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**Directorate General for
Agriculture and Rural
Development**

**Preparatory action on
EU plant and animal genetic resources
(AGRI-2013-EVAL-7)**

WORKSHOP REPORT

**FGR in Europe in a changing climate: challenges and
needs for conservation**

16 June 2015, Amsterdam

FGR in Europe in a changing climate: challenges and needs for conservation

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The Workshop formed part of the study launched by DG AGRI of the European Commission: "Preparatory action on EU plant and animal genetic resources" which is being conducted by a Consortium of experts and consultants. The study started in July 2014 with a completion date of June 2016. The objective of this preparatory action is to support the EU in recognizing the potentials for added value in the field of conservation and sustainable use of agricultural genetic resources.

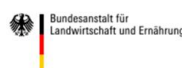
A total of seven workshops are being organised during the period June 2015 – March 2016. Each workshop is dedicated to specific topics/issues linked to a specific regional context and/or covering sectorial or methodological issues.

The aim of the workshop was to provide recommendations concerning approaches and solutions applicable for the conservation and sustainable use of GR, reflecting the objectives and themes of the preparatory action.

More information on the objectives of the study can be found on the study website: <http://www.geneticresources.eu>.

This workshop (Workshop 2) was the second in the series and dealt specifically with Forest Genetic Resources.

Preparatory Action on EU Genetic Resources



CONTENTS

1	Introduction	1
1.1	Background	1
1.2	Particular issues for the conservation of FGR	2
2	Agenda of the Workshop.....	3
3	Summary of the presentations (setting the scene)	5
4	Workshop format and outcome	8
5	Findings and recommendations	11
6	Final remarks and next steps	13
7	References	13
	Appendix 1: List of participants	14
	Appendix 2: Details of all the suggestion card contributed	16

1 Introduction

Workshop 2 which focused on “*FGR in Europe in a changing climate: challenges and needs for conservation*” was held by the study consortium in Amsterdam on June 16, 2015. It was prepared by:

- Sven de Vries (Centre for Genetic Resources, the Netherlands CGN), Wageningen University and Research Centre)
- Joukje Buiteveld (Centre for Genetic Resources, the Netherlands CGN), Wageningen University and Research Centre)
- Colin Kelleher (National Botanic Gardens, Ireland)
- Michele Bozzano (Bioversity International, EUFORGEN secretariat)

The workshop was attended by 25 invited participants, bringing together experts from a range of disciplines including: specialists in forest genetic resources representatives of EUFORGEN, managers of gene banks, researchers, policy makers, ecologists and tree breeders (see Appendix 1 for participant list).

The key objective of Workshop 2 was to explore options for conservation of FGR at a pan-European scale, with particular focus on the potential impacts of climate change on these resources. The workshop aimed to stimulate discussion and deliver recommendations on conservation of FGR in the context of climate change.

The issues addressed were wide ranging and the options proposed included: potential for networking and cooperation, communication and research knowledge exchange, landscape and rural development, sustainable use (all themes of the Preparatory Action).

1.1 Background

Forest Genetic Resources (FGR) provide the basic material for conservation and maintenance of forest resources and for sustainable forest management. FGR contain the genetic variation that allows adaptation of species and populations to current and future conditions. As such, FGR is fundamental to the continued survival of tree populations and species.

A number of national and international programmes have been developed which aim to conserve FGR within European states and across Europe. In particular, the incorporation of many European species into the EUFGIS database and other EUFORGEN programmes on pan-European conservation measures have raised awareness, understanding and action on the conservation of FGR. National conservation areas and the European NATURA 2000 network of protected areas

include forest habitats and thus also help in conservation of FGR. However, despite these efforts, the FAO State of the World's Forest Genetic Resources (2014) highlighted that worldwide knowledge on FGR is generally inadequate. There are exceptions and some species have received more attention than others. This lack of knowledge is a concern, particularly when viewed in conjunction with the additional threat from climate change. Despite their key role in adaptation, little is known about the potential impacts of climate change on FGR. However, the general scientific consensus is that FGR will be impacted and populations at the periphery or margins of distribution ranges will likely be the ones most negatively affected. Changes in the genetic composition of populations will lead to uncertain futures.

1.2 Particular issues for the conservation of FGR

To be able to conserve FGR under future conditions of climate change we need to identify those populations/species/regions that are most at risk, assess the likely level of risk, monitor it and act on it. Within this framework there are a number of issues that need to be addressed.

The effects of climate change are uncertain. Although models are useful for predictions, a large degree of uncertainty remains regarding the exact magnitude and geographic scale of change that will happen and what effect this will have on FGR.

Forest trees pose particular issues due to their biology. Trees tend to be long-lived dominant species in a landscape. Their life-time can span multiple human generations and the effects of climate change or silvicultural practices on FGR are only evident after many years. Thus, policy makers and managers need to be conscious of conserving genetic variability for the future.

