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in Science and Technology
- COST -**

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Secretariat

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MEMORANDUM OF UNDERSTANDING

Subject : Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action FP1202: Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest tree to climate change in Europe (MaP-FGR)

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 185th meeting on 6 June 2012.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as
COST Action FP1202
STRENGTHENING CONSERVATION: A KEY ISSUE FOR ADAPTATION OF
MARGINAL/PERIPHERAL POPULATIONS OF FOREST TREE TO CLIMATE
CHANGE IN EUROPE (MaP-FGR)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 “Rules and Procedures for Implementing COST Actions”, or in any new document amending or replacing it, the contents of which the Parties are fully aware of.
2. The main objective of the Action is to generate relevant knowledge on the role and use of the genetic resources of marginal/peripheral populations (MaP FGR) to adapt forests to global change using a multidisciplinary approach. The Action will train researchers and establish active and efficient networking/exchanges.
3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 76 million in 2012 prices.
4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.
5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

Marginal/peripheral (MaP) forest populations are at the edges of species ranges and contain an original genetic diversity due to unsuitable conditions for survival. Studying adaptive processes in MaP populations is crucial and of mutual interest for European and non-European countries for understanding the future of forest ecosystems. Developing conservation and management strategies for Forest Genetic Resources (FGR) of MaP populations is needed to adapt European forests to Global Change. Because of their millennia-long history of adaptation to environmental changes, FGR in southern Europe may prove invaluable for adapting the European forestry sector. However, southern MaP populations are not only threatened by ongoing climate change but also by other disturbances arising from human activities. Southern Europe represents an ideal model where the effects of climate change on FGR will be stronger and more rapid than in the rest of Europe. This COST Action, with its broad research spectrum and partnership, addresses the conservation and management of MaP FGR by: (i) compiling information on climate change impacts on MaP populations, (ii) making information available for preparing national and pan-European forest plans and strategies for adaptation and mitigation, (iii) developing criteria for monitoring and conserving FGR, (iv) sharing results with forest managers.

Keywords: Forest Genetic Resources, Adaptation to global change, Marginal/peripheral Populations, Genetic Erosion, Conservation

B. BACKGROUND**B.1 General background**

Global change will seriously affect all of Earth's biomes. Forest ecosystems and people dependent on their goods and services are at risk. Preserving Forest Genetic Resources (FGR) is crucial for forest ecosystems and people's well-being. Marginal/Peripheral (MaP) populations, *i.e.* from the edge of distribution areas, are particularly important for adapting forests to global changes. In Europe, all major biomes contain MaP populations. Surviving well under unsuitable ecological conditions, they might contain unusual adaptations and constitute valuable FGR for expanding as well as retreating European forests.

Many species worldwide are moving to higher latitudes and elevations in response to climate change. Range shifts are generated by widespread establishment of new populations at the high latitude range margins and massive extinctions of MaP populations. The limit of species ranges remains understudied and the need for long term conservation of genetic diversity of these populations is underestimated. These populations are particularly threatened by climatic changes because the changes act in combination with other disturbances originating from human activities.

There is no agreement on what the crucial mechanisms are that govern the resilience of MaP populations, including the role of local adaptation, demography, population dynamics and migration. MaP populations generally encounter more extreme biotic and abiotic conditions than those at the centre of the distribution and have therefore had to adapt to these conditions. Forest ecosystems and many species in southern Europe have experienced and survived post-glacial warming, and represent a valuable and original source of genetic variation. However, the speed of the current climate change will greatly exceed that of the past climate changes as well as the migration potential of forest trees.

Southern European forests are ecologically rich and have resisted climate changes throughout the Pleistocene. Consequently they represent “hot spots” of genetic diversity. In view of the expansion of southern-Europe-like climate conditions to large portions of Europe by the end of the 21st century, FGR of southern edge MaP populations are particularly important for the future of European forests. FGR of MaP populations represent a great potential for European forests under climate change that need to be taken into account in national and pan-European forest plans and strategies for adaptation and mitigation.

Current knowledge on MaP populations is, at best, fragmented and impossible to be transferred into management and policy making. Genetic variation is a crucial factor for the long term adaptation of forests to climate change. In spite of this, FGR have been insufficiently taken into account in national forest plans (NFP), national strategies for adaptation and mitigation, and even in practical aspects of forest management activities. Strategies for use of ‘pre-adapted’ southern MaP FGR for dealing with Global Change in northern forests (*i.e.* assisted migration) remains controversial.

To tackle these problems, a multidisciplinary approach, engaging a range of experts and stakeholders (*e.g.* geneticists, breeders, sociologists, economists, ecologists, entomologists, climatologists, forest managers, policy makers) from COST countries is needed. New tools and methodologies are required. A COST Action represents the best mechanism to achieve the objectives as it is designed as an efficient tool for networking, training, and sharing information, which are essential for fostering interdisciplinary approaches in scientific fields.

