




THE SECOND REPORT
ON THE STATE
OF THE WORLD'S

FOREST GENETIC RESOURCES

COUNTRY REPORT

CZECHIA



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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Country Report

The state of the world's forest genetic resources

The second national report on the state of forest
genetic resources in the Czech Republic

Authors:

Alžběta Pařízková

Josef Frýdl

Pavλίna Máchová



www.uhul.cz
Information on Czech Forests

Forest management institute Brandýs nad Labem



Forestry and Game
Management
Research Institute

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Introduction

The Forest Management Institute publishes this Country Report that includes information and priority areas of forest genetic resources in the Czech Republic. This report is structured due the FAO guidelines. The background description in each chapter is based on comprehensive information about forests in the Czech Republic (from official government documents), from published reports, statistics or based on analyses from database and national register of forest genetic resources and basic material. The conservation and sustainable use of forest genetic resources has essential importance for economical, ecological and social values in the Czech Republic. This report could be adequate information source of measures for concerning the management of forest genetic resources, necessary research and policy development.

We would like to express our gratitude to those who has contributed to this report.

Summary

This report presents the statements mainly concerning the use, management, institutional framework, research, conservation and information of forest genetic resources. Finally, the needed basic action is listed.

The Czech Republic (also known as Czechia) is a small, landlocked country in Central Europe with the area 78 871 km². The territory of the Czech Republic can be subdivided into four ecoregions: The Western European broadleaved forests, Central European mixed forests, Pannonian mixed forests and Carpathian montane conifer forests. The territory of the Czech Republic is divided into 41 Natural Forest Regions (NFR) - these areas are defined during the survey of forest habitats on the basis of geological, climatic, orographic and phytogeographical conditions. Forests and forestry play a significant role in the Czech Republic. They have a long history and there is a traditional industry there. The amount of forests in the Czech Republic places this country among the top of Europe. The forests cover 33.95% of the state's territory. The area of forests in protected areas represents 27.2% of the total area of forests in the Czech Republic. Forest management is greatly diversified thanks to the fact that the forests have apart from an economic and ecological function also an importance as the place of relaxation, sports and health and in forming the landscape.

The Czech Republic has basic material for 12 coniferous and 31 broadleaved forest tree species. Especially basic materials for *Picea abies*, *Pinus sylvestris*, *Larix decidua*, *Abies alba*, *Fagus sylvatica*, *Quercus robur* and *Quercus petraea* are managed or utilized for forestry. To the December 31, 2020, the registered reduced tree area was 65 253.41 ha of basic material in category selected, source type "stand" in 6 171 units of basic material. Remaining forest tree species are used to a limited extent in forestry. That is why the number of their basic materials is so low (only 0.04 %). There has been a noticeable decline of the basic material area in the selected category in some natural forest areas of Czech Republic in recent years as a result of timber harvesting, particularly of incidental bark beetle harvesting. The year 2020 was characterised by above-average seed production for almost the main economic tree species. 1 586 master certificates for seed material were issued by the authorised person Forest Management Institute (FMI) in 2020 according to the legislation.

The Czech Government approved in 2020 the Principles of State Forestry Policy and the conceptual document "Concept of State Forestry Policy until 2035". This Concept responds to the current state of the forests and it is the basic strategy of the forestry sector. It focuses on the Czech forestry as a whole. The concept was prepared by a working group composed of members of the Ministry, forestry associations, universities, regions, municipalities and non-governmental organisations. The Government assists to forest owners through a number of enumerated financial contributions and subsidies. In the selected cases, the forest owner is entitled to the provision of financial funds for activities and measures to achieve long-term objectives such as increasing biodiversity in forest ecosystems, their integrity and ecological stability and for sustainable forest management. The Czech Republic signed The Convention on Biological Diversity (CBD) on June 4, 1993 with approval December 3 of the same year. Signature of the country to the Cartagena Protocol on Biosafety was added on May 24, 2000.

The Czech Republic forest sector consists of a large number of participants and can be described in several ways, for instance: forest owners, governmental organization, non-governmental organizations, universities and research institutions. National or regional cooperation includes in the field of forest genetic resources research, development of new projects, new research methods and analyses, publication activities, presentation of research results, and participation in seminars.

The Ministry of Agriculture announced the "National Programme for the protection and reproduction of the forest tree species gene pool" (first for the period 2014–2018 and next currently

valid program for period 2019–2027) to motivate owners of genetic resources to preserve, protect and enable their reproduction, through subsidies. The aim is to provide support for the conservation of forest genetic resources and the conservation of reproductive material resources of higher quality forest tree species or endangered species and populations.

The Czech strategy for the forests consists of sustainable forest management based on the maximal using of the natural processes, which will ensure sustainable and balanced production in the forest. The Czech Republic aims at creating stable, mixed forests with various spatial and age groups.

The forests are important for the Czech economy, ecology and society.

In addition to genetically unsuitable stands, whose phenotypic expressions often include reduced resistance to changing of climatic conditions. In forestry practice it is often impossible to distinguish non-native populations and spontaneous hybrids of native species with geographically distant populations from native wild populations without costly molecular genetic laboratory analyses. Forestry and Game Management Research Institute (FGMRI) has elaborated optimized methodological procedures to use DNA analyses by nuclear microsatellite markers to determinate the clonal identity and receiving of genetic characteristics in some tree species populations. The use of sufficiently genetically variable source material for afforestation will result in more stable and resilient stands that will increase biodiversity and are more able to adapt to potential climate change and thus contribute to environmental protection.

In the Czech Republic, there are almost 65 253 ha of forests registered as *in situ* forest genetic resources of type selected stand, which is 6 171 stands, and almost 70 229 ha of forests are registered as *in situ* genetic conservation units (GCUs), which comprise 133 GCUs, so called “gene bases”, for 16 forest tree species. It may be registered either for one forest tree species or for more forest tree species as well. In 2020, the area of declared GCUs increased by 350.69 ha.

Species of special value or endangered and other important populations and individuals may be better preserved and conserved by *ex situ* measures. Long-term storage of seeds for the main tree species with orthodox seeds is done in The National Forest Tree Seed Bank. Vegetatively propagated plants (explant cultures), are cultivated for a long-term preservation in The National Bank of Forest Tree Species Explants in the FGMRI. Conservation in seed orchards and clonal mixtures is another method of *ex situ* conservation.

In the future, it will still be necessary to search new high quality and valuable sources, to protect them *in situ*, to conserve *ex situ*, to promote research, to carry out information collection and database maintenance on sources and to use the right material for reforestation and afforestation.

The need for cooperation is becoming more important as climate change adaptation and the occurrence of harmful agents is integrated into forestry and forest genetic resources in the EU, European and global level. The Czech Republic will also welcome the input of knowledge from other countries.

PART I

Structured questionnaire

2nd COUNTRY PROGRESS REPORT

CZECH REPUBLIC

Monitoring the implementation of the *Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources*

October, 2021 (updated)

Prepared by:

Ing. Alžběta Pařízková, Forest management institute Brandýs nad Labem

Ing. Josef Frýdl, CSc., Forestry and Game Management Research Institute

Ing. Pavlína Máchová, Ph.D., Forestry and Game Management Research Institute

Part A: Responses of countries to the Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources (FGR)

	Yes, No, Initiated, n.a.	Establishment, Year	Areas of work/activities/stakeholders
A.1.1.1 National FGR inventory	Y	1951	<ul style="list-style-type: none"> • Conservation of forest genetic resources (FGR) • Production of forest reproductive material (FRM) • Research and development efforts (provenance trials, tree breeding etc) • FGR transferred internationally
Comments: National and EU seed FRM legislation; Data system ERMA2 – Forest reproductive material information system.			
A.1.2.1 National FGR information systems	Y	1995	<ul style="list-style-type: none"> • Conservation of FGR • Production of forest reproductive material • FGR transferred internationally
Comments: Data system ERMA2 – Forest reproductive material information system.			
A.2.1.1 National <i>in situ</i> conservation system	Y	1985	<ul style="list-style-type: none"> • <i>In situ</i> conservation units of FGR • Protected areas • Forests managed for production of wood and/or non-wood products
Comments: Genetic conservation units (GCU)=Gene basis; National program on protection and conservation of gene pool.			
A.2.2.1 National <i>ex situ</i> conservation system	Y	1951	<ul style="list-style-type: none"> • Ex situ conservation stands • Field collections • Storage facilities for seed, pollen or other tissue
Comments: Seed orchards, clonal mixtures, clonal archives (mixture of clones), National seed bank and National bank of explants.			
A.3.1.1 National tree seed programmes	Y	1951	
Comments: National seed legislation, European seed legislation, National program on protection and conservation of gene pool.			
A.3.2.1 Tree breeding programmes	Y		<ul style="list-style-type: none"> • Public entities • Private companies • Private–public partnerships

