



Silva Mediterranea

**Working Group on “FOREST GENETIC RESOURCES IN
THE MEDITERRANEAN REGION”**

2009-2012 Work Plan

**CONSERVATION OF MEDITERRANEAN FOREST GENETIC
RESOURCES IN THE CONTEXT OF CLIMATE CHANGE**

**FAO/SILVA MEDITERRANEA DRAFT PROPOSAL
FOR AN IMMEDIATE ACTION IN MEDITERRANEAN AREA**

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*Genetic Diversity a key issue for
Mediterranean Forest adaptation
to Climate Change*

I) Background and context in Mediterranean

The Forest Genetic Resources cannot be conserved, managed or used without considering the ecosystem to which they belong to. Natural and social components should be taken into account too. The Mediterranean Region is expected to face the effects of the climate change more directly and earlier than other regions of the world. Countries of both the northern and southern sides of the Mediterranean Basin will be affected with different intensities and consequences by the phenomenon. Common actions are strongly required to mitigate the impact of such trends.

Importance of the genetic resources in the Mediterranean Basin

Most Mediterranean ecosystems are undergoing the most recent climate post-glaciation's warming. **The Intergovernmental Panel on the Climate Change (IPCC, 2001) predicted an average temperature increment of 2 - 4° C.** About 30% of the annual precipitations would be lost, especially from rainfalls concentrated in winter and spring. In autumn these could be considered a problem due to the occurrence of floods. The geographic distribution of rainfall would also predictably be changed and in many areas drought occurrence would increase. Consequently, living cycles of species as well as reproductive systems, phenology, adaptability at earlier and adult stages, will be severely tested by the changes on climatic and environmental parameters. Gene pool erosion has also to be expected. **In some cases we should see extinction of species or part of them**, especially in the most extreme conditions of their natural range.

Research on forest genetic resources is able to provide innovative approach to cope with the cited issues and come up with the most appropriate solutions (*Cf. Recommendations of Forest Genetic Resources Chania Workshop*). The wide research and common experimental networks of more than 800 field tests, established since the last 30 years in the Mediterranean Basin by *FAO Silva Mediterranea* in cooperation with IUFRO Working Group on "Mediterranean Conifers" may be considered as the main basic tools to start with. Such research **will aimed to find strategies for an integrated and synergic action focussed on preserving important Mediterranean forest gene resources.**

Environmental, socio-economic and policy context in the Mediterranean.

The Mediterranean area has often been an agreeable host for the migrating forest ecosystems. Important **refuges** have existed during glaciations for forest species. **The presence of endemic or relic species/populations and the wealth in multi-specific genera in this area show its ancient and periodic function as a refugee in this part of the world.** As a consequence of the impacts of the above reported environmental and social factors, the Mediterranean Region forest tree populations are in general small, and many are genetically eroded. Most of them are isolated, and genes flow and exchanges are often limited. Species are generally distributed by meta-populations which exchanged genes in past times, when the climate allowed their expansion. Nowadays, human activities interrupted the possibility of gene flows -often definitively and probably for longer times than similar interruptions in natural conditions.

The negative impacts on forest species and ecosystems became harder in the last 50 – 100 years after the human population increased and more agriculture lands requested. Mountain forests were fragmented, over-exploited and/or destroyed to use also higher elevation lands. The water cycle has been in several areas modified to drought, the forest humus mineralised or soils eroded and the desertification risks were increased. The present global-trade system, interacting with the climate effects on agriculture, seems to have modified again the economy and the social structure equilibrium especially in rural and mountain areas. It is again time of wide migrations and the Mediterranean Region is again the crossroads.

In this framework, the nations living on the coasts of the Mediterranean, the European Union southern Countries, the northern African Countries and the Nearest-Orient Nations need to face together this new challenges and to reinforce regional cooperation to develop new Forest Genetic Resources conservation methods in Mediterranean.

