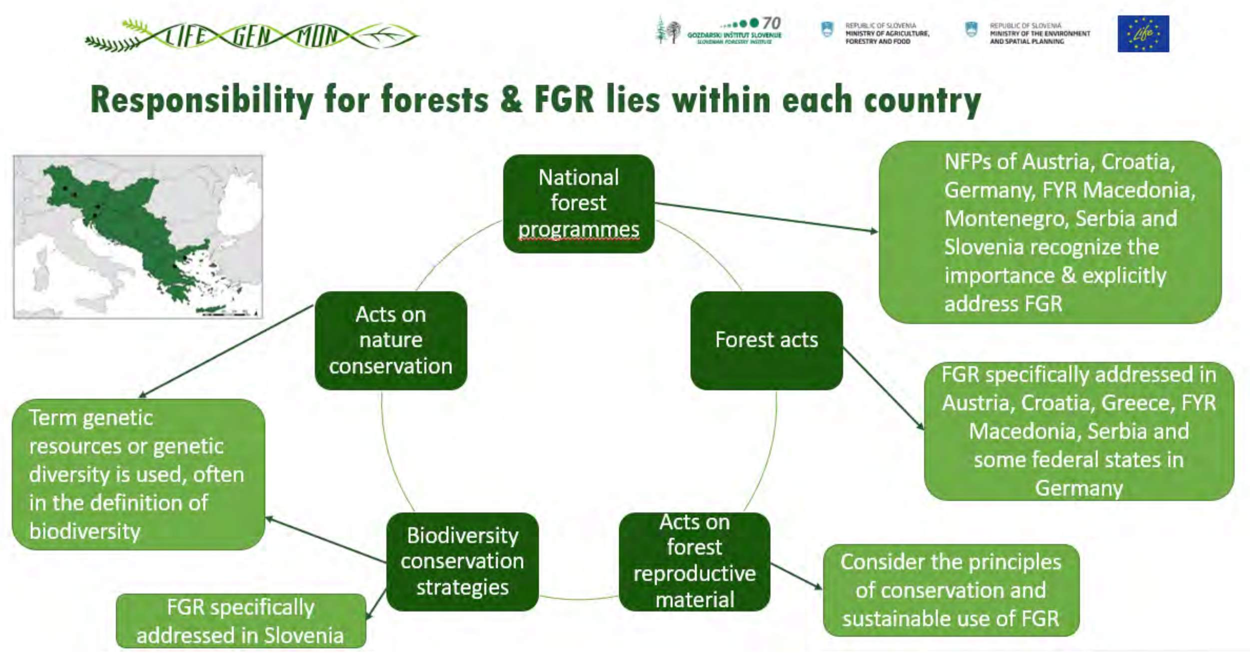
The participants were primarily scientists, foresters who implement FGM in the field, and stakeholders from institutions responsible for forest administration (see Annex 2).

Day 1- 24 October 2017

The meeting was opened on behalf of local organizers by Phil Aravanopoulos, Professor at the Faculty of Agriculture, Forest Science & Natural Environment, Aristotle University of Thessaloniki and by Nikitas Fragiskakis, the General Director of Forests & Rural Affairs of the Decentralised Administration of Macedonia and Thrace (G.D.D.A.Y-D.A.M.T). They gave the floor to representatives of the local authorities: the General Director of Forests in Greece, Kostas Dimopoulos for some welcoming words. He was followed by the Chairman of the School of Forestry & Environment, Aristotle University of Thessaloniki, Prof. Th. Zagas.

After an illustration of the agenda of the meeting (see Annex 1), a series of introductory presentations was provided. The project LIFEGENMON was presented by its coordinator, Hojka Kraigher from the Slovenian Forestry Institute (design, define and implement FGM). The GenTree project was presented by its coordinator Bruno Fady (expectation for GenTree: WP1 on Improving genetic conservation strategies for European forest trees, WP5 on Adapting management and policies to optimise the use of forest genetic resources, WP6 on Dissemination, stakeholder engagement and knowledge transfer).

To provide a broader context for genetic monitoring, Marjana Westergren (Slovenian Forestry Institute) presented national and international processes addressing conservation and sustainable use of forest genetic resources. She mentioned the global policies, including the Convention on Biological Diversity, which explicitly recognize three dimensions that constitute biological diversity (ie, genetic, species, and ecosystem diversity) and refer to monitoring in legally binding terms (eg. CBD 1992- Article 7: Identification and Monitoring). She also mentioned the FAO Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources (2014), as a voluntary and non-binding document. Primary responsibility for its implementation lies with governments. FAO has a strong commitment to supporting countries in these efforts, working with governments and other partners at the national, regional and international levels.



She then recalled European policies & programmes dealing directly and indirectly with FGR:

- FOREST EUROPE (MCPFE); resolutions S2 Conservation of forest genetic resources (1990), V4 Conserving and enhancing forest biological diversity in Europe (2003), M2 Protection of forests in a changing environment (2015)
- EU Forest Strategy (2014 – 2020); "should strengthen forest genetics conservation (tree species diversity) and diversity within species and within populations", "genetic diversity must be enhanced and endangered genetic resources protected"
- EU Biodiversity Strategy (until 2020)

- EC Directive on Forest Reproductive Material 1999/105/EC
- Rural development programme (RDP, 2014-2020)
- EU ABS Regulation 511/2014
- Regulation 1143/2014 on invasive alien species
- Council Directive 200/29/EC on organisms harmful to plants (Regulation 2016/2031 from December 2019)

Finally, she mentioned the European Forest Genetic Resources Programme (EUFORGEN), which had a working group on indicators for monitoring, and the national policies & programmes (NFPs), which represent an excellent tool to incorporate forest genetic resources and their monitoring into national forest (and biodiversity) policies. They are based on a strong participatory approach and are used as a tool guiding the development of national forest legislation. Overall, the recognition of FGR in sectorial policies is positive. Yet, the lack of explicit mention of FGR in main forest acts and the lack of legal obligation for their conservation are serious limitations.

In the following presentation, representatives of the forest services from two main partner countries in LIFEGENMON, Chrysi Sarvani and Paulos Bekiaroglou from Greece, **Živan Veselič** and Boris **Rantaša** from Slovenia, illustrated the main characteristics of the forest sector in the two countries.

In Greece, forestland covers ca. 49% of the total land area and it is largely public. The main challenges are: climate change, fires, illegal logging, tree diseases and pests (increased "mobility" of diseases imported from other countries through the introduction of species) and low forest production (this has declined in recent years compared with the late 80s). In most Natura 2000 sites (over 50 % of Greek forests), multi-purpose forestry is applied, but production functions are important.

In Slovenia, clear cutting has been legally banned since 1947, to make space for a close-to-nature silviculture. Growing stocks have increased over the years. Protection forests are ca. 8 %, including also 170 strict forest reserves. Natura 2000 sites extend over 45 % of Slovenian forests. In most of them, production functions are also important. Forested areas include 70.7 % of Natura 2000 sites. The main challenges for the forestry sector are extreme climatic events (ice break for example), pest outbreaks and game management.

The forest service staff also presented what their expectations were from forest genetic scientists and from the two projects. Their main expectations were:

- Knowledge made available on forest genetics and support in early identification of actual threats to the genetic diversity of forest tree species. Scientific outputs are expected to be accessible and easy to understand
- Scientific support in dealing with challenges in forest management.
- Scientific support in ensuring forest legislation addresses the actual challenges in managing particular tree species and forest ecosystems.

To implement FGM, there is a need for automatized data loggers, for a simple language and of clear protocols, etc. They also expect an early warning system, scientific knowledge for adapting legislation and support to data collection on the ground. The manual on FGM that will be developed in LIFEGENMON should help in translating tricky or complex procedures into a harmonized and simplified approach for monitoring. Collection of 'difficult' indicators should be avoided and the timing should be sufficiently spaced.

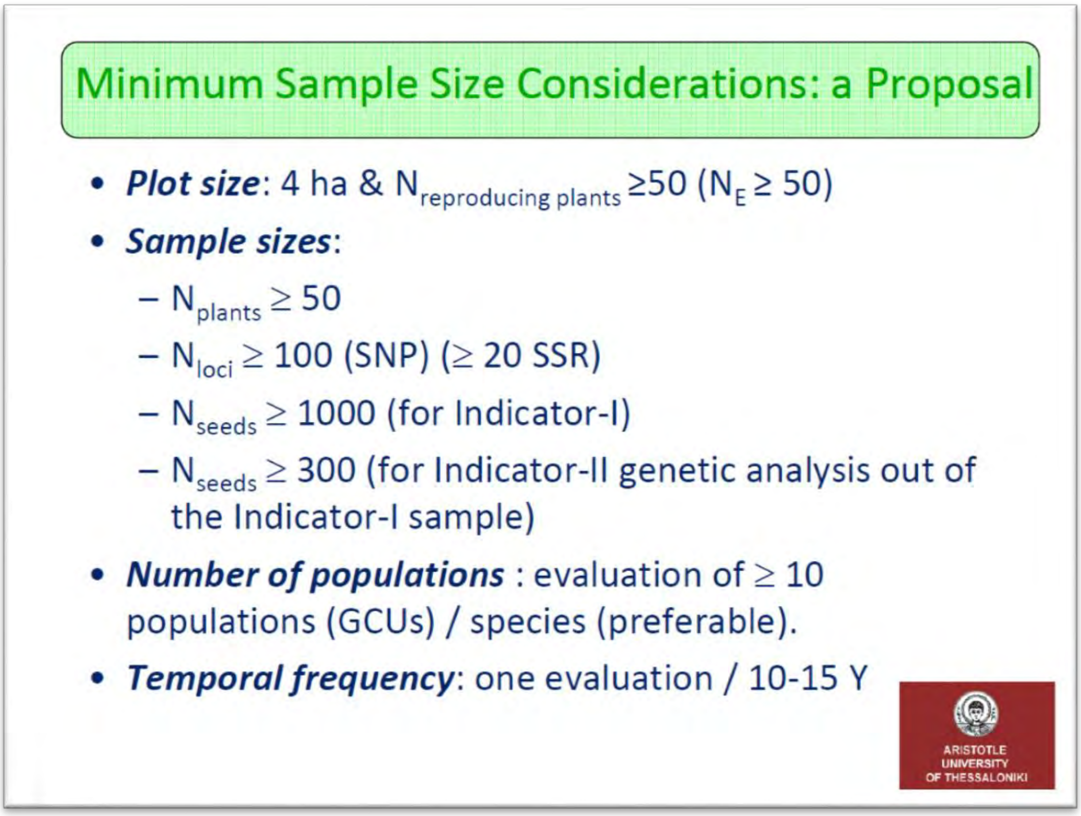
Phil Aravanopoulos introduced the state-of-the-art in science, presented experience in practical implementation of genetic monitoring and reviewed FGM principles. He recalled that monitoring is a key tool to assess whether we are adequately conserving genetic diversity, due to its crucial importance for life. The debate over genetic monitoring is 30 years old; the aim of genetic monitoring is to assess the current status of genetic resources and quantify relevant changes at a temporal scale in light of preserving long-term adaptive evolutionary potential. This is particularly useful when the environment is changing. Monitoring should be used as a research tool, an early detection tool and a means to secure conservation.

