




THE SECOND REPORT
ON THE STATE
OF THE WORLD'S

FOREST GENETIC RESOURCES

COUNTRY REPORT

SLOVENIA



This country report was prepared as a contribution to the FAO publication, *The Second Report on the State of the World's Forest Genetic Resources*.

The country reports had two elements: (1) an online questionnaire to gather data and information on forest genetic resources; and (2) a complementary written report. For the written reports, countries were invited to follow the structure of the global report and reporting guidelines adopted by the Commission on Genetic Resources for Food and Agriculture at its Seventeenth Regular Session in 2019.

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Report on Slovenian forest genetic resources and the system for certification of forest reproductive material for the State of the World Forest Genetic Resources, FAO, 2022 *

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1. OVERVIEW OF FORESTS AND FORESTRY IN SLOVENIA

1.1. Introduction

Slovenia is highly heterogeneous regarding its topography, climate (from sub-mediterranean to continental and to alpine) and ecological conditions, and its biogenic origin. Its main characteristics include a large proportion, 40%, of areas with specific karst phenomena (defined as such by J.V. Valvasor in his *The Duchy of Carniola* (1689), based on the Karst region in South-west Slovenia), its hilly to mountainous topography (the average inclination is 40%), and the large area covered by forests: about 60% of Slovenia is covered by mainly naturally managed and well preserved forests. It all results in high biodiversity at all levels.

The soils on limestone, which is the predominating ground rock material, are strongly dependent on the vegetation, and if the forest is cut, the soil disappears along with it, and the ground rock material is exposed for centuries or millennia before the soils are reformed (Vrščaj et al., 2017).

From the approximately 3300 plant species in Slovenia, around 350 are woody plants, and around 75 are forest tree species (Martinčič et al., 2007) of which 22 are endemic to Slovenia. Including the animal and fungal component, Slovenia belongs to the European 'biodiversity hot belt' (Mršič, 1997). Around 37.16% of Slovenian territory is included into NATURA 2000 areas, from which 71% is forests (ZGS, 2021), while the only national park, named after Triglav, the highest peak in Julian Alps (2964 m/asl), has been established already in 1924.

The present forest area of 1,185,930 ha represents 58% of the total country area, from which around 80% are private forests, owned by over 410,000 private owners. According to the forest management plans (ZGS, 2021) their management status is as follows:

- 1.068.288 ha managed forest,
- 98.828 ha protective forests and
- 9.426 ha forest reserves.

Besides water, forests are the most important renewable natural resource in Slovenia. The total growing stock is 357 Mm³, or 303,5 m³/ha. The average annual increment is 7.4 m³/ha, the possible annual timber harvest in 2021 was 7.166.665 m³, and the actual harvest in 2021 amounted to 57% of the possible cut (ZGS, 2021).

In 87% of forests the species composition is equal to or similar to the natural one (Figure 1, done by SFI in 2003 and was used in report by Kraigher et al, 2019), which is also in line with the last SFS report (ZGS, 2021): 51,4% preserved, 35,2% slightly changed, 10,7% largely changed, 2,7% replaced. Beech associations dominate around 70% of all forests. However, the growing stock of beech is only around 33% of the total, while Norway spruce is 30%, Silver fir is 7.5%, pines are 5.4%, larch and other conifers are 1.5% for, oaks are 7.1%, noble hardwoods are 5%, for other hardwoods are 8.5%, and 1.7% are soft broadleaves (ZGS, 2021).

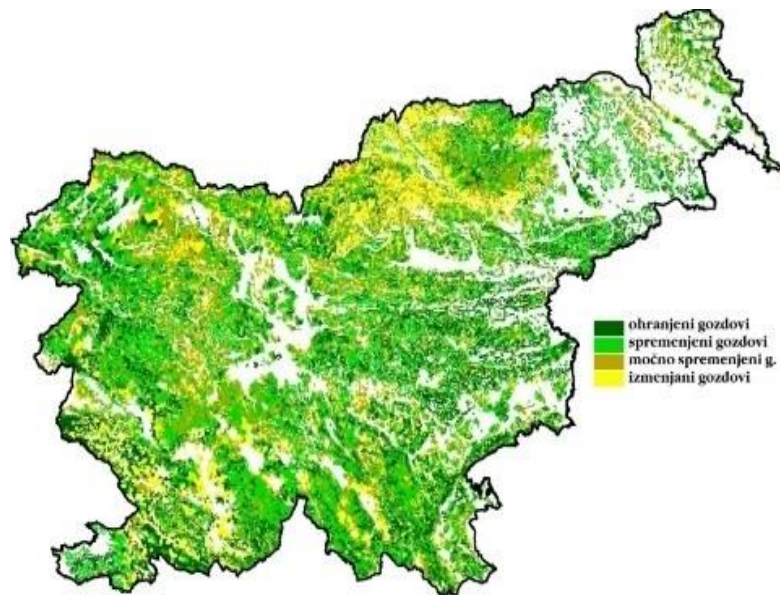


Figure 1) Forests cover 58% of the Slovenian territory, and are well preserved (green: species composition equal to (dark green) or very similar to the natural one (light green), only in 13% of forest tree species composition is different from the natural one (yellow colours) (Kraigher et al., 2019)

Forests in Slovenia provide 0.3 % GDP, with an increasing tendency, and more than 6000 full time equivalent jobs. Forests and the forest based industry in Slovenia has reached its minimum in 2012 of providing for the whole sector (including forestry, woodworking and pulp and paper industry) merely 1 % of GDP and 24,000 employees (MKGP, 2017) However, the sector has a growing tendency in the last decade.

Due to the large Karst areas, where any clearcutting would result in loss of forest soils, the traditional forestry is based on sustainable forest management, as already suggested in the Ordinance on forests in Carniola by Maria Theresia in 1774, and put into practice by Dr. Leopold Hufnagl, the leading forester in the Auersperg's forests in the large forest areas in south-eastern Slovenia. He was also the originator of the first forest management plans, leading to establishment of 'virgin forest reserves' already in 1892, aimed for conservation and research purposes only. Consecutively, after some limited clearcutting just after the 2nd World war, sustainable forest management was already included in the forestry legislation from the 1960-ties onwards. The Act on forests (1993) enacts and defines sustainable, co-natural and multifunctional forestry as the basis for forest management practices in Slovenia.

1.2. The European dimension with special emphasis on EUFORGEN and EUFGIS

Slovenia has been actively participating in EUFORGEN since 1995 (www.euforgen.org). It was a partner in the EUFGIS (Agri Gen Res, www.eufgis.org) project, and contributed to the preparation of the Forest Genetic Resources Strategy for Europe (EUFORGEN...2021), the Genetic Resources Strategy for Europe (GenRes.... 2021), and the overview entitled Hotspots of genetic diversity in Europe (Phillips et al 2021), all within the GenRes Bridge project. Within the EUFGIS information system, 41 forest gene reserves (gene conservation units) for 21 forest tree species are from Slovenia, all also a part of the National list of the seed objects and the *in situ* part of the Slovenian Forest Gene Bank (Kraigher 1996). Furthermore, all harmonization processes in development of the new Slovenian legislation on FRM have been largely enabled through participation at EUFORGEN events. Among important outputs of the EUFORGEN programme was also the organization of the Steering Committee meeting in Novo Mesto in 2007, the organization of the Conifers network meeting in Brdo by Kranj in 2010, the preparation of the Manual for forest genetic monitoring (Bajc et al 2020) within the LIFE GENMON project

(LIFE13/ENV/SI/000148, www.lifegenmon.si), and preparation of Guidelines for the production of planting material for restoration of riparian forests (Božič et al 2021) within the Interreg Danube project REFOCUS.