The distributions of tree species and populations do not conform to geopolitical boundaries and consequently they occur across multiple European states and beyond Europe. There is therefore a need for a highly integrated approach and for a distribution of resources to address the species on a range-wide scale as opposed to a local national scale. International communication is a vital component in conservation of FGR. For example, research knowledge must be efficiently disseminated to practitioners and policy makers to inform the development of their management strategies.

2 Agenda of the Workshop

The workshop aimed to address multiple issues relating to the conservation of FGR. The objective of this inclusive workshop was to gather ideas and suggestions that would enable the identification of appropriate actions needed for the conservation of FGR with a specific focus on climate change.

Prior to the workshop background information was provided for the participants including a draft of a recent EUFORGEN report on 'Approaches to the Conservation of Forest Genetic Resources in Europe in the Context of Climate Change' (Kelleher et al. 2015).

The following agenda was developed for the workshop. First, there was a session in which a number of speakers provided scene-setting presentations which were followed by open floor discussions to gather suggestions. Secondly, in the form of a facilitated workshop the group contributed to the gathering of ideas, needs and actions. Participants then submitted their suggestions which were subsequently discussed, grouped and prioritized. The prioritized topics were then discussed in greater detail and a consensus was developed from which a set of recommendations was formulated.

The workshop addressed the following topics/questions:

- What is needed to make the current strategies on conservation of FGR work in the context of climate change?
- What is needed to assess the likely effectiveness of assisted migration? If adopted, what is needed to operationalise assisted migration as a strategy to conserve FGR in terms of technical requirements, financial, policy, knowledge, collaboration between countries etc.?
- How can *ex situ* activities best serve the strategy on conservation of FGR and how should this be organized?

The proposed timetable was as laid out below. The discussions after lunch were geared towards active participation and working with the ideas developed during the earlier brainstorming session.

Time		
8.30 – 9.00	Welcome of the participants Short introduction of the preparatory action Workshop overview and objectives Introduction by the European Commission (DG AGRI)	Sven de Vries Joukje Buiteveld Emanuela Galeazzi
9.00 – 10.30	Scene-setting presentations	
	Genetic conservation strategies of forest trees in the context of climate change: state of knowledge (10')	Sven de Vries
	A Nordic perspective on challenges and needs for FGR conservation in a changing climate (20')	Tor Myking
	Adaptation of forest trees in a changing climate: focus on Mediterranean species (20')	Bruno Fady
	A decision cascade tool for gene conservation under climate change (20')	Andreas Rudow
	Questions (20')	
10.30 – 11.00	Coffee break	
11.00 – 12.30	Brainstorming discussion focusing on needs to make the current strategy on conservation of FGR work in climate change	Facilitator: Michele Bozzano, Rapporteurs: Colin Kelleher and Joukje Buiteveld
12.30 – 13.30	Lunch	
13.30 – 15.30	Continuation of discussions on assisted migration and <i>ex situ</i> activities	
15.30 -16.00	Coffee break	
16.00 - 17.00	Summary and closing of the meeting	Sven de Vries

The workshop aimed to deliver the following outputs:

- A list of the main concerns for FGR in the light of potential impacts from climate change.
- A prioritised list of actions needed to secure the conservation of FGR in Europe.
- Recommendations to different stakeholder groups for strengthening conservation of FGR in Europe (European Commission, national governments, NGOs, forest managers).

3 Summary of the presentations (setting the scene)

Pan-European strategy for genetic conservation of forest trees: state of knowledge

Sven de Vries, Genetic Resources Netherlands (CGN) The Netherlands

The diversity of forests, at the level of species and at the level of genetic diversity within species, is a key resource for Europe. Over the past several decades countries have made efforts to conserve the diversity of tree species and genetic diversity. However, until recently there was no harmonised approach to establishing or managing units for genetic conservation, and no systematic data were available with which to assess the status of genetic conservation across Europe. A project to address these shortcomings was established in 2005, and resulted in the development of the EUFGIS portal, in which countries have to date shared information on more than 3200 conservation units and more than 4000 individual populations of about 100 tree species. While this indicates considerable European commitment to the conservation of FGR diversity, an analysis of the EUFGIS information revealed significant gaps in terms of the species entered and the geographical distribution of the units within each species range. Accordingly, within the EUFORGEN program, a pan-European genetic conservation strategy for 14 pilot tree species representing four categories, depending on their geographical distribution (wide vs. restricted) and their ecology (stand-forming vs. scattered) was developed with focus on the conservation of adaptive diversity based on an environmental zoning classification for Europe. For each species, the strategy calls for a core network of dynamic conservation units. These units are not necessarily interconnected by geneflow, but together aim to capture the current genetic diversity across the European continent. This exercise revealed that there are considerable differences in the numbers of units entered for each species. For example, five economically important tree species make up for 80% of all the conservation units, while other species are poorly represented.

In addition, the consensus of the group recommended that a strategy to mitigate the negative effects of climate change be developed.

Furthermore it was agreed that monitoring progress in the overall implementation of the strategy is essential in order to ensure that it can be adapted to meet future requirements.