With regard to species selection, genetic monitoring can focus on: a) keystone/model species of ecological/economic importance to prevent losses of important diversity, b) endangered or rare species to restore diversity, c) marginal species and populations to prevent loss of diversity or restore it.

Monitoring should start from protected areas, preferably genetic conservation units. The monitoring method should be ideally, and as much as possible, applicable to all species ("species free"). Sampling should be easy and straightforward, to avoid excessive challenges when applied in remote areas. Also, a minimum set of parameters to be measured should be selected for an adequate assessment of the monitoring areas, comparable across time. The monitoring scheme is designed around a set of criteria, indicators, verifiers. He then illustrated the proposed monitoring scheme that will be used in GenTree, based on the geneecological approach (see details in the slides below). In GenTree, there is a plan to extend FGM also to populations conserved *ex situ*.

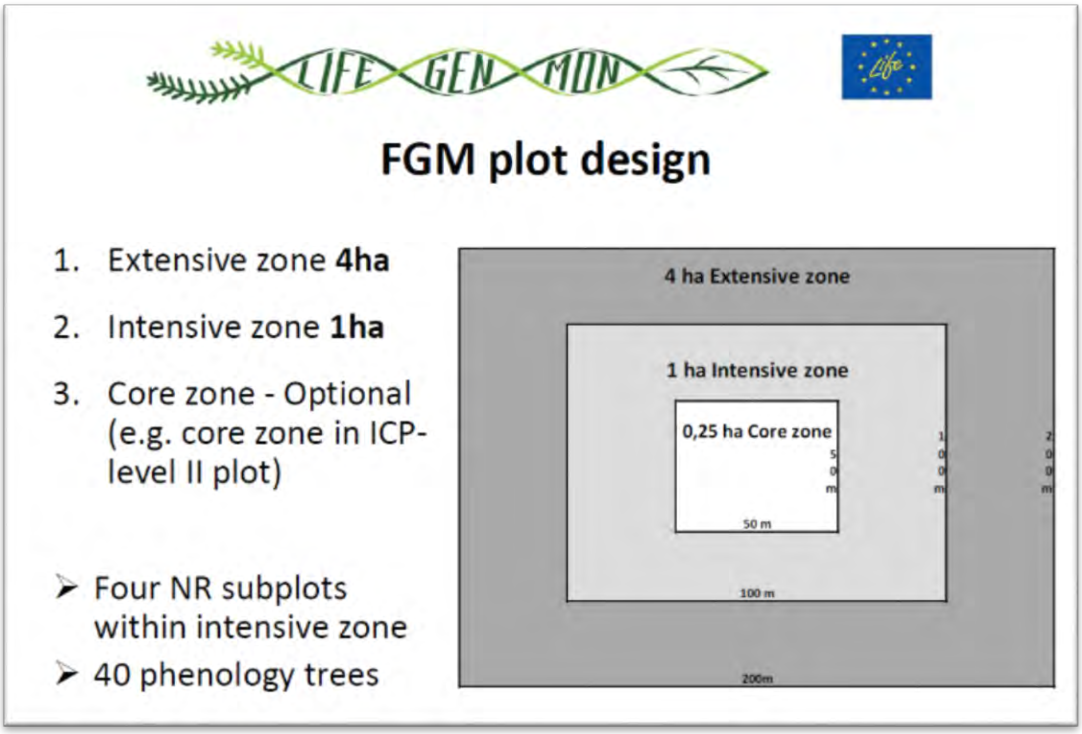
Critical differences in genomic monitoring parameters at the evaluation of temporal changes: a Proposal

Indicator	*Verifier*	*Critical Difference*
Selection	age/size class distribution	2 standard errors
	reproductive fitness – mast years (% of filled seeds, % of germination)	> 50 %
	regeneration abundance	> 50 %
	mortality / fructification	> 50 %
	F_{ST} outlier analysis	> 25 %
Genetic drift	genetic diversity (allele/genotype frequencies,, N_A, P, H_E, H_O,, F_{IS}, F_{ST})	> 25 %
	effective population size (N_E)	< 50 (absolute value)
	allelic richness	> 25 %
	latent genetic potential	> 25 %
Gene flow	outcrossing /actual Inbreeding rate	>10 %

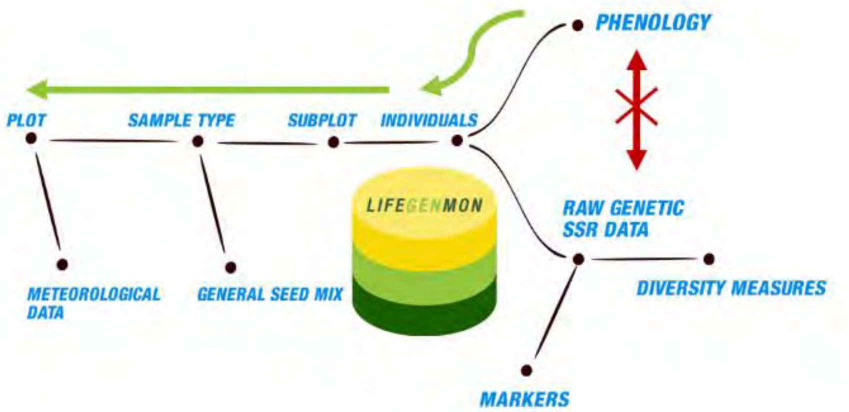


Darius Kavaliuaskas and Domen Finžgar illustrated progress achieved in LIFEGENMON in the definition, selection and establishment of FGM plots and in the development of a database with FGM plot data. Darius Kavaliuaskas recalled the theoretical basis of genetic monitoring and presented a pilot implementation of FGM in Germany. This experience provided the basis for designing the monitoring plots established within LIFEGENMON (see image below).

Genetic monitoring was first proposed by experts from the FAO Panel of Experts on Forest Genetic Resources, in 1996 (Namkoong et al. 1996, 2002). The approach was then simplified for practical use by the German programme for conservation of forest genetic resources (BLAG – expert group (2004): Concept on the genetic monitoring for forest tree species in the Federal Republic of Germany, Konnert et al. 2011) and by experts from the EUFORGEN working group on FGM (Aravanopoulos et al. 2015). In LIFEGENMON, FGM is implemented in six plots for two selected target tree species (*Fagus sylvatica* and the *Abies alba / A. borisii-regis* complex) across a transect from Greece to Bavaria (South Germany). The selection of the monitoring plots followed precise criteria and the design of the plots included: an extensive zone (4ha), an intensive zone (1ha), a core zone (optional), four subplots to assess natural regeneration, within the intensive zone and 40 tree individuals subjected to observations of phenology (see image below).



Domen Finzgar presented a database built to contain data derived from monitoring. The database was created using a free online software called Open Foris, developed by FAO (see the scheme of data input below).



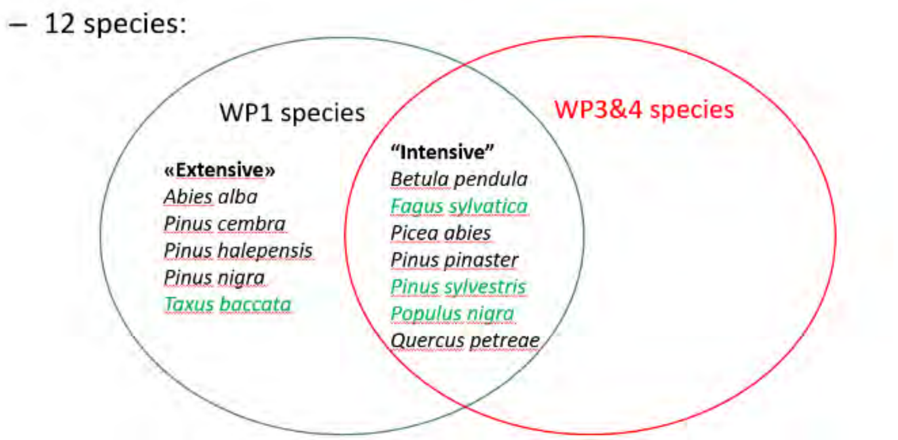
Tor Myking presented the GenTree sampling design for genetic monitoring. He reminded that genetic monitoring has an important scientific goal, that is, to achieve a better understanding of the spatial scale of local adaptation. In particular it aims at:

- better defining in situ and ex situ conservation strategies and breeding zones;
- elaborating a genetically sustainable forest management plan and policies;
- identifying where valuable forest genetic resources are located.

In GenTree, the activities related to FGM are in WP1 (see below) and refer to genetic conservation strategies:

- Identify populations endangered by habitat shifts;
- Characterise European core in situ conservation network and identify gaps;
- Test methods for monitoring *in situ* and *ex situ.*

GenTree's research is targeting 12 tree species overall, while four species (*Taxus baccata, Fagus sylvatica, Pinus sylvestris, Populus nigra* – in green below) are specifically targeted for genetic monitoring.