II) Baseline and Chania Workshop Recommendations

Debate is still ongoing about the real **ability of species to adapt**, but from the pragmatic point of view it is necessary to establish strategies and possibly common actions plans for the event that they become in danger of genetic impoverishment or extinction. Many studies have been carried out on the genetics of forest tree populations and on quantitative productive traits in multi-site comparative trials. **Such traits can be considered as indirect indicators for adaptability, but no specific research has been systematically carried out on the effects of the climate change.**

During its last meeting in Chania (FAO-CIHEAM Regional Workshop / 24-26 November 2009) *Silva Mediterranea* Forest Genetic Resources experts of Working Group IV proposed the following common recommendations for Mediterranean region:

Key messages and recommendations about Forest Genetic resources and Climate Change

1. Mediterranean forests require special attention because:

- *They provide crucial basic resources as well as **high-value** but non-market services ;*
- *They are a world natural heritage in terms of **biodiversity**, including **forest genetic resources** ;*
- *Their conservation and management affects the availability of **soil** and **water** resources ;*
- *Their future is **seriously endangered** by climate and land-use changes.*

2. Key messages related to climate change

- ***Mediterranean region is very sensitive to climate change**, which is having rapid and severe impacts on ecosystems and populations ;*
- ***Climate change is multifactorial**, there is a need to consider steady changes as well as the impacts of extreme events ;*
- ***Some Mediterranean forests can become net sources of carbon**, which limits perspectives for Climate Change mitigation ;*
- ***Consider the specificity of Mediterranean conditions regarding water and forests interactions: the survival of Mediterranean forests is at stake ;***
- *Considering that water is the main limiting factor in the region, the water balance for providing different forest goods and services should be considered: **“Water Accounting”** ;*
- ***Optimizing forest management (spatially and temporally) regarding the trade-offs among water, soil protection and other goods and services is required ;***
- ***Strategic research priorities for Mediterranean forests have been identified and jointly adopted in the Mediterranean Forest Research Agenda 2010-2020 (MFRA) ;***

3. Key messages related to genetic diversity

- **Genetic diversity is a key component involved in evolutionary processes for adaptation to climate change ;**
- **Information on forest genetic resources is needed for preparation and implementation of conservation strategies at national and regional levels ;**
- **Projections of future species distribution in relation to climate and its change should be improved by integrating the evolutionary processes based on genetic diversity ;**
- **Most Mediterranean tree populations have a very high genetic diversity: hotspots ;**
- **Human actions can impact genetic diversity and adaptation/adaptability ;**
- **The selection of populations now should consider the adaptability to future conditions;**
- **Biotic interactions, which can have severe impacts, are hardly predictable.**

4. A new paradigm of Mediterranean forest management:

- **Move from “carbocentric” centered approaches to water-based forest management to ensure multifunctional Mediterranean forests ;**
- **Integrating knowledge from genetics, eco-physiology and forest dynamics to develop new decision support models and tools that can address the specificity of Mediterranean forests and forestry ;**
- **Combining monitoring, research and forest management: basis for adaptive management.**

This new paradigm requires multidisciplinary research and innovative capacity building as identified in the Mediterranean Forest Research Agenda

5. Specific recommendations for managers

- **Managing forests must be based on the understanding of processes and the specific environmental constraints of the region ;**
- **Maintaining genetic diversity over the long term (keeping options open);**
- **Fostering evolutionary processes (acting on natural regeneration and plantations to accelerate them);**
- **Integrate the genetic dimension in forest management practices ;**
- **Coppice forests might be at risk due to climate change and their specific water-carbon balance: need for conversion to more resilient structures should be considered if possible ;**

6. Recommendations for policy makers:

- **Incorporate the management of forest genetic resources into National Forest Programmes and National Adaptation Strategies to Climate Change ;**
- **Review existing guidelines for transferring reproductive material ;**
- **Maintain and establish networks for long-term multidisciplinary experiments (including genetics, ecophysiology and forest dynamics) to analyze responses to changing environmental conditions ;**
- **Building up and sharing scientific capacities to these new challenges with Climate Change ;**
- **Enhance International cooperation based on exiting networks and organizations like CIHEAM, FAO Silva Med, EFIMED, Bioversity, WWF, IUCN, Plan bleu, AIFM, including north-south and south-south cooperation ;**

7. In view of the future expansion of Mediterranean-like conditions:

- Mediterranean forest genetic resources can be used for other regions ;
- Mediterranean forest ecosystems and management can be a model situation ;

According to these recommendations **species' adaptation and phenotypic plasticity are presently considered as a key as regards to climate changes**. In this context research initiatives should be prioritized in order to save time and resources. These priorities have to be based on a list of tree species which are presently considered to be seriously endangered (*high intensity of the threat and high potential value of genetic resources*) and, simultaneously, on identification of model species able to represent different climatic situations (*or altitude ranges*) and on which innovative conservation approaches can be developed during the next ten years (EFIMED: Mediterranean Forest Research Agenda 2010-2020).