Whereas much research is now focusing on processes occurring at the expanding high latitude limit of the species distribution, populations at the low latitude range remain understudied. This is unfortunate because they represent extremely important reservoirs of genetic variation. Moreover they represent natural laboratories for predicting how populations will respond and adapt to future climate changes. In view of the future shift and expansion of Mediterranean-like conditions, MaP FGR will be important for use in higher latitude European countries. Southern Europe is a region where cooperation (North-South, North-North and South - South) is particularly relevant to overcome the challenges of adapting to climate change in the context of the neighboring policy of the European Union.

Countries from across Europe, as well as from other regions, can bring new ideas, skills and experience developed at local level on how to protect FGR. Cooperation, networking and involvement of all the scientific community is thus a basic principle for obtaining effective results from a possible COST Action.

There is increasing concern in Europe over the sustainability of forest ecosystems under global change (See recommendations from Ministerial conferences on the protection of forests in Europe : FOREST EUROPE 2011, Oslo, <http://www.foresteurope.org/>). Several issues raised by FOREST EUROPE involve adaptation to climate change, genetic diversity of forest trees and their conservation as a way of safeguarding the evolutionary potential of forest ecosystems over time. The recommendations of an international workshop on climate change and forests, organized in 2005 in Paris by EUFORGEN (European Forest Genetic Resources Programme) and IUFRO (International Union of Forest Research Organizations) in collaboration with FOREST EUROPE liaison unit (Warsaw) clearly stated that safeguarding and using genetic diversity of keystone forest ecosystem species should be a priority on policy maker's agendas to mitigate the effects of climate change.

The goals of this COST Action also deal with some of the challenges defined in the Oslo Declaration on the occasion of the Fifth Ministerial Conference on the Protection of Forests in Europe (Oslo Declaration, 2011; <http://www.foresteurope2011.org>). For example “item 21c. Promote education, research and the use of scientific knowledge and facilitate sharing of experiences across countries, sectors and stakeholders on all aspects of sustainable forest management and other forest related issue.”

B.2 Current state of knowledge

Climate change cannot be considered as an independent factor or only as a complex of natural factors, but it should be considered within the wider context of interactions arising from the increasing human activities and the biosphere known as Global Change. Although comparing central and peripheral populations as a long tradition in ecology and genetics, a static view of species distribution has prevailed so far (Eckert *et al.*, 2008). A new perspective is needed to evaluate how the distribution range of species moves in response to climatic change.

1) Current state of knowledge on impact of Climate Change in Southern Europe

1. South European areas are very sensitive to climate change, which is having rapid and severe impacts.
2. Climate change is multi-factorial and there is a need to consider steady changes as well as the impacts of extreme events on FGR (Màtyàs, 2000).
3. Risk of forest fires is already increasing in southern Europe and this risk will also become more important in several other European regions (*EU project Fire Paradox, EU Project on ALP FFIRS*).
4. Climate induced degradation may reduce carbon sequestration and result in extreme cases in the limitation of mitigation potential of forests that will act only as net carbon sinks (*EU project CarboEurope*). Use of appropriate FGR could improve the potential of southern European forests for carbon sequestration.

5. Considering the specificity of water and forest interactions: the survival of MaP southern forests is at stake in several zones with already visible forest decline (EFIMED Mediterranean Forest Research Agenda)..
6. Biotic interactions (insects, pathogens), which can have severe impacts on forest ecosystems, are unpredictable in particular in the context of climate change (Brazier 1996). Soil evolution, litter degradation and mineralization of organic horizons will be also influenced by climate change and will interact with species and water stocking ability (Albergel et al. 2010).
7. Isotherms will probably shift very rapidly because of increasing average temperatures (Màtyàs 2007).
8. MaP populations represent highly instructive models and natural laboratories to investigate how populations respond to demographic and ecological challenges (Heckert et al. 2008, Gaston 2009) and eventually how they will adapt to future climatic conditions.

The improvement of knowledge on MaP FGR will allow new models and tools to be developed in order to optimize forest management taking into account forest genetic resources issues.

II) Current state of knowledge on MaP FGR/genetic diversity in Europe

1. Genetic diversity is a key component involved in evolutionary processes of forest ecosystems and species for adaptation to climate change (González – Martínez *et al.* 2006, Vendramin *et al.* 2008, Matyas *et al.* 2009; Grivet *et al.*, 2009, 2011; Ganopoulos *et al.*, 2011).
2. Human actions can impact genetic diversity and adaptation/adaptability to climate change (Koskela *et al.*, 2007).
3. Overall, tree species at the southern range have a very high genetic diversity (Smulders *et al.* 2009) but at MaP FGR level genetic diversity can vary tremendously, some populations displaying very low diversity (Grivet *et al.* 2009, 2010; Fady 2005; Fady and Conord 2010). In fact, as MaP populations are frequently smaller, they may be less variable (but potentially more adapted to future climate conditions) than populations in the central part of the distribution area of the species (Sagarin and Gaines, 2002). Others MaP populations, particularly in Southern Europe, contain an original genetic diversity as a legacy of past evolutionary processes (Hampe and Petit, 2005).