The design of monitoring is based on a genecological approach (Aravanopoulos 2011, Graudal et al. 2014, Konnert et al. 2011) and targets the following elements:

- Two different cohorts: mature trees and seeds;
- Demographic measurements;
- Germination rate;
- Outcrossing/inbreeding rate;
- Standard genetic diversity;
- Long distance dispersal.

Marco Bajc presented the results from a ring test aimed at developing a laboratory manual to harmonize the analysis of microsatellite markers data across different labs involved in FGM. To replicate studies using microsatellite markers across different countries and to compare them or to run analyses in parallel between different laboratories, raw data should be adjusted to ensure that allele sizes are comparable, even when identical machines are used across labs. For this purpose, institutions participating in LIFEGENMON project performed an inter-laboratory comparison, i.e. ring testing, on samples from two species: *Abies alba* and *Fagus sylvatica*. The objectives were to:

- assess differences in allele sizes between laboratories;
- devise a set of rules allowing inter-laboratory comparison of results;
- assess the technical suitability of tested microsatellite markers for FGM purposes;
- indirectly assess the suitability of each laboratory's standard operating protocols for FGM.

It was found that standard laboratory protocols of all three laboratories produced comparable results and were suitable for FGM. Observed differences in allele size between laboratories depend on a complex set of factors. No extrapolation of results to new (untested) markers is possible, so every marker has to be ring-tested to determine the exact difference in allele size between laboratories.

Standardized rules were devised to minimize differences between laboratories due to different allele scoring/sizing protocols and operator error. Although ring testing is not necessary for the establishment of a FGM system per se, it expands the range of analyses that can be performed on a combined dataset – e.g. gene flow and post-glacial migration analyses, landscape genetics etc. Also, it can help to detect potential deficiencies in the analytical process that would go unnoticed if analyses were performed only individually by each laboratory. A laboratory manual will be part of the FGM manual in preparation.

Genetic monitoring per se refers to the temporal analysis of the same site (e.g. a GCU), which is usually going to be performed by the same laboratory every time. Nevertheless, in case different laboratories are used, a ring test prior to the experimental analysis is the optimal solution.

At the end of the presentations, the participants addressed in plenary the question about whether genetic monitoring should be performed as part of *in situ* genetic conservation within the genetic conservation units (GCUs) or should be applied more broadly.

The views that emerged from the discussion are presented below:

- Implementing genetic monitoring in GCUs is a priority. To give more visibility to this field of work, it seems strategic to link FGM with global efforts related to FGR (e.g. efforts led by ICRAF, or forest restoration initiatives targeting the goals set by the Bonn Challenge, linking aspects of conservation with the demands for forest reproductive material).
- The use of FGM could be expanded and adopted in national forest inventories and nature conservation areas. One limitation may be that the points covered by national forest inventories may not be enough (i.e., they may include a number of trees too low for genetic analysis).
- Monitoring should be conducted in GCUs and should go hand in hand with a continuous assessment of whether new GCUs should be added, based on assessment of threats.
- Different sets of indicators could be adopted; one to detect changes and provide an early warning system at global level; one set to be used within GCUs to monitor evolutionary processes.
- Different indicators provide information about different types of threats, so an a priori understanding of main threats to be targeted would help selecting and prioritizing the indicators to be used.
- Monitoring of GCUs is applied at the local scale, while national forest inventories provide information at a different scale, so there is need to be clear about the scale targeted because the type of indicators may not be the same.
- According to some participants, applying genetic monitoring to daily forest management might be difficult because there is no possibility to judge whether the changes produced by management and detected by monitoring have positive or negative effects on genetic diversity. There are no standards to define if the changes observed are positive or negative, so it might be hard to couple monitoring with forest management. In addition, costs are high and they should be balanced by clear benefits for which evidence still needs to be provided.
- Yet, in Germany, there is a plan to incorporate genetic monitoring into forest management for a few species on a pilot basis by screening a large number of trees (250) in managed plots and combining phenotypic and genetic data (e.g. Project "GenMon" has establishing a network of FGM plots for Norway spruce (Picea abies) (10 FGM plots) and European beech (Fagus sylvatica) (14 FGM plots) in Germany, some of which are located in managed stands and some of them are in protected areas).

- We should not focus only on state indicators, but also on response and benefit indicators, which highlight the benefits of a monitoring system and what kind of responses would follow the particular signals detected through monitoring.
- A priority setting exercise for the identified indicators should be carried out; there is a need to link indicators to their meaning and the aspects, processes, threats they associate with, to be able to interpret the changes detected and decide what indicators are most meaningful in a particular context or to address specific questions.
- The kind of threat we are trying to detect provides guidance on what tools to use and on the time scale. If we wished to detect particular bottlenecks which took place in the past, we need genetic approaches, while to understand the future trajectory of a tree population, we may need just demographic data.
- Some indicators may bring conflicting information, so a ranking would help tackling this issue.
- In line with the need to set priorities, according to some participants, it would be crucial to focus monitoring on seeds and examining demography, which is already very informative, without necessarily coupling it with genetic information; the question is about the marginal usefulness of molecular indicators versus other simple, very informative demographic indicators.
- Marginal populations deserve particular attention; mixed forests should be targeted too, as different species may react very differently to environmental changes.
- Genetic studies are expensive and long. They provide valuable scientific knowledge, but their value for managers in everyday forestry outside of GCUs is unclear. Thus, the objective of monitoring needs to be well stated.
- Using simulations to validate indicators, instead of waiting for a long time interval (e.g. 15 years) to re-measure the same plots could speed up the process of identification of redundant indicators.
- An important aspect to take into account is whether indicators can be practically applied and used by foresters for monitoring purposes, without excessive investment of resources in training and in implementation of the actual information.
- The idea in LIFEGENMON is to set the baseline and collect a large amount of data, possibly larger than actually needed and applicable in practice, and to progressively select and reduce the indicators to those that are most informative about changes.

Participants were divided into four groups, tasked to discuss different topics. Each group included participants with different backgrounds and competences. Furthermore, participants from the two projects were mixed to create more interesting dynamics in the conversation and facilitate exchange of experiences. All four groups of participants had to rotate through topics, so everyone had the opportunity to discuss all themes.

Group 1 was given the task to address the following points:

- Discuss already tested protocols for the establishment of FGM plots and the monitoring of targeted species within the plots: are the suggested protocols feasible for practitioners? What is the minimum 'scientific upgrade' necessary to keep the indicators up to date with the progress in scientific understanding?

- Monitoring guidelines are developed at species level; how can these guidelines be applied to species other than those on which they have been tested? How can monitoring guidelines be applied at a level higher than for individual species?
- Discuss how to link FGM to modelling efforts carried out within GenTree.

Main points from the discussion

For foresters, there is a need for simple indicators and traceable traits (not just numbers). The heaviest part of the monitoring is the collection of demographic indicators. The GenTree project provides an example of how demanding the sampling effort can be in order to generate meaningful scientific data and results; the project invested a large amount of resources to characterize more than 100 plots across Europe. FGM should be simpler.

In order to estimate adaptive potential of a tree population, monitoring should focus on traits that have to do with effective population size (age class distribution, mortality and regeneration) along gradients and could be done using a two (multiple)-step monitoring process: detect if regeneration is present and, if absent, implement a deeper sampling.
It is important to link forest genetic monitoring to the decision-making tool that EUFORGEN is developing, which guides management decision on forest tree populations in GCUs, using thresholds that trigger specific management actions. Follow up management measures need to be associated to the detection of particular signals through genetic monitoring.

Genetic monitoring tools should be transferred from one species to another to be used in different circumstances. Adaptation to new species is more complex for genetic indicators than for other kinds of indicators.

Group 2 was given the task to address the following points:

- How to ensure that FGR monitoring costs are not too high? Discuss the implementation costs.
- Discuss whether the proposed protocols are too demanding for those in charge of collecting data in the field.
- Discuss other potential constraints in the implementation of genetic monitoring.

Main points from the discussion

In order to discuss the possibility of a cost reduction, the very first step is a clear definition of the scientific questions to be addressed by implementing FGM: what is its goal? State (how), pressure / threat (why), benefit (for what), response (what)?

The selection of indicators comes before the discussion around plot design and experimental design. Indicators should be tested and ranked, first by their degree of usefulness, which is defined by the amount of information provided to answer the main scientific questions. Usefulness is also defined by a cost-benefit analysis and the uncertainty of obtaining the value of the indicator.
Secondly, indicators should be subject to control where, after each assessment, they are evaluated to determine which are the most informative ones and to narrow down their number. At the same time, the level of redundancy of each indicator versus others available should be examined.

Thirdly, indicators should be selected based on their linkages with actual threats to be monitored. This would enable to derive a list of MIN-OPT-MAX number of indicators that would address the key scientific questions.

The ideal characteristics of indicators are:

- They partly coincide with information and data already collected regularly by foresters.
- They are based on new technologies like remote sensing (e.g. to check vitality of trees or their phenology).
- They are understandable and usable by policy-makers.

Other cost-saving proposals that emerged from the discussion:

- Use a common laboratory for analyses of all samples from FGM plots. Alternatively, funding should support training of staff across several laboratories.
- Due to similarities of tree populations in conservation units located relatively close to each other, genetic conservation units could be grouped to form FGM 'regions' based on uniformity. Monitoring would be carried out in only one site per region.
- Time scale must be considered. Costs could change significantly depending on whether monitoring takes place every decade or every 20 years. The type and number of indicators could be calibrated based on the intervals of assessment.

The amount of resources for FGM depends on the source of funding: funds from local forest administrations are very limited while the industry or EU programs could fund more costly FGM schemes. Participants emphasized that local forest experts in FGM should be engaged in the development of protocols to gain their interest and involvement. FGM should also be better integrated into forest management plans by establishing linkages between FGM indicators and actual threats (e.g., climatic changes, pests, fire). However, by adopting this approach, new threats would not be accounted for.