Furthermore activities of the *FAO Silva Mediterranea* Working Group 4 can be easily related and coordinated with other initiatives carried out at national and international level. The TREEBREDEX Virtual Research Centre being established by the EU, the Bioversity International network EUFORGEN and IUFRO WG20213 are all working on this subject from different point of view. These networks have demonstrated their interest on the establishment of *Silva Mediterranea* Working Group end on the opportunities offered by the existence of a so widely spread network of still-efficient experimental tests. They agreed also to support the activities of *Silva Mediterranea* for the future having in mind the meaning of the group as a bridge for knowledge and experiences between so many countries and different environments.

Considering the above, attention and therefore priority should be given to species or populations which are isolated or which grow in extreme conditions. Very often these are important for specific uses or are rare. In these populations, gene flow is generally reduced, the ecosystem is reduced to below critical mass and there are problems related to low dispersal capacity together with problems related to genetic erosion. This is the typical situation where the habitat has been severely reduced and even small additional disturbances can compromise the survival of the population. Extreme examples are *Abies nebrodensis*, *Cupressus dupreziana* and a number of others as Cedars etc... Very few are known about the real situation of broadleaves in most of countries. In this context actions should be undertaken by *in situ* and/or *ex situ* conservation specialists and related strategies developed. New strategies have to be identified, tested and adopted according to common agreement, in order to reduce the negative impacts of climate change on tree species and populations and the loss of the genetic information they represent.

Regarding *in situ* conservation of forest tree species aimed at **mitigating effects of climate change**, there is actually no reliable scientific information available for the Mediterranean area. It is time to start studies (*task of Silva Mediterranea WG 5*) on the role of *in situ* conservation. Special attention should be given to the control of the microclimate through regulating canopy cover. Forest managers should keep in mind the necessity to know the genetic structure of their forest. Closer interaction with breeders and geneticists should be developed. *Ex situ* conservation can be also carried out either at national, regional and international level. The possibility for entering international agreements for safeguarding national genetic resources in another country should be reviewed and better developed in Mediterranean region.

III) Objectives

The overall objective of the project is to contribute to adaptation of Mediterranean Forest to Climate Change.

The Specific objective of the project is to develop relevant strategies (*in situ* and *ex situ*) for conservation of Mediterranean Forest Genetic Resources in order to reduce the negative impacts of climate change on tree species and populations in Mediterranean area.

IV) Expected results and main activities

4.1. Main Results

1. Mediterranean countries have integrated Forest Genetic Resources (FGN) conservation strategies/activities in National Plan/Framework for Adaptation to Climate Change and, also, in National Forest Programmes ;
2. Mediterranean countries have gathered information necessary to the definition of national forest genetic resources strategies/programmes, thus producing Country Reports as their contribution to the first State Of the World Forest Genetic Resources ;
3. *Silva Mediterranea* Forest Genetic Resources Working Group (WG 4) is enhanced and its capacity built to function as a regional action network linking research to practice on Mediterranean Forests Genetic resources and Climate change, working on the following main long term topics/results :
 - Mediterranean Forest Genetic Resources (*as well as regional human and infrastructure resources*) are inventoried and available for users (*as well as researchers than forest managers*) in a specific *Silva Mediterranea* Database ;
 - *Ex situ* conservation networks are monitored with a long term approach in Mediterranean countries ;
 - New approaches for conservation (including *in situ* conservation methods) are tested in Mediterranean area ;
 - Guidelines about conservation of FRG in a context of Climate Change are available for forest managers in Mediterranean area ;
 - Number of species targeted by conservation and genetic management is increased in Mediterranean area ;
 - International/Regional agreements for maintaining national genetic resources in other countries are concluded in Mediterranean area ;
4. Urgent *in situ* and *ex situ* conservation activities are developed and tested for the most critical landscapes/emblematic species in Mediterranean Area (*Atlas Cedar? Juniperus thurifera? Cork oak? Others species ?*), with implementation of new methodologies and, also, with a participatory approach involving local communities and different stakeholders concerned with these most critical landscapes;