4. So far species were generally successfully able to adapt to past climate changes (Eriksson *et al.*, 1998; Hamrick 2004; Hampe and Petit, 2005). On the other hand humankind and its significant and rapid demographic and industrial development represent a new factor influencing species adaptive potential (Lefèvre, 2004).
5. Rates of spread of forest trees (m/year) are far below what would be necessary (3000 to 5000 m/year) for species migration to track future climatic warming (Mátyàs, 2007). Gene flow capabilities (via pollen) are also below what would be necessary to track climate change and increasing turnover has been proposed as a way of recruiting non-local genes to populations (Kramer *et al.*, 2008; Savolainen *et al.*, 2007).
6. Flowering phenology studies indicated that climate change could result in pronounced asynchrony among male and female flowering and thus in lack of seed set for xerothermic years in forest ecosystems (Xiaoqiu *et al.*, 2005; Estrella *et al.*, 2006; Perini *et al.*, 2007; Moriondo and Bindi, 2007; Alizoti *et al.*, 2010).
7. Over a long period of time, many studies have been made on genetic variation and international comparative genetic trials have been carried out with a regional perspective (Besacier *et al.*, 2011). FGR have already been tested in climate conditions that are predicted to occur in more northern latitudes in Europe in the future (EU FORADAPT – EU MPC – EU NOVELTREE – EU TREEBREEDDEX – FAO *Silva Mediterranea* – IUFRO). Data and results from international trials on several forest species established throughout Europe indicate a high variability at adaptive traits as well as a high phenotypic plasticity (Savolainen *et al.*, 2007). The existing experimental networks established within the framework of international trials (FAO *Silva Mediterranea* and IUFRO, FORADAPT) represent a relevant source of information to estimate genetic parameters in relevant adaptive traits and clarify the role of phenotypic plasticity as a mechanism allowing forest species to cope with environmental heterogeneity (Sultan, 2000).
8. Information from new techniques (*e.g.* high throughput genotyping and phenotyping techniques) is now available from some EU countries (EU EVOLTREE – ERA-net, Biodiversa *LinkTree*).

B.3 Reasons for the Action

Information on FGR (and their adaptability to future conditions) is needed for preparing and implementing conservation strategies at national and regional levels. Projections of future species distribution in relation to climate and its change (envelope models) should be improved by integrating the evolutionary processes based on genetic diversity. Forest decline already occurring in certain areas will provide the environmental thresholds for the species existence and reproduction, so that assisted migration or evacuation actions could be taken with the first signs of decline.

Currently the results and tools from the previous research are not easily available for users such as forest managers, conservationists and policy makers. New concepts and guidelines should be developed as quickly as possible. In the same way, genetic knowledge and monitoring of populations' structure could help to find adaptive management options and for developing mitigation strategies for forest ecosystems.

This COST Action will:

1. Contribute to reducing the fragmentation in European research around the key problems of conserving and using MaP FGR.
2. Increase knowledge and identify gaps for future research on the relationship between genetic diversity and adaptation to climate change.
3. Highlight the importance of southern MaP FGR for countries further north under climate change conditions, because they are often adapted to warm and dry climates, which are expected to extend north in the near future.
4. Provide researchers across Europe with the opportunity to observe forests undergoing climate –related stress, with a view to understanding processes likely to affect forests more widely in the future.
5. Aid European countries to establish or to improve their adaptation and mitigation strategies.
6. Integrate skills, knowledge and tools in order to develop efficient and common strategies to preserve European FGR.

7. Develop clear and readily applicable guidelines and tools for forest managers and decision makers (expert-based recommendation methods, decision-making tools, etc.).
8. Enhance the collaboration/cooperation among countries in the field of MaP FGR which is of mutual interest in the context of global change.

Fostering a dialogue among scientists from different disciplines will provide new insights on the adaptation of MaP FGR to the effects of climate change. The results of this dialogue will be the basis for providing guidelines and recommendations at different levels (forest management plans, national forest plans and strategies for adaptation to climate change, regional strategies or initiatives relevant to forests and climate change adaptation).

The results of this COST Action will be an added value for the implementation of European activities on forest reproductive material, genetic resource conservation and use, forest management and afforestation guidelines, biodiversity conservation and sustainable use, within the Pan-European Process of Forest Protection (Forest Europe).

B.4 Complementarity with other research programmes

At the European level this COST Action will act to synthesize outputs from several EU projects as TREEBREEDX, EVOLTREE, NOVELTREE, EUFGIS, COST FPS-ECHOES, COST ESSEM-CLIVAGRI, AGORA, LINKTREE, FORGER, TREES4FUTURE. Tools and methodologies provided by these projects and networks will be used in this COST Action and serve the goal of strengthening cooperation and exchange of information between countries.