A Nordic perspective on challenges and needs for FGR conservation in a changing climate

Tor Myking, Nordic Gene Resource Centre (NordGen),

The aim of the presentation was to provide some reflections on the NordGen Forest conference organised in Son, Norway in 2014, particularly to highlight the importance

of transferring scientific results into improvements in forest practice. An overarching challenge is to maintain an unbroken chain from science via coordination, translation and dissemination to implementation. The main scientific challenges highlighted in the presentations of the conference were adaptability, pace of selection and migration in relation to climate change, decrease in genetic diversity and increase in wind throw damage. The various ways of meeting the challenges, such as breeding, assisted migration, diversification of the gene pool, ex situ conservation, genetic monitoring and shorter rotations were discussed. Fixed cooperation in the Nordic region is facilitated by NordGen Forest, Nordic Forest Research (funding body) and to some degree the Svalbard global seed vault. In addition various project based cooperation, such as activities within Future Forest (Swedish research program), has been important. The transfer functions for use of Scots pine and Norway spruce FRM developed within Future Forest provides a nice example of Nordic science cooperation that has been translated to a web portal where results on site-specific seed sources under various climates are available to forestry. A questionnaire on preparedness of Nordic forestry to climate change that NordGen Forest undertook in 2014 shows that although Nordic forestry is well aware of the challenges of climate change, preparedness is modest, perhaps because we have not succeeded adequately with the translation and dissemination. It is an open question whether this refers to modest interest between the scientific and applied level in forestry, but better implementation could be obtained by more commitment to research cooperation, e.g. such that stakeholders are an integral part of research projects from their outset– not only through participation in the reference groups, but also via WP-leadership and as part of the management group. It might be a useful exercise in project initiation to identify possible bottlenecks in the chain from science to implementation to increase the impact of the scientific results at the practical level in forestry.

Adaptation of forest trees in a changing climate: focus on Mediterranean species
Bruno Fady, INRA – URFM, Ecologie des Forêts Méditerranéennes, Avignon, France

The presentation focuses on five main points relevant to FGR. 1- The Mediterranean basin is a high biodiversity area in terms of both species richness and genetic diversity. 2- The Mediterranean basin represents the rear-edge populations of most ecological and economic importance for European forest tree species. 3- These rear-edge populations are genetically distinct core populations and may contain adaptive novelty related to their past history (glacial refugia) and current ecological requirements at the edge of the species ecological niche. 4- Mediterranean FGR are under threat from climate change, lack of knowledge and lack of economic interest. 5- Mediterranean FGR merit high priority in terms of protection efforts based on *ex-situ* and *in-situ* conservation approaches. In conclusion, Mediterranean FGR are valuable (but underused and under-protected) for adapting European forestry to the challenges of climate change in the 21st century.

A decision cascade tool for gene conservation under climate change
Andreas Rudow, Swiss Federal Institute of Technology (ETH) Zurich

Climate change causes ecological pressure on forest genetic resources (FGR) and triggers threats for several tree species or some of their regional populations. Species and populations can react naturally on threat (e.g. triggered by climate change) by adaptation or migration. Conservation measures target on the compensation of deficits in adaptation or migration abilities. The more conservation measures can make use of the natural self-preservation mechanisms within species and populations, the more effective they are. At least, the natural self-preservation mechanisms led species metapopulations through past environmental changes (e.g. ice ages and interstadials) to the present time.

“Decision cascade tool” is the working title for a decision system to support the decision making on effective gene conservation measures. The aim of such a tool is to maximize the output of gene conservation measures and make decision making transparent. The systemic view on the decision making process elucidates the relationship of indicators and measures (matrix structure). With increasing threat the level of measure intensity has to increase as well (cascade): no measures/general measures only (e.g. EUFGIS entry, monitoring) >> *in situ* measures (e.g. silviculture) >> dynamic ex situ measures (e.g. assisted migration) >> static ex situ measures (e.g. cryo conservation).

The EUFORGEN working group on forest genetic resources under climate change recommends the development of a transparent decision system in order to optimize output under limited financial resources. Therefore a matrix of appropriate indicators of threat and corresponding gene conservation measures is urgently required. Furthermore, a EUFGIS extension for consistent monitoring data of dynamic gene conservation units (DCU) is needed, as well as a general FGR species and subpopulations database for the supply of specific indicator information.

4 Workshop format and outcome

Format of the workshop

The workshop was run as a facilitated workshop: a neutral facilitator helped the group in brainstorming the questions and in developing a prioritised list of the main concerns for the FGR in the light of potential impacts from climate change. Furthermore, the group was facilitated to prioritise a list of actions needed to secure the conservation of FGR in Europe. In addition, the group formulated recommendations for strengthening conservation of FGR in Europe. Facilitated workshops are an efficient and effective way of brainstorming and achieving consensus. The workshop was facilitated in a way that promoted comprehensive participation and allowed all invited participants to contribute equally to the discussion and enabled a consensus to be reached on the various tasks in the very limited timeframe.