			<ul style="list-style-type: none"> • Other stakeholders (please specify under Comments)
Comments: Any stakeholder operated with FRM in the forest.			
A.3.3.1 Extension programmes	Y	2014	<ul style="list-style-type: none"> • Forest owners • Others (please specify under Comments)
Comments: Forestry and Game Management Research Institute, National seed bank and National bank of explants; owners of protected tree species forest stands.			
A.4.1.1 National coordination mechanism	Y	1951	<ul style="list-style-type: none"> • Governmental organizations (including state-owned enterprises) • Research organizations (including universities) • Relevant ministries
Comments: National seed legislation, European seed legislation, National program on protection and conservation of gene pool.			
A.4.2.1 National FGR strategies	Y	1951	<ul style="list-style-type: none"> • Conservation of FGR • Use of FGR • Development of FGR
Comments: National program on protection and conservation of gene pool.			
A.4.3.1 Aligned with regional strategies	Y		
Comments: National seed legislation is aligned with European seed legislation, National program on protection and conservation of gene pool is based on Nagoya protocol, Forest Europe - implementation of the conference conclusions.			
B.4.1.1 FGR integrated into NFP or national forest policies	Y		
Comments: National program on protection and conservation of gene pool.			
B.4.1.2 FGR integrated into biodiversity action plans	Y		
Comments: National program on protection and conservation of gene pool.			
B.4.1.3 FGR integrated into CC strategies	Y		
Comments: National program on protection and conservation of gene pool.			
B.4.2.1 Participation in regional networks	Y		
Comments: EUFORGEN, EUFGIS.			
B.4.3.1 Participation in international R&D	Y		Number of national organizations currently participating: 3
Comments: Forestry and Game Management Research Institute; The Czech University of Life Sciences Prague - Faculty of Forestry and Wood Sciences; Mendel University in Brno - Faculty of Forestry and Wood Technology.			

Part B: State of conservation, use and development of forest genetic resources

	National distribution available	Non-molecular characterization	Molecular characterization	In situ programme	No. of in situ units	Area of in situ (ha)	Ex situ programme	No. of ex situ units	Area of ex situ (ha)	No. of ex situ accessions	National tree seed programmes	Tree breeding programmes	Area of seed stands (ha)	No. of seed stands	Area of seed orchards (ha)	No. of seed orchards	Amount of planting stock produced per year	State of tree breeding programme (generation)
<i>Abies alba</i>	1	1	1	1	16	12548	1	2	1	0	1	1	1195	1094	2	1	11615300	1
<i>Abies grandis</i>	1	1	0	0	0	0	1	1	2	0	0	1	56	108	2	1	206000	1
<i>Acer campestre</i>	1	1	0	0	0	0	0	0	0	0	1	0	57	64	0	0	34965	n.a.
<i>Acer platanoides</i>	1	1	0	1	1	191	0	0	0	0	1	0	200	283	0	0	681440	n.a.
<i>Acer pseudoplatanus</i>	1	1	1	1	10	4504	1	5	6	0	1	1	1579	818	6	5	10454211	1
<i>Alnus glutinosa</i>	1	1	1	0	0	0	1	1	1	0	1	1	3660	847	1	1	5406200	1
<i>Alnus incana</i>	1	1	0	0	0	0	0	0	0	0	1	0	210	199	0	0	23790	n.a.
<i>Alnus viridis</i>	1	1	0	0	0	0	0	0	0	0	1	0	3	1	0	0	0	n.a.
<i>Betula pendula</i>	1	1	1	0	0	0	0	0	0	0	1	0	3810	610	0	0	401170	n.a.
<i>Betula pubescens</i>	1	1	1	0	0	0	1	1	1	0	1	1	116	29	1	1	113020	1
<i>Carpinus betulus</i>	1	1	0	1	3	3325	0	0	0		1	0	2215	339	0	0	1768400	n.a.
<i>Fagus sylvatica</i>	1	1	1	1	63	35521	1	3	4	0	1	1	30726	2019	4	3	76496000	1
<i>Fraxinus angustifolia</i>	1	1	0	0	0	0	0	0	0	0	1	0	252	8	0	0	0	n.a.
<i>Fraxinus excelsior</i>	1	1	0	1	4	2012	0	0	0	0	1	0	2489	593	0	0	170600	n.a.
<i>Larix decidua</i>	1	1	1	1	5	1390	1	20	67	1	1	1	1520	644	67	19	7533000	1
<i>Malus sylvestris</i>	1	1	0	0	0	0	1	0	0	35	1	0	1	5	0	0	52510	n.a.
<i>Picea abies</i>	1	1	1	1	47	25619	1	78	58	49	1	1	26836	1834	47	17	557410000	1
<i>Pinus banksiana</i>	1	1	0	0	0	0	0	0	0	0	0	0	5	21	0	0	0	n.a.
<i>Pinus cembra</i>	1	1	0	0	0	0	1	1	5	0	0	1	1	1	5	1	0	1
<i>Pinus mugo</i>	1	1	1	1	4	3937	0	0	0	0	1	0	285	22	0	0	0	n.a.
<i>Pinus nigra</i>	1	1	0	0	0	0	0	0	0	0	1	0	382	155	0	0	89500	n.a.
<i>Pinus sylvestris</i>	1	1	1	1	15	7416	1	31	89	5	1	1	5568	655	89	26	28970000	2
<i>Populus alba</i>	1	1	1	0	0	0	0	0	0	0	1	0	47	43	0	0	0	n.a.
<i>Populus nigra</i>	1	1	1	0	0	0	1	5	1	0	1	0	19	55	0	0	2000	n.a.
<i>Populus tremula</i>	1	1	1	0	0	0	1	2	1	0	1	1	404	331	1	1	129750	1
<i>Populus x canescens</i>	1	1	1	0	0	0	0	0	0	0	1	0	5	5	0	0	0	n.a.
<i>Prunus avium</i>	1	1	1	0	0	0	1	10	10	1	1	1	51	212	10	9	736900	1
<i>Pseudotsuga menziesii</i>	1	1	1	0	0	0	1	1	1	0	0	1	626	510	1	1	2749900	1
<i>Pyrus pyraeaster</i>	1	1	0	0	0	0	1	1	1	0	1	1	4	13	1	1	65180	1

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<i>Quercus cerris</i>	1	1	0	1	1	574	0	0	0	0	1	0	12	11	0	0	89340	n.a.
<i>Quercus petraea</i>	1	1	1	1	10	7374	0	0	0	0	1	0	12089	725	0	0	5512000	n.a.
<i>Quercus pubescens</i>	1	1	0	0	0	0	0	0	0	0	1	0	6	6	0	0	0	n.a.
<i>Quercus robur</i>	1	1	1	1	4	2731	0	0	0	0	1	0	7498	840	0	0	13060000	n.a.
<i>Quercus rubra</i>	1	1	0	0	0	0	0	0	0	0	0	0	267	169	0	0	1339800	n.a.
<i>Robinia pseudoacacia</i>	1	1	0	0	0	0	0	0	0	0	1	0	261	90	0	0	40000	n.a.
<i>Salix alba</i>	1	1	0	0	0	0	1	2	3	0	1	1	1	4	0	0	10000	n.a.
<i>Sorbus aria</i>	1	0	0	0	0	0	0	0	0	0	1	0	2	7	0	0	0	n.a.
<i>Sorbus aucuparia</i>	1	1	0	0	0	0	0	0	0	0	1	0	69	101	0	0	162800	n.a.
<i>Sorbus domestica</i>	1	1	1	0	0	0	0	1	1	0	1	1	0	0	1	1	3600	1
<i>Sorbus torminalis</i>	1	1	1	0	0	0	1	8	2	5	1	1	46	46	2	3	109280	1
<i>Taxus baccata</i>	1	1	1	0	0	0	1	1	2	0	1	1	4	9	2	1	4000	1
<i>Tilia cordata</i>	1	1	1	1	4	2033	1	110	5	106	1	1	1950	505	5	4	2469480	1
<i>Tilia platyphyllos</i>	1	1	0	0	0	0	1	1	1	0	1	1	5	8	1	1	20800	1
<i>Ulmus glabra</i>	1	1	1	1	1	191	1	56	9	50	1	1	12	59	9	6	480330	1
<i>Ulmus laevis</i>	1	1	1	0	0	0	1	29	3	27	1	1	6	23	3	2	64070	1
<i>Ulmus minor</i>	1	1	1	0	0	0	1	34	1	33	1	1	24	88	1	1	231680	1

PART II

Complementary report

Prepared by:

Ing. Alžběta Pařízková, Forest management institute Brandýs nad Labem

Ing. Josef Frýdl, CSc., Forestry and Game Management Research Institute

Ing. Pavlína Máchová, Ph.D., Forestry and Game Management Research Institute

Abbreviations and definitions list

FMI - Forest Management Institute

FGMRI - Forestry and Game Management Research Institute

GCU - Genetic conservation unit (units) = gene base (bases)

Basic material - units of approval for the production of forest reproductive material

CBD - Convention on Biological Diversity

NFR - Natural forest region

ERMA2 - Czech database on forest reproductive material, basic material, GCU, Certificates, Master Certificates and other.