Moreover it is in line with the priorities included in the Mediterranean Forest Research Agenda 2010-2020 (EFIMED) and agreed by the European Forest-Based Sector Technology Platform (FTP). In particular this COST Action is complementary to the ERA-net project “FORESTERRA” (reinforcing the scientific coordination and integration of forest research among Mediterranean countries and other Mediterranean climate areas) currently under preparation.

In addition this COST Action is in synergy with several initiatives such as:

- European Forest Genetic Resources Programme (EUFORGEN) for implementing Resolution S2 of the Ministerial Conference on the Protection of Forests in Europe (Strasbourg 1990);
- The Work Plan of the working group on Forest Genetic Resources in the framework of the FAO Committee on Forestry Questions (*Silva Mediterranea*);
- Training activities of the International Center of Advanced Mediterranean Agronomic Studies (CIHEAM);
- Activities of the IUFRO – Division 2, the WP 2.02.13 “Breeding and genetic resources of Mediterranean Conifers” and WP 2.04.01 “Population, ecologic and conservation genetics”.

At the global level this COST Action will contribute to several international initiatives:

- It is consistent with the needs identified by UNFCCC for adaptation and mitigation to Climate Change (Intergovernmental Panel on Climate Change - IPCC- scenarios for the Mediterranean region will be applied in this COST Action);
- It will contribute to the State of the World Forest Genetic Resources launched by FAO and to be published in 2013;
- It is also in line with International Union for Conservation of Nature (IUCN) priorities and International Union Forest Research Organizations (IUFRO) goals proposed during the last World Congress held in Seoul (2010).

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main objective is to generate relevant knowledge on the role and use of MaP populations to adapt forests to global change using a multidisciplinary approach. Because they emerge from different processes, not all MaP populations may hold the same value for adapting forests to climate change (Lesica and Allendorf 1995). Some, resulting from maladaptive gene flow from central populations (Lenormand 2002) may have little value for conservation and use.

Others, particularly those in Southern Europe, result from long term evolutionary and adaptive processes (Hampe and Petit 2005) and their FGR may contain original genetic combinations of high value for mitigation and adaptation. Prioritizing MaP FGR on the basis of their genetic value is one of the objectives of this Action. The expected results will have direct relevance for conservation and management, by identifying populations of unique conservation value and by producing guidelines for long term protection of MaP FGR. This COST Action will train researchers and establish active and efficient networking/exchanges among scientists.

C.2 Objectives

Specific objectives are:

- To collect, collate, analyze and synthesize information from past and ongoing projects related to genetic diversity and impacts of climate change;
- To record and list existing conservation efforts and status, in order to identify gaps and set conservation priorities;
- To analyze and raise awareness on the role of FGR in the adaptation of MaP populations;
- To perform meta-analysis of collected data to identify common trends on the dynamics of genetic diversity in relation to the response to the effects of global change;
- To provide recommendations and guidelines for forest managers and national policy makers to conserve and sustainably use MaP FGR for forest adaptation and mitigation to climate change;
- To highlight the potential of MaP populations for the adaptation to climate change in other networks dealing with FGR conservation;
- To identify new research priorities on FGR for future joint EU projects;
- To organize conferences, workshops and training schools for the scientific community, end users and stakeholders on the role of FGR from southern edge populations for adapting forests to global change.
- To publish results in journals with public access policy.

C.3 How networking within the Action will yield the objectives?

The objectives will be achieved by:

1. Combining existing information from several sources on forest genetic resources and ecological conditions on MaP populations and making this information usable through available databases. For this purpose, the experience gained at European level from work of the EUFORGEN, TREEBREEDDEX, EUFGIS and EVOLTREE networks will be of major importance.
2. Analyzing this combined information to increase knowledge on the relationship between genetic diversity and adaptation to global change and particularly to climate change;
3. Identifying gaps for future research and providing tools for forest managers and decision makers (guidelines, recommendations, methods, decision-making tools, etc.);
4. Training and networking researchers through the organization of annual training schools and the establishment of active and efficient exchanges among scientists (workshops, conferences, working groups, publications, etc.);
5. Combining information on the current conservation status of FGR and identify gaps related to species/MaP populations.

C.4 Potential impact of the Action

The benefits of this COST Action will be at three main levels:

1. Scientific and Technological Knowledge:

- genetic and ecological data made available through an open access database, sharing scientific information to reduce fragmentation and gaps in knowledge and research;
- model on conservation and management of MaP FGR provided in the context of global change;
- knowledge provided on the value of MaP populations as long-term reservoirs of genetic variations and evolutionary potential for central populations.

2. Capacity building:

- standardized methods and protocols to provide common methodology for conservation and management of MaP FGR;
- training of scientists and practitioners.