Outcome of the workshop

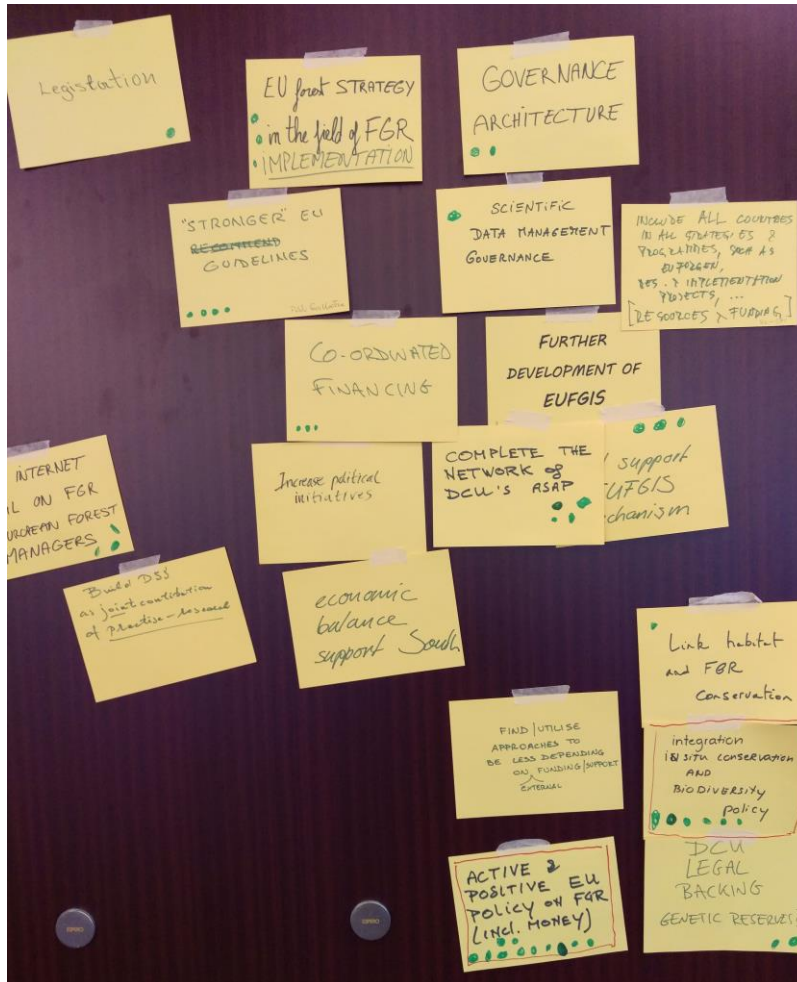
The outcome of the workshop represents a collation of ideas and suggestions and a synthesis of these into a set of recommendations for conservation of FGR in the context of climate change. The participants were provided with cards and pens and were asked to submit their ideas relating to the following posed questions.

- **What is needed to make the current strategies on conservation of FGR work in the context of climate change?**
- **What is needed to assess the effectiveness of assisted migration? If adopted, what is needed to operationalise assisted migration as a strategy to conserve FGR in terms of technical requirements, financial, policy, knowledge, collaboration between countries etc.?** The term assisted migration can have a variety of interpretations. Definitions of this human mediated activity fall into two broad categories which cover either mass movement of a species or population from a vulnerable site to a more suitable site (*ex situ*), or alternatively the use of pre-adapted genotypes and genes to adapt *in situ* populations to future climate change (the latter more specifically termed assisted gene flow). Both of these are relevant to FGR, from the perspectives of threatened populations and future adaptation.
- **How can *ex situ* activities best serve the strategy on conservation of FGR and how should this be organized?**

Each participant submitted at least one proposal and thereafter the floor was opened to additional suggestions. A total of 73 cards were put on the board (see Appendix 2 for a list of all the submissions). Following the accumulation of all the suggestions some grouping of cards was undertaken through consensus discussion with the workshop participants. After this the participants then selected their priority topics by placing a dot on the cards they considered merited most

attention. This allowed the facilitators to select the topics for further discussion i.e. those with the most dots. The following five topics listed below were chosen and discussed.

- **Active EU policy on FGR**
This topic highlighted the need for clear and active EU policy in the area of FGR.
- **Funding EUFORGEN**
EUFORGEN is a key element in formulating and implementing FGR conservation strategies and from this perspective, the workshop participants recommended increased support from the EU.
- **Knowledge**
The workshop participants noted a lack in knowledge on FGR in some areas. These are detailed later in the report. Increased knowledge was seen as crucial to effective conservation of FGR.
- **Awareness**
Continued and increased awareness of the importance of FGR is needed across all stakeholders, from the general public to managers and policymakers.
- **Assisted Migration**
Assisted migration was a particular discussion topic that was requested by the Commission. The discussion on assisted migration highlighted issues including a need to gather knowledge on the potential benefits and risks of this as a strategy for *ex situ* conservation of FGR.



A selection of cards showing priority dots.