Group 3 was given the task to address the following points:

- How to initiate the preparation of common actions that would lead to inclusion of FGM in national and EU strategies and policies?
- Discuss if FGR monitoring could be implemented as part of everyday forest management

Main points from the discussion

Both bottom-up (i.e., starting from a dialogue at national level to reach the EU level) and top-down approaches (process of dialogue at EU level first, and then national level) were considered in the group discussion. Some countries seem to be better prepared to take initiatives to raise visibility of FGM at national level, others felt that the support should come from the EU level to initiate action in countries. Demonstration of the benefits derived from FGM should come from countries where activities are already well coordinated at national level.

A useful framework for anchoring activities at EU level are the EU Biodiversity Strategy and the EU Forest Strategy. The development of a completely new strategy for genetic monitoring at EU level was not considered feasible in the near future. Other important policies identified within which FGM could fit, are: control of the trade of forest reproductive material (both EU directive and OECD Scheme) and ICP Level II monitoring. IUFRO was mentioned as an organization that could facilitate the goal of raising visibility of FGM.

The FAO Global Plan of Action on FGR mentions genetic monitoring in several strategic priorities. Europe is much more advanced than other regions in the development of common initiatives for FGR conservation and sustainable use, so European countries could take the lead and influence other regions through the development of FGM guidelines and their broad dissemination.

Forest certification schemes and IUCN were also mentioned. Finally, a possibility of getting a new indicator related to FGM within FOREST EUROPE was highlighted but FOREST EUROPE decisions are not legally binding for the countries. Several participants reminded that the mandate for FGM implementation comes from CBD-commitments and that the European Parliament might be a channel for dialogue to raise future funding for FGM.

Regardless of the process selected to raise visibility of FGM, good supporting arguments are needed for its promotion. The concept of an early warning system was considered to be attractive to a wider audience. It was also proposed that connecting genetic monitoring with the quality of seed (source identified) that could be supplied by well-monitored sources could interest the industry. Involvement of OECD was suggested and a change in the EU Directive on FRM was proposed so that the role of genetic monitoring for assessing/predicting the seed quality and the level of seed genetic variation is included.

The development and presentation of a case study on FGM to demonstrate its benefits would be highly instrumental for widely promoting FGM, but evidence is not yet there in the forestry domain. Some experience in genetic monitoring has been developed in the fish genetic resources sector and could offer an interesting example to build on the necessary evidence, given some strong affinities between forest resources and fisheries. However, several participants repeatedly highlighted that the whole concept of FGM was now at an early stage of development and not yet ready to be marketed to policy makers.

In relation to the question of whether FGR monitoring could be part of everyday forest management, the forest managers who participated in the discussion had a positive attitude to including some measurements/observation in their forest management planning, but highlighted the need of using simple demographic indicators for genetic monitoring.

The amount of resources for FGM depends on the source of funding: funds from local forest administrations are very limited while the industry or EU programmes could fund more costly FGM schemes. Participants emphasized that local forest experts in FGM should be engaged in the development of protocols to gain their interest and involvement. FGM should also be better integrated into forest management plans by establishing linkages between FGM indicators and actual threats (e.g., climatic changes, pests, fires). However, by adopting this approach, new threats would not be accounted for.

There is already a good alignment between some indicators used in FGM and observations normally carried out by foresters, but forest management practices are not homogeneous across countries, so it is not possible to generalize. Thus, the inclusion of FGM into national forest inventories would be easy in some countries, but very difficult in others. It was highlighted that the term 'data collection', 'assessment' and 'monitoring' have to be used correctly.

Group 4 was given the task to address the following points:

- How to communicate effectively about forest genetic resources?
- Discuss communication needs and propose examples of good practices in communication that could be adopted to create awareness and understanding of forest genetic monitoring

Main points from the discussion

Three take home messages for communicating effectively about forest genetic resources were elaborated:

- Have a plan. A communication strategy requires research on the needs, expectations and preferences of your target audiences. Clear and concise key messages are part of that strategy. Link to broader issues (give context) to increase understanding. Tailor your messages to the target audiences. Build long-term relationships.
- Tell a story. All audiences need an interesting and relatable story to truly grasp the messages. The story should make our audiences engage with our topics on an emotional level.
- **Show, don't tell.** „We understand what we see". Conduct communication activities in the forest! Provenance trials convince policy makers, visualizations bring forest genetic resources closer to audiences.

At the end of the working group session, results from each group were presented in plenary. The necessity to clearly spell out the goals of FGM and showcase the benefits deriving from the implementation of FGM were further stressed.

Day 2- 25 October 2017

During the last day of the workshop, the participants visited the forest genetic monitoring plot in Arnaia (Chalkidiki) established by LIFEGENMON, and then attended a working lunch nearby the FGM plot. The closing session of the event took place at the University forest facilities in Taxiarchis.

Paulos Bekiaroglou from the Decentralised Administration of Macedonia and Thrace (G.D.D.A.Y-D.A.M.T) and Phil Aravanopoulos, from the Aristotle University of Thessaloniki welcomed the participants and illustrated in detail the forest genetic monitoring plot. The participants were informed on the process of FGM and on data delivered from the monitoring.

Final wrap up

The final wrap up was an occasion to remark additional elements that emerged from the field visit and to elaborate some final recommendations from the workshop.

The main conclusions were elaborated though a role play in which some participants staged the behavior of different stakeholders dealing with forest-related matters, mimicking what they thought were the typical behavior traits of each character: a forest manager (Santiago Gonzales-Martinez, INRA, France), a policy-maker (Michele Bozzano, EUFORGEN) and scientists (Phil Aravanopoulos, AUTH, Greece and Jason Hubert, Forestry Commission, UK).

After the role play, Bruno Fady remarked the main points that had emerged from the workshop:

- In order to be effective in a dialogue with policy-makers, scientists should explain what a monitoring tool can do and not how it works. An aspect worth emphasizing is that a monitoring tool works as insurance; the return for the investment is a greater capacity to cope with extremely critical situations that cannot be foreseen. Genetic monitoring should help anticipating what cannot be detected early enough through simple standard observations carried out within monitoring plots. However, it is true that some highly catastrophic events cannot be monitored. Furthermore, sometimes monitoring may be more necessary after disturbance, to assess the trajectory of a forest ecosystem, for example, after fire, or in forest restoration activities.

- The purpose of genetic monitoring should be clearly formulated. There is agreement that it should be applied as an early warning tool as part of a conservation strategy for GCUs. It could also have the purpose to assess whether seed crops are diverse enough in seeds stands, potentially bringing economic benefits. However, the tool is still at a research stage. The effectiveness of the tool in detecting early signs of changes due to climate change in GCUs requires assessment. Thus, before promoting wide upscaling, and before considering the opportunity of using it as a management tool, further investigation is needed. Case studies are also needed to highlight the benefits of genetic monitoring.
- The questions about what indicators should be used and what should be the frequency of monitoring are still open.
- With regard to the activities to be carried out within GenTree, future directions are clear. A dialogue between LIFEGENMON and GenTree will be established to collaboratively advance the discussion around a set of meaningful indicators for monitoring within GCUs. The modelling work foreseen within GenTree could also provide input to LIFEGENMON, assisting in the selection of indicators, by implementing simulations under different climate change and management scenarios.

Fotis Kiourtsis & **Boris Rantaša** provided a summary of the conclusions from the dialogue between the Greek and Slovenian Forest Services. Both institutions highlighted the high importance of having in place FGM to support forest management, especially in light of the envisaged increasing challenges posed by environmental changes. They have also expressed the following observations:

- in the short-term, forester practitioners do not expect forest genetic diversity to be severely threatened, but the implementation of FGM as part of close-to-nature forest management may become useful in light of the increasing rate of environmental changes and their effects on forests.
- Additional research on the subject is needed and supported by both forest services, especially for what regards research on the application of the practices proposed. Both forest services support the LIFEGENMON and GenTree projects and would like to take part in future projects concerning the practical aspects of forest geneticconsideration into forest management.
- More communication, outreach, education and extension on the subject are needed. Awareness materials developed in both projects should be prepared in a language suited to forestry practitioners.

Finally, Hojka Kraigher highlighted the need to maintain a dialogue between science, practice and policy, aiming to an effective implementation of FGM, through appropriate communication of the results obtained. LIFEGENMON will develop a communication plan based on the Slovenian experience; this effort will be an example for other countries in the identification of resources for FGM implementation in practice. In the last three years of implementation, the project LIFEGENMON has invested large efforts in the testing the feasibility of FGM practical implementation and inclusion in forest management. The projects aims at generating scientific documentation to support policy makers in the development of national legislative frameworks facilitating FMG adoption and to contribute to regional and EU-wide discussions on this subject Finally, she closed the event thanking the organizers and the participants for their active participation.

ANNEX 1

Tentative Agenda

Porto Palace Hotel, Thessaloniki (Greece) 24-25 October 2017

Arrival of participants on 23 October 2017

Tuesday 24 October		Moderator
8.30	Registration at Porto Palace Hotel, 65, 26th Octovriou Avenue, 54628 – Thessaloniki – Greece)	
9.00-9.15	• Opening of the meeting by the local hosts (Ph. Aravanopoulos, N. Fragiskakis) • Welcome opening by Local Authorities (General Director of Forests, Greece; Chairman, School of Forestry & Environment, Aristotle University) • Presentation of the agenda	Ph. Aravanopoulos & F. Kiourtsis
9:15-10:15	• Brief introduction about the LIFEGENMON project (H. Kraigher) (10 min) • Brief introduction about the GenTree project (B. Fady) (10 min) • Presentation of how the theme of the meeting relates to national and international processes addressing conservation and sustainable use of forest genetic resources (M. Westergren) (15 min) • Expectations from the forest service (Ch.Sarvani - P. Bekiaroglou & Ž. Veselič - B. Rantaša) (15 min) Presentations are follow by Q&A (10 min)	Ph. Aravanopoulos & F. Kiourtsis
10:15-11:15	• General presentation about genetic monitoring principles (P. Aravanopoulos) (15 min) • Definition, selection and establishment of the forest genetic monitoring (FGM) plots and development of a data base (D. Kavaliauskas & D. Finžgar & P. Hasilidis) (15 min) • Gentree sampling design (T. Myking) (10 min) • Lab manual and ring tests (M. Bajc) (10 min) Presentations are follow by Q&A (10 min)	Ph. Aravanopoulos & F. Kiourtsis
11:15-11.45	Coffee/tea break	
11.45-13:00	• *Continuation of presentations from the session before* • Open discussion on: should we perform genetic monitoring as part of *in situ* gene conservation within the genetic conservation units (GCUs) or broader?	Ph. Aravanopoulos & G. Rousakis
13:00	Lunch	