The project will be organised with the following three main components:

1. Component n°1 : Improvement of National Forest Genetic Resources Strategies and Forest Genetic Resources Country Reports ;
2. Component n°2 : Implementation of long term activities of *Silva Mediteranea* Forest Genetic Resources Working Group (WG 4) ;
3. Component n°3 : Test of new *in situ* and *ex situ* conservation approaches for the most critical landscapes/species in Mediterranean area ;

4.2. Activities

The following list of activities is indicative. It will be reviewed and better defined during the project formulation stage (Workshop 2010).

Component 1: Improvement of National Forest Genetic Resources Strategies and Forest Genetic Resources Country Report

Activities:

- Regional workshop, regional training for researchers/forest managers and exchange of experiences / study tours are organized for South Mediterranean countries (Maghreb and Middle East) to help them to promote and develop National Forest Genetic Resources Strategies in National Plan for Adaptation to Climate Change ;
- Preparation of guidelines for forest managers to integrate Forest Genetic Resources strategies in silvicultural and forest management and restoration practices ;
- Organisation of specific activities (training, national workshop, short term experts....) to help South Mediterranean countries to prepare before march of 2012 their Country Reports for the first State Of the World Forest Genetic Resources ;

Outputs:

- National Forest Genetic Resources Strategies are integrated in National Plan for Adaptation to Climate Change ;
- Guidelines are available for forest managers to integrate Forest Genetic Resources strategies in SFM practices ;
- Country report are available before march 2012 for the first State Of the World Forest Genetic Resources ;

Component 2: Implementation of long term activities of *Silva Mediteranea* Forest Genetic Resources Working Group (WG 4) ;

4.2.2.1. Mediterranean Forest genetic Resources Data Base

Activities:

- Each government should supply lists of contacts/coordinators at national level and skills as well as available equipment should be listed to provide a complete view of forces at the disposal of the *Silva Mediterranea* Working Group ;
- Creation of a list with short descriptions of different conservation actions with special reference to climate change ;
- All maps and data concerning vulnerability assessments, impacts assessment of climate change on Mediterranean forest ecosystems, species and forest genetic resources should be collected, possibly geo-referenced in GIS and used to produce a **pan-Mediterranean map** of possible scenarios of environmental changes. This map will be the main reference tool used for taking decisions for strategies and advancing the work of *Silva Mediterranea* Working Group. For this purpose, experiences gained at European level from work of the Euforgen network is of major importance¹ and data sheets prepared to collect information could be requested directly to Euforgen. The location of the GCU's should be also overlapped by GIS method on maps obtained by the above task C).

¹ A Data Base of Genetic Conservation Units (GCU's) is being developed in Euforgen (which operates within the framework of Bioversity International).

Outputs:

- a list of responsible scientific contacts and coordinators at national level ;
- a Data Base on the infrastructures and working groups delegated by States ;
- a list of conservation initiatives undertaken at national level with special reference to climate change ;
- an Inventory of maps or links to web sites of climatic maps to produce a **pan Mediterranean map** of possible scenarios of environmental changes ;
- a Gene Conservation Units (GCU) Data Base ;
- a Data Base of roles and laws concerning management and trade and Forest Reproductive Materials (FRM) ;
- a new directory or a Data Base of in situ Basic Materials (Seed Stands) in the Mediterranean Region ;
- a preliminary literature survey of the existing information (and gaps) on variability of relevant genetic parameters

4.2.2.2. Ex situ conservation networks in Mediterranean countries

Activities:

- Extension of DB within the framework of the earlier *Silva Mediterranea* Working Group done for Conifers (INRA – Avignon) ;
- Organization of seminars, workshops and parallel *SM* meetings of researchers in order to train research officers on the topics of this WG and to agree on common approaches and methods of registration of indicator traits related to Adaptation and to Phenotypic plasticity ;
- Choice of experimental sites which in the future will host common Forest Genetic Resources. *Phenology* (growth, hardening, flowering etc.), *drought tolerance, frost avoidance, cambial activity, survival etc... using FRM chosen a priori by considering the priorities suggested.*

Outcomes :

- an extended Data Base to other species (not only conifers) and to hardwoods ;
- Research officers trained on the topics of this Working Groups and common approaches and methods agreed for Mediterranean area ;
- Maps and DBs analysed and Mediterranean experimental networks chosen in Mediterranean area ;

4.2.2.3. New methodologies for conservation (including *in situ* conservation methods)

Activities:

- Capacity building of breeders and specialists in the fields specified in this *Silva Mediterranea* Work Programme ;
- Organization of a "summer school" each year in Arezzo (IT) in collaboration with Treebreedex and Euforgen networks ;
- Investigation and test of surveying methods concerning the effects of climate change on Forest Genetic Resources ;
- Organization of seminars/meetings to propose and agree these new methods of field survey in the experimental networks. Provenances included in experimental networks should be identified and studied *in situ* for the same traits as well as monitored for their genetic structure ;
- Re-establishment of populations in environments where it will be possible to start dynamics. Methods must be studied and tested in order to propose clear and efficient solutions and sites where *ex situ* populations could be potentially hosted should be reviewed and agreed upon in principle.

Outputs:

- Forest Genetic Resources Specialist trained in the fields of *Silva Mediterranea* Work Programme ;
- Common experimental networks and agreed experimental methods and research protocols ;
- Genetic analysis of variation and characterisation of populations with QTL, QTN, SNIPS and other genetic mapping methods ;
- Agreements for transferring endangered populations in most relevant sites in Mediterranean area.

4.2.2.4. Species targeted for conservation and genetic management in Mediterranean area

Activities:

- Selection of species considered as priority model species for studies or rescue action in Mediterranean Area (level 2) ;
- Choice in this second list a third level (level 3) of the highest priority (because they are endangered) ;
- For all species listed (level 1) preparation of distribution maps, possibly geo-referenced. These will be over-laid with the existing pan-Mediterranean climatic map.

Outputs:

- List (DB) of forest tree species recorded in FRM trading national rules (level 1) ;

4.2.2.5. International/Regional agreements are concluded for ex situ conservation in Mediterranean area

Activities:

- Information collected in the previous tasks (Maps, tests, trial networks, analyses...) will be used to prepare these agreements ; *(clearly and carefully agreed upon, in view of the long periods of time that the populations or species will be hosted by the introducing country. The ownership of introduced material will remain that of the donor country).*

Outcomes:

- Most endangered genetic materials are transferred at the most relevant locations with clear agreements between countries ;

4.2.2.6. Sustainable financial resources to support regional strategy for conservation of Mediterranean Forest Genetic Resources

Activities:

- Development of small exploratory projects *(these projects could be national or cooperative research programmes) ?*
- Development and implementation of projects aimed to further develop specific aspects of research on specified model species ?

Outcomes:

- Existing laboratories on FGR reinforced and efficiency of institutions improved in Mediterranean area ;
- Training seminars, workshops and Integrated R&D Projects financed in Mediterranean area ;

Component 3: Test of new in situ conservation methodologies for the most critical landscapes/species in Mediterranean area

Activities:

- Urgent *in situ* and *ex situ* conservation activities are developed for the most critical landscapes/emblematic species in Mediterranean Area *(Atlas Cedrus ? Others species ?)*, with implementation of new methodologies and, also, with a participatory approach involving local communities and different stakeholders concerned with these most critical landscapes ;

Outputs:

- Most endangered species are conserved *in situ* and *ex situ* with involvement of local stakeholders, forest managers and researchers of South Mediterranean countries ;
- New methodologies for in situ conservation of Forest Genetic Resources are tested on most urgent situation in Mediterranean ;
- Best practices for in situ conservation of Forest Genetic Resources are available in Mediterranean region ;