5 Findings and recommendations

The workshop developed recommendations for the European Commission in five main areas: (i) Active EU Policy on FGR, (ii) Funding EUFORGEN, (iii) Knowledge, (iv) Awareness, (v) Assisted migration. In addition, the workshop organizers were asked by the European Commission specifically to discuss assisted migration. This arose in discussions in some of the other areas, but is listed separately to meet the Commission's request. Details of the findings and recommendations are summarized below:

Active EU Policy on FGR

- Extend EU policy on the marketing of Forest Reproductive Material (FRM) (Council Directive 105/1999/EC on the marketing of forest reproductive material) to FGR conservation.
- Extend the list of species in the Directive on FRM to include additional minor species. Adding minor species will link to 2020 targets on reducing loss of biodiversity.
- Implement FGR-relevant FOREST EUROPE resolutions and declarations through EU legislation or regulation.
- Implement the FAO Global Plan of Action on FGR.
- Make efforts to incorporate FGR conservation into existing conservation frameworks, such as in the Habitats Directive.
- Actively participate in EUFORGEN.
- Facilitate collaboration with neighbouring countries on FGR through EUFORGEN.

The funding of EUFORGEN

The EC is encouraged to consider the possibility of providing direct funding to the EUFORGEN programme in order to:

- Focus on species and their genetic resources. Use regional mechanisms to enable conservation of FGR throughout a species range rather than on a country by country basis.
- Facilitate all EU countries to participate equally in this Programme.
- Implement strategies for dynamic conservation and appropriate use of FGR under climate change conditions, in cooperation with non EUFORGEN member countries

Knowledge

The workshop recommends that the following knowledge gaps are addressed.

- Adaptation and adaptive capacity. It is currently unknown whether extant genetic resources have the capacity to adapt to new climatic changes and

further societal needs. Knowledge is lacking in the following areas relating to adaptation:

- Metapopulation dynamics
- Biodiversity (including genetic diversity)
- Marginal/peripheral populations/species
- Threats and indicators
- Rare and endemic species
- There is a deficit of knowledge in FGR and breeding programmes on the subject of ecological interactions in the following areas:
 - Biotic (especially traits relevant to CC)
 - Symbiont interactions
 - Clinal variation
- There is a need to develop rapid phenotyping methods for measuring complex traits.
- Monitoring. Long-term monitoring is key to understanding the impacts of climate change on FGR.
- Effective knowledge transfer is vital to create an unbroken chain from research to forest management, e.g. this could be mediated through datasharing internet portals.

Awareness

The group agreed that priorities relating to the topic of awareness should be:

- Increase the awareness of the crucial role that FGR play in providing ecosystem services in the long term. The long-term adaptive capacity of forests is reliant on FGR
- Emphasise the importance of cross-sectoral communication to improve integration of FGR conservation objectives with biodiversity objectives, for instance, those from the IUCN.
- Raise awareness for the importance of genetic resources of neglected species.
- Promote the use of FGR for future site-adapted material
- Identify appropriate awareness tools (e.g. decision making support tools, ...)

Assisted migration and *ex situ* activities

In addition to the previous four topics, the workshop organizers were specifically asked by the Commission to address the issue of assisted migration, which is recognised to be an important part of FGR conservation strategies that/and needs further attention (i.e. research experiment, policy etc.) together with other *ex situ* activities.

As far as it has been discussed the workshop recommends the EC to:

- Facilitate the establishment of adequate documentation of source material. Have this freely available for end users to make informed choices. Also make use of information already available

- Facilitate the assessment of potential risks of assisted migration built on the results of past/current/future provenance and progeny trials

Furthermore it was agreed that the importance of establishing common gardens experimentation using marginal populations should be carefully considered.

Regarding the development of adequate policy to allow assisted migration, access and benefit sharing (ABS) has to play an important role.

Issues involving financing of assisted migration, technical requirements and collaboration between receiver and donor should be further explored.

A report was prepared from the workshop and was sent to all participants for review. A number of comments were received and these were taken into account for the final report.

6 Final remarks and next steps

This report presents results from a brainstorming and consensus building workshop on the action need to conserve FGR in Europe in light of climate change. The workshop included a range of participants from policy implementation to forest managers to researchers. Despite the broad range of the preparatory action themes the workshop managed to formulate clear recommendations in five priority areas; **EU policy, EUFORGEN funding, Knowledge, Awareness and Assisted migration/ex situ conservation**. The list of recommendations laid out in the report can be directly implemented or can be used for developing future policy on FGR and to guide funding of suitable actions to maintain FGR in light of increasing threat due to climate change.

7 References

Kelleher, C. T., de Vries, S.M.G., Baliuckas, V., Bozzano, M., Frýdl, J., Gonzalez Goicoechea, P., Ivankovic, M., Kandemir, G., Koskela, J., Koziol, C., Liesebach, M., Rudow, A., Vietto, L., and Zhelev Stoyanov P. 2015. Approaches to the Conservation of Forest Genetic Resources in Europe in the Context of Climate Change. European Forest Genetic Resources Programme (EUFORGEN), Bioversity International, Rome, Italy. xiv+47 pp.

