Pan-European minimum requirements for dynamic gene conservation units of forest trees

November 2008

Summary

The purpose of these minimum requirements is to define what 'a dynamic gene conservation unit' is and increase awareness of how such units should be managed so that they contribute long-term gene conservation, i.e. maintenance of evolutionary processes within tree populations. This document also serves as a check list for national focal points before they start entering data into the EUFGIS information system.

The units should have a designated status as gene conservation areas of forest trees at national level. The units can be located in forests managed for multiple uses, protected areas or seed stands.

The minimum size of a unit depends on tree species and conservation objectives as follows; 1) 500 or more reproducing trees (when the objective is to conserve gene diversity of widely occurring and stand-forming conifers or broadleaf species), 2) 50 reproducing trees (when the objective is to conserve adaptive or other traits in marginal or scattered tree populations) or 50 seed bearing trees (scattered tree species with sexual dimorphism), and 3) 15 unrelated reproducing trees (when the objective is to conserve remaining populations of rare or endangered tree species).

One or more tree species should be recognized as target tree species for each unit. This means that the management efforts for the purpose of gene conservation are being carried out to equally favour these species. If a unit has several target species, each target species must meet the appropriate minimum population size, as indicated above.

The management of the units should aim to maintain and enhance the long-term evolutionary potential of tree populations. This means that management measures and silvicultural techniques are applied, as needed, to favour genetic processes that maintain the long-term viability of target tree populations.

The monitoring of the units should be carried out by visiting them regularly to observe that they still serve their purpose and that they have not been damaged or destroyed. A comprehensive assessment of the units should ideally be carried out through systematic field inventories conducted every 5 or 10 years.

Introduction

This document provides common minimum requirements for '*a dynamic gene conservation unit*' of forest trees in Europe. These pan-European minimum requirements were developed as part of the EUFGIS project (Establishment of a European Information System on Forest Genetic Resources, April 2007-September 2010) which is one of the 17 actions co-funded by the European Commission through the Council Regulation (EC No 870/2004) on genetic resources in agriculture. The EUFGIS project is being implemented in close collaboration with the European Forest Genetic Resources Programme (EUFORGEN) which is a collaborative effort to promote conservation and sustainable use of forest genetic resources in Europe with over 30 participating countries. A large group of scientists, experts, managers and policy-makers in these countries contribute to the work of

EUFORGEN via the Conifers, Scattered Broadleaves, Stand-forming Broadleaves and Forest Management Networks. Both EUFORGEN and the EUFGIS project are coordinated by Bioversity International.

Previously, the EUFORGEN Networks have developed requirements for gene conservation units of different groups of tree species (conifers, scattered broadleaves and stand-forming broadleaves). The EUFGIS project aims to harmonise these species-specific requirements and develop pan-European minimum requirements for the units that could be applied to any tree species. The purpose of the pan-European minimum requirements is also to serve as a first-level check of what kind of units can be included into the EUFGIS information system. Furthermore, the EUFGIS project is developing common data standards for the information that will be compiled on the units and included into the information system. The drafting work was done by a small expert group established as part of the EUFGIS project.

The pan-European minimum requirements and the data standards contribute to sustainable use of forests as conservation of forest genetic resources is one component of the pan-European criteria and indicators for sustainable forest management. They will also increase synergies between FGR conservation and the overall biodiversity conservation. By making available geo-referenced data on the existing gene conservation units of forest trees across their entire distribution range in Europe, the EUFGIS information system will facilitate development of truly pan-European gene conservation strategies or action plans, and sharing of responsibilities in FGR conservation among European countries.

Dynamic gene conservation units

Dynamic gene conservation emphasizes the maintenance of evolutionary processes within tree populations to safeguard their potential for continuous adaptation. This means either managing tree populations at their natural sites within the environment to which they are adapted (*in situ*), or artificial, but dynamically evolving populations, elsewhere (*ex situ*). Climate change makes it even more important to apply the concept of the dynamic gene conservation to manage the genetic resources of forest trees for the long-term sustainability of forests and forestry in Europe.

Assessment of the state of gene conservation and development of gene conservation strategies for forest trees at pan-European level have been hampered by a lack of harmonized and comparable data across different countries. This is mainly due to the fact that there is no common, widely agreed definition for a gene conservation unit. In addition, there is no clear understanding of the level of management required in order to declare an area for gene conservation purposes at pan-European level. Scientific definitions for *in situ* and *ex situ* conservation are clear but operational definitions have been more difficult to develop and subsequently countries apply a range of definitions while implementing and reporting their gene conservation efforts for forest trees.

Due to the lack of common minimum requirements, a wide range of protected and production forests are presently declared as gene conservation areas in addition to more clearly defined gene reserve forests. However, most protected areas are established solely for species or habitat conservation and their suitability for long-term gene conservation of forest trees has rarely been assessed prior to their establishment. Furthermore, gene conservation often has a low priority in the management of the protected areas and in most cases any active silvicultural measures, which are often needed for managing the genetic resources, are not allowed in the protected areas. In the case of production forests, it is often assumed, without any documentation available, that seemingly natural forests consist of autochthonous, genetically diverse tree populations. However, historical records show that forest reproductive material has been traded and distributed across Europe for hundreds of years. Unfortunately, the use of this material was and still is poorly documented in practical forestry operations.

Dynamic gene conservation can be integrated with other management goals of forests. Thus it does not prevent forests from being used for forestry nor biodiversity conservation. The existing gene conservation units in European countries are typically located in forests managed for multiple uses, protected areas or seed stands. The reasons for establishing the gene conservation units can be classified into the following categories; 1) to maintain genetic diversity in large tree populations, 2) to conserve adaptive or other traits in marginal or scattered tree populations which are often relatively small, and 3) to conserve rare or endangered tree species with populations consisting of a low number of remaining individuals. Seed stands also contribute to gene conservation and they can be classified into the first or second category, depending on tree species.

The EUFGIS information system will include data on gene conservation units which are established for these reasons, have a designated status as gene conservation areas of forest trees at national level, and which are also managed for this purpose. Only those seed stands which meet the minimum requirements can be included in the information system. The EUFGIS project does not attempt to include all seed stands as there are other ongoing efforts to document seed production stands and tree breeding material in Europe (e.g. TREEBREEDEX).

The expert group recommended that the minimum size of a gene conservation unit can be adjusted according to tree species and specific conditions. The minimum size and other specific requirements are described in detail in the following chapters.

Minimum size of a gene conservation unit

Each unit should have a sufficient number of effectively mating and reproducing trees to fulfil the objectives (e.g. the above-mentioned categories), to prevent reduction of genetic diversity through demographic bottlenecks and consanguineous mating, and to maintain genetic diversity. The sufficient number of reproducing trees is dependent on the biology of a given species, density and spatial arrangement of trees, as well as biotic and abiotic conditions. The number of trees should be high enough to reasonably assume that sexual reproduction takes place randomly and that the level of relatedness among the next generation of trees is as low as possible. However, it is often very difficult to determine the number of reproducing trees and their sexual function in the field.

To be included into the EUFGIS information system, a gene conservation unit must meet one of the following minimum requirements in terms of population size.

- Case 1: If the purpose of the unit is to maintain genetic diversity of widely occurring and stand-forming conifers or broadleaf species, the unit must consists of 500 or more reproducing trees.

- Case 2: If the unit was established to conserve adaptive or other traits in marginal or scattered tree populations (both scattered conifers and broadleaf species), the unit must harbour a minimum of 50 reproducing trees or, in the case of dioecious tree species with sexual dimorphism, 50 seed bearing trees.

- Case 3: If the unit is aiming to conserve remaining populations of rare or endangered tree species, it must harbour a minimum of 15 unrelated reproducing trees.

Some tree species are capable of vegetative reproduction through root sprouts or partially buried shoots, for example. Efforts should be made, when feasible, to check if there are identical genotypes (clones) of such tree species present within a unit and take this into consideration when estimating the number of reproducing trees.

In Cases 1 and 2, the minimum number of reproducing trees within a unit can be temporarily lower than what is indicated above if it is necessary to thin the original tree population within the unit (or stands within the unit) or to create gaps to promote natural regeneration. The prerequisite is that enough reproducing trees have contributed to mating (and seeding depending on the species) before the regeneration process has been initiated with silvicultural measures. Furthermore, it is expected that the number of reproducing trees will recover to the minimum level or above in the near future.

Gene conservation units established for maintaining the remaining populations of rare or endangered tree species (Case 3) can only be included in the EUFGIS information system if it can be demonstrated that they contribute to dynamic gene conservation. A national focal point should contact the EUFORGEN Secretariat and make a special request to include such units into the information system.

Target tree species and populations

In each gene conservation unit, there should one or more tree species which are recognized as '*target tree species*'. This means that the management efforts for the purpose of gene conservation are being carried out to equally favour these species. If a gene conservation unit has several target species, each target species must meet the appropriate minimum population size, as indicated above.

The units should be ideally located in autochthonous tree populations[1]. Additional *ex situ* units can also be included if they represent well-adapted forests. The *ex situ* gene conservation units are artificially established and transplanted tree populations that are managed for gene conservation and/or seed production purposes within or outside of the natural distribution range of a given species.

Units of introduced tree species (i.e. species introduced to new areas from within Europe or from other regions outside Europe) will also meet the minimum requirements if they are established to conserve well identified and differentiated characteristics compared to their original source populations (landraces) and managed following the concept of dynamic gene conservation.

The gene conservation units can consist of pure and/or mixed-species stands. No unknown or non-adapted genetic material should be present within a unit, but natural interspecific hybrids are allowed.

Management of the gene conservation units

The management of the units should aim to maintain and enhance the long-term evolutionary potential of tree populations. This means that any management measures and silvicultural techniques applied should primarily aim to favour genetic processes that maintain the long-term viability of tree populations. The management of the units should favour all tree species which have been recognized as target species. It is a prerequisite that the conservation units are secured for the future.

Silvicultural techniques should be applied in such a way that they support reproductive processes and result in adequate regeneration of the target tree species. Natural regeneration should be favoured as a regeneration method, but stands within a unit can also be regenerated by planting or seeding. If stands are regenerated artificially, the reproductive material should originate from the same gene conservation unit, or, if not available, from another autochthonous stand nearby. Silvicultural techniques applied within a unit should also be adapted to protect the tree population(s) against strong environmental changes and extreme weather events. For example, different selective cutting and regeneration techniques could be used within and among the units to promote variability in mating patterns (e.g. clustered, random and regular spacing of seed trees).

[1] A tree population which has been continuously regenerated by natural regeneration.

The EUFGIS information system will only include gene conservation units which have a designated status as long-term gene conservation areas or stands, recognized by the appropriate authorities or agencies in a country. The designated status does not necessarily mean that such units should have a legal status; an administrative status or other similar arrangement is enough. The gene conservation units should have a basic management plan and gene conservation should be recognized as a major management goal. All management efforts carried out within a unit should be documented in detail. The records of management efforts will not be included into the EUFGIS information system but they should be maintained either by the landowner, the organization responsible for the management of the unit or a relevant national authority.

Monitoring gene conservation units

Monitoring of the units is highly recommendable in order to evaluate the regeneration success and to ensure the maintenance of reproductive capacity of trees over time. The gene conservation units should be visited regularly to observe that they still serve their purpose and that they have not been damaged or destroyed by storms or insect outbreaks, for example. At the country-level, there should also be a communication mechanism in place to ensure that a local forest manager is able to alert the national focal point of the EUFGIS information system about such damages or other changes in the state of a unit.

A comprehensive assessment of the units should ideally be carried out through systematic field inventories conducted every 5 or 10 years, as indicated by the management plan. The field inventories should focus on assessing the success of natural regeneration and the effective population size. The EUFGIS information system will facilitate future monitoring efforts by storing old data records on the units and thus building time series of the data. Furthermore, when countries join the information system (through a Memorandum of Understanding), they agree to update the data they provide at reasonable intervals.

The most intensive and expensive level of monitoring is genetic monitoring of tree populations using specific genetic criteria and indicators (C&I) or even molecular markers. There are various efforts underway to improve genetic C&I, including the work of the EUFORGEN Networks. In the future, further guidance on this type of monitoring will become available for those countries that have resources for it.