3. Social and Economic impacts:

- preserve multifunctional forests together with the goods and services they provide to local populations and other stakeholders in the forestry sector, safeguard precious MaP FGR and transfer of knowledge to policy makers.

C.5 Target groups/end users

The achievements obtained in this COST Action will contribute to the current international initiatives to assess biodiversity at all levels of organization.

This COST Action expects to provide the scientific community, especially biologists and ecologists, with a deeper understanding of the importance of tree genetic diversity for the sustainability and resilience of forest ecosystems.

It will provide forest managers, nature conservationists and policy makers with guidelines to manage forest ecosystems and MaP FGR that are affected by global change.

This COST Action will be able to provide guidelines to policy makers for the choice of appropriate “minimum requirements” to select forest ecosystems and MaP FGR stands that will be recognized and managed as conservation units at the European scale.

Forest Researchers will be able:

- to improve synergy between countries/institutions/teams/networks;
- to enhance their access to relevant information/data/maps through databases;
- to develop new innovative research projects on FGR and genetic diversity in the context of global change;
- to train a new generation of researchers on MaP FGR (Capacity building).

Policy makers will enhance their ability to integrate FGR issues in National Forest Programs and strategies for adaptation and mitigation to global change. New tools and methods will be available at national level to improve monitoring, regulation and certification of FGR.

Forest Managers will be able to integrate FGR issues in their practice for Sustainable Forest Management using the recommendations and guidelines provided by this COST Action;

Conservationists will be able, with maps and data made available by this COST Action, to identify the most endangered populations/species and the best sites for *ex situ* conservation.

Forest owners will be able to choose the best adapted reproductive materials to future climate conditions for reforestation/afforestation activities.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

Task 1 – Scientific and technical information on ecological conditions including climate change impacts on MaP populations at southern limits of the species.

1. Inventory of regional/national maps and/or links to web sites of climatic maps including future scenarios: all maps and data concerning estimated climate change scenarios should be collected, standardized, possibly geo-referenced in GIS and used to produce a climate scenarios map;

2. Inventory of regional/national maps and/or links to web sites concerning location of soil types and morphology: all maps and data concerning the soil, topography and geomorphology (*i.e.* European map of soils, maps of aspects and slopes) should be collected, possibly geo-referenced in GIS and used to produce a combined map;
3. Identification of pedo-climatic parameters characterizing species ranges.

Expected deliverables:

- *Maps, atlas, databases (D1)*

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

1. Identification of most relevant species;
2. Identification of skills and gaps in forest genetics research capacity;
3. Survey and description of conservation and mitigation methods and actions with special reference to climate change;
4. Survey and description of available FGR;
5. Survey of the existing information on variability of relevant genetic parameters by species for molecular markers and adaptive traits.

Expected deliverables:

- *A web-based directory of human resources and infrastructure/organizations working or skilled on FGR of MaP populations (D2);*
- *A directory of genetic resource conservation methods applied in COST and neighboring countries, with special reference to global change (D3);*
- *Database of forest genetic resources for conservation and for use (genetic conservation units, basic material, genetic trials)(D4);*
- *Maps of the present variation of the main genetic parameters related to erosion - extinction risks by species/populations (D5).*

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

1. Discussion on the impact of possible scenarios of environmental changes on FGR highlighting risk areas and refuge areas;
2. Inventory of most endangered populations with need for immediate conservation actions, and identification of suitable areas for rescue;
3. Suggestions for development of indicators (at regional level) for monitoring FGR for conservation and sustainable forest management in the context of global change;
4. Identification of gaps on information and knowledge on species, areas of distribution and tools, for conservation and use of MaP FGR in COST and neighboring countries;
5. Preparation of Technical Guidelines for forest managers and for national policy makers for conservation of MaP FGR and forest reproductive material for climate change adaptation;
6. Facilitation of exchanges of genetic resources for conservation and research purposes among Europe and neighboring countries, according to international agreements on FGR transfer.

Expected deliverables:

- *Predictive maps of changes in the distribution, composition and structure of some selected species in relation to climate change scenarios (D6);*
- *Report on scientific and technical information on the potential effects of climate change on FGR including analysis of existing comparative genetic trials (D7);*
- *List of most endangered/diverse species and populations and those key for the future of the EU forest sector under global change (D8);*
- *Guidelines for mainstreaming genetic diversity into sustainable forest management in the context of global change in Europe (including legal transfer issues) (D9).*

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

In this work package, this COST Action will interact with end users and will involve stakeholders (foresters, NGO representatives, forest owners, etc.) in project discussions and meetings. Target groups will include scientists, nature conservationists, national forest managers and European policy makers. In close collaboration with EUFORGEN and other European networks, the Action will implement the communication plan to reach stakeholders and general public. A panel of representative end users in the management community will be identified to interact with scientists involved in ongoing forum discussion and specific sessions during the course of the project.