Appendix 1: List of participants

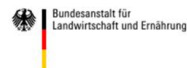
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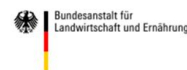
Appendix 2: Details of all the suggestion cards

Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
1	Current strategies	Threats mapping	To produce European maps on the threats of forest genetic resources, and the values of diversity for the main species as a way to monitor the progress in the efforts of conservation of genetic resources.	6
1	Current strategies	Threats mapping	Integration of GIS and satellite images (NVDI) to assess: (1) degree of dieback in ecologically or geographically marginal/peripheral populations and (2) degree of stress levels especially during extreme years.	
1	Current strategies	Threats recognition and proposals of their overcoming	Some active conservation measures have to be worked out and implemented as in many cases regarding many species passive conservation is not enough in climate change conditions. These measures should include e.g.:(1) assisted migration; (2) adaptability of populations to different environmental conditions; (3) mass propagation of endangered species/populations and the establishment of ex situ populations. (4) change national official regulations concerning FRM movement (on the basis of genetic diversity knowledge)	1
1	Current strategies	European map of tardy populations of trees (conservation units)	Taking into consideration the climate change, for the natural regeneration our big problem is the late frost in spring (in the flowering period for most of the species), so the ??becomes ??the tardy trees, tardy populations of trees. ?? to create a European map of tardy populations for species important	1
2	Current strategies	Use of outside the EU FGR		2
2	Current strategies	Management and conservation of valuable FGR in private forests	Find solutions and ways of financial support at the national level to recognise and conserve FGR being in private hands: public awareness, recognition, conservation (active way), monitoring, expert support of foresters for the private owners as far as management is concerned	1

Preparatory Action on EU plant and animal genetic resources

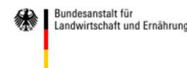
Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
2	Current strategies	Decoupling use and sustainability from economic revenues		1
2	Current strategies	Common strategies on STM (SFM?) - use of FRM	support to sustainable multi-functional forestry including extended provenance regions (therefore prov. tests) and concrete silvi cultural measures (for high genetic diversity) to be tested & supported	
2	Current strategies	Use of FRM	The regulations on trade should allow for (flexibility) reactions to climate change. Conservation and use linked.	4
2	Current strategies	Novel FGR for breeding and FRM deployment	Include FGR from marginal populations into breeding. Deploy FRM with novel traits/adaptation. Support use of diverse species.	
3	Current strategies	Increase knowledge in marginal areas (1)	Increase knowledge (genotypic and phenotypic) from Mediterranean populations within Europe and outside.	2
3	Current strategies	Increase knowledge in marginal areas (2)	Test the adaptive value of marginal (ecological and geographical) populations (phenotypic traits) in common gardens and in-situ.	
3	Current strategies	Further development of EUFGIS	Continuing and developing EUFGIS activities	
3	Current strategies	Complete the network of DCU's ASAP	Urge all European focal points of EUFGIS to accomplish their work/duty on identifying DCU's	4
3	Current strategies	Prioritise regions and species for implementation of the strategy	prioritise the work on FGR in a way that the most threatened regions and species get first attention in the implementation of the strategy	1
3	Current strategies	DCU's in marginal areas	Analyse gaps in in-situ conservation efforts and focus DCU's in climate-margins of distribution areas	2
4	Current strategies	Integration in situ conservation and biodiversity policy	Better integration/consistency between in situ conservation measures and biodiversity policy. E.g. how to protect FGR in reserves when there are restricted silvicultural measures? Legal status?	6

Preparatory Action on EU plant and animal genetic resources



Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
4	Current strategies	Link habitat and FGR conservation	Habitat (species) conservation and DCU's are often done separately. A need to reconcile the two strategies. Raising awareness of the importance of FGR. Change governance.	1
4	Current strategies	DCU legal backing, Genetic reserves?	Give the pan-European core network a legal backing to enable long-term conservation - independent of country. E.g. like SAC/SPA have genetic reserves	2
5	Current strategies	Key, rare and threatened species	Rare and threatened species. Draw attention of stakeholders for their importance, especially when they play a key role at the site of the DCU. Link with economical losses where ever possible, e.g. Sand dunes, avalanches.	3
5	Current strategies	Promote neglected species	Action on neglected species, those that are currently of minor economic importance. How to promote these species in terms of conservation and sustainable use?	
5	Current strategies	Focus on 'rare' populations (rear edge, isolated)		1
6	Current strategies	In situ	Genetic variability is the basis for adaptation. Keep it simple when possible (and cheap)	
6	Current strategies	Highlight individual conservation units	Make the individual conservation units more 'tangible' by highlighting their special features, with a view to also set standards for all the long run, copying best practices and improving others.	1
6	Current strategies	Observers in Euforgen	Invite representatives for specific NGO's as observers in EUFORGEN to increase involvement and communication (Forest owners organisations, IUCN etc.)	2
6	Current strategies	Communication and involvement	Involve all relevant parties in decision making and implementation (research, decision makers, forest owner organisation, etc.).	3
6	Current strategies	Awareness	Political and public awareness about the importance of the conservation on FGR in climate change	2