Furthermore, Slovenian scientists have been partners in a number of bilateral and international projects, such as the Central Europe Interreg project BIOGOV discussing participatory forest management planning in Slovenia, while the bilateral projects FRANGUSAVA with Croatia and Serbia have contributed to population genetic studies of ash species (*Fraxinus excelsior* and *F. angustifolia*) along the Sava River, and the feasibility for division of the area of Slovenia on different provenance regions for the major and selected minority species. Among COST actions, EUROSILVA E6 was the first, also deriving from the resolutions of the MCPFE process in Strasbourg, contributing to belowground physiological and eco-physiological studies for protection of forests. It was followed by actions:

- E38, FP803, FP903, FP1305 on belowground processes and climate change impacts on forest ecosystems
- E28 on genetic population studies
- E52 on development of the international beech provenance trial and analysis of its results
- FP1202 on identification of common problems and development of common strategies for marginal populations of forest trees
- E42 on enhancing the growing of valuable broadleaf tree species

The COST FP1405 NNEXT contributed to development of common overviews, risks and applications of non-native forest tree species in Europe, while the COST action G BIKE contributes to genetic diversity and monitoring studies in all kingdoms of living organisms.

Within IUFRO (International Union of Forest Research Organizations) the contributions of Slovenian scientists were maximal during the organization of the XVIII World IUFRO Congress in Ljubljana under the presidency of prof. Dušan Mlinšek, when also The Slovenian Forestry School was presented to the world forestry scientists and professionals. At present, the activities within the forest gene conservation scopes in Slovenia are linked to the IUFRO sessions on Norway spruce genetics, air pollution effects on forest trees and forest ecosystems, on the session on Forest genetic monitoring, as well as others. Furthermore, the Slovenian Forestry School and conservation of hidden biodiversity were presented as a plenary keynote presentation at the 125th Anniversary IUFRO Congress in 2017, and at the sessions on Biodiversity and policy interface, presenting predominantly the LIFEGENMON aims and output at this congress, as well as in several sessions at the IUFRO World Congress in 2019.

The excellent international networking and personal collaboration has also enabled Slovenia to participate and coordinate several international and European projects. Among these, the 7FW project EUFORINNO, the LIFE environment fund project LIFEGENMON, and the Interreg Danube project REFOCUS were of special importance in the last decade, while several are still ongoing (such as LIFE SySTEMiC, FORGENIUS, OptFOREST).

Furthermore, participation within the EUFORGEN programme has enabled personal exchange and collaboration of experts on FRM legislation who have contributed to the preparation and harmonization of the FRM Act and subordinate legislation, to participate in past and current Horizon projects, and in contributing to the preparation of EUFORGEN publications and strategies.

2. FOREST GENETIC RESOURCES AND MONITORING OF GENETIC DIVERSITY

2.1 Development of a forest genetic monitoring system in Slovenia

Conservation and management of Forest Genetic Resources (FGR) is an essential part of sustainable forestry. Genetic monitoring can track changes of FGR adaptive and neutral genetic variation through time caused by climate change, forest management (in particularly FRM production and use, Gömöry et al 2021), and conservation measures through defined indicators and their verifiers (Namkoong et al., 1996; Aravanopoulos et al., 2015; Fussi et al., 2016, Kraigher et al., 2019).

Forest genetic monitoring is an essential prerequisite for maintenance and control of sustainable forest management aiming to conserve genetic and consequently biological diversity at species, ecosystem and landscape levels, especially in marginal and peripheral populations (Fady et al., 2016). The need for monitoring genetic diversity has been recognized by the United Nation's Convention on Biological Diversity, which in Article 7 calls for action to "monitor through sampling and other techniques the components of biological diversity" (CBD, 1992). Further, genetic monitoring has been recognized to be an integral part of managing gene conservation units in forests (Koskela et al., 2013).

Forest genetic monitoring was first proposed by experts from FAO (synthesized by Namkoong et al., 1996), and later on simplified for practical use by the German programme for conservation of forest genetic resources (Konnert et al., 2011) and by the EUFORGEN working group on forest genetic monitoring (Aravanopoulos et al., 2015). The German concept of forest genetic monitoring was put into practice and the baseline data for selected indicators collected (Konnert et al., 2011). Recognizing the importance of forest genetic monitoring, Slovenia has under the framework of the LIFE GENMON project, together with Germany (Bavaria) and Greece, and within the SIFORGEN programme, developed and implemented the first internationally coordinated system for forest genetic monitoring, as synthesized in the Manual for forest genetic monitoring (Bajc et al 2021) and Guidelines for forest genetic monitoring (for 7 species or groups of species; Kavaliauskas et al for silver fir and king-Boris fir, and for wild cherry, Westergren et al for European beech and for common ash, Alizoti et al for Austrian pine, Božič et al for black poplar, Sever et al for common and sessile oaks, all 2021).

Regarding plot selection their representativeness for the area / ecogeographic region / genetic lineage have to be considered, while the Manual also includes protocols for establishment of plots, field and lab work, and evaluation of monitoring results, including development of a general support among stakeholders, policy makers and the public for its implementation, rendering the policy interface, and communication with foresters from practice, NGOs, and others, among important goals for long-term sustainability of the system under development. The system was proposed to be selected either as a minimum, standard or advanced forest genetic monitoring approach, based on the needs and means to be decided upon at the national level.

2.2 Measures for »genetic protection of forests« - SIFORGEN

Based on the tradition of forest gene conservation in Slovenia starting with Maks Wraber and Miran Brinar in 1950 - 1960 the Slovenian forest genetic resources programme (SIFORGEN) was established alongside with participation within the EUFORGEN programme. Within different phases of EUFORGEN, Slovenia contributed country reports on the state of forest genetic resources within all EUFORGEN networks and to the working group on forest genetic monitoring.

The most visible past activity of SIFORGEN was publication of the translations of 21 issues of Technical guidelines for conservation of forest genetic resources with Slovenian additions, some

of which combine more species than the originals (available at <http://www.euforgen.org/member-countries/slovenia/>). The SIFORGEN's overview, strategy and action plan considers the discussion line with the Slovenia Forest Service, problems and measures per tree species, the current situation in forest seed husbandry and nurseries, and the needs for further development of the Slovenian forestry school, development of a system for forest genetic monitoring, and for better supporting forest genetic diversity in development of silvicultural practices. SIFORGEN is under continuous development, concentrating especially on measures, which would enhance genetic diversity of all components in the forest ecosystem, and help maintain the adaptability potential of forest trees to the future environments. It considers the anticipated fast climate change and other stressful events, which are diminishing the chances of forests to remain in their current distribution area and structure, as we know today.

The "Measures for genetic protection of forests" (Kraigher et al., 2019) comprise the following requirements:

- Every silvicultural / forest management measure to be considered with respect to its impact on genetic diversity of the stand / population(s)
- Support of natural regeneration,
- Assist regeneration by co-planting and co-sowing of a high number of tree species based on site-matching (enrichment planting),
- Use of adequate forest reproductive material (FRM) of high genetic diversity, through:
 - Defining the minimum number of seed trees for FRM production,
 - Collection of FRM in full mast years,
 - Controlled and prescribed mixing of seed units,
- Use of advanced seed and seedling production systems,
- Test provenances for transfer and mixing of FRM.

Furthermore, traceability of all FRM planted in forests should be established, including monitoring the effects of all tending measures to the newly forming forests. Therefore guidelines for a 'georeferenced planting' of mixtures of provenances and species are to be prepared, and their long-term monitoring established within new 'e-forestry' approaches, which are included in the NextGen projects within the European mechanism for resilience and recovery in Slovenia.

Among forestry practices that have shown to help maintain processes in genetic diversity among the adult stand and young regeneration centers the irregular shelterwood system as applied in Slovenia was shown to be especially appropriate (Westergren et al., 2015). However, since all anticipated measures for genetic protection of forests can only be accepted if forestry practice, decision makers and the public recognize the role of forest genetic diversity and its monitoring, communication is of an utmost importance for the future of our forests. The communication strategy 'for future forests' demands to:

- Communicate to general and target audience the needs for conservation of FGR, FGM and measures for genetic protection of forests through a well-developed narrative
- Develop the positive attitude towards forests and forestry through the whole national education system
- Forestry should get to the hearts of people by helping people in need
- Formalize the „science on communicating science“ in forestry
- Establish a national and international science – policy interface.

3. SLOVENIAN SPECIFICS REGARDING FGR and FRM

3.1. Historical overview leading to definition of “The Slovenian Forestry School”

Slovenia is a Member of the European Union since 2004. Thus, the Slovenian legislation is harmonised with the EU and all European Commission (EC) legislation regarding FRM production and certification has been adopted. However, forestry and forest reproductive material certification principles are much older. Historically the first forest ordinances were linked to mining ordinances (Mihelič, 2008), aiming at sustainable wood production for mining purposes. However, these were early on followed by forest ordinances, as overviewed by Boštjan Anko (cit. by Zupančič M., 2013), who organized reprinting of facsimile of a number of forest ordinances from 1406 onwards, while the main impact on forest management practices through centuries had the Forest Ordinance of Maria Teresia for Carniola in 1774.

These ordinances, followed by forest management plans, recommended that no clearcutting is done in forests on sensitive karst terrains, in which any plant cover removal would lead to soil erosion, resulting in exposure of bare ground limestone rock material.

The sustainable forest management persisted through centuries, yet the German forestry school had an important influence by actively favoring Norway spruce at the cost of European beech distribution in actual vegetation cover in Slovenian forests. In addition, the land-use change into agricultural lands led the area of forests to reach only about 38% of the total area of Slovenia by mid-20th century

After the Second World War and a brief episode of large exploitation of forests (of about five years), clearcutting was again forbidden by the law (from 1949 onwards), while abandoned agricultural lands underwent natural reforestation. At establishment of the Slovenian Forestry Institute (1947) and the Forestry Department (1948) of the Biotechnical Faculty (1947) in Ljubljana, the first five scientists have also established the basis for future development of forests and forestry in Slovenia (Kraigher and Žitnik, 1999). The phytocoenologist dr. Maks Wraber divided Slovenia into phytogeographic regions, and founded silvicultural measures on genetic basis (1950). This scientific background was incorporated into forest gene conservation practice by dr. Miran Brinar (1961), the founder of the first national Register of forest seed objects, and certification of forest reproductive material (FRM) (Kraigher and Žitnik, 1996; Westergren et al., 2006; Kraigher et al., 2019).

Therefore, the practice and legislation in Slovenia preceded the two EC directives of forest seeds and seedlings (EC/404/66 and EC/161/71) in which the origin of FRM was stipulated to be of primary importance for a successful reforestation. The principles by M. Wraber and M. Brinar were that biology is the theoretical and practical basis for contemporary forestry, in which the success is based on the following (Wraber, 1951):

- Enlargement of forest areas,
- Improvement of yield regarding quantity and quality,
- Improvement of wood quality, and
- Use of site-adapted high value species' FRM being the first priority in professional silviculture and forest management.

Brinar (1961) defined principles and methods for approval of seed stands for practical use, and delineated seven Slovenian forest seed regions, based on ecological, phytocenological, technological, and silvicultural criteria, and defined criteria for approval of seed stands, based on source (autochthony), homogeneity, size, site, adaptation, age, mixture, silvicultural state, density, isolation, and technical characteristics of wood. He also established the Register of seed stands (the first revision made available in 1971). This was later revised by Pavle (1987 and 1997), before the new Forest reproductive material act (ZGRM, 2002) formed the basis for the present National list of forest seed objects, published yearly in the Official gazette (the last revision in January 2021; Seznam CSO, 2021)), and in the EU database FOREMATIS.

Silviculture based on forest genetics (M. Wraber 1951) was also the introduction into development of the Slovenian forestry school. The 'Free silvicultural technique' or 'Freestyle forestry' as defined by Dušan Mlinšek (1968) is based on learning from processes in natural forests, aiming at sustainable management and active support of all functions and roles of forests.

The 'Slovenian Forestry School' is based on the following principles (as reported in IPGRI/FAO and EUFORGEN country reports by Kraigher et al., 1996 and Smolej et al., 1998):

- "small-scale flexible forest management, adapted easily to site characteristics and natural development of forests;
- active protection of natural populations of forest trees;
- protection and conservation of biological diversity in forests;
- support of the bio-ecological and economic stability of forests by improving the growing stock;
- tending of all developmental stages and all forest forms for supporting of vital and high-quality forest trees, which could fulfil optimally all functions of forests;
- natural regeneration is supported in all forests;
- if seedlings are used, they should derive from adequate seed sources / provenances, and only adequate species can be used."

These principles form the basis of the current Forestry Act (1993) and the resolutions in the National Forest Programme (NGP, 2007).

3.2. Organisation of supply with seed and seedlings in Slovenia

Since 1991 the regeneration with planting and seeding in Slovenian forests has diminished from production of around 20 million seedlings per year to less than 1,5 million seedlings per year. In parallel the number of forest nurseries has declined, and the largest seed producer has ceased to exist in 2014. However, the large scale disturbances, such as ice-sleet in 2014, severe droughts, bark-beetle gradations from 2016 onwards, and windbreaks from 2017 onwards, have impacted around 60 % of forests and 40 % of the forest growing stocks. Therefore, the seed husbandry and forest nurseries are expected to recuperate.

It is not possible to manage forest development sustainably with planting and sowing as an activity complementary to natural reforestation without establishing a comprehensive system that ensures a permanent supply with seed and seedlings. Seedlings are usually grown on a multi-year basis. For this reason, a medium-term programme (for 5–10 years) for the needs for seedlings and collection of seed is required as a basis for planned seedlings production and, if necessary, also for sowing in open fields. The medium-term programme needs to be supplemented on an annual basis; both are prepared within the Public forest service by the Slovenia Forest Service with expert support by the Slovenian Forestry Institute. Based on forest management plans, annual reforestation programmes and medium-term programme for the needs for seed, annual programmes and plans for the collection of seed and programmes for the growing of seedlings by tree species, quantities and provenances are created. In order for the supply of tree nurseries with seed to be undisrupted, previous stocks need to be available for years when there is no seed crop. This role is performed by the Seed storage, kept by the Slovenia Forest Service. Due to the mentioned problems with the production of seed in 'selected' seed stands, also forest stands or groups of trees for FRM category 'source identified' are approved regularly.

Currently 8 forest seed and nurseries operators (by 5 private owners) are registered at the Ministry of agriculture, forestry and food (MAFF). Two of them, that provide seedlings for most forests, are located in the North (Omorika) and SW (Matenja vas) of Slovenia. Another one is specialized in seed production and marketing (by the same owner), and located in the central part, while all others are located in the NE part of Slovenia, and are specialized in production of

seed and planting material for flood-plain forests, predominantly for the Prepannonian provenance region.

The Slovenian nurseries produce only bare-root seedlings; when containerized seedlings are required, the production is done predominantly with the seed material originating from Slovenia, but produced in a neighboring nursery in Austrian Styria (LEICO).

The majority of FRM is produced in Slovenian forest nurseries, while some is produced in Austria and Croatia. The use of the FRM from non-Slovenian origin is limited, defined within the Rules on determination of regions of provenances (PO, 2002), and each lot can only be used upon a written expert opinion by the Slovenian forestry institute.

Currently, a discussion line has been reopened to support further development of the Slovenian forestry school regarding increase enhancement planting to better direct future forests resilient fo the changing environments. Furthermore a new NextGen project within the Mechanism for resilience and recovery specifically supports development of the infrastructure for a new Center for seeds, nurseries and forest protection.

Table 1: Collection of seed in forest stands for production of FRM category ‘selected’ and in forest stands, groups of trees and seed trees for production of the FRM category ‘source identified’ in Slovenia, and seeds and seedling used for planting and sowing in Slovenia in 1998 (only for reforestation after regular felling) and in 2018

	Collection of seed in forest stands for production of FRM category 'selected' and in forest stands, groups of trees and seed trees for production of the FRM category 'source identified' in Slovenia in 1998/1999 and in 2018			Seeds and seedlings used for planting and sowing in Slovenia in 1998 (only for reforestation after regular felling) and in 2018 (quantities do not comprise sanitary felling for which additional up to 1.3 million of seedlings a year may be required).					
Tree species	Quantity of seed (kg)	Quantities needed by the SFS in 1999 (kg)	Quantities relative to the certificates issued in 2018 (kg)	Seed sowing (kg) in 1998	Seed sowing (kg) in 2018	Seedlings in 1998 (rounded to 1.000)	Seedlings (%) in 1998	Seedlings in 2018	Seedlings (%) in 2018
<i>Picea abies</i>				24		789.000	46	488.233	52,96%
<i>Abies alba</i>	69	69	92	4		18.000	1	10.298	1,12%
<i>Pinus silvestris</i>				5		41.000	2	5.865	0,64%
<i>Pinus nigra</i>				414	32		3	1.200	0,13%
<i>Larix decidua</i>						51.000		214	0,02%
Other conifers						4.000		2.083	0,23%
<i>Fagus sylvatica</i>		1.316	538	4		229.000	13	309.598	33,58%
<i>Fagus sylvatica</i> - plants from natural regeneration			200.000						0,00%
<i>Quercus petraea</i>	600	1.429	4.950	20	5	152.000	9	1.558	0,17%
<i>Quercus robur</i>	600	1.151	7.620	724	1.460			68.225	7,40%
Noble deciduous trees						353.000	21		
Hardwood deciduous trees						11.000	1		
Fast-growing deciduous trees						61.000	4		
Other deciduous trees				31	5	5.000			

<i>Fraxinus excelsior</i>	98	537		na	3				
<i>Fraxinus ornus</i>		10							
<i>Acer pseudoplatanus</i>	136	414	90					4.911	0,53%
<i>Prunus avium</i>	94	30	541					21.695	2,35%
<i>Alnus glutinosa</i>		1	3	na	1			17	0,00%
<i>Carpinus betulus</i>		3	4.200					373	0,04%
<i>Ostrya carpinifolia</i>		10							
<i>Populus spp.</i>								2.805	0,30%
<i>Tilia platyphyllos</i>								242	0,03%
<i>Sorbus aucuparia</i>								842	0,09%
<i>Crataegus spp.</i>								650	0,07%
<i>Malus sylvestris</i>			1					595	0,06%
<i>Acer platanoides</i>			160					575	0,06%
<i>Juglans regia</i>								551	0,06%
<i>Castanea sativa</i>			2.600					527	0,06%
<i>Ulmus minor</i>								400	0,04%
<i>Pyrus pyraster</i>								382	0,04%
<i>Sorbus domestica</i>								38	0,00%
<i>Sorbus torminalis</i>	1	1						27	0,00%
<i>Sorbus aria</i>								1	0,00%
<i>Pseudotsuga meziensis</i>			1						
Total	1.598	4.971	220.796	1.226	1.506	1.714.000	100	921.905	1

In 1998 quantities do not comprise sanitary felling for which additional up to 1.3 million of seedlings a year may be required.

3.3. The legislative framework on forest reproductive material

3.2.1 The European framework

Slovenia is part of the European Union and therefore the Slovenian legislation on forest reproductive material is harmonized with the *EC Directive on marketing of FRM (EC/105/1999)*.

Regarding the list of species from the Annex 1 of the *Directive on marketing of FRM (EC/105/1999)*, 10 spp. were excluded from the formal list with the Commission Decision of 6 December 2005 releasing Denmark and Slovenia from certain obligations for marketing of forest reproductive material under Council Directive EC/105/1999 (2005/871/EC). On the other hand, the total list of species for which the Slovenian FRM Act is valid includes several additional tree species.

Regarding reporting the Commission Recommendation of 14 February 2012 on guidelines for the presentation of the information for the identification of lots of forest reproductive material and the information to be provided on the supplier's label or document (EC/90/2012) is applied.

The *Commission Regulation EC/1597/2002 of 6 September 2002* is laying down detailed rules for the application of Council Directive EC/105/1999 including reporting to the EC and uploaded into the FOREMATIS database. The *Commission Regulation (EC) No 1598/2002 of 6 September 2002* lays down detailed rules for the application of Council Directive EC/105/1999 as regards the provision of mutual administrative assistance by official bodies is applied regarding the required information for certification forms provided by member states. The *Commission Regulation EC/1602/2002 of 9 September 2002* lays down detailed rules for the application of Council Directive EC/105/1999 as regards the authorisation of a Member State to prohibit the marketing of specified forest reproductive material to the end-user.

Relevant national plant health and phytosanitary legislation regarding FRM has also been adopted to EU requirements. Regulation (EU) 2016/2031 on protective measures against plant pests ("Plant Health Law") entered into force on 14 December 2019 and together with several delegated and implementing acts by the Commission is directly implemented in EU Member States. Regulation (EU) 2016/2031 goes hand-in-hand with Regulation (EU) 652/2014, which lays down provisions for the management of expenditure relating to the food chain, animal health and animal welfare. It relates to Regulation (EU) 2017/625 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products.

3.2.1 The Slovenian legislation on FGR and FRM

The principles for conservation of forest genetic resources as the basic principle, referred to also in the Forest Reproductive Material Act (ZGRM, 2002) in Slovenian legislation, are formalized within the Nature conservation act (ZON, 1999), the Forest Act (ZOG, 1993), the Biodiversity Conservation Strategy of Slovenia (BCSS, 2002), and the Resolution on the National Forest Programme (NGP, 2007). The detailed rules are defined in the Forest Reproductive Material Act (ZGRM, 2002) and its subordinate regulations (available at http://www.mkgp.gov.si/zakonodaja_in_dokumenti/veljavni_predpisi/).

Forest Act

This Act regulates the protection, cultivation, exploitation and use of forests and the role of forests as natural resources with the aim of ensuring sustainable and multifunctional management in accordance with the principles of environmental protection and natural values,

sustainable and optimal functioning of forests as ecosystems and exercising their functions. It defines the use of FRM.

Forest Reproductive Material Act

This Act is harmonised with the EU Directive on Marketing of FRM (EC/105/1999), while it is also based on conservation of forest genetic resources (# 2). It was first prepared in 2002 with a few later amendments, mainly considering joining the EU. It lays down

- the conditions for the production, marketing and use of forest reproductive material;
- obligations of persons involved in the production,
- rules for marketing and importation of reproductive material;
- professional tasks and procedures related to the certification of origin, quality and identity of reproductive material;
- rules for obtaining, using and exchanging data and information;
- establish seed reserves (storage) and the forest gene bank;
- costs;
- Bodies implementing this law, and inspections.

This Act is based on the principles of conservation of forest genetic resources and is valid in:

- reforestation by planting and sowing,
- afforestation,
- design and maintenance of permanent protective or anti-erosion belts of forest trees,
- design and maintenance of tree plantations.

This Act also transposes the Directive EC/123/2006 of the European Parliament and of the Council of 12 December 2006 on services in the internal market (OJ L 376, 27.12.2006, p. 36).

Order on the List of tree Species and Artificial Hybrids

This order implements the list of tree species and artificial hybrids from the Annex 1 of the Directive on marketing of FRM (EC/105/1999), while excludes 10 non-autochthonous (exotic) tree species according to the European Commission Decision no. 2005/871, and adds several additional, nationally important tree species (Table 2).

Table 2: List of species that the FRM Act applies as listed in the National list (2010)

No.	Botanical name	13.	<i>Betula pendula</i> Roth*
1.	<i>Abies alba</i> Mill.*	14.	<i>Betula pubescens</i> Ehrh.*
2.	<i>Abies cephalonica</i> Loud.*	15.	<i>Carpinus betulus</i> L.*
3.	<i>Abies grandis</i> Lindl.*	16.	<i>Carpinus orientalis</i> Mill.
4.	<i>Acer campestre</i> L.	17.	<i>Castanea sativa</i> Mill.*
5.	<i>Acer monspessulanum</i> L.	18.	<i>Celtis australis</i> L.
6.	<i>Acer obtusatum</i> W. et K. ex. Willd.	19.	<i>Cercis siliquastrum</i> L.
7.	<i>Acer platanoides</i> L.*	20.	<i>Fagus sylvatica</i> L.*
8.	<i>Acer pseudoplatanus</i> L.*	21.	<i>Ficus carica</i> L.
9.	<i>Acer tataricum</i> L.	22.	<i>Fraxinus angustifolia</i> Vahl*
10.	<i>Alnus glutinosa</i> (L.) Gaertn.*	23.	<i>Fraxinus excelsior</i> L.*
11.	<i>Alnus incana</i> (L.) Moench *	24.	<i>Fraxinus ornus</i> L.
12.	<i>Alnus viridis</i> (Chaix) DC.	25.	<i>Ilex aquifolium</i> L.

26.	<i>Juglans regia</i> L.	52.	<i>Prunus avium</i> L.*
27.	<i>Laburnum alpinum</i> (Mill.) Bercht. et J. Presl	53.	<i>Prunus mahaleb</i> L.
28.	<i>Laburnum alschingeri</i> (Vis.) C. Koch	54.	<i>Prunus padus</i> L.
29.	<i>Laburnum anagyroides</i> Medik.	55.	<i>Pseudotsuga menziesii</i> (Mirb.) Franco*
30.	<i>Larix decidua</i> Mill.*	56.	<i>Pyrus amygdaliformis</i>
31.	<i>Larix kaempferi</i> (Lamb.) Carr.*	57.	<i>Pyrus pyraister</i> (L.) Burgsd.
32.	<i>Larix x eurolepis</i> Henry*	58.	<i>Quercus crenata</i> Lam.
33.	<i>Laurus nobilis</i> L.	59.	<i>Quercus cerris</i> L.*
34.	<i>Malus sylvestris</i> (L.) Mill.	60.	<i>Quercus ilex</i> L.*
35.	<i>Mespilus germanica</i> L.	61.	<i>Quercus petraea</i> (Matt.) Liebl.*
36.	<i>Olea europaea</i> L.	62.	<i>Quercus pubescens</i> Willd.*
37.	<i>Ostrya carpinifolia</i> Scop.	63.	<i>Quercus robur</i> L.*
38.	<i>Phillyrea latifolia</i> L.	64.	<i>Quercus rubra</i> L.*
39.	<i>Picea abies</i> (L.) Karst.*	65.	<i>Quercus suber</i> L.*
40.	<i>Pinus cembra</i> L.*	66.	<i>Robinia pseudoacacia</i> L.*
41.	<i>Pinus halepensis</i> Mill.*	67.	<i>Salix</i> × spp.
42.	<i>Pinus mugo</i> Turra	68.	<i>Sorbus aria</i> (L.) Crantz
43.	<i>Pinus nigra</i> Arnold*	69.	<i>Sorbus aucuparia</i> L.
44.	<i>Pinus pinaster</i> Ait.*	70.	<i>Sorbus domestica</i> L.
45.	<i>Pinus pinea</i> L.*	71.	<i>Sorbus torminalis</i> (L.) Crantz
46.	<i>Pinus sylvestris</i> L.*	72.	<i>Taxus baccata</i> L.
47.	<i>Pistacia terebinthus</i> L.	73.	<i>Tilia cordata</i> Mill.*
48.	<i>Populus alba</i> L.	74.	<i>Tilia platyphyllos</i> Scop.*
49.	<i>Populus nigra</i> L.	75.	<i>Ulmus glabra</i> Huds.
50.	<i>Populus tremula</i> L.	76.	<i>Ulmus laevis</i> Pall.
51.	<i>Populus x spp</i> *	77.	<i>Ulmus minor</i> Mill.

* Tree species and artificial hybrids identified in accordance with Council Directive EC/105/1999 (OJ L 320, 8.12.2005, p. 50) and Commission Decision of 6 December 2005 exempting Denmark and Slovenia certain obligations in the marketing of forest reproductive material in accordance with Council Directive 1999/105/EC (OJ L 320, 8.12.2005, p. 50)

The other rules include the delineation of regions of provenances, registering of forest seeds and seedling operators and their reporting methods (last modified in 2021), rules for approval of basic material (seed objects), on certificates for FRM and keeping records, rules on determining data for forest seeds and for inspection.

The Slovenian legislative framework on plant health (pests and diseases) is based on the Plant protection act and all relevant European regulations and directives, such as the Decree on implementation of EU regulations on protection measures against pests of plants for the implementation of Regulation (EU) 2016/2031 and Delegated Regulation (EU) 2019/827 and Delegated Regulation (EU) 2019/829, the Decree implementing the Regulation (EU) on official controls and other official activities concerning food, feed, animal health and welfare, and plant health and plant protection products for the implementation of Regulation (EU) 2017/625.

3.2.2 Rules on the determination of areas of provenance

In accordance with Directive EC/105/1999, the territory of Slovenia has been divided into regions of provenance (as proposed by Kutnar et al. 2002). These are created in the sense of continuing in the direction outlined by Wraber in 1950 and upgraded by M. Pavle in 1987. The upgrade is based on a new phytogeographic division of Slovenia, as proposed by Mitja Zupančič

and Vinko Žagar (1995). For individual species, they are also created based on population and genetic research. A similar division based on ecologically related regions has been accepted in some other European countries.

The basis for demarcation are broader ecological regions that are on the ground delineated in more detail with boundaries between regional units – forest management areas and administrative boundaries – cadastral municipalities, which enables precise control over the production and recommended use of forest reproductive material (FRM) in individual forest management areas and forest management units.

The current Rules on the determination of areas of provenance (Ur.l.RS 72/03, 58/12 and 69/17) combines the ecological regions, soil types, and main topographical and administrative borders, including the 14 Slovenian forest regions, while each region is divided into 4 elevation zones (Figure 2). For majority tree species (*Abies alba*, *Fagus sylvatica*, *Picea abies*, *Quercus petraea*, *Quercus robur*) Slovenia is divided into 7 provenance regions. For all other (“minority”) species it would not be feasible to produce and use FRM in the same way, therefore Slovenia as a whole represents a single provenance region for these species, but still divided into the four elevation zones. The Regulation includes recommendations for use of FRM, while the decisive role is on the forest rangers formalizing the use in their Decree on detailed silvicultural plan.