14:00-16:00	Work in groups organized around the following themes DG1- • discuss already tested protocols for the establishment and monitoring of FGM plots: what can be done by practitioners? • how to upgrade FGM guidelines at the species and above species levels? • how to prepare guidelines for species for which the pilot-FGM-plots and protocols have not been tested in the projects so far? • how to include FGM issues and indicators into forest dynamics modelling framework (particularly relevant for GenTree)? DG2- • check implementation costs & discuss how to ensure FGR monitoring approaches are not too expensive or too demanding for those in charge of collecting data • discuss other potential constraints in the implementation of genetic monitoring DG3- • how to initialize potential preparation of common action plan(s) that would lead to inclusion of FGM in the national and EU strategies and policies (particularly relevant for LIFEGENMON)? • can FGR monitoring be simply implemented within everyday forest management? DG4- • How to communicate effectively about forest genetic resources? • Discuss communication needs and propose examples of good practices in communication that could be adopted to create awareness and understanding of forest genetic monitoring.	Groups are moderated by GenTree & LIFEGENMON team members *NB. All participants will rotate across working groups in order to cover all themes in sequence*
16:00-16:30	• Presentation of points emerging from work in groups to plenary • Discussion	Moderated by LIFEGENMON & GenTree
16:30-17.00	Coffee/tea break	
17.00-18:00	• Continuation of the discussion • Key points emerging from the various sessions	Moderated by LIFEGENMON & GenTree
18:00-18:30	• Wrap-up of the day • A few words about the field visit (by Fotis Kiourtsis) • Closing of the day	Moderated by LIFEGENMON & GenTree
20.00	Social dinner	

Wednesday 25 October		Moderator
8:30	Departure for field visit (distance from Thessaloniki, 93 km)	
10:30-12.30	Arrival to destination and visit	P. Aravanopoulos & P. Bekiaroglou
12:30-14.30	Lunch at University Forest facilities in Taxiarchis (36 km away from field site)	
14:30-16:30	*(at University Forest facilities)* • Discussion about new aspects that emerged from the field visit • Wrap-up and closing of the meeting	B. Fady & H. Kraigher
16.30-18:30	Travel back to Thessaloniki	

Annex 2 – List of participants

Surname – Name - Position -Organisation – Country- E-mail

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Annex 3 – Organizers

The EU project Gentree (http://www.gentree-h2020.eu/) has the goal to provide the European forestry sector with better knowledge, methods and tools for optimising the management and sustainable use of forest genetic resources (FGR) in Europe in the context of climate change and continuously evolving demands for forest products and services.

To reach its goal, GenTree will make scientific, technological and implementation breakthroughs in:

- designing innovative strategies for dynamic conservation of FGR in European forests
- broadening the range of FGR used by European breeding programmes
- preparing new forest management scenarios and policy frameworks fully integrating genetic conservation and breeding aspects, to adapt forests and forestry to changing environmental conditions and societal demands.

GenTree focuses on economically and ecologically important tree species in Europe, growing in a wide range of habitats and covering different societal uses and values.

Bioversity International delivers scientific evidence, management practices and policy options to use and safeguard agricultural biodiversity to attain sustainable global food and nutrition security. Bioversity International is a member of the CGIAR Consortium, a global research partnership for a food secure future.
www.bioversityinternational.org

The LIFGENMON project is focused on forest genetic monitoring (FGM) as a crucial component of sustainable forest management. The use of genetic monitoring would enable to detect relevant changes in a species and/ or populations' adaptive and neutral genetic variation through time. Based on indicators and their verifiers, genetic monitoring would work as an early warning system to aid the assessment of a species response to environmental changes in the long-run.

The expected outputs of LIFEGENMON are the preparation of guidelines for forest genetic monitoring for selected tree species, the development of a manual and a decision support system to assist decision makers in the establishment of a forest genetic monitoring system in different countries and regions, the preparation of background documents to support the preparation of potential regulatory measures. All these outputs will lead to adaptive forest management, based appropriate on the conservation and sustainable use of forest genetic resources.

http://www.lifegenmon.si/

Annex 4 – Information on the Gentree project

Horizon 2020 - Work Programme 2014-2015
Societal Challenge 2: FOOD SECURITY, SUSTAINABLE AGRICULTURE, MARINE AND MARITIME RESEARCH AND THE BIO-ECONOMY

GenTree

Optimising the management and sustainable use of forest genetic resources in Europe

Topic: SFS-7-2014/2015 (Genetic resources and agricultural diversity for food security, productivity and resilience)
Sub-topic: SFS-07b-2015 (Management and sustainable use of genetic resources)
Start date: 1st March 2016
Duration: 48 months
Budget: 7.9 Million Euro (with a 6.7 Million Euro grant by the European Union)
Coordinator: Dr. Bruno Fady, INRA, France (bruno.fady@inra.fr)

GENTREE

This project has received funding from the European Union's Horizon 2020

GENTREE | OPTIMIZING THE MANAGEMENT AND SUSTAINABLE USE OF FOREST GENETIC RESOURCES IN EUROPE

Overall concept of GenTree – Expected impacts

GenTree will provide the European forestry sector with:

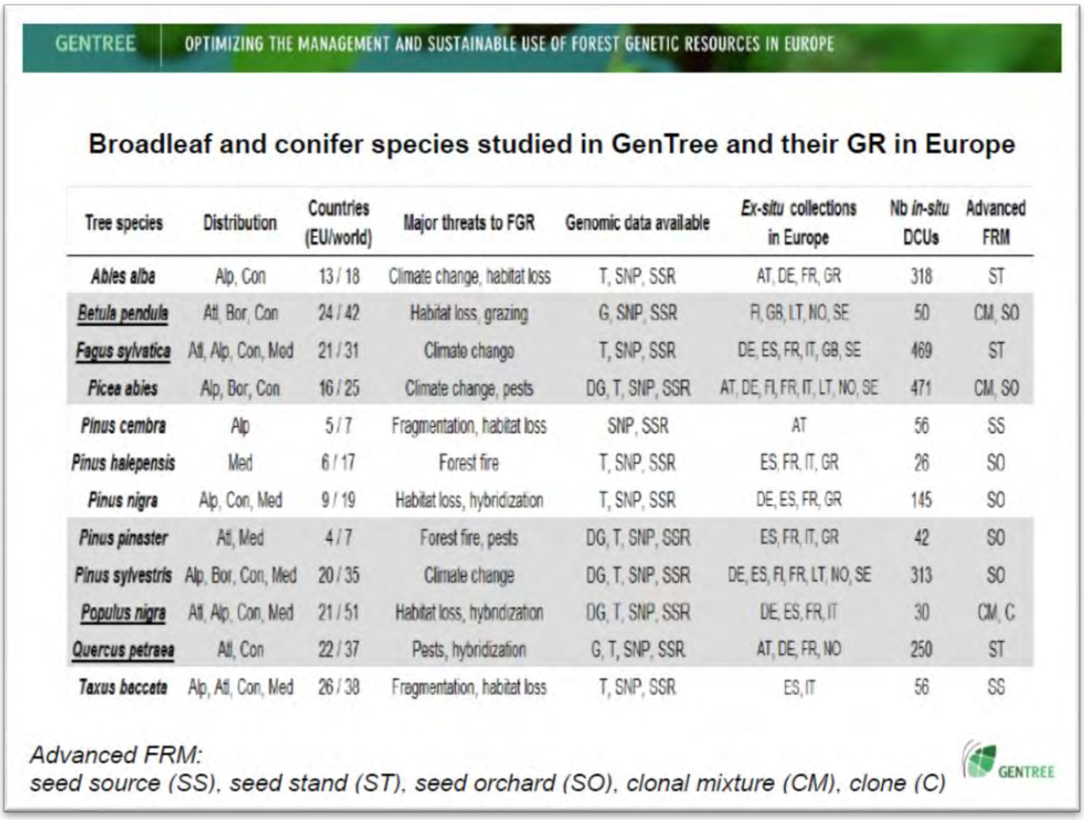
(i) **Better characterisation** of in-situ and ex-situ conservation units and underused natural resources,

(ii) **Better scientific knowledge** on how genetic diversity, phenotypic trait diversity and environmental diversity co-vary over multiple spatial scales, and

(iii) **New tools and models** for efficient **management and sustainable use of FGR** in the context of environmental change and evolving societal demands

http://www.gentree-h2020.eu/resources/public-awareness-materials/

GENTREE



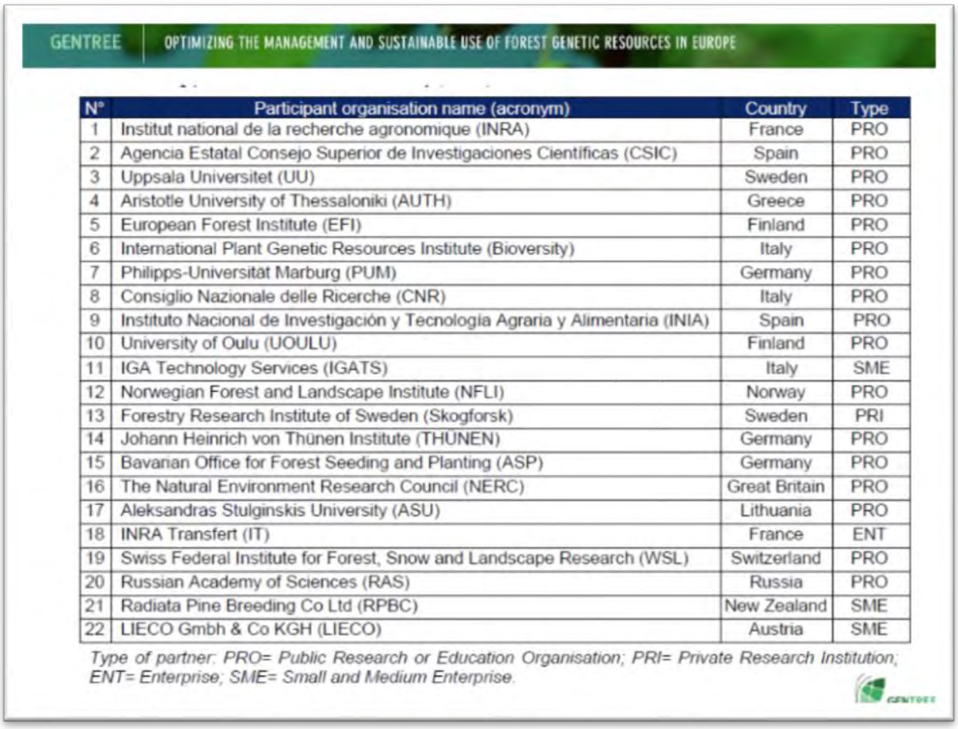
GENTREE OPTIMIZING THE MANAGEMENT AND SUSTAINABLE USE OF FOREST GENETIC RESOURCES IN EUROPE