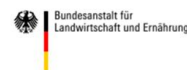
Preparatory Action on EU plant and animal genetic resources



Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
6	Current strategies	Demonstrate effectiveness	I don't know how, but at some point of time there's got to be some attempt at verifying whether the network of conservation units serves the purpose, by actual experimentation e.g. is it really so that marginal populations are better prepared for climate change? Or on the contrary, are large and genetically diverse units better suitable to provide future FRM?	1
7	Current strategies	Improve knowledge on adaptation	Most animal and plant natural genetic resources in Europe are the result of range expansion from southern glacial refugia and have suffered acute colonization bottlenecks, reducing genetic diversity and incrementing inbreeding and expansion load. It is currently unknown whether such genetic resources will be able to adapt to new climate changes and further colonization episodes, responding to the current and future societal needs. It is thus needed to combine genomic and ecological approaches in a whole ecosystem framework to improve our knowledge on adaptation in European plant and animal natural genetic resources.	6
7	Current strategies	Improved understanding of the distribution of adaptive variation in FGR	We need a better understanding of the scale and distribution of adaptive variation in FGR across Europe. How much intra-population diversity is there? Is there cryptic variation? Do our populations have the capacity to adapt – what level of loss of trees is acceptable before adaptation occurs without intervention by assisted migration?	2
7	Current strategies	The key role of FGR on the future of European forests	Conservation of FGR at European level show that: (1) without strong and sustainable GR forest species will not be able to cope with climate change and evolve mechanisms for resistance upon pest and diseases, specially exotic ones (growing threats); (2) GR needs interactive use of knowledge coming from molecular and field trials as a basis to draw guidelines and selection of DCU's.	6

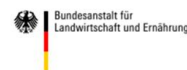
Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
7	Current strategies	The role of symbionts – Wood Wide Web	The role of mycorrhizae networks. ??adaptation in migrated seedlings in ?? integrates plant communication and complex adaptive ?? in plant & microorganism communities. Not only pest and diseases are important for future adaptation and growth in changing climates, besides genetic diversity also symbionts need attention	1
7	Current strategies	Use clines for sampling GCU's	Distribute GCU's proportionally to selection pressure a long climatic drivers i.e. temperature and precipitation. Use clines along these axes, not only marginal/peripheral populations. More intense sampling along clinal variation, less in core of distribution. Use this information for recommendations on use of FGR.	1
7	Current strategies	Funding and long-lasting studies for further incorporation of results on genetic knowledge for CGR	Field trials provide unique information on genetic variability that is fundamental to interact with 'lab' studies.	1
8	Current strategies	Monitoring	Cooperation/agreement to a monitoring tool which will be used by all countries	
8	Current strategies	FGR monitoring	FG monitoring is needed to know the processes in populations of forest trees of different species in different locations & climate influences, as well as processes influence by disturbances and management practices etc.	2
8	Current strategies	Resources for monitoring		
9	Current strategies	Funding EUFORGEN	Finding a financial instrument who will contribute to attend more countries in EUFORGEN and on this basis EUFORGEN to coordinate the process of linking the FGR with climate change and developing EUFGIS portal with species ?? from climate change	7
9	Current strategies	EU support to EUFGIS mechanism	EUFORGEN developed important instruments for conservation of FGR: network, EUFGIS, DCU strategy. Resources should support existing and 'proven' ways. EU Commission should help to continue EUFORGEN/EUFGIS by financial support.	3

Preparatory Action on EU plant and animal genetic resources



Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
9	Current strategies	Funding EUFORGEN	Change the way that membership of EUFORGEN is funded from the National to the EU level. I suggest this because membership of EUFORGEN is the best way to become informed of progress & pan-European thinking on conservation of FGR- but due to lack of funds at the national level (particularly in countries with rich FGR's), EUFORGEN is threatened by loss of members.	2
9	Current strategies	Mutual (cross-border) support	Experience tells that waiting for 'action' to take place in individual countries is not enough when it comes to implement conservation measures. More efforts are needed to support such action where it is obviously needed most. Networking and funded research projects have laid a good ground for that in the past, the logical next step is to support implementation.	
9	Current strategies	(EU) financial support of FGR conservation (in situ, ex situ, breeding populations)	more financial support (EU) needed for conservation of genetic resources (Breeding populations as well as in situ populations of FGR	
9	Current strategies	Resources & funding	FGR don't stop at country borders: how to include all countries in programmes such as EUFORGEN, provide EU common funds for all (such as ??, Montenegro). Include all countries in all strategies and programmes, such as EUFORGEN, research & implementation projects.	
9	Current strategies	Co-ordinated financing	European funding for a European issue. Co-ordinated funding. Discussion or agreed mechanism to distribute funds for FGR on European scale.	3
10	Current strategies	Ecosystem approaches		1
10	Current strategies	FGR as an ecosystem service	Convince society of the usefulness of FGR on the need to spend money for their description, conservation and use.	
11	Current strategies	Active & positive EU policy on FGR (incl. money)	we need active policy from the EU in order to be able to execute all the work that needs to be done to fulfil and execute our strategy, including financial back up	11