A web-based, user friendly toolbox will be constructed in order to facilitate scientific exchanges among participants, disseminate the results to end users and manage databases in a long term and open access perspective. The web page will be developed in close collaboration with webmasters responsible for web sites such as EUFGIS, EUFORGEN, TREEBREEDDEX, FORADAPT, EVOLTREE, for a better integration of databases and to avoid duplications.

In addition, to increase the efficiency of dissemination, this COST Action will organize workshops and conferences for target groups to promote and facilitate uptake of the results, at international, regional, national and local level.

Because COST Action results are expected to be of interest for a broad scientific community, their publication will be targeted in broad audience journals and wide technical methods will be published in more specialized ones.

At the graduate level, emphasis will be put on improving the trans-disciplinary perception of the function of FGR and, particularly MaP FGR, in securing long term adaptability of forest ecosystems. Possibilities for specialization in this field will be provided by organizing training schools.

A final meeting will be organized to present the results to the target groups, to discuss the implications of the results for the management of MaP FGR and to adopt recommendations and guidelines.

Expected deliverables:

- *Conferences, workshops, training schools, open access databases, web toolbox, reports, publications, STSMs (D10).*

D.2 Scientific work plan methods and means

The project will benefit from an unprecedented multidisciplinary approach. The work plan will be carried out by 4 Working Groups (WG):

- **WG1:** Gathering of already available data and compilation of ecological, genetic and global change information, and particularly climate effects, on FGR and distribution of MaP populations (*e.g.* climatic scenarios and models, forest decline maps, lists of endangered materials). WG1 will include climatologists, soil scientists, ecologists and geneticists and will be mainly focused on Task 1 and Task 2 (deliverables D1, D2, D3, D4);
- **WG2:** Evaluation and analysis of WG1 information (*e.g.* genetic diversity maps per species/populations, methodology for evaluation of FGR diversity, compilation of databases of relevant institutions, genetic material, trials and networks, gaps of information). Standardization of methods. Meta-analysis of the data to identify common and divergent trends of FGR response to global change. WG2 will include ecologists, geneticists and silviculturists and will be focused on Task 2 and Task 3 (deliverables D5, D6, D7, D8);
- **WG3:** Mainstreaming genetic diversity into sustainable forest management in the context of global change, considering both conservation and use of FGR. WG3 will include breeders, geneticists, ecologists, silviculturists, forest managers and policy makers and it will focus on Task 3 (deliverable D9)
- **WG4:** Coordination and organization of all networking, databases management, training and communication activities: conferences, workshops, training schools, web toolbox, open access databases, reports, publications, STSMs. WG4 will provide the integrative approach of the Action and will be focused on Task 4 (deliverable D10).

E. ORGANISATION

E.1 Coordination and organisation

The management and organization of this COST Action include the Management Committee (MC) and four Working Groups (WGs) responsible for the four tasks and transverse networking activities. A Steering Committee (SC) will be nominated for monitoring the output and progress of the Action, made of: Chair, Vice-Chair, Leaders of the four Working Groups, two External Members (one scientific and one management expert on FGR) and a Stakeholder Advisory Group. The SC will meet at least once a year with MC and WG leaders.

The MC will identify its rules during the kick-off meeting according to the COST regulations. Each National Representative of the MC will indicate the expert to be nominated within each WP.

The basic research necessary for the achievement of the four tasks will be financed by participating countries. COST budget will support networking and coordination actions for implementing the Action.

The Management Committee will be responsible for the coordination of national research in implementation of the Action, with the support of WG4 for all networking activities (conferences, workshops, training schools, web toolbox, open access databases, reports, publications, STSMs). The MC will identify and discuss the topics of the training schools, workshop and conferences during the meetings and an “ad hoc” Scientific Management Team (SMT) will be nominated for each event. The SMT has the responsibility for the organization of the events by designing the program, identifying speakers and procedures to select the students. WG4 will be the “tool” of MC to organize networking, communication and training activities of the Action

Milestones

- M1. Kick-off meeting and establishment of the Management Committee (including the nomination of Chair, vice Chair) and Working Groups (nomination of WP leaders) (by the end of month 3).

- M2. Selection of relevant species and MaP populations for methodological aspects of Task 3 (by the end of month 3).
- M3. Web-site operational (by the end of month 6).
- M4. Climate, soil and topographic information for the distribution area of the selected species and MaP populations (by the end of month 12).
- M5. Organization of the first training school on the impact of global change on FGR and, particularly, on MaP FGR (by the end of month 18). Additional training schools will be organized according to the needs identified by COST Action participants.
- M6. Database of FGR established or updated (depending on species) for the selected species and MaP populations (by the end of month 24)
- M7. Genetic diversity and adaptive variability data for the selected species and MaP populations (by the end of month 24).
- M8. Overlaid maps of species range, current climate change scenarios and genetic diversity parameters (by the end of month 36).
- M9. Production of guidelines on MaP FGR sustainable use and conservation (by the end of month 40).
- M10. Joint workshop with scientists, stakeholders and policy makers for discussion and approval of recommendations and guidelines on MaP FGR sustainable use and conservation (by the end of month 44).
- M11. Final conference (by the end of month 48)

E.2 Working Groups

During the kick-off meeting, the four Working Groups will be established and their composition identified; a chair and vice-chair will be chosen by the Management Committee based on their expertise.