Broadleaf and conifer species studied in GenTree and their GR in Europe

Tree species	Distribution	Countries (EU/world)	Major threats to FGR	Genomic data available	*Ex-situ* collections in Europe	Nb *in-situ* DCUs	Advanced FRM
Abies alba	Alp, Con	13 / 18	Climate change, habitat loss	T, SNP, SSR	AT, DE, FR, GR	318	ST
Betula pendula	Atl, Bor, Con	24 / 42	Habitat loss, grazing	G, SNP, SSR	FI, GB, LT, NO, SE	50	CM, SO
Fagus sylvatica	Atl, Alp, Con, Med	21 / 31	Climate change	T, SNP, SSR	DE, ES, FR, IT, GB, SE	469	ST
Picea abies	Alp, Bor, Con	16 / 25	Climate change, pests	DG, T, SNP, SSR	AT, DE, FI, FR, IT, LT, NO, SE	471	CM, SO
Pinus cembra	Alp	5 / 7	Fragmentation, habitat loss	SNP, SSR	AT	56	SS
Pinus halepensis	Med	6 / 17	Forest fire	T, SNP, SSR	ES, FR, IT, GR	26	SO
Pinus nigra	Alp, Con, Med	9 / 19	Habitat loss, hybridization	T, SNP, SSR	DE, ES, FR, GR	145	SO
Pinus pinaster	Atl, Med	4 / 7	Forest fire, pests	DG, T, SNP, SSR	ES, FR, IT, GR	42	SO
Pinus sylvestris	Alp, Bor, Con, Med	20 / 35	Climate change	DG, T, SNP, SSR	DE, ES, FI, FR, LT, NO, SE	313	SO
Populus nigra	Atl, Alp, Con, Med	21 / 51	Habitat loss, hybridization	DG, T, SNP, SSR	DE, ES, FR, IT	30	CM, C
Quercus petraea	Atl, Con	22 / 37	Pests, hybridization	G, T, SNP, SSR	AT, DE, FR, NO	250	ST
Taxus baccata	Alp, Atl, Con, Med	26 / 38	Fragmentation, habitat loss	T, SNP, SSR	ES, IT	56	SS

Advanced FRM:
seed source (SS), seed stand (ST), seed orchard (SO), clonal mixture (CM), clone (C)

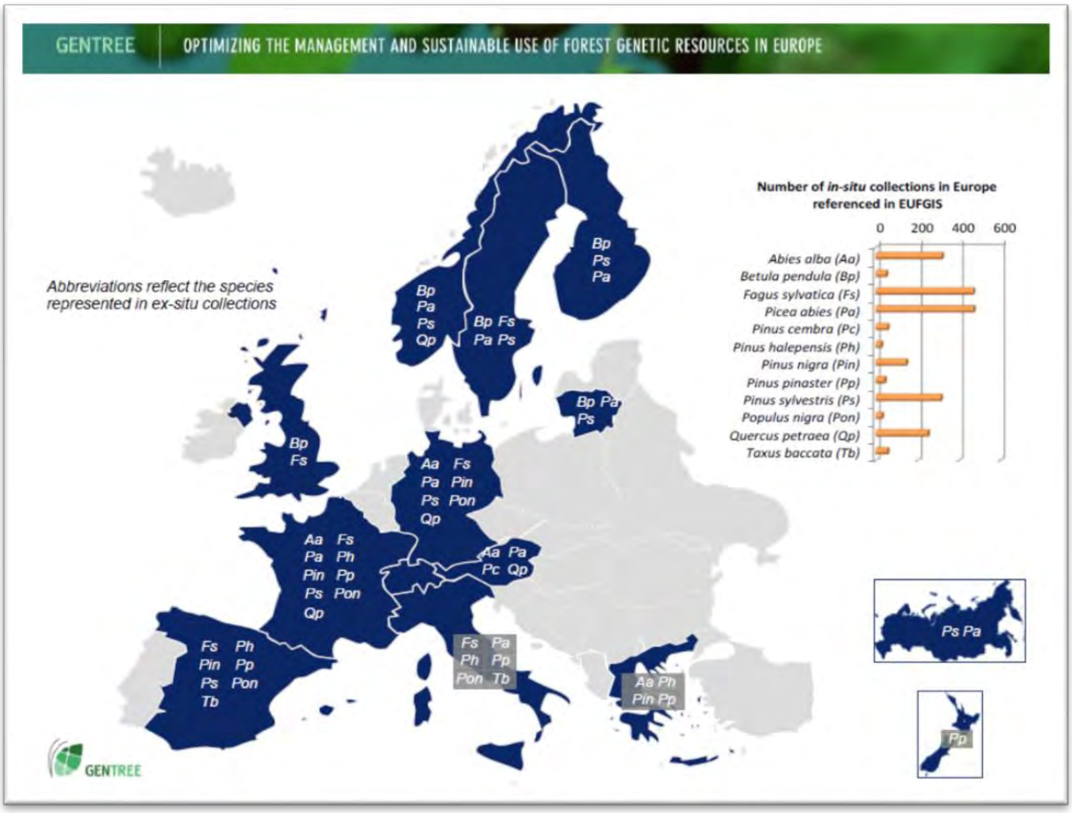
GENTREE



GENTREE OPTIMIZING THE MANAGEMENT AND SUSTAINABLE USE OF FOREST GENETIC RESOURCES IN EUROPE

N°	Participant organisation name (acronym)	Country	Type
1	Institut national de la recherche agronomique (INRA)	France	PRO
2	Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC)	Spain	PRO
3	Uppsala Universitet (UU)	Sweden	PRO
4	Aristotle University of Thessaloniki (AUTH)	Greece	PRO
5	European Forest Institute (EFI)	Finland	PRO
6	International Plant Genetic Resources Institute (Bioversity)	Italy	PRO
7	Philipps-Universität Marburg (PUM)	Germany	PRO
8	Consiglio Nazionale delle Ricerche (CNR)	Italy	PRO
9	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA)	Spain	PRO
10	University of Oulu (UOULU)	Finland	PRO
11	IGA Technology Services (IGATS)	Italy	SME
12	Norwegian Forest and Landscape Institute (NFLI)	Norway	PRO
13	Forestry Research Institute of Sweden (Skogforsk)	Sweden	PRI
14	Johann Heinrich von Thünen Institute (THÜNEN)	Germany	PRO
15	Bavarian Office for Forest Seeding and Planting (ASP)	Germany	PRO
16	The Natural Environment Research Council (NERC)	Great Britain	PRO
17	Aleksandras Stulginskis University (ASU)	Lithuania	PRO
18	INRA Transfert (IT)	France	ENT
19	Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)	Switzerland	PRO
20	Russian Academy of Sciences (RAS)	Russia	PRO
21	Radiata Pine Breeding Co Ltd (RPBC)	New Zealand	SME
22	LIECO Gmbh & Co KGH (LIECO)	Austria	SME

Type of partner: PRO= Public Research or Education Organisation; PRI= Private Research Institution; ENT= Enterprise; SME= Small and Medium Enterprise.