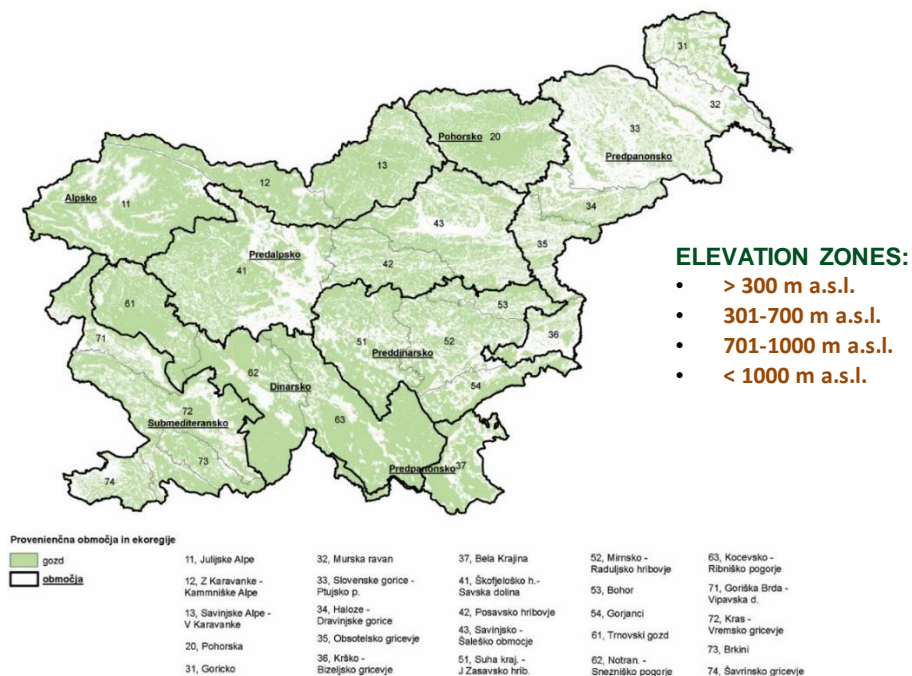


Figure 2. Regions of provenances based on ecological regions & subregions: 1. Alpine, 2. Pohorje, 3. Prepannonian, 4. Prealpine, 5. Predinaric, 6. Dinaric, 7. Submediterranean

Article 7 of the Rules determining regions of provenance (Pravilnik PO, 2003) includes the following guidelines for use:

"(1) In order to steer the use of FRM, the following suitability scale for the use of FRM is applied:

1. most suitable: use of FRM in a certain sub-region of provenance and altitudinal zone produced from a seed source in the same sub-region and altitudinal zone,
2. very suitable: use of FRM in a certain region of provenance and altitudinal zone produced from a seed source in the same region of provenance and altitudinal zone,
3. suitable: use of FRM in a certain region of provenance and altitudinal zone produced from a seed source in a neighboring region of provenance and the same altitudinal zone,

4. *less suitable*: use of FRM in a certain region of provenance and altitudinal zone produced from a seed source in the remaining regions of provenance and the same altitudinal zone,

5. *exceptionally suitable*: use of FRM in a certain region of provenance and altitudinal zone produced from a seed source in the remaining regions of provenance and a neighboring altitudinal zone,

(2) *If the most suitable or very suitable FRM is not available in a seed source of a certain region of provenance and altitudinal zone and if it is not available even in a seed storage, FRM for suitable or less suitable use may also be stored or used, although only for the needs of one year at the most.*

(3) *If not even FRM for less suitable use is available for more than 10 years, FRM for exceptionally suitable use may also be stored or used, although only for the needs of one year at the most.*

(4) *Notwithstanding the provisions from the preceding paragraphs, in order to preserve the forest genetic resources in the Šavrinija sub-region of provenance, it is permitted to use only FRM from that sub-region."*

This article was subsequently amended several times. After the latest harmonisation it is permitted to also use FRM from certain regions of provenance from the neighbouring countries (Austria, Croatia and Hungary) in certain areas and altitudinal zones in Slovenia, in case of lack of adequate FRM originating from within the Slovenian forests, for sanitary reasons after large-scale disturbance, and after obtaining a positive expert opinion of the Slovenian Forestry Institute.

3.4. The FRM certification system and official bodies in Slovenia

According to the FRM Act (ZGRM, 2002) the tasks and relations of institutions ensuring the FRM certification scheme in Slovenia are as follows (Figure 3):

- All bodies exercising control over the production, marketing, import or use of reproductive material shall cooperate with each other, exchange data and information and report on their work to the *Ministry of Agriculture, Forestry and Food (MAFF)*.
- Supervision of suppliers in the process of production and marketing of reproductive material, except when the supplier obtains reproductive material in the seed object, and the use of reproductive material by the end users, is carried out by *forestry inspectors (Inspectorate of the Republic of Slovenia for Agriculture, Forestry, Hunting and Fisheries, IAFHF)*.
- Supervision of the import of reproductive material is carried out by *phytosanitary inspectors (PhSI)*.
- Supervision over the production of reproductive material in stands and groups of trees is carried out by the *Slovenia Forest Service (SFS)*. It is also in charge of distributing FRM to forest owners, maintaining the Seed storage and organizing public tenders for production of seeds and planting material.
- Supervision over the production of reproductive material in seed orchards, parents of families, clones and clonal mixtures is carried out by the *Slovenian Forestry Institute (SFI)*; it is also in charge of approving forest seed objects (basic material), issuing master certificates of origin of FRM for the four categories (source identified, selected, qualified, tested) and quality certificates for seeds in the Seed storage, organizing the Register of seed objects, publishing of the National list in the Official gazette and in FOREMATIS, and supporting all requirements from the inspectorate regarding the source of FRM. It also organizes the Slovenian forest gene bank and maintains its seed bank.

It should be noted that the purpose for which FRM is produced in an individual seed object may be labelled as:

- "for multi-purpose forestry",
- "not for use in forestry", such FRM has not been produced under any survey and not in the approved seed objects for production of FRM of the above four categories, or
- "with limited importance for wood production" – the latter is intended for use in forestry, although its primary purpose is the conservation of forest genetic resources.

The current National list of basic material – forest seed objects is available at www.gozdis.si.

MAFF: Secondary control body, information exchange, records on marketing, register of suppliers, ...		
SFS: Field confirmation (<i>in situ</i>) Forest management planning Decree on silvicultural measures Evidences Seed storage Forest data,	SFI: Approval of FSO Master certificate Register of FSO FOREMATIS Forest gene bank Diagnostic services Field confirmation (<i>ex situ</i>) Expert opinion & comparative tests ...	IAFHF: Master certificate for mixed lot Control in nurseries Use of FRM PhSI: Border - import

Figure 3 Institutions and overview of their roles & authorizations in certification of FRM

The provision of conditions for the implementation and performance of tasks under public authority is financed from the budget of the Republic of Slovenia.

The Slovenian Forestry Institute (SFI) and the Slovenia Forest Service (SFS), as holders of public authority in accordance with the Forest Reproductive Material Act are responsible to the Ministry of Agriculture, Forestry and Food for the performance of tasks for which they have been authorized.

The Ministry of Agriculture, Forestry and Food is the second level authority (in case of appeals) in administrative matters decided by SFI and SFS in accordance with the Forest Reproductive Material Act.

3.5. The Slovenian Forest Gene Bank and the National List of Forest Seed Objects (Basic Material)

3.5.1. The Slovenian Forest Gene Bank

Forest management and silvicultural measures depend on the long life span of forest trees, well adapted to the site conditions, while seeds of a number of tree species are impossible to store over longer periods in seed storage and seed banks. Therefore, the Slovenian Forest Gene Bank (SFGB) (Kraigher and Žitnik, 1999) *sensu lato* is a gene bank, including *in situ* and *ex situ* components of the gene bank, as defined in the Nature conservation act (ZON, 1999): “Gene banks shall be the controlled or cultured populations or parts of animals and plants, in particular seeds, spores, reproductive cells and other biological materials which are managed for the purposes of conserving species or their gene pools.”

The *in situ* components of the SFGB *sensu latissimo* consider as its parts all natural populations of autochthonous forest tree species, managed according to the principles of co-natural sustainable forest management, and particularly forest stands in protection forests and in different nature conservation areas (Table 2). SFGB *sensu lato* comprise all *in situ* and *ex situ* forest seed objects – approved basic material for production of forest reproductive material, while SFGB *sensu stricto* comprises *in situ* dynamic gene conservation units - forest gene reserves, *ex situ* living archives, provenance tests, the Forest seed bank, the DNA library and molecular databases.

Table 2 Components of the Slovenian Forest Gene Bank

Component of SFGB	Area (ha) / Number / Established in	Reference
Protection forests	98,759.80	UVG, 2005
Forest reserves (173)	9,508.16	UVG, 2005
Forests in TNP	52,965	Klopčič <i>et al.</i> , 2015
Forests in 36 regional parks	30,045	Kraigher 1996
National List of Seed Objects	1,146.145 ha / 256 SO	Off. g. 4, 2020
Forest Gene Reserves – Dynamic Conservation Units	1,134.45 / 40 FGR / 39 spp	Off. G 4, 2020 & EUFGIS database
Forest Seed Bank	154 accessions / 26 spp	SFI int. report, 2020
DNA library (2014-2016)	6163 extractions	SFI int. report, 2020
Provenance trials / species:		
<i>Fagus sylvatica</i>	Est. 1998, 38 provenances, Kamenski hrib - Straža	Božič <i>et al.</i> , 2000, Westergren <i>et al.</i> , 2010
<i>Picea abies</i>	Est. 2017, two sites, 6 provenances	SFI int. report, 2020
<i>Pseudotsuga menziesii</i>	Est. 1971 and 1972, 27 provenances	Breznikar, 1991
Living archives / species:		
<i>Metasequoia glyptostroboides</i>	Est. 1993, 350 trees, Zadobrova	Kraigher, 1996
<i>Populus ssp.</i> and their artificial hybrids	43 clones, Zadobrova 31 clones, Pince-Marof 13 clones, Ižakovci	Božič, Krajnc, 2012, Božič, 2016
<i>Populus nigra</i>	Est. 2013, 14, 17, Ižakovci, Mura river	Božič, 2016, SFI int. report 2020

(TNP – Triglav National Park)

3.5.2. National Register of Forest Seed Objects (Basic Material)

The National List of Forest Seed Objects is the publicly available part of the Register of Approved Seed Objects, organized and lead by the Slovenian Forestry Institute. The Institute is responsible for leading the approval, the database and information system, and to report – publish the National list yearly in the Official gazette and submit the list into the EU FOREMATIS database. The location of the seed objects in the publicly available National list is restricted to a single point, while for ownership it states the code of the owner and ownership (the state or different categories of private ownership). The restricted part of the Register

includes full information on the forest owners and the exact location; this part is only available to the authorized personnel at the SFI.

In 2022, the list included 255 seed objects for 39 species approved “for forestry purposes” (code of purpose 1, remark “for multifunctional forestry”), or “with a limited wood-production purpose” (code of purpose 2, remark “gene conservation unit”) (Table 3). The list was largely amended in 2023 due to the increase demands for seeds and seedlings after large forest fires.

In 40 cases the approved seed objects are also gene conservation stands or stands for forest genetic monitoring (2 stands so far).

Including 15 approved plus trees, the total number of seed objects for forestry purposes is 270.

Additionally, the whole of Slovenia, or the whole provenance region for the stand-forming tree species, has an i.d. number of a seed object “not for use in forestry” (code 2, remark “not for use in forestry”). Including these (127 in total, FRM production not under any control), the total number is 397 seed objects in the national Register.

Table 3: Overview of approved forest seed objects in Slovenia (till January 2022)

Type of forest seed object	Number	Forest gene reserve	Forest genetic monitoring plot
Forest stands or groups of trees for production of FRM category ‘Source identified’	93	6	/
Forest stands for production of FRM category ‘Selected’	161	34	2
Seed orchards, parents of families, clones or clonal mixtures for production of FRM category ‘Qualified’	1	/	/
Plus trees*	15	/	/
Provenance regions for production of FRM category ‘Not for use in forestry’**	127	/	/
Total	397	40	2

No forest seed object for the category “Tested” has been approved so far.

*The database of plus trees, which may be used in future for collection of material from which seed orchards or clones or clonal mixtures might be established, has also been included in the national Register.

**The national Register also includes the list of provenance regions (for majority spp) or whole Slovenia (for all other species) per species as ‘seed objects’ with the purpose ‘Not for use in forestry’; therefore all FRM, produced in Slovenia, receives a Master certificate with a specific purpose, including ‘not for forestry purposes’.

3.6. Procedures and criteria for approval of forest seed objects

The *in situ* stand or group of seed trees is evaluated on 10 criteria, corresponding to the (better defined) criteria set-up in the Directive EC/105/1999, but with more stringent requirements regarding the category ‘source identified’ in order to support quality as well as diversity of FGR:

- Type of the seed object: forest stand or group of seed trees (Master certificate for ‘source identified’ and ‘selected’ categories, for the category ‘qualified’ and ‘tested’. When

produced in the seed orchard the type can state: seed orchard, parents of families, clones, mixture of clones)

- Origin: autochthonous, non-autochthonous, origin if non-autochthonous (unknown or known; if known, the source is written down under remarks)
- Isolation: distance from another stand of the same species with different origin or characteristics
- Effective Population Size: minimum area and number of trees / groups of trees is defined for majority species to over 5 ha and over 70 trees)
- Age and Development: sufficient for the different characteristics to be evaluated
- Adaptation to the ecological conditions: whether the population can sustain itself on the site, based on regeneration (mainly generative: flowering, fructification, germination, survival of natural regeneration)
- Health and Resistance: presence of any pests and diseases, mechanical damages, and resistance to biotic / abiotic stressors
- Volume production: in comparison to other stands in the region
- Wood Quality: in comparison to the other stands in the region
- Form or Growth Habit: share of trees in the population with unfavorable (presumable inherited) growth habit is limited to 20%.

For 'source-identified' the criteria under 8 and 9 are not important, while in no. 10 a higher share (40 %) of unfavorable phenotypes can be present.

For the seed orchards, the establishment and management plan is to be approved in advance by the SFI. Upon approval, the number and repetition of clones is checked, and if needed, the identity of the clone is defined by molecular techniques. In the case of a *Fraxinus excelsior* seed orchard, the number of hybrids with *F. angustifolia* were identified and the proposed seed orchard, established in the 1983-1989, when the chosen plus trees were not checked by the Institute in advance, has not been approved. At present only one seed orchard (for category "qualified") has been approved in Slovenia, for *Alnus glutinosa* in NE Slovenia.

Additionally, 'plus trees' have been registered according to the same procedures as for approved seed stands, based on individual assessment of these trees. So far only 15 plus trees of *Prunus avium* have been included into the database, while a total of 105 potential wild cherry plus trees have already been evaluated. Also *Populus nigra* trees have already been identified for future approval as plus trees. The plus trees are to provide stock material (cuttings and graftings) for establishment of new seed orchards. The plus trees (15 so far, all for *Prunus avium*) are approved individually, based on the criteria for each tree species, and on the application for approval signed by the owner (same procedure as for other in situ seed objects).

3.6.1. Seed trees or stands for the production of FRM of the "source identified" category

Due to the large-scale disturbances in the last 10 years, and shortage of FRM, as well as the need to conserve forest genetic resources, a larger number of forest seed objects for the production of FRM of the "source identified" category has been approved in Slovenia. However, even these forest seed objects (FSO) must meet the criteria for approval as written down for FSO for the "selected" category, only that criteria 8, 9 and 10 are not taken into account in the approval (see 4.2); in these, the share of trees with major defects may be up to 40 %. Such seed object may be a stand or a group of seed trees, and for indigenous tree species it must as a rule be of natural origin (only for the spruce or black pine it may be non-indigenous or of unknown origin). For seed objects that are not of natural origin, a note should be added that the stand originates from FRM of local origin or from local tree nurseries.

3.6.2. Selected seed stands – for production of FRM category ‘selected’

Seed material for reforestation with planting in Slovenia is acquired primarily from selected seed stands. These represent the best part of the populations of a tree species in terms of properties important for future development and yield of this tree species in a managed forest. The objective of management of a seed stand is adjusted to the role of production of seed and includes production of quality seed with excellent genetic traits along with the implementation of other forest management objectives. Seed from the seed stands under the European Directive for the categorisation of forest reproductive material belongs to the "selected" category. Information about provenance, climatic conditions in this region and a series of other information about it is known, while the starting material (seed stand) has been selected based on phenotypic properties of the tree population in the stand.

In reforestation with sowing and planting, sustainable and multi-purpose forest management requires consistent consideration of the origin of seed and constant selection of seed material. Saplings that are created by means of reforestation with sowing and planting must be able to meet all forest management objectives in a future forest. The series of measures in the selected seed stands thus represents the ‘breeding without breeding’ of forest trees. Its purpose is to improve hereditary characteristics of the future populations of forest trees in accordance with the envisaged objectives, and at the same time preserve a broad genetic diversity that will provide security to the population and species in the case of unpredictable changes in the environment.

3.6.3. Description and tending of selected seed stands, and directives for production of FRM

A description and analysis of the state of a stand is the basis for the planning of detailed silvicultural measures in seed stands. A detailed analysis of the state of a forest stand is already performed during the procedure to select seed stands of individual tree species. The analysis of the stand includes evaluation and assessment of:

- the needs for selected seed stands of a certain species in the relevant region of provenance and altitudinal zone,
- the information about the site and stand,
- the overview of the stand on the basis of phenotypic properties of the population,
- Comparison to the stands of the same tree species in the region.

Basic information includes information about the site, forest community, size of stand, growing stock, increment, number of trees of the relevant tree species, age of stand, stand structure, forest management unit, rate of the mixing of tree species, etc. This information helps to create an appropriate long-term silvicultural objective for the seed stand and a list of silvicultural measures with which this objective will be attained. The required information is listed in the description sheet for the seed stand, which is an integral part of the documentation of every seed stand. This information is also the basis for the silvicultural plan, which is somewhat more complex due to the production of a seed being pronounced and which requires more information than for a managed forest, where this function is not as pronounced.

A long-term silvicultural plan is prepared for the seed stand to determine the future state of the stand that would satisfy the need for production of FRM. It needs to be taken into account here that a seed stand realizes more functions than a normal managed forest. A long-term silvicultural plan thus consists of several components:

- production of seed material with excellent genetic characteristics; as maintain as much genetic diversity as possible,
- production of large quantities of quality seed in a specific period of time,
- providing conditions for collecting seed (adequate stand structure, management of the ground vegetation),

- implementing the wood production functions of the stand (seed stands are stands with a particular quality of timber, which is why the importance of this objective is specially pronounced),
- implementation of all other functions of forests, such as protective and social functions (their relative importance is a result of evaluation in a broader environment).

Silvicultural measures (thinning) in seed stands are directed primarily towards:

- selection in terms of target traits (removal of specimens with undesired properties, in particular those that are more dependent on genetic basis - heredity),
- increasing seed crop (releasing tree crowns),
- maintaining an adequate stand structure (distribution, stability, existence of canopy layer, withholding natural regeneration),
- protecting genetic diversity (size of the population that is mutually pollinated),
- increasing the value increment of the stand (the wood production function is less important; felling of quality trees is not supported for the time during which the stand will be used for the production of quality seed).

3.6.4. Detailed procedures related to the approval of forest seed objects (basic material)

Approval of seed objects (Basic material) – an overview

The approval of forest seed objects for the "source identified" and "selected" categories starts based on an application by the owner of the seed source. If there is a need to obtain forest reproductive material, the Slovenian Forest Service (SFS) makes a record of the expectedly suitable seed sources and starts a procedure to obtain an application for the approval of the forest owner – communication with owners mostly depends on competent district foresters or other SFS experts competent for specific localities or regions.

At the time of the evaluation, the decision is taken whether the seed object is to be registered, and under which category. Furthermore, at approval, the criteria for dynamic gene conservation units – forest gene reserves are discussed aiming at whether they are conforming to the minimum criteria (Lefèvre et al., 2012), the owner is consulted whether the seed stand can also be considered for a forest gene reserve, or for a forest genetic monitoring plot. Finally, the directives for tending and production of FRM are discussed and written into the Decree on approval of the seed object by SFI; these directives become an integral part of the forest management plans, and the prescribed minimum number of trees for production of seed is considered at issuing the Master certificate. The directives mainly contribute to conservation of forest genetic diversity in produced seeds from an appropriate and still feasible number of forest trees, and on supporting the stability of the stand and supporting the species in concern, while at the same time eliminating the negative phenotypes.

Detailed procedures for approval of a seed object in situ:

Upon receiving the application of the forest owner or his authorized representative for approval of *in situ* basic material, the SFI obtains a description sheet from the SFS and, if the seed objects is approved, defines:

- guidelines for tending the stands,
- guidelines for collection of FRM, such as the minimum number of trees for collection of FRM, distance between them etc.; for majority tree spp the minimum number of trees is 25 (recommended 50), and for minority tree spp it is 10 (recommended 25) trees.

The SFI issues the approval decision and enters the new forest seed object in the register, which is then published (the public part of it) every year and submitted to FOREMATIS. The SFS

reviews the FSO of the "source identified" and "selected" categories once a year. The SFI reviews the "qualified" and "tested" categories once a year.

Brief overview of the certification process

The certification in Slovenia is a two stage process:

- the Slovenia Forest Service (SFS) surveys the production of FRM in all *in situ* seed objects (in EC Directive these are named 'basic material'), and the Slovenian Forestry Institute (SFI) surveys the production of FRM in the seed orchards; upon finalization a 'Field confirmation' is issued stating the daily and total weight of the produced seed / cones / fruits, which accompanies the seed lot to the producer's extraction infrastructure; simultaneously a sample from each tree used for production and a copy of the Field confirmation is sent to the SFI;
- upon receiving the samples from the field and the Field certificate, the SFI checks the I.D. of the approved seed object, the data on the Field certificate, extracts the DNA from each mother tree and stores it in the DNA library; after extraction is finalized, the producer sends a sample from composite seed lot to the SFI together with the extraction protocol stating the initial and final seed weight; if all is correct the SFI issues the Master certificate of origin within 7 days upon receipt of the Extraction protocol;
- in case of an urgency (transport of the seed lot outside country borders) the Master certificate can be issued on the basis of the Field confirmation;
- in case of doubt on the authenticity of the produced seed lot the DNA samples are used for molecular identification and comparison to with the Molecular database of the seed objects.

The SFI sends a yearly report on issued Master certificates to the Ministry (MAFF), Inspectorate (IAFHF) and the SFS, while the producers send a yearly report on marketing of FRM to the Ministry. The Ministry is the second level authority for control of all other organizations.

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