The Management Committee will rely on Working Groups to implement the Action. Each Working Group will be focused on one or more tasks or a transverse activity and will design a detailed work plan. The chair of each group will be invited to participate in the Management Committee for a better follow up of tasks.

This COST Action will be organized in order that the four working groups will coordinate in an integrated way for developing tasks. Task 1 and Task 2 will be developed to supply basic data, maps and scenarios concerning climate and species by WG1 and WG2. WG3 will process the information collected and produced in the framework of Task 2 and Task 3, in order to develop common criteria, principles and guidelines. WG4 will represent the connection between Management Committee and the other Working Groups and it will take care of Task 4 for training, dissemination and all networking activities.

Working Groups will interact to develop the following tasks and training activities:

Task 1 – Scientific and technical information on ecological conditions including climate change impacts on MaP populations at the limits of species ranges.

- Available resources (maps and databases) on climate, soil and topography and climate projections will be used to highlight the current and future situation of ecological conditions in the distribution area of selected species and MaP populations. The consortium will include specialists in bio-climate, soil science, plant ecology and GIS-experts.
- At least two workshops will be organized for specific planning and standardization of information and methods at the beginning of the project and at the end of the second year before the start of Task 3.
- At least eight short-term scientific missions will be organized during the first two years

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

- To get information on the variability of adaptive traits, the most relevant trial networks will be chosen for a limited set of species. Existing data from genetic trials will be revisited for some common adaptive traits like survival, phenology, growth rhythm, reproduction. A list of genetic parameters will be decided.
- To get information on genetic diversity through genetic markers, literature and existing databases will be surveyed and the most appropriate measures will be selected (richness, structure).

- Experts in quantitative and molecular genetics and in GIS will contribute to this Task. At least two workshops will be organized for specific planning and standardization of information and methods at the beginning of the project and at the end of the second year before the start of Task 3.
- At least eight short-term scientific missions will be organized during the first two years.

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

- Data analysis and GIS techniques will be used to produce summary maps on major threats and challenges for MaP FGR in a changing environment. It will help to highlight gaps in the scientific knowledge. It will be the basis for recommendations which could make sense in a context of climate change (assisted migration, delineation of regions of provenances, seed transfer recommendations, seed collection methods, etc).
- Recommendations will be prepared including all types of expertise available among the scientific community but also stakeholders and policy makers. To be more efficient, the produced recommendations will be discussed and validated during a workshop. A training session will be organized to disseminate and promote implementation of recommendations including genetic diversity for sustainable management of forests.
- At least four workshops in the last two years will be organized for experts from Tasks 1 and 2 for a synthesis of ecological and genetic information and consolidation of results.
- At least ten short-term scientific missions will be carried out.
- The Action will benefit from the EUFGIS/EUFORGEN platform, concerning databases of GCU (Genetic Conservation Units) of FGR *in situ* conservation and range of species. It also benefits from EU-FORADAPT, TREEBREEDDEX - EU Infrastructure “Virtual Forest Tree Breeding Laboratory” and TREES4FUTURE platforms for recording the *ex situ* conservation and international and national trials established in Europe.
- Other EU projects as EVOLTREE (EVOLution of TREEs) as drivers of terrestrial biodiversity, NOVELTREE (Novel tree breeding strategies), LINKTREE (Linking genetic variability with ecological responses to environmental changes) where forest trees are intended as model systems, will support this COST Action thanks to the skills and knowledge of partners

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

- At least one training school per year will be organized on topics to be identified during the COST Action meetings.
- At least one meeting per year of the Management Committee and of the Steering Committee will be organized.
- Workshops will be organized based on needs identified by WGs.
- All relevant information produced by the COST Action Working Groups will be published on the web site.
- One annual report will be produced by the Management Committee with the support of the 4 Working Groups.
- At least one publication per year will be submitted by COST Action participants to international scientific journals.

E.3 Liaison and interaction with other research programmes

- Scientists involved in this COST Action are already participating to and/or coordinating other European Union-funded projects (EVOLTREE, TREEBREEDEX, NOVELTREE, LINKTREE, AGORA, EUFGIS, TREES4FUTURE, FORGER, ERA-net/FORESTERRA) and networks (FAO - *Silva Mediterranea*, Bioversity International/EUFORGEN, IUFRO 2.02.13 and 2.04.01, EFIMED) dealing with similar topics. This will ensure a better integration of activities and prevention of redundancies.
- The Action will use skills, data and tools generated by the above-mentioned projects and networks when relevant.
- International bodies will help in training, networking and interfacing with policy makers.
- The web-site of the Action will have links with the different web sites of projects, networks and bodies referred above.
- The databases will be integrated within existing platforms (EVOLTREE, EUFGIS, TREEBREEDEX, FAO *Silva Mediterranea*, etc.) for harmonizing metadata and ensuring long term and public access.
- Joint conferences/workshops will be organized when appropriate.