Preparatory Action on EU plant and animal genetic resources

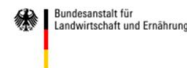


Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
11	Current strategies	Governance architecture	To define a clear governance architecture on shared responsibilities in the field of FGR policy. For example world level = FAO, continental level (FAO European region) = EUFORGEN and within the EU, coordination by European Commission (DG AGR?), national level = state level with a national focal point.	2
11	Current strategies	Legislation	Legislative act produced with the help of European Commission that will connect the FGR with climate change and strategies related to forestry.	1
11	Current strategies	EU forest strategy in the field of FGR implementation	To strengthen the EU policy in the field of FGR. Only 14 EU countries sent a report to FAO on national state of play on FGR. Need for strengthen EU coordination. Decreasing number of countries participating to EUFORGEN. But, with Directive 99/105, 28 registers of basic material for FRM.	3
11	Current strategies	Stronger EU guidelines		4
11	Current strategies	Increase political initiatives	Use political initiatives (Forest Europe) and increase engagement of the COM in order to support EUFORGEN and countries to strengthen and better coordinate work on 'climate gene conservation'	
12	Current strategies	FGR internet portal on FGR for European forest managers	To meet the needs of European forest managers in the field of FGR information: to put on one internet portal scientifically validated information on: (1) indigenous and non-indigenous distribution areas per species; (2) climate information; (3) basic material list – regions of provenance; (4) units of conservation list	5
12	Current strategies	Scientific data management governance	Convince scientists and managers to share their data and put them in databases: governance, IT support, recognition	1
	Current strategies	Information gathering & networking/exchange activities	Needs & knowledge are different per category stakeholders and per country - without background information and targets, conservation (and use) of FGR will have lower success rate. Need for networking and going beyond self 'interests'.	

Preparatory Action on EU plant and animal genetic resources

Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
	Current strategies	Rural development programmes	Be aware that opportunities for funding exist under RD (and not only under Horizon 2020. But this means interact with national and regional managing authorities, rather than with the Commission.	2
	Current strategies	Find/utilise approaches to be less depending on external funding/support	Conservation should include the aspect of sustainable use: funding is limited and avenues for 'self-sustainability' of conservation should be explored (economic, ecosystem services, recreational,)	
	Current strategies	Economic balance support South		
	Current strategies	Build DSS as joint contribution of practise-research	Build any DSS in close collaboration with users.	
	Current strategies	Tools for the identification of the origin of FRM	Tools for identification the origin of forest reproductive material used in Europe, and the information on the regions of provenance, as a way to increase the control of seed transfer, improve the seed transfer guidelines, and the effects on the future of the genetic resources in Europe.	
	Current strategies	Strategy based also on recent/new results from old provenance trials	Investigation to find adequate forest reproductive material (adapted to cc) (because of rotation period (long lived organisms) > 100 years FRM must be prepared). Need actual recent results from older provenance trials and other	
	Current strategies	Coordination	Projects should privilege the use of field plots and trials where there are already studies. Sustainable use of field plots	
	Current strategies	Euforgen demonstration projects	local demonstration projects about appropriate use of FGRs based on Euforgen guidelines (e.g. combining in situ + ex situ methods for Populus nigra)	
	Current strategies	Negative effects using 'inappropriate' FGR	Dissemination of scientific results about negative effects using 'inappropriate' FGRs, targeting forestry sector	

Preparatory Action on EU plant and animal genetic resources



Grouping of cards	Theme/question	Issues on card	Explanation (on back of the card)	Dots
	Current strategies	Supporting measures for conservation and use of FGR	Effective supporting measures in the future RD programmes to encourage farmers and foresters 'financially' for conservation and use FGRs in an appropriate (science based) way (e.g. following EUFORGEN guidelines etc.)	
	Current strategies	Positive effects using 'appropriate' FGR	Dissemination of scientific results about positive effects using 'appropriate' FGRs, targeting forestry sector	
	Current strategies	Simplified dissemination to forestry sector	More simplified dissemination of information to the forestry sector (e.g. information about the importance of FGRs and effects of climate change)	
	Current strategies	Dissemination of science on effects of climate change on FGR	More intensive dissemination of science based information about effects of climate change of FGRs	
	Assisted migration	Invasive species	Invasive potential of species: exotic and native. Link with EPPO? For forest species. Especially in relation to assisted migration.	
	Assisted migration	Monitoring/assisted migration	Records on each population transfer (and control if needed)	6
	Ex situ	Access & Benefit sharing for FGR	To increase knowledge on FGR from Mediterranean countries there is a need for increased collaboration and implementation of ABS (Nagoya protocol)	
	Ex situ	ex situ activity	Conservation of breeding populations for areas with changing climate conditions	
	Ex situ	include so far neglected traits in breeding (reproductivity, health and drought issues)	resulted the discussion and was 'parked' at ex situ issues	

?? = not readable