1 Value and importance of forest genetic resources

1.1 Forests and forestry in the Czech Republic (Czechia)

The Czech Republic (also known as Czechia) is a small, landlocked country in Central Europe. Its area is 78 871 km². The country is bordered by Poland to the North, Germany to the West, Austria to the South and Slovakia to the East. Its capital and largest city is Prague with 1.3 million inhabitants.



Fig. 1. - Location of the Czech Republic (Czechia) on google maps

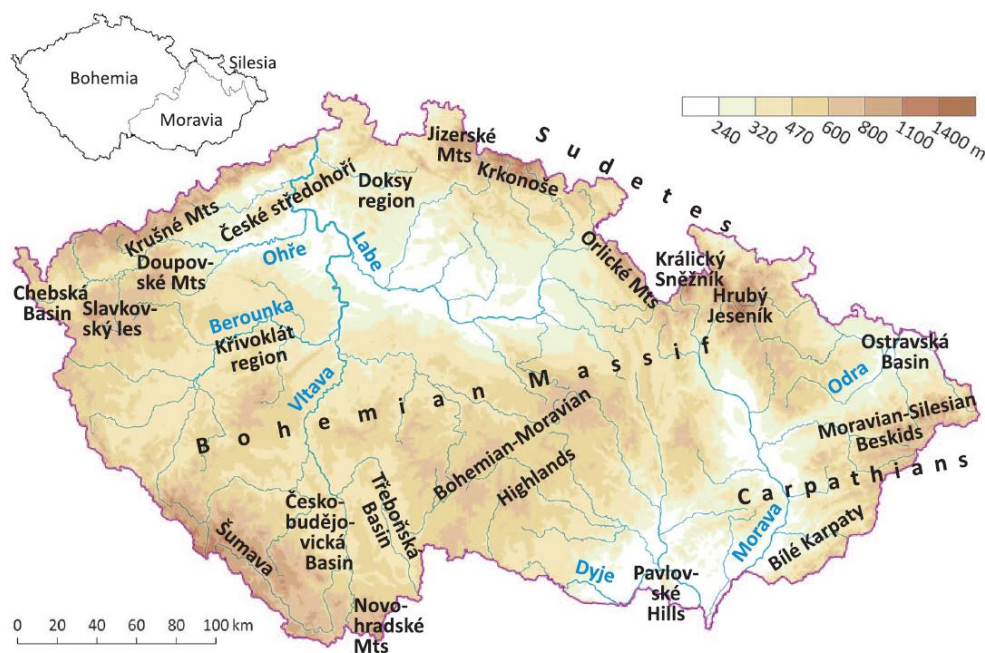


Fig. 2. - Basic topographic map and historical lands of the Czech Republic (Chytrý M., 2012: Vegetation of the Czech Republic: diversity, ecology, history and dynamics. Preslia 84: 427–504)

The Czech Republic includes the historical territories of Bohemia and Moravia and a small part of Silesia.

The territory of the Czech Republic can be subdivided into four ecoregions: The Western European broadleaf forests, Central European mixed forests, Pannonian mixed forests, and Carpathian montane conifer forests.

The Czech Republic has a temperate climate, situated in the transition zone between the oceanic and continental climate types, with warm summers and cold, cloudy and snowy winters. The temperature difference between summer and winter is due to the landlocked geographical position.

The territory of the Czech Republic is divided into 41 Natural Forest Regions (NFR) - these are areas defined during the survey of forest habitats on the basis of geological, climatic, orographic and phytogeographical conditions.

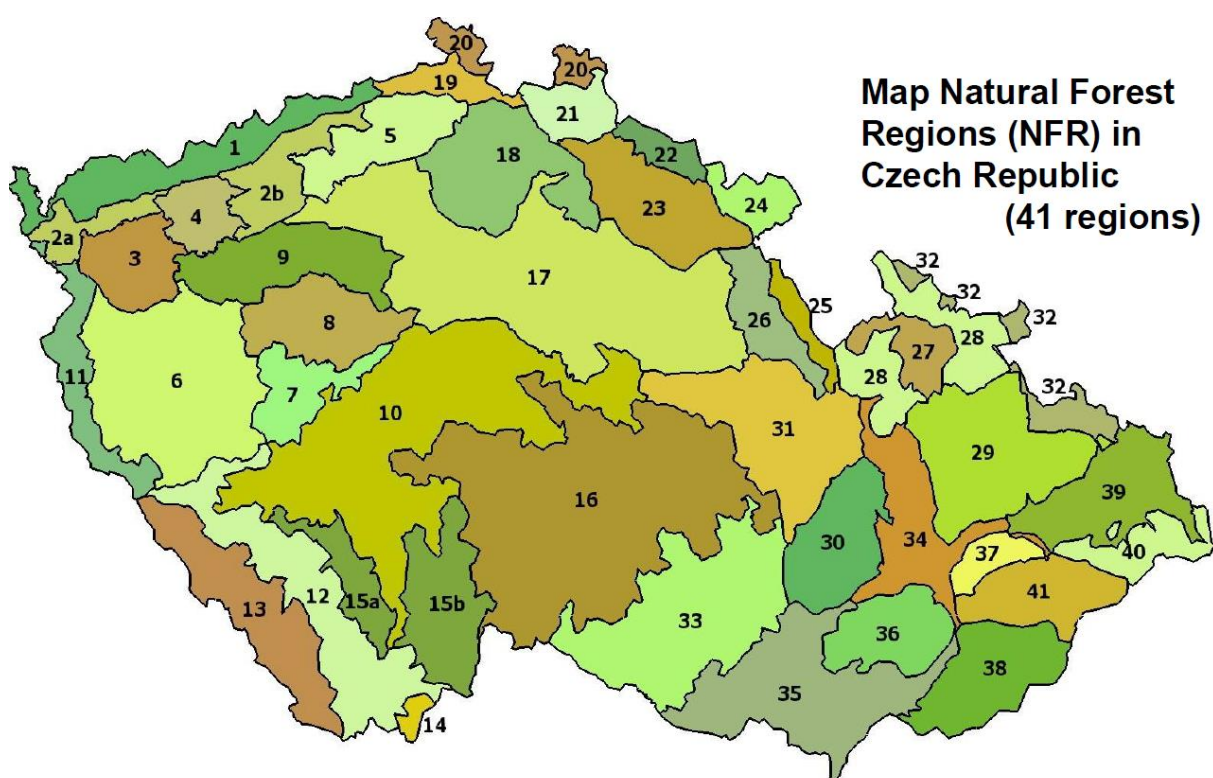


Fig. 3. - Map of Natural Forest Regions (NFR) in the Czech Republic (41 regions): 1. Krušné hory (Ore Mountains), 2. Podkrušnohorské pánve, 3. Karlovarská vrchovina, 4. Doupovské hory, 5. České středohoří, 6. Západočeská pahorkatina, 7. Brdská vrchovina, 8. Křivoklátsko a Český kras, 9. Rakovnicko-Kladenská pahorkatina, 10. Středočeská pahorkatina, 11. Český les, 12. Předhoří Šumavy a Novohradských hor, 13. Šumava, 14. Novohradské hory, 15. Jihočeské pánve, 16. Českomoravská vrchovina, 17. Polabí, 18. Severočeská pískovcová plošina a Český ráj, 19. Lužická pískovcová vrchovina, 20. Lužická pahorkatina, 21. Jizerské hory a Ještěd, 22. Krkonoše, 23. Podkrkonoší, 24. Sudetské mezihoří, 25. Orlické hory, 26. Předhoří Orlických hor, 27. Hrubý Jeseník, 28. Předhoří Hrubého Jeseníku, 29. Nízký Jeseník, 30. Dražanská vrchovina, 31. Českomoravské mezihoří, 32. Slezská nížina, 33. Předhoří Českomoravské vrchoviny, 34. Hornomoravský úval, 35. Jihomoravské úvaly, 36. Středomoravské Karpaty, 37. Kelečská pahorkatina, 38. Bílé Karpaty a Vizovické vrchy, 39. Podbeskydská pahorkatina, 40. Moravskoslezské Beskydy, 41. Hostýnskovsetínské vrchy a Javorníky.