E.4 Gender balance and involvement of early-stage researchers (ESR)

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its agendas. The Action will also be committed to involve early-stage researchers. This item will also be placed as a standard item on all agendas.

This COST Action involves nearly 23% of women.. To benefit both gender balance and ESR, female researchers and ESR will be nominated as members of the SC and as group and task leaders during the kick off meeting. Moreover, gender and ESR balance will be one of the most important criteria for selecting applicants, students and teachers for summer/training schools and STSM. The innovative nature of this COST Action combined with the relevance of the topics will allow to producing high quality research papers that will benefit the ESR scientific career.

Training young researchers and forest managers for improving a common mentality, common approaches and to transfer knowledge and skills among countries but also among generations is a clear objective of the network.

F. TIMETABLE

This COST Action will last for 48 months.

Tasks 1 and 2 will start together at the beginning of the project and will last for 24 months. Based on results provided by Tasks 1 and 2, Task 3 will start and last for 30 months.

The beginning of Task 3 may overlap Tasks 1 and 2 according to progress in these tasks. The Task 4 will start at the beginning for all duration of the Action.

	year1				year 2				year3				year4			
	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
Coordination	M1		m				m				m				m	M11
Networking activities Task4		M3		TS			TS				TS			TS		
Task1	M2					M5		M6								
Task2				M4				M7								
Task3													M8		M9	M10

m =plenary annual meeting

Mi refers to milestones (above)

TS =training School

G. ECONOMIC DIMENSION

The following COST countries are involved in this COST Action: AT, BA, BE, BG, DE, EL, ES, FI, FR, HU, IL, IT, NO, PL, PT, RO, SK, TR, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 76 Million € for the total duration of the COST Action. Other COST countries expressed their interest to participate and will be invited.

H. DISSEMINATION PLAN

H.1 Who?

This COST Action will spread knowledge and excellence in its domain at all levels in the Europe, from the scientists through the stakeholders to the citizen. This COST Action recognizes the need to take a proactive role in ensuring the adoption and adaptation of project outputs into practical recommendations for improved conservation and sustainable use of MaP FGR. The COST Action will increase the awareness of managers and policy makers to novel and improved techniques and disseminate the results to the full range of user-groups and target audiences: scientists, forest tree breeders, forest owners, forest managers, European forest-based sector, policy makers and end users.

Scientists: papers, workshops and conferences, proceedings, training schools, atlas of southern Europe maps of environmental impacts on MaP FGR, databases, access to inter-and intra-net pages of the web-site.

Policy makers: one workshop, final conference, recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, atlas of southern Europe maps of environmental impacts on MaP FGR, free access to the internet pages of the web-site.

Forest Managers: recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, atlas of southern Europe of environmental impacts on MaP FGR, free access to the internet pages of the web-site, final conference.

Conservationists: recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, atlas of southern Europe of environmental impacts on MaP FGR, free access to the internet pages of the web-site, final conference.

Forest owners: recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, free access to the internet pages of the web-site, final conference.

Public: non-technical publications (press-release and any other forms of media), access to the internet pages of the web-site.

H.2 What?

Scientific: papers, workshops and conferences, proceedings, training schools, atlas of southern Europe maps of environmental impacts on MaP FGR, databases, access to inter-and intra-net pages of the web-site.

Policy: one workshop, final conference, recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, atlas of southern Europe maps of environmental impacts on MaP FGR, free access to the internet pages of the web-site.

Conservation: recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, atlas of southern Europe maps of environmental impacts on MaP FGR, free access to the internet pages of the web-site, final conference.

Management: recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, atlas of southern Europe maps of environmental impacts on MaP FGR, free access to the internet pages of the web-site, final conference.

Private forestry: recommendations and guidelines on ways to manage, monitor and regulate MaP FGR conservation and use, free access to the internet pages of the web-site, final conference.

Public awareness: non-technical publications (press-release and any other forms of media), access to the internet pages of the web-site. In addition according to COST rules, a progress report will be produced each year by the end of the year as well as a final report at the end of this Action.

H.3 How?

Each scientific Working Group will be responsible for the dissemination of results produced with the help of WG4. The WG4 is in charge of Task 4 activities drawing information from Tasks 1 – 3.

Workshops, conferences, training schools will be advertised through the web-site and TREEBREEDEX, EUFORGEN, *Silva Mediterranea*, TREES4FUTURE, etc. mailing lists provided by partners.

Materials and/or minutes for Workshops, conferences and training schools will be made available through the web-site. The dissemination plan of this Action will be revised every year by the Management Committee.