DOES THE TRANSFER OF FOREST REPRODUCTIVE MATERIAL SIGNIFICANTLY AFFECT LOCAL TREE DIVERSITY?

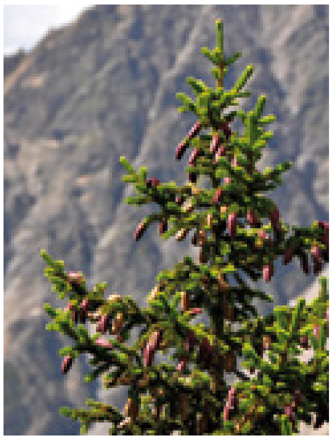
PROJECT BRIEF

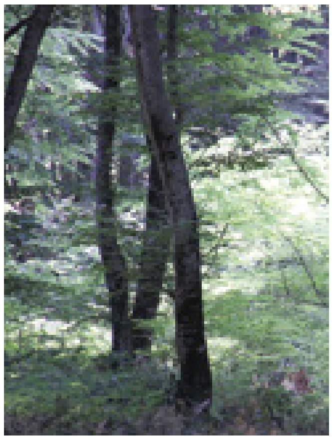
FORGER

TOWARDS THE SUSTAINABLE MANAGEMENT OF FOREST GENETIC RESOURCES IN EUROPE

Genetic variation within tree species is an important component of forest biodiversity. It enables forest ecosystems to adapt to environmental changes and it provides genetic material for breeding to sustainably increase production. In the framework of forestry activities, tree genetic resources are often transferred in the form of forest reproductive material (FRM).

Given the crucial role of the quality of FRM (e.g. seeds and seedlings) in successful forestry and the implications for biodiversity conservation, it is of crucial importance to know where it originates from. New data compiled in the context of the FP7 project FORGER indicate that the movement of FRM is considerable, with patterns that vary significantly across species and among EU member states. However, data on FRM movements are very scattered. Both the movement of FRM and its use have been poorly documented by individual countries, despite the importance of this information in supporting the implementation of adaptive forest management practices.





Since the first European Directive on the movement of FRM was implemented in 1966 (1), the marketing of FRM has been regulated in member states by adopting the same categories to describe the FMR traded. The legislation has evolved into the current Council Directive 1999/105/EC (2) and complementing regulations, implemented by individual countries, defining additional requirements applied within national boundaries. Also the first Ministerial Conference on the Protection of Forests in Europe (Forest Europe) held in 1990 produced a resolution (Strasbourg Resolution S2 (3)) that emphasized the need for appropriate documentation of FRM:

"… the maintenance of sufficient diversity in the choice of afforestation and restocking species, the keeping - at least for public forests - of records covering the exact identity of the reproduction materials used for planting and regeneration".

Knowledge of the 'exact identity' of FRM, and associated information on the performance of FRM from different sources, are considered critical elements in support of decision making in forestry and conservation actions. Despite five decades having passed since the first legislation on the trade (quantity and quality) of FRM translocated among member states, no evaluation has yet been performed on it. No monitoring has been conducted in order to assess the suitability of the FRM moved to the particular conditions of the site of introduction. Also no guidance has been provided to the countries—whether exporting or importing FRM— on how to perform appropriate monitoring and improve the records on the FRM moved.

IMPORTANCE OF GENETIC DIVERSITY IN FOREST TREE SPECIES

Tree species are not uniform biological entities (see last page). They have undergone significant evolutionary changes and over time have differentiated into geographical types (equivalent to landraces in agriculture) called 'provenances'. In contrast to agriculture where plant and animal landraces are more easily identifiable, tree provenances have distinct traits that may not be distinguishable without analysis of their genetic profile. For this reason, this important component of forest biodiversity—forest tree genetic diversity—tends to often be neglected.

Looking at the increasing demand for goods and services from forests, more intensive management of European forests can be expected in the future, so careful consideration should be paid to the appropriate management of forest genetic resources.