Many Czech toponyms either do not have an English equivalent or the equivalent is rarely used and poorly known.

Tab. 1.1.1 Land types and area of forest land in the Czech Republic (according to the Cadastre)

Land type	Area (hectares as of 31 December 2020)	Percentage of the total
Arable land	2 931 713	37.17
Hops	9 548	0.12
Vineyards	20 179	0.26
Gardens	172 056	2.18
Fruit orchards	44 022	0.56
Permanent grassland	1 022 686	12.97
Forest areas	2 677 329	33.95
Water areas	167 248	2.12
Built-up areas and courtyards	133 277	1.69
Other areas	709 044	8.98
Total	7 887 102	100

1.2 Economic, environmental, social and cultural values

Economic Value

An analysis of economic developments in 2020 shows that the Gross value added (GVA) fell by 5.5% last year and the slump hit majority of branches (with the exception of agriculture and forestry, information and communication, and also the segment of public administration, education, health, and social work). Reduction of number of vacancies was in effect all-encompassing, the only positions which grew were positions for qualified workers in agriculture and forestry.

Tab. 1.2.1 Employees and wages in forestry

Indicator	Total
Average registered number of employees - actual persons	13 682
Average registered number of employees - full-time equivalent	13 371
of which: manual workers	6 353
Wages excluding other personnel expenses (thousand CZK)	5 560 889
of which: manual workers	2 018 887
Average monthly gross wage (per employee - actual person) (CZK)	33 870

The branches with the predominance of the government institution sector worked the most against the deeper fall of the GVA in the economy last year, especially in the second half of the year (+0.3 p.p.), when the demands on the outputs in health care grew as a consequence of the adverse epidemic situation. The same was also valid for information and communication. Still, the GVA grew here the least in the last eight years last year (+1.6%). The GVA of agriculture, forestry and fishing climbed up by nearly 5% last year and similarly to year 2019, it represented one of the most dynamic economic branches.

The Gross domestic product (GDP) of the Czech economy plunged by 5.6% in real terms in year 2020, which represented the most severe downturn in the existence of the independent Czech Republic. All GDP components contributed to the slump last year, the domestic consumption and investment the most. Q4 2020 itself was affected by further wave of measures against the spread of covid-19. The situation in forests was also reflected in the economic results of forest owners.

As a result of the significant overpressure of wood on the market, the prices of softwood also fell sharply. The economic results of all categories of forest owners (state, municipal and private) in 2019 and 2020 were the worst in modern history. Without contributions to forest management, the economic result of all categories of forest owners would be negative and the owners would not have the money for the necessary reforestation. The ongoing bark beetle calamity in the Czech Republic puts many forest owners in a difficult economic situation. State support is needed to give owners the money for the necessary reforestation after logging. Despite the threatening condition of some forests, the current situation is also an opportunity to change the shape of our forests so that they are more resilient to the effects of climate change in the future. Thanks to the setting of support and changes in legislation, the planting of deciduous trees in forests now significantly exceeds.

The continuing calamity in the forests in 2019 and 2020 is the main cause of record timber harvesting. The so-called "incidental extraction", caused by harmful factors (especially bark beetle, drought, wind, fungal diseases), in 2020 reached a record value of 33.912 million m³, which is 3.03 million m³ more than last year. Incidental logging represents 95% of total logging, which amounted to 35.754 million m³. Compared to the previous year, total extraction increased by 3.17 million m³.

Environmental, social and cultural value

Most forest land is owned by the state and is predominantly managed by the state company Czech State Forests (or also LČR). The company's main objective is to manage more than 1.2 million hectares of state-owned forest estates (54% of forest area of the Czech Republic and almost 83% of all state-owned forest estates). Private entities and municipalities represent other major forest owners. More substantial modifications in the ownership structure are to come in the following years as a result of restitution of forest property to Churches.

Tab. 1.2.2 Forest ownership structure

Ownership	Area of forest stands (%)
State forests	54
Forests owned by individuals	19
Forest cooperatives and associations	2
Forests owned by Churches and other religious entities	5
Municipal forests	17
Legal persons	3

Forests are the most visited natural environment areas. People in the Czech Republic like free movement in nature and in forests, they generally acquire affection for nature and wildlife. Right of Public Access or Freedom to roam in the Czech Republic gives the freedom to people for pursue outdoor recreational activities, pick berries and mushrooms regardless of forest ownership. Some prohibitions however include no entry of motor vehicles, prohibition of free movement of dogs, not to cut down trees or cause damage to a landowner's property or to objects or sites of natural, historical or heritage value.

The forests are used for the activity "Forest pedagogy", too. Groups of interested people, especially from schools, are guided through the forest by a forester and introduced to various forestry activities. They are taught to know the species of trees, plants and animals and their way of life. The international forestry competition YPEF - Young People in European Forest - also targets school pupils, 11 European countries are actively involved in this competition. The national coordinator of the competition in the Czech Republic is Czech Forestry Society (CFS - is an independent, non-governmental, non-profit, professional organization).

1.3 Contribution to sustainable development

The Government of the Czech Republic approved the Principles of State Forestry Policy and the conceptual documents based on them. In the selected cases, the forest owner is entitled to the provision of financial funds for activities and measures to achieve long-term objectives such as increasing biodiversity in forest ecosystems, their integrity and ecological stability and for sustainable forest management. The Government assists forest owners through a number of enumerated financial contributions and subsidies. The Czech Republic signed The Convention on Biological Diversity (CBD) on June 4, 1993 with approval December 3 of the same year. Signature of the country to the Cartagena Protocol on Biosafety was added on May 24, 2000.

The Ministry of Agriculture has announced the "National Programme for the protection and reproduction of the forest tree species gene pool" (for the period 2014–2018 and next period 2019–2027) and used to motivate owners of genetic resources to preserve, protect and enable their reproduction, through subsidies. The aim is to provide support for the conservation of forest genetic resources and the conservation of reproductive material resources of higher quality forest tree species or endangered species or populations.

The forestry strategy of the Czech Republic consists in sustainable forest management based on the maximum use of the power of nature, which will ensure sustainable and balanced production in the forest. The Czech Republic aims at creating stable, high-quality mixed forest with various spatial and age groups.

The forest is important both for the Czech economy and for the purposes of soil and water protection, including recreational use.



Fig. 4. - Genetic conservation unit (GCU) "Kaňkovy hory" with natural regeneration of beech

2 State of forests

2.1 State of Czech forests

Forests and forestry play a significant role in the Czech Republic and has a long history, being part of traditional industry there, too. The extension of forests in the total area of the Czech Republic ranks this country among the top in Europe. Forests cover 33.95% of the state's territory. Forest management is greatly diversified regarding that forests have apart from an economic and ecological function also an importance as place of relaxation, sports and health and in shaping the landscape.

2.1.1 Land area and protected forests

Land types and area of forest land in the Czech Republic is given in the Tab. 1.1.1, in Chapter 1. The Czech landscape exceedingly varies within its regions. From Bohemia in the west to Moravia in the East it comprises rolling plains, hills, and plateaus surrounded by mountains. The country's highest point is Mt. Sněžka at 1 603 m (5 259 ft) in the Krkonoše Mountains along the North central border with Poland. The Elbe River is the longest river in the country with a length of 1 154 km; it is located in the northwest and leads North to Germany.



Fig. 5. - Krkonoše Mountains

There are four national parks with an area of 1 190.18 km² in the Czech Republic. The oldest one is the Krkonoše National Park (Biosphere Reserve), and the others are Šumava National Park (Biosphere Reserve), Podyjí National Park, Bohemian Switzerland and 26 Protected Landscape Areas an 11 381.84 km² (7 of them are Biosphere Reserves) and another small-size specially protected areas in the Czech Republic. The overall acreage of forests in specially-protected areas is almost 7 310 km², which amounts to 27.2% of the total forest area. The natural site Jizera Mountains Beechwoods is on the UNESCO World Heritage List since 2021. It is the first domestic natural site on this list and covers an area of approximately 27 km².

2.1.2 Drivers of change in the forest sector, and their consequences for forest genetic resources

The total area of coniferous trees continues to decrease. In contrast the proportion of broadleaved trees is steadily increasing, particularly beech, oak and other broadleaved trees.

Mixing ratio of individual tree species within these units is consistently increasing in favour of mixed stands and stands with a predominance of broadleaved trees. This upward trend was also observed in the year 2020. This is the result of the foresters' sustained efforts to achieve optimal species composition of forests, which has been supported by the long-term targeted state subsidy policy.

The natural species composition was reconstructed as the composition of the natural forest communities that would have evolved without human intervention under the given natural conditions and the current climate.