GENTREE
OPTIMIZING THE MANAGEMENT AND SUSTAINABLE USE OF FOREST GENETIC RESOURCES IN EUROPE
Abbreviations reflect the species represented in ex-situ collections
Number of in-situ collections in Europe referenced in EUFGIS
0 200 400 600
Abies alba (Aa)
Betula pendula (Bp)
Fagus sylvatica (Fs)
Picea abies (Pa)
Pinus cembra (Pc)
Pinus halepensis (Ph)
Pinus nigra (Pin)
Pinus pinaster (Pp)
Pinus sylvestris (Ps)
Populus nigra (Pon)
Quercus petraea (Qp)
Taxus baccata (Tb)
Bp Ps Pa
Bp Pa Ps Qp
Bp Fs Pa Ps
Bp Pa Ps
Bp Fs
Aa Fs Pa Pin Ps Pon Qp
Aa Fs Pa Ph Pin Pp Ps Pon Qp
Aa Pa Pc Qp
Fs Ph Pin Pp Ps Pon Tb
Fs Pa Ph Pp Pon Tb
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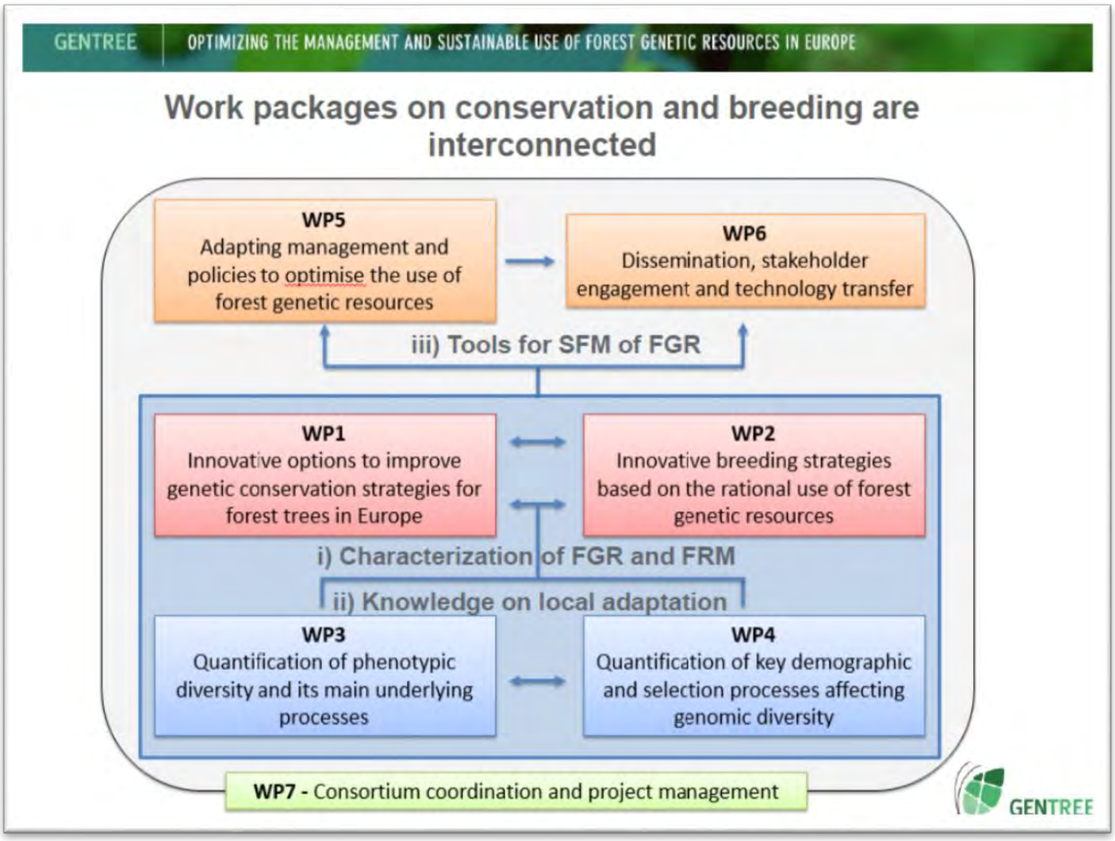
Ps Pa
Pp
GENTREE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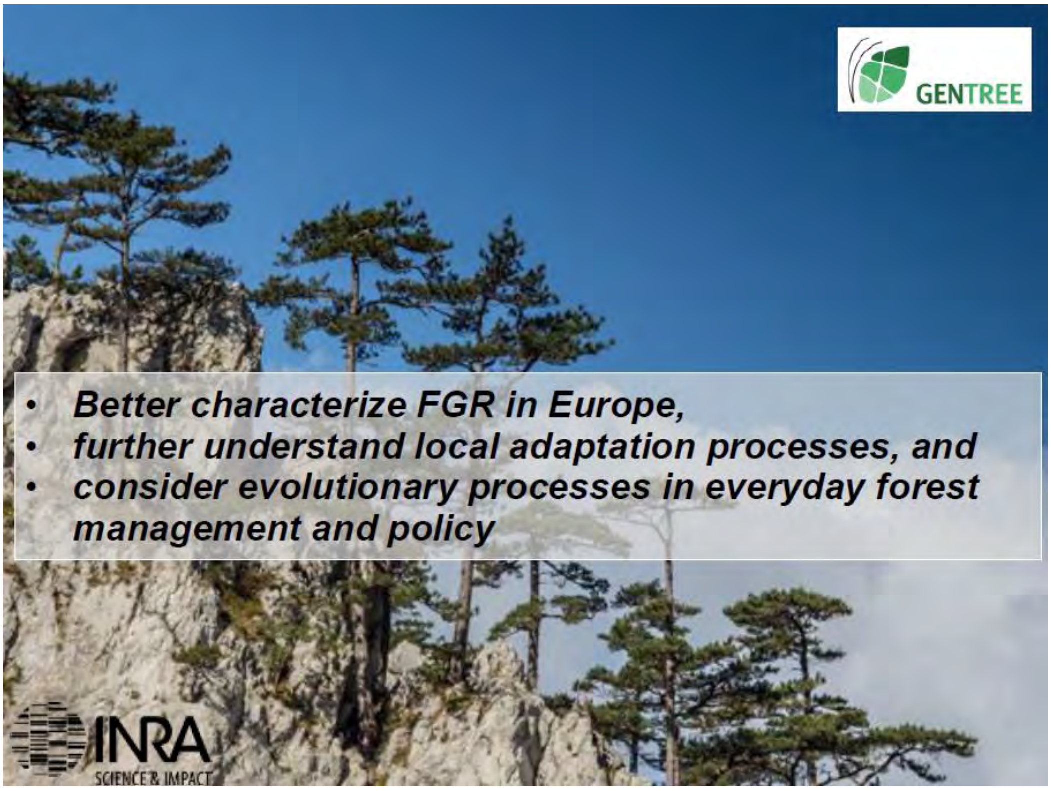
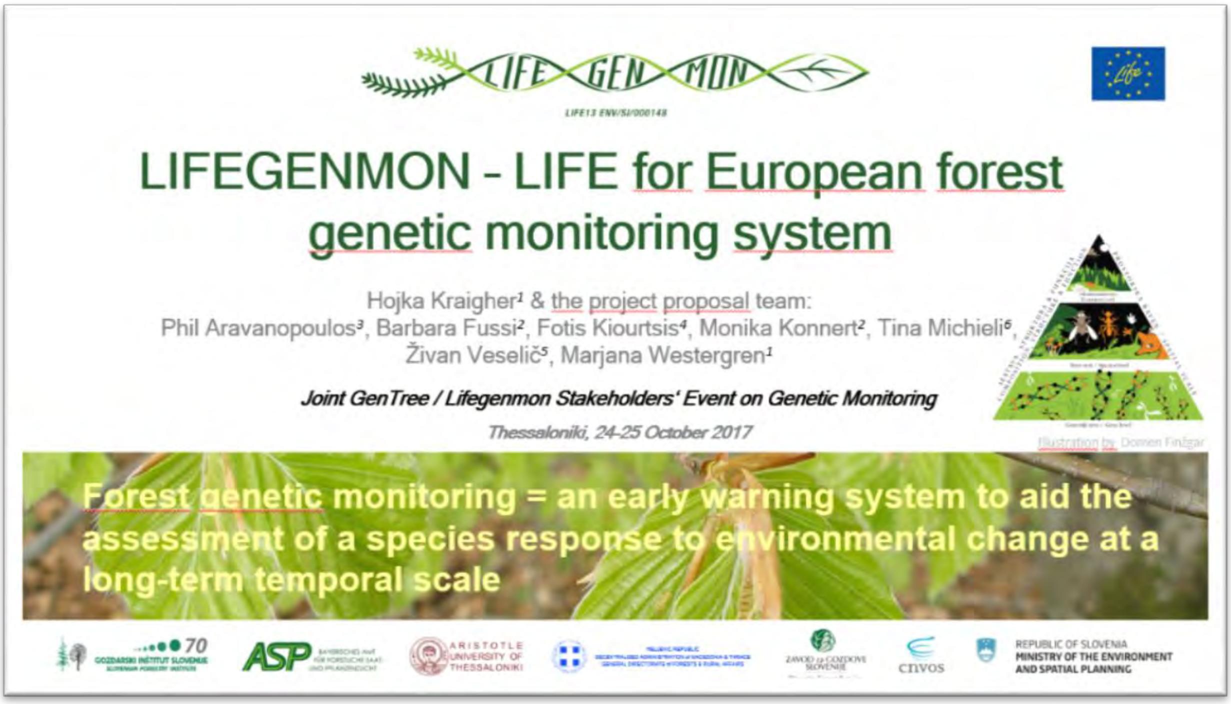
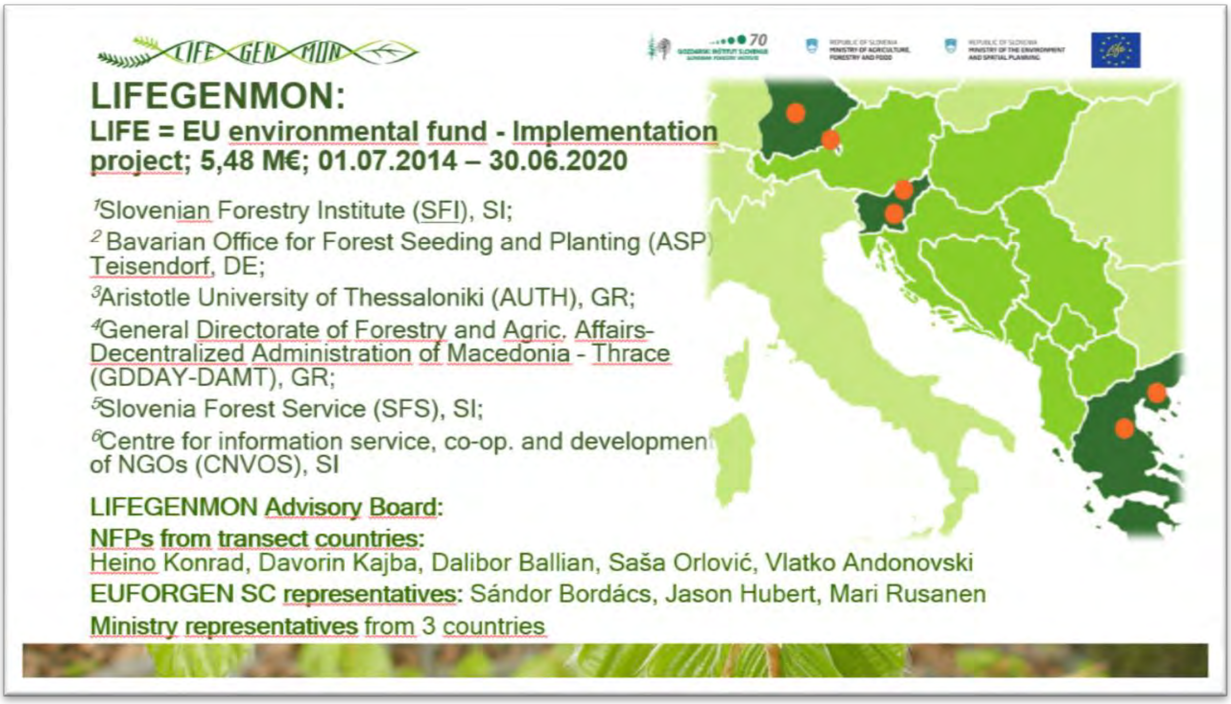
OPTIMIZING THE MANAGEMENT AND SUSTAINABLE USE OF FOREST GENETIC RESOURCES IN EUROPE
Work packages on conservation and breeding are interconnected
WP5
Adapting management and policies to optimise the use of forest genetic resources
WP6
Dissemination, stakeholder engagement and technology transfer
iii) Tools for SFM of FGR
WP1
Innovative options to improve genetic conservation strategies for forest trees in Europe
WP2
Innovative breeding strategies based on the rational use of forest genetic resources
i) Characterization of FGR and FRM
ii) Knowledge on local adaptation
WP3
Quantification of phenotypic diversity and its main underlying processes
WP4
Quantification of key demographic and selection processes affecting genomic diversity
WP7 - Consortium coordination and project management
GENTREE

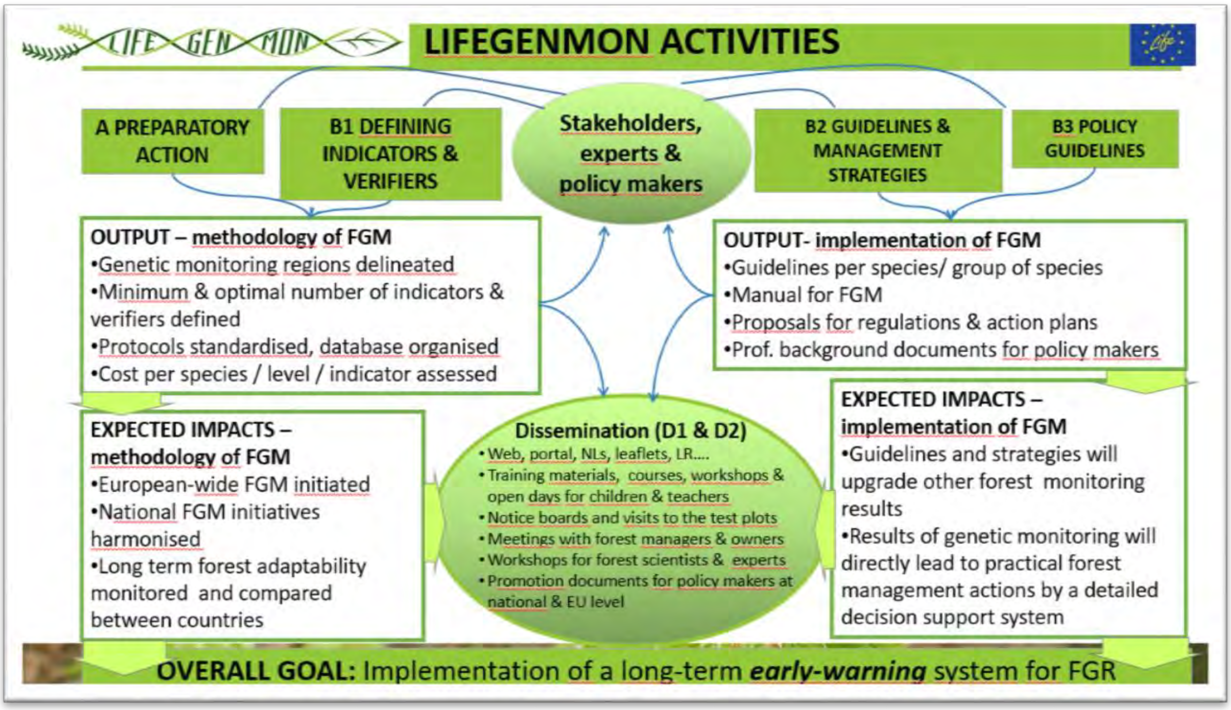

GENTREE
• Better characterize FGR in Europe,
• further understand local adaptation processes, and
• consider evolutionary processes in everyday forest management and policy
INRA
SCIENCE & IMPACT

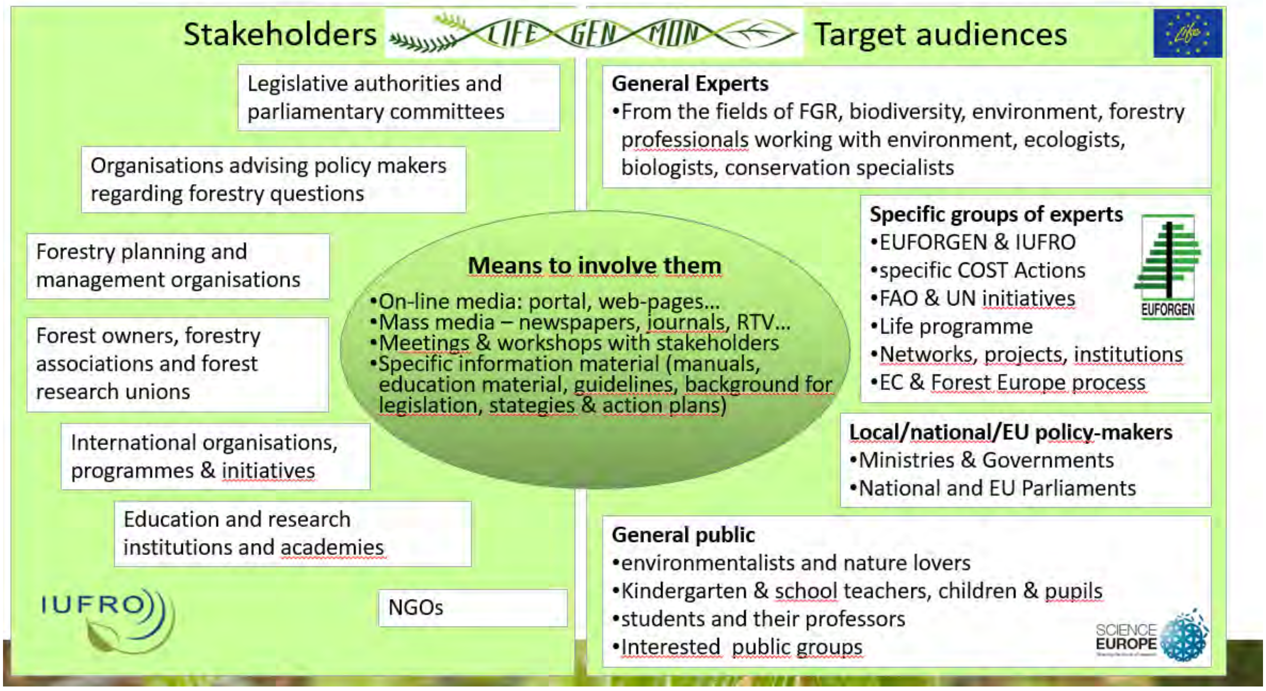

Horizon 2020 - Work Programme 2014-2015
Societal Challenge 2: FOOD SECURITY, SUSTAINABLE AGRICULTURE, MARINE AND MARITIME RESEARCH AND THE BIO-ECONOMY
GenTree
Optimising the management and sustainable use of forest genetic resources in Europe
OPTIMIZING THE MANAGEMENT AND SUSTAINABLE USE OF FOREST GENETIC RESOURCES IN EUROPE
Website: http://www.gentree-h2020.eu/
@GentreeProject
GENTREE
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 676876.

Annex 5 – Information on the LIFEGENMON project






LIFEGENMON ACTIVITIES
A PREPARATORY ACTION
B1 DEFINING INDICATORS & VERIFIERS
Stakeholders, experts & policy makers
B2 GUIDELINES & MANAGEMENT STRATEGIES
B3 POLICY GUIDELINES
OUTPUT – methodology of FGM
•Genetic monitoring regions delineated
•Minimum & optimal number of indicators & verifiers defined
•Protocols standardised, database organised
•Cost per species / level / indicator assessed
OUTPUT- implementation of FGM
•Guidelines per species/ group of species
•Manual for FGM
•Proposals for regulations & action plans
•Prof. background documents for policy makers
EXPECTED IMPACTS – methodology of FGM
•European-wide FGM initiated
•National FGM initiatives harmonised
•Long term forest adaptability monitored and compared between countries
Dissemination (D1 & D2)
•Web, portal, NLs, leaflets, LR....
•Training materials, courses, workshops & open days for children & teachers
•Notice boards and visits to the test plots
•Meetings with forest managers & owners
•Workshops for forest scientists & experts
•Promotion documents for policy makers at national & EU level
EXPECTED IMPACTS – implementation of FGM
•Guidelines and strategies will upgrade other forest monitoring results
•Results of genetic monitoring will directly lead to practical forest management actions by a detailed decision support system
OVERALL GOAL: Implementation of a long-term early-warning system for FGR


Stakeholders
Target audiences
Legislative authorities and parliamentary committees
Organisations advising policy makers regarding forestry questions
Forestry planning and management organisations
Forest owners, forestry associations and forest research unions
International organisations, programmes & initiatives
Education and research institutions and academies
NGOs
IUFRO
Means to involve them
•On-line media: portal, web-pages...
•Mass media – newspapers, journals, RTV...
•Meetings & workshops with stakeholders
•Specific information material (manuals, education material, guidelines, background for legislation, stategies & action plans)
General Experts
•From the fields of FGR, biodiversity, environment, forestry professionals working with environment, ecologists, biologists, conservation specialists
Specific groups of experts
•EUFORGEN & IUFRO
•specific COST Actions
•FAO & UN initiatives
•Life programme
•Networks, projects, institutions
•EC & Forest Europe process
EUFORGEN
Local/national/EU policy-makers
•Ministries & Governments
•National and EU Parliaments
General public
•environmentalists and nature lovers
•Kindergarten & school teachers, children & pupils
•students and their professors
•Interested public groups
SCIENCE EUROPE