The proper selection and use of planting materials is fundamental in both agriculture and forestry. However, in forestry the implications of this initial choice are even more critical, given the long production (rotation) time from planting to harvesting timber or obtaining other renewable goods. An example of the impact of mismanaging the sources of FRM illustrates the importance of getting it right. Failure of translocated plant material has been observed in Sweden, where Scots pine seeds from German sources were heavily imported from 1850. Several planted stands developed poorly and survival after 15–20 years was modest, leading to a halt in its import by the Swedish Government. The results, likely attributable among other factors, to the unsatisfactory selection of FRM, are still visible 60 years later, across the 20,000 ha planted with poor quality FRM.

NEW FINDINGS FROM FORGER

Within the framework of FORGER, a unique attempt to collate data on the movement of FRM at the European level, differentiating by species, was carried out. The following seven tree species were examined: ash, beech, Norway spruce, pedunculate oak, red oak, sessile oak and Scots pine. The objective was to assess, by species, the volume of movement, its direction and its distance. In addition, this information was to provide some indication about how the past and ongoing transfer of FRM across Europe may have substantially affected the native gene pool of forests in large regions of Europe.

The data were provided by official focal points within the EU countries contacted. The analysis revealed large gaps in documentation. The flows of FRM translocated were difficult to reconstruct systematically for all species of focus. In the period 2004–2014, approximately 302 million plants (ca. 30 million plants/year) were moved within the EU (Table 1). This equals a monetary value of approximately €150 million.

The term "movement" here indicates a permanent transfer of FRM from a Member State to another. Any transfer of FRM carried out within the framework of a plant production programme implemented abroad in non-domestic nurseries, with a final objective of re-introducing the plants in the country of origin, is not considered in the figures presented in this brief.

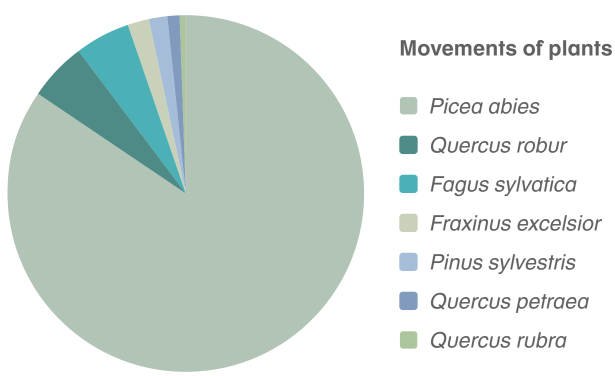
Table 1: Movement of plants within the EU between 2004 and 2014

Tree species	Forest plants permanently translocated among EU Member States
Norway spruce *(Picea abies)*	248,653,520
Pendunculate oak *(Quercus robur)*	18,435,305
Beech *(Fagus sylvatica)*	18,232,768
ash *(Fraxinus excelsior)*	5,196,572
Scots pine *(Pinus sylvestris)*	7,159,775
Sessile oak *(Quercus petrea)*	3,662,032
Red oak *(Quercus rubra)*	1,559,355
TOTAL	**302,899,327**

Table 2: Average estimated proportion of non-domestic Norway spruce plants introduced in different countries from 2004 to 2014, based on the size of the overall area interested by forest regeneration (both artificial and natural).

Member State	Norway spruce area [ha]	Proportion of non-domestic plants introduced based on the size of the area annually subjected to regeneration [%]
Finland	5,520,000	10.15
Estonia	575,000	3.94
Latvia	517,000	7.44
Sweden	9,718,000	5.51
Netherlands	15,840	5.42
United Kingdom	84,000	4.03
Austria	1,750,000	0.87
Germany	3,000,000	0.55
France	1,368,000	0.71

Figure 1: Proportion of FRM of different species permanently translocated within EU Member States based on trade data (2004-2014)



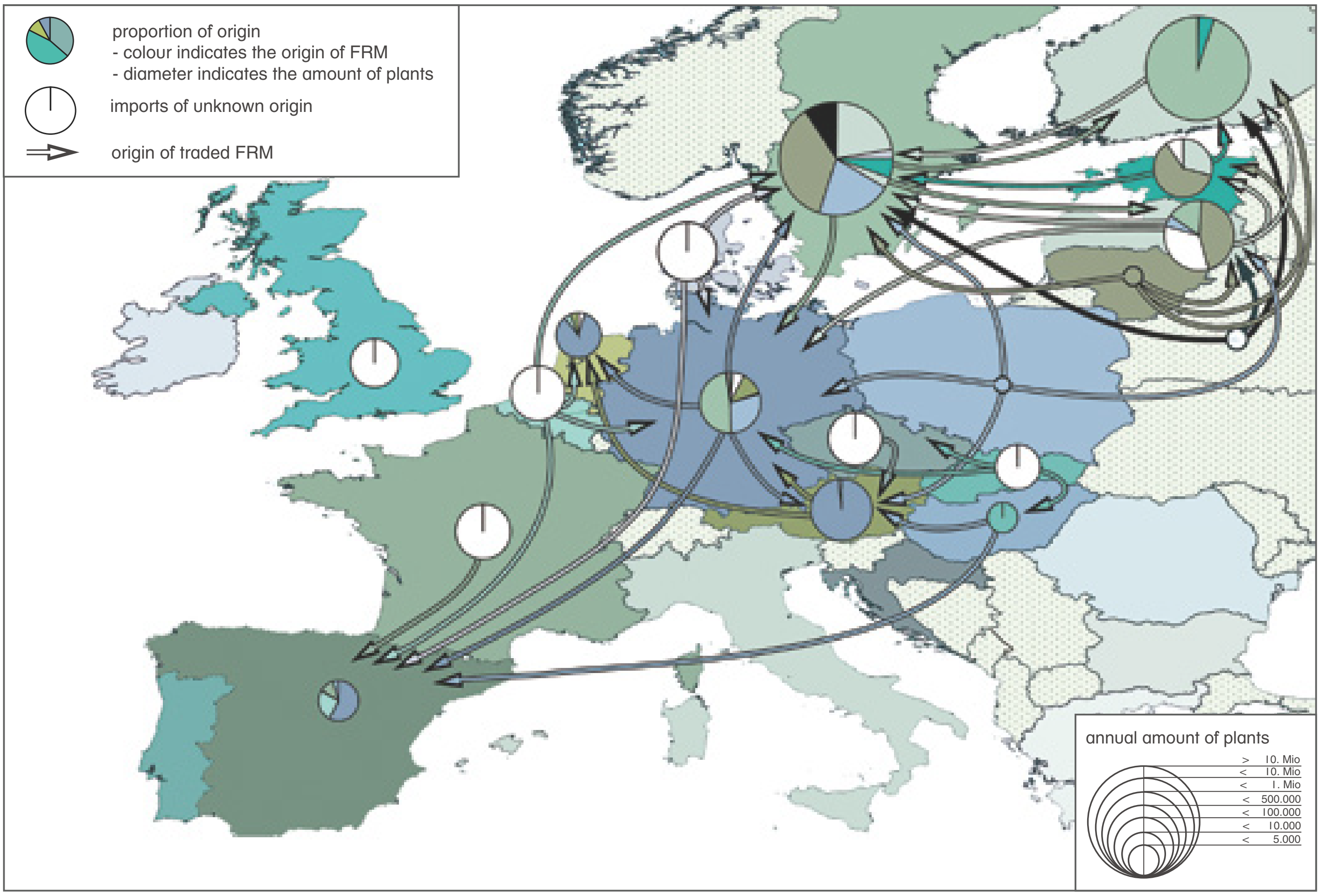


Figure 2: Norway spruce *(Picea abies)* plants translocated within EU Member States. Annual plants movements 2004 - 2014.

Norway spruce was the species most subject to movement during the period assessed, with on average 24.9 million plants moved each year, accounting for 82% of all translocated plants, while beech and penduncculate oak together amounted to slightly more than 12% of the total volume (Figure 1). The remaining 6 % of translocated plants was evenly distributed among the other forest tree species examined.
In order to understand the potential influence of introduced FRM on local tree diversity, an assessment was carried out for Norway spruce, looking at estimated proportions of areas planted with local versus introduced FRM.

The average annual demand for Norway spruce planting material was roughly estimated based on simplified assumptions: 100 yrs rotation time, 2,000 plants per hectare artificial, the quantity of plants of non-domestic origin imported by a country is driven by a demand closely associated with the size of the area to be replanted. The figures obtained (Table 2) provide an indication of the extent to which, over the 10-year study period, the domestic gene pool has been affected by introduced sources of FRM. In Finland, for example, the estimate is of 10.15% non-domestic plant material introduced between 2004 and 2014.

The reconstruction of the major flows of FRM in Europe (Figure 2) showed that origin of approximately 95% of the FRM of Norway spruce introduced to Finland has been from Swedish seed sources; the remaining part originated from several countries in Northern and Eastern Europe. It should explicitly mentioned that the transfer of FRM does should be explicitly have a negative impact on forest growth and survival. If appropriate material is translocated this may even enhance the productivity or the ability of tree populations to withstand climate change. However, any translocation of non-domestic FRM necessarily contributes to decreases the naturalness of the native gene pool of local tree species.

FINAL CONSIDERATIONS

- Forest reproductive material is transferred across Europe, in significant amounts particularly for a few species and in some regions of Europe;
- Considerable gaps exist in the records about sources of forest reproductive material and about the use of the material;
- A proper recording of use of the forest reproductive material has a large potential to generate key information to support sustainable forest management in the face of climate change;
- A legally binding regulatory framework on FRM documentation is in place. The results generated by FORGER strongly indicate the need to strengthen the implementation of existing regulations and to harmonize data on transfer of FRM across EU member states.

FOREST SPECIES ARE NOT UNIFORM BIOLOGICAL ENTITIES

Over thousands of years forest trees have adapted to their local environment. Forest tree species are generally highly diverse and often their natural distribution extends over a wide range of ecological conditions. The natural distribution area of Scots pine in Europe, for instance, extends across ca. 10,000 km, from Portugal in the west to the Russian Federation in the far east, growing from lowlands to elevations of 2,500 meters above sea level. The within species genetic composition profile of Scots pine is therefore highly diverse given the range of environmental conditions covered and evolutionary processes, that have led to the development of tree populations with distinct characteristics (provenances). Therefore, seeds or seedlings of the same tree species, but originating from different provenances, may have very different growth characteristics (eg: phenology, winter hardiness, trunk shape) and also vary in their ability to react to environmental changes.

Two oak stands established with different seed sources (provenances), Austria. (© BFW)

Related documentation

- http://eur-lex.europa.eu/legal-content/EN /TXT/PDF/?uri=CELEX:31966L0404&from=GA
- http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:011:0017:0040:EN:PDF
- http://www.foresteurope.org/docs/MC/strasbourg_resolution_s2.pdf

This brief presents recommendations that are based on the findings of the final report of the project to be published in 2016.

Reference to the document:
Climate change affects forest genetic resources: consequences for adaptive management

Thomas Geburek and
Simon Jansen (BFW, Austria)
FORGER Brief 2016

www.fp7-forger.eu

For more information on FORGER:
Dr. Koen Kramer, Project Coordinator
Alterra, Wageningen, The Netherlands
E-mail: koen.kramer@wur.nl
Tel.: +31-317-485873

The FORGER project is financially supported by the European Commission under the 7th Framework Programme