The recommended tree species composition represents economically, ecologically and functionally optimised representation of tree species that guarantees a balanced fulfilment of the productive and non-productive functions of the forest. In the Czech Republic, there are 61.3% of coniferous stands, 10.8% of broadleaves stands and 27.9% of mixed stands, according to the area of the forest land.

Tab. 2.1.2.1 Species composition of forests

Name	Natural tree species composition	Actual forest composition	Recommended tree species composition
Beech	40.2	8.8	18
Pine	3.4	16.1	16.8
Oak	19.4	7.4	9
Fir	19.8	1.2	4.4
Elm	0.3	0	0.3
Ash	0.6	1.4	0.7
Maple	0.7	1.5	1.5
Linden	0.8	1.2	3.2
Larch	0	3.8	4.5
Norway spruce	11.2	49.6	36.5
Hornbeam	1.6	1.3	0.9
Birch	0.8	2.8	0.8
Alder	0.6	1.7	0.6
Other conifers	0.3	0.3	2.2
Other broadleaves	0.3	1.6	0.6
Unstocked forest area	0	1.3	0

Climate change, adaptation and mitigation are important for the Czech Republic forestry sector. Many problems, such as windfalls, infestations of the spruce bark beetle (*Ips typographus*) and

drought, have highlighted the need to create more resilient forests. At the same time, there is a high demand for timber resources.



Fig. 6. - Forest nursery “Pexídr s. r. o.” with planting stock of spruce clones for seed orchard

In other chapters, this report describes both *in situ* conservation and *ex situ* conservation of forests genetic resources, their use, genetic improvement, management, and institutional framework.

3 State of other wooded lands

3.1 State of other wooded lands

In the Czech Republic, it is compulsory to comply with the legislation on marketing of forest reproductive material (FRM), when the area (forest land), where the Forest Act is in force, is regenerated. This legislation of FRM solve the issue with afforestation or reforestation. In this Act, it is stated that when non-forestry land is afforested, it has to be done by using forest reproductive material suitable for the place of growth. This material is produced according to the rules on marketing of FRM. If the area is not forest land or meant to become as a forest land, but it is other forested land, the Forest Act or legislative of FRM is not applied to the production and use of the material. Non-forestry issues of other forested land belong to agricultural sector (agroforestry, energy production) or horticultural sector (greening, horticulture, gardening etc.). In the Czech Republic, there are species produced for non-forest purposes mainly used as ornamental species, or for tree planting in cities or gardens. Forest nurseries in the Czech Republic do not grow tree species used exclusively for non-forestry purposes.

Forests in alpine areas, in inaccessible places, on steep slopes and in swamps or peat bogs and in impenetrable areas have a protective function and there are also places with high biodiversity and the occurrence of endemic species of animals, plants and trees.

Therefore, such areas are often classified as special protection areas, national parks, small-size specially protected areas and genetic conservation units. The total area of forests in specially protected areas represents 27.2% of the total area of forests in the Czech Republic.



Fig. 7. - The Krkonoše Mountains and the neighbouring Jizera Mountains are one of the last two areas in our country with a relatively large blackgrouse population

4 State of diversity of forest trees

4.1 Tree species in terms of their basic material

The Czech Republic has basic material for 12 coniferous and 31 broadleaved forest tree species. Mainly basic material for *Picea abies*, *Pinus sylvestris*, *Larix decidua*, *Abies alba*, *Fagus sylvatica*, *Quercus robur* and *Quercus petraea*, it is managed or utilized for forestry. To the December 31, 2020, the registered reduced tree area was 65 253.41 ha of basic material category selected, source type "stand" in 6 171 units of basic material. Remaining forest tree species are used to a limited extent in forestry and that is why number of their basic materials is so few of the total (only 0.04 %). As a result of timber harvesting, particularly incidental bark beetle harvesting, there has been a noticeable decline in the area of basic material of the stand type category selected in some natural forest areas of Czech Republic in recent years. The greatest relative decline in the area of recognised units was recorded for spruce (17.6%), pine (11.3%) and larch (10.3%). For other tree species, the loss is less than 10 % of the area of the recognised unit, which can be considered normal.

For reforestation or afforestation in the Czech Republic, it can be used only reproductive material from Czech units of basic material. The exception are the giant fir and Douglas fir from selected areas of Canada or the USA, which can be used in the Czech Republic, if the rules of the legislation are followed.

4.2 Introduced forest tree species

Experimental plots with geographically non-native tree species were established 60 years ago. *Pseudotsuga menziensis*, *Abies grandis* and other species of the genus *Abies* and North American species of the genus *Picea* were tested. The second largest arboretum ('Sofronka' arboretum near Pilsner city in the West Bohemia) of the genus *Pinus* in the world was established. Subsequently, various test plots were established with different *Pinus* species using planting material from this 'Sofronka' arboretum. The vast majority of these test plots were established according to the IUFRO methodology, so they are mostly fully comparable with other international plots. The use of introduced tree species in reforestation and landscaping has been significantly restricted by legal measures after 1992, when Act No. 114/1992 Coll. on Nature and Landscape Protection came into force. §5, sentence 4 says that:

"The deliberate spread of a geographically non-native plant or animal species into the landscape is only possible with the permission of the nature protection authority; this does not apply to non-native plant species if they are managed according to an approved forest management plan or a forest management plan adopted by the forest owner. It is also prohibited to permit or carry out the deliberate spread of geographically non-native plant and animal species in national parks, protected landscape areas, national nature reserves and nature reserves."

Resolution H-1 /General Principles for the Sustainable Management of Europe's Forests/ of the Helsinki Conference and Resolution L2 "Pan-European criteria, indicators and guidelines at operational level for sustainable forest management" adopted at the Ministerial Conference on the Protection of European Forests in Lisbon are relevant in an international context. Whenever they are used as a substitute for native ecosystems introduced tree species are used, appropriate action should be taken at the same time to conserve native flora and fauna'. The use of geographically non-native species must therefore be based on the objective of increasing forest production while respecting the principle of not compromising biodiversity and the stability of forest ecosystems.

In the Czech Republic, the basic material of introduced tree species is also registered in database ERMA2.

Outside protected areas, many species of introduced trees are now commonly used in forestry. In forestry, the cultivation of suitable non-native tree species can contribute to increasing forest production and to some extent to increasing forest stability and biodiversity. Cultivation of selected non-native tree species can have a positive impact on the adaptation of forest stands to ongoing climate change.

4.3 Invasive forest tree species

Published lists of invasive forest tree species vary, each other. The view of them from a forestry or natural science point of view is different. Invasive species generally include species with significant negative impacts on biodiversity or on human economic activities. They can be a source of new diseases and pests and interbreed with native species, which is unwelcome. A species that is a troublesome invasive species in one place may behave quite harmlessly elsewhere. In the Czech Republic, there are lists according to the impact of the invasive species and the effort required to manage them using the precautionary principle (black, grey and warning lists). Invasive species in the Czech Republic include mainly *Ailanthus altissima*, *Acer negundo* and also *Quercus rubra*, *Robinia pseudoacacia*, *Pinus strobus*, *Pinus nigra*, *Populus x canadensis*. Attention should also be paid to the distribution of *Juglans regia* and *Aesculus hippocastanum*.

4.4 Protected forest tree species

The Czech Act No. 114/1992 Coll., on the Protection of Nature and Landscape, provides special and stricter protection to selected, rare or scientifically and culturally important species of plants and animals. According to the degree of threat to each species, three categories of protection are established, namely critically endangered, very endangered and endangered species. The basic material of protected tree species is also registered in database ERMA2. The number of basic materials for the species is given here in brackets:

Critically endangered species: *Sorbus sudetica* (0) and *Sorbus aria* (8)

Very endangered species: *Taxus baccata* (47) and *Juniperus communis* (1)

Endangered species: *Betula nana* (0), *Quercus pubescens* (7)

5 State of diversity within tree species

5.1 Non-native populations of native species

Non-native populations of native tree species are difficult to separate from native populations. The gene pool of native populations is thus continually being further degraded. It is necessary to build on existing knowledge, to maintain existing legislation, to pay attention to further provenance research and to favour the use of native populations through financial subsidies, even at the cost of greater difficulties (costs) in obtaining reproductive material. In addition to genetically unsuitable stands, whose phenotypic expression often includes reduced resistance to changing climatic conditions, it is often impossible in forestry practice to distinguish non-native populations and spontaneous hybrids of native species with geographically distant populations from native wild populations without costly molecular genetic laboratory analyses.

5.2 Learning and applying knowledge about the genetic quality of basic material

FGMRI has elaborated optimized methodological procedures DNA analyses by nuclear microsatellite markers for determination the clonal identity and receiving of genetic characteristics in some tree species populations (*Picea abies*, *Pinus sylvestris*, *Quercus petraea*, *Quercus robur*, *Fagus sylvatica*, *Ulmus* sp., *Abies alba*, *Tilia cordata*, *Prunus avium*, *Larix decidua*, *Betula pendula*, *Acer pseudoplatanus*, *Taxus baccata*, *Sorbus torminalis*, *Sorbus domestica*, *Pinus mugo*, *Pseudotsuga mensiesii*, *Betula pubescens*, *Alnus glutinosa*, *Populus alba*, *Populus nigra*, *Populus tremula*).

Selected polymorphic nuclear microsatellite markers proved suitable for finding the genetic parameters for verifying the clonal identity and levels of genetic diversity of different populations of forest trees. At phenotypically high-quality individuals, it will be possible to verify the genetic quality using the methodologies of DNA analyses and to select suitable individuals with sufficient diversity for the establishment of next propagation stands, such as e.g. the seed orchard. An important economic aspect of these methodological procedures leading to knowledge of the genetic quality of basic material is also the societal benefit. The use of sufficiently genetically variable source material for afforestation will result in more stable and resilient stands that will increase biodiversity, better adapt to potential climate change and thus contribute to environmental protection.

6 *In situ* conservation of forest genetic resources

6.1 State of *in situ* conservation

In the Czech Republic, almost 65 253 ha of forest are registered as *in situ* forest genetic resources of type selected stand, which is 6 171 stands, and there have been currently (to 31. 12. 2020) registered more than 133 genetic conservation units (GCUs), having been certified as autochthonous, or from other reasons considerable and valuable ecotypes of both coniferous and valuable ecotypes of both coniferous and broadleaved tree species (Norway spruce, Scots pine, European larch, silver fir, European beech, oaks sp., maple sp., crane sp., elm sp., etc.), in total area 70 229 for 16 species of tree species. It may be more target tree species within one GCU. In 2020, the area of declared GCUs increased by 350.69 ha. (Database ERMA2).

Genetic conservation units (GCUs) – one from the most important treatments having been realized in the Czech Republic for the most valuable forest tree species gene pool sources, including e.g. European beech, which has been initiated in the Czech Republic, having presented also as an example for another European countries, in frame of solution problems connected with preservation and reproduction of valuable forest tree species gene pool.

GCUs (also called Dynamic Genetic Conservation Units or gene bases) represent particularly valuable units from the genetic, seed management, silvicultural point of view, including production aspect, as well. Practically, GCUs represent the most valuable sets of forest stands, often valuable remains of original autochthonous populations of forest tree species, which have retained in more or less scale in the Czech Republic, up to now. In concordance with dynamic forest management principles, there should be applied “nature oriented” forest management procedures in these units, including maximal use of processes used to take place in forest ecosystems with aim to induce, stimulate and support their natural regeneration, among others.

6.2 Organization and management of *in situ* conservation units

In the Czech Republic GCUs present considerable base for reproductive material harvesting; GZ seed stands have been certified according national and EU legislative; these stands have been used for basic research aims, in frame of mass selection (testing of their progenies), as well of individual selection (parent trees, resp. clones, and their testing). The GCUs are installed in management forests and in protected areas (e.g. national parks, natural forest reserves), too. In management forests by specific silvicultural management measures loss of genetic diversity shall be avoided and natural regeneration shall be induced. Long regeneration periods should allow as many individuals as possible of different age and from different vertical and horizontal layers to pass their genes to the next generation. The selection of these *in situ* means was done to represent as many natural forest communities as possible. It was assumed, that the genetic diversity of the species in question was sufficiently captured in this way, by selecting populations from diverse natural forests areas. Natural forest areas are such areas, which are defined by forest habitat surveys on the basis of geological, climatic, orographic and phytogeographical conditions. The Czech Republic is divided into 41 natural forest areas.

In situ units are to conserve adaptability of these Czech forests, therefore GCUs should be distributed evenly among the territory of the Czech Republic.

GCUs are monitored and evaluated by Forest management institute experts every 10 years. Forest owners and the general public need to become better informed about the importance of these genetic conservation units (GCUs).

The existence and management of GCUs are supported by the National program of protection and renewal of forest tree genetic pool. The costs to the owner of GCU, which arise in connection with its

determination and management, are compensated for the eligible costs paid for achieving the objectives of the support program. The financial resources are allocated from the State budget.



Fig. 8. - *In situ* forest genetic resources of type selected stand CZ-2-2A-OL-00002-24-4-H (*Alnus glutinosa*)

Table 6.1 Forest species included to GCUs within *in situ* conservation.

Scientific name	Number of GCUs	Area (ha)
<i>Fagus sylvatica</i>	63	35 521
<i>Pinus uncinata</i>	2	217
<i>Pinus sylvestris</i>	15	7 416
<i>Quercus cerris</i>	1	574
<i>Quercus robur</i>	4	2 731
<i>Quercus petraea</i>	10	7 374
<i>Carpinus betulus</i>	1	3 325
<i>Abies alba</i>	16	12 548
<i>Ulmus glabra</i>	1	191
<i>Fraxinus excelsior</i>	4	2 012
<i>Acer platanoides</i>	1	191
<i>Acer pseudoplatanus</i>	10	4 504
<i>Pinus mugo</i>	4	3 937
<i>Tilia cordata</i>	4	2 033
<i>Larix decidua</i>	5	1 390
<i>Picea abies</i>	47	25 619



Fig. 9. - GCU No. G099-1 named „Káranice, Obora, Lišice” for *Quercus robur* and *Quercus petraea*

7 Ex situ conservation of forest genetic resources

7.1 State of and approaches used for *ex situ* conservation

Species of special value or endangered or other important populations and individuals may be better preserved and conserved by *ex situ* measures. This kind of conservation measure is static, because the gene pool of this genetic sources does not change over time. In the Czech Republic, different approaches for *ex situ* conservation have been applied.

The National Forest Tree Seed and Explant Bank

Long-term storage of seeds for the main tree species with orthodox seeds is done in The National Forest Tree Seed Bank. The National Forest Tree Seed Bank was established in the FGMRI, the Kunovice Research Station. The aim of this seed bank is to preserve *ex situ* populations of forest trees of all forest owners in the Czech Republic. The seed bank is located in separate building, which was built in 2014–2015. The amount of stored seeds for this purpose should be large enough to conserve the genetic diversity of the tree populations in questions. Preservation of genetic resources of forest trees *ex situ* is an "insurance" against the extinction of important forest tree populations. These measures are also becoming increasingly important in the context of climate change in Europe.

Tab. 7.1.1 Samples in the National Forest Tree Seed Bank

Scientific name	Number of different seed samples
<i>Pinus sylvestris</i>	5
<i>Larix decidua</i>	1
<i>Picea abies</i>	49



Fig. 10. - The National Forest Tree Seed Bank, FGMRI, the Kunovice Research Station

Vegetatively propagated plants (explant cultures) are cultivated for a long-term preservation in The National Bank of Forest Tree Species Explants in the FGMRI, Jíloviště.

Tab. 7.1.2 Samples in the National Bank of Forest Tree Species Explants

Scientific name	Number of different clone explant's samples
<i>Sorbus torminalis</i>	5
<i>Malus sylvestris</i>	35
<i>Ulmus minor</i>	33
<i>Ulmus glabra</i>	50
<i>Ulmus laevis</i>	27
<i>Tilia cordata</i>	106
<i>Prunus avium</i>	1

Explants of forest tree species are intended for the maintenance of the biodiversity of forest ecosystems, breeding purposes, the needs of forestry research and education, for the purposes of fulfilling international treaties concerning genetic resources to which the Czech Republic is bound, including the provision of samples on the basis of compliance with the principle of mutual provision of equal or similar benefits. Explant cultures are also used for the purpose of implementing projects to ensure the return of forest tree species population reproductive material to their original habitat or to other suitable habitats. In particular, clones of tree species whose generative reproduction are limited, or the particularly valuable endangered (e.g. endemic, relict) or other important genotypes of forest tree species are conserved in the explant bank.





Figures 11. - The National Bank of Forest Tree Species Explants, FGMRI, Jíloviště

The establishment of The National Forest Tree Seed and Explant Banks is associated with the announcement „National Programme for the protection and reproduction of the forest tree species gene pool” (for the period 2014–2018, is still running in the period 2019–2028).

Seed orchards

Using of seed orchards are another method of *ex situ* conservation. Each seed orchard is the result of a specific breeding programme, and the seed orchard is the production population (unit of basic material) as a result of this breeding programme. In the case of seed orchards establishment, we apply the principle of selection at the level of the individual (selection of the best trees, clones), not at the level of the population (stand), as in the case of forest stand registration. The gene pool of these selected individuals is then reproduced in the orchard according to certain rules (growing seedlings to establish the seed orchard from the vegetative parts of the selected clones).

Breeding programmes can be relatively simple, but they can also be more complex, consisting of several sub-steps, where the seed orchard is only one of the 'intermediate' products of the overall breeding objective. The objective of the breeding programme can vary, with common breeding objectives being the requirement for wood production (a combination of quantity and quality), or it can be one of a number of specific objectives such as increasing resistance to specific biotic or abiotic factors, programmes to conserve the gene pool of a particular tree species or population, etc.



Fig. 12. - Seed orchard CZ-3-3-TS-00196-40-4-T named „Libotín “of the species *Taxus baccata*. This tree species is classified by the legislation of the Czech Republic as a specially protected species in the category of highly endangered species.

In the past (1980s), the programme for establishing seed orchards in the Czech Republic was centrally managed within the state forests. Today, the establishment of seed orchards is managed by individual forest owners according to their own concepts and programmes. In general, it can be stated that in the conditions of the Czech Republic in the area of seed orchard establishment, rather simpler breeding programmes prevail (predominantly first-generation seed orchards) with the predominant aim of preserving and reproducing the gene pool of regional populations of tree species, often with an emphasis on the preservation of the gene pool. In the last decade, the focus has been on broadleaved tree species, for which it is expected that seed collection will be simplified.

Tab. 7.1.3 Seed orchards of forest tree species

Scientific name	Area of seed orchards ha)	Number of seed orchards
<i>Pinus uncinata</i>	1.32	2
<i>Pinus sylvestris</i>	88.93	26
<i>Pseudotsuga menziesii</i>	0.81	1
<i>Abies alba</i>	1.6	1
<i>Abies grandis</i>	2.34	1
<i>Pinus cembra</i>	4.65	1
<i>Larix decidua</i>	67.14	19
<i>Picea abies</i>	47.1	17
<i>Taxus baccata</i>	1.7	1
<i>Fagus sylvatica</i>	3.56	3
<i>Sorbus torminalis</i>	2.17	3
<i>Pyrus pyraeaster</i>	0.6	1

<i>Ulmus minor</i>	0.44	1
<i>Ulmus glabra</i>	8.74	6
<i>Ulmus laevis</i>	2.75	2
<i>Acer pseudoplatanus</i>	6.14	5
<i>Tilia cordata</i>	5.35	4
<i>Tilia platyphyllos</i>	1.35	1
<i>Alnus glutinosa</i>	1.33	1
<i>Populus tremula</i>	0.26	1
<i>Sorbus domestica</i>	0.87	1
<i>Prunus avium</i>	10.17	9

These seed orchards were created by propagating certain clones of endangered or other important genotypes of forest tree species, resulting in artificial populations. The seeds harvested in these orchards then have enhanced genetic diversity and can be used to produce reproductive material (plants), to actively conserve variation in these tree species. The seed orchard sites were chosen in a way to avoid pollen contamination by outside sources.

Clonal mixtures

Another type of protective measure is clonal mixtures. Clonal mixtures are collections of clones intended only for vegetative propagation and for the conservation and protection of clones of important genotypes tree species or the conservation of particularly valuable endangered (e.g. endemic, relict) populations of forest tree species. In 2020 was registered 23 clonal mixtures form 5 forest tree species.

Tab. 7.1.4 Clonal mixtures of forest tree species

Scientific name	Number of clonal mixtures
<i>Populus tremula</i>	1
<i>Picea abies</i>	12
<i>Populus nigra</i>	5
<i>Populus</i> spp. and artificial hybrids between those species	3
<i>Salix alba</i>	2

8 The state of use

The year 2020 was characterised by above-average seed production for almost all the main economic tree species. A total of 1 586 certificates of origin for seed material were issued by the authorised person (FMI) in 2020 according to the legislation rules.

8.1 Use of basic material and seed production

The potential based on the quantity and quality of basic material is high and their use for collecting seed material is still relatively low, but is increasing year-on-year. Basic material includes the following types: seed source, seed stand, seed orchards, parents of families, clone and clonal mixture. The minimum requirements to approve basic material in the categories source-identified, selected, qualified and tested are described in the annexes of the Council Directive 1999/105/EC.

The production and marketing of forest seed and plants within the EU is harmonized with the Council Directive 1999/105/EC⁹⁹ on the marketing of forest reproductive material and its implementation in national legislation.

Finding and recording quality forest reproductive material resources and using them for harvesting contributes to the reproduction of genetically richer and thus more stable stands that will increase biodiversity and better adapt to climate change, thus contributing to environmental protection. A better genetic production base increases the quantitative harvesting potential and contributes to the economic viability and competitiveness of sustainable forest management.

All seed produced in EU member states must come from officially approved and registered basic material. A Master Certificate is issued by the national competent authority to each seed lot after collection. The Master Certificate proves that seeds are collected from an approved basic material and include information on the type of basic material, phenotypic and genetic quality and origin of the material. To market forest reproductive material is a Master Certificate and a Supplier's Document required.

Table 8.1.1 shows the percentage of basic material for collection out of the total number of basic materials for the main forest tree species by basic material category.

Tab. 8.1.1 Percentage of resources used for collection out of the total by material category

Scientific name	Category of basic material		
	Identified	Selected	Qualified
<i>Picea abies</i>	0	1.25	0.03
<i>Pinus sylvestris</i>	0	10.53	5.94
<i>Quercus robur</i>	20.54	25.1	0.08
<i>Quercus petraea</i>	26.28	30.71	16.3
<i>Fagus sylvatica</i>	14.12	17.62	33.33

The next table shows the percentage contribution of the categories of basic material to the total amount of seed collected. The role and use of registered seed orchards and other qualified sources in the seed collection of forest reproductive material should be better.

Tab. 8.1.2 Percentage contribution of the categories of basic material to the total amount of seed collected

Scientific name	Category of basic material		
	Identified	Selected	Qualified
<i>Picea abies</i>	0	90.19	9.81
<i>Pinus sylvestris</i>	0	62.37	37.63
<i>Quercus robur</i>	66.61	33.38	0.01
<i>Quercus petraea</i>	57.73	42.25	0.02
<i>Fagus sylvatica</i>	62.89	37.01	0.10

The requirement of reproductive material of suitable origin has been increasing in recent years in view of the increased task of artificial reforestation in connection with the bark beetle calamity.

Tab. 8.1.3 Seed production (kg)

Scientific name	Seed production	Approximate annual need for cones /seeds
<i>Picea abies</i>	10 477	46 000
<i>Pinus sylvestris</i>	77 128	40 000
<i>Abies alba</i>	115 670	65 000
<i>Fagus sylvatica</i>	245 843	56 000
<i>Quercus robur</i>	569 816	85 000
<i>Quercus petraea</i>	429 573	55 000

Information about the quantity of harvested cones for conifers and the quantity of seeds for the broadleaved trees are in the table 8.1.3. The quantity of indicative annual need is calculated from the baseline of the balance of unstocked forest areas for the period outside the bark beetle calamity. After recalculation according to the actual unstocked forest areas in the ongoing bark beetle calamity, we then plan the necessary amount of seeds to plant seedlings for reforestation. Some of the unstocked forest areas will decrease during the year due to natural forest regeneration.

Tab. 8.1.4 Balance of unstocked forest areas in years 2018–2020 (ha)

ha	Year		
	2018	2019	2020
Indicator			
Area of unstocked forest areas as at 1 January	24 151	35 761	54 497
Total unstocked forest area increases over year	35 867	51 745	55 631
Due to:			

Fellings	27 824	43 501	47 538
Afforestation/reforestation losses	3 941	3 799	3 621
Natural disasters	4 102	4 445	4 472
Total unstocked forest area decreases over year	24 257	33 009	39 216
Due to:			
Afforestation/reforestation	21 013	28 449	33 351
Natural regeneration	3 244	4 561	5 865
Area of unstocked forest areas as at 31 December	35 761	54 497	70 912

8.2 Trade within the EU and import

International trade of reproductive material of forest tree species between the Czech Republic and EC Member States, or between the Czech Republic and third countries, began to be recorded centrally in accordance with the applicable legislation in 2004. Czech Republic exports and imports forest reproductive within Member States EU in accordance with article 16(2) of Directive 1999/105/EC and Commission Regulation (EC) No 1598/2002. To 31 December 2020 official body (Forest management institute) registered export 16 318.35 kg of pure broadleaved seed and 99.16 kg conifer seed (including 3 103.6 kg of cone seed material of *Abies alba*) for forestry purposes to Belgium, Sweden, Germany, the Netherlands, Austria, Great Britain, Poland and Slovakia. Imports as of 31 December 2020 totalled 22.00 kg of seed material of coniferous trees and 635.074 kg of seed material of broadleaved trees for contract growing. Export of seedlings from the Czech Republic to EC Member States was 1 249 448 pcs for forestry purpose to Germany, Austria, Poland and Slovakia. Of this quantity, 78.57% of the seedlings were of Czech origin. Import of seedlings into the Czech Republic for use for another purpose was 477 280 pcs of seedlings. Import of forest reproductive material from third countries to Czech Republic is realised with accordance Council Decision 2008/971/EC (direct imports into the EC zone). The direct import of forest reproductive material in 2020 was made from Canada in the amount of 126.593 kg of *Pseudotsuga menziesii* seed material and 20 kg of *Abies grandis* seed material for forestry purpose.

9 The state of genetic improvement and breeding programs

9.1 History and Development

Till the first half of seventies:

- Orientation aimed to collection of basic information about forest tree species
- Mainly: Phenotype variability and provenance tests

Individual phases:

- Certification, documentation and use of forest tree species reproduction material (plus trees, seed orchards and clone archives, certified forest stands and seed stands).
- Study of forest tree species genetic parameters (heritability, genetic correlations, general and specific combination ability).

Aim:

- To use obtained findings in the course of choice of appropriate breeding strategies and for breeding programs processing till their successful realization in current time.

9.2 New Trends

- **Relationship of continuing damage of forests' health condition:**
 - Forest tree species breeding aimed to their resistance
 - Study and application of biotechnology methods
 - Measures aimed to preservation and reproduction of forest tree species gene pool

9.3 Current State

- In the Czech Republic, there are solved problems of forest tree species breeding and improvement and gene pool preservation in all complex just in Forestry and FGMRI Jíloviště (www.vulhm.cz) in the long-term scale.
- It is based on main character of this Institute activities being mainly aimed to applied research, and partially to basic research, too.
- Other scientific and research work places (e.g. Prague and Brno Agricultural Universities, Research Institute of Decorative Gardening in Průhonice, Šumava Mts. National Park, etc.) used to solve just partial problems of forest tree breeding and improvement tasks. Research activities used to be often realized on co-operative level with other units, including FGMRI.

9.4 Main Orientation of Forest Tree Species Breeding and Improvement in FGMRI

Jíloviště:

1. Continuation of long-term breeding programs for both coniferous and broadleaved tree species.
2. Realization of research projects and measures aimed to both gene pool conservation and forest tree species biodiversity preservation with utilization of biotechnology and molecular biology methods (vegetative propagation by explant cultures, DNA and RNA analyses).
3. Testing of suitable introduced forest tree species, provenances and their mixtures.

Ad. 1. Continuation of long-term breeding programs for both coniferous and broadleaved tree species

- Testing of genetic heritability, abilities of adaptability, increasing of biomass volume and quality production, resistance against both biotic and abiotic factors, regarding of environment conditions changes.
- Provenance research of forest tree species.
- Hybridisation projects with aim to receive another information about genetic parameters (heritability, genetic correlations and information about combination abilities of tested variants) and improvement of valuable hybrid combinations to be used in forest practice.
- Testing of seed orchards and certified forest stands with aim to enlist the best units to the category of reproduction sources tested.

Ad. 2. Realization of research projects and measures aimed to both gene pool conservation and forest tree species biodiversity preservation

- Increasing of forest ecosystems stability and ensuring of their existence.
- Another aim, this is an optimization of methodological principles of both generative and vegetative reproduction of coniferous and broadleaved tree species gene sources with aim to protect and preserve gene pool with aim to ensure reproductive material of high quality to be used in forest practice. In case of vegetative propagation, micropropagation technologies (explant cultures) used to be used, too.

Ad. 3. Use of molecular biology methods (DNA and RNA analyses)

Study of forest tree species genetic variability, stability and adaptability, solution of some practical assignments (e.g. forest tree species genetic inventories, diagnostics and regionalization /zoning/ of forest tree species reproductive material).

Ad. 4. Testing of suitable introduced forest tree species, provenances and their mixtures

Possibilities of their use in changed climatic conditions, between others also with regards to specific extreme site conditions, including testing of possibilities aimed to preservation and reproduction of current forest tree stands with introduced tree species mixtures.

9.5 Brief survey of some results (examples)

Provenance research, hybridization experiments, gene pool preservation and reproduction:

- Evaluation of European beech provenance trials, recommendation to involve the best units to be used within the framework of regionalization (zoning) of this species reproductive material.
- Evaluation of research trials with progeny of European larch certified stands (Sudetic ecotype), recommendation to involve the best units to category of tested units.
- First results of evaluation of larch research trials with progeny from both inter- and intra-species hybridisation, preliminary recommendation to involve the best units to another breeding use.
- New findings about adaptability of European larch (Sudetic ecotype).
- Results of evaluation of the European larch provenance tests of series IUFRO 1958/59.
- Results of evaluation of European larch seed orchard progeny tests of series 1994 as the base for preliminary recommendation to involve the best units to the category of selected units.
- Evaluation of research trials with progeny of Norway spruce certified stands, recommendation to enlist the best units to category of selected units.
- Evaluation of Silver fir provenance trials, recommendation to involve the best units to be used within the framework of regionalization (zoning) of this species reproductive material.
- New criteria for elite tree and certified stands of forest tree species, worked out on the base of research results.
- Evaluation of research trials with progeny of Scots pine clones from selected seed orchards
- General strategy for preservation and reproduction of Noble Hardwoods gene sources have been worked out and presented.

- Optimization of micropropagation procedures for more than thirty species of forest trees and critically endangered plant species.
- Since 2015, the National Bank of Forest Tree Species Explants, which is part of the National Bank of Seeds and Forest Tree Explants, has been operated.
- Genetic screening of important forest tree species populations (Norway spruce, Scots pine, silver fir, European beech, pedunculate oak, sessile oak, elms) was carried out. In current time, DNA analysis procedures, using SSR markers in 23 forest tree species, are used.

9.6 Measures aimed to preservation and reproduction of forest tree species gene pool

In frame of current measures aimed to preservation and reproduction of forest tree species gene pool, there are research projects thematically aimed to the utilization of vegetative variants of resistant Ore Mountains Norway spruce in forest regeneration in the Ore Mountains, to identification of surviving individuals of some forest tree species in calamitous areas, their preservation and research of their resistance, to preservation of genetic resources of Ore Mountains resistant Norway spruce variants in the context of implementing measures to mitigate drought effects and ongoing environmental changes, etc.

9.7 Some examples of FGMRI international co-operation:

IUFRO – provenance research (Norway spruce, European larch, European beech);

EU – common research projects (Towards a European larch, TREEBREEDEX, COST, Copernicus /Biotechnology/, etc.);

Individual mutual projects with Germany, Poland, Canada, Japan, etc. (European larch, Japanese larch, Western larch, Silver fir, European beech).

9.8 Examples of research outputs realization of in forest practice

- Proposals to enlistment of verified sources of reproductive material to category E according EU classification.
- Proposals for using of both genetically valuable populations and verified improved varieties in forest practice.
- Proposals of treatments aimed both at increasing of forest ecosystems stability and improvement of forest stands volume production.
- Proposals of measures aimed at salvation and preservation of valuable and threatened populations in the course of maintenance of desirable level of biodiversity.
- Results of both current and another research activities have contributed to the solution of problems connected with alterations and renewals of forest tree species composition within the framework of expected potential climatic changes.

9.9 Prospects of forest tree species breeding and improvement in the Czech Republic - examples

- Another research of genetic variability of forest tree species.
- Application of modern diagnostic methods.
- Realisation of another hybridisation programs.
- Another research of vegetative ways of forest tree species propagation.
- To maintain research of early diagnostics (early tests).
- Use of results of research to refinement of reproductive material regionalisation (zoning).

10 Management of forest genetic resources

10.1 The using of genetically and morphologically suitable forest reproductive material

The using of genetically and morphologically suitable forest reproductive material in artificial forest reproduction and afforestation is a condition for improving the health of forests, conservation of biological diversity and the fulfilment of all production and non-production functions of forests. The genetic quality of reproductive material is of key importance to the success of a forest stand as it has a major influence in determining its adaptability, growth and wood quality. To ensure the success of any planting programme a regular and continuous supply of high-quality seed is vital. Only the best and most suitable material currently available should be used. Once a forest stand is established, it is difficult to remedy failures or substantial losses caused by poor seed selection.

10.2 Management of the gene conservation units

The selection, certification and management of the GCU were initiated by Dr. Jiří Šindelář (FGMRI) in the early 1970s, in co-operation with FMI. The research efforts have been carried out for analysing the geographical pattern of forest genetic diversity in the country and for establishing gene conservation units and tree breeding programmes, including provenance trials, seed orchards and clone archives. These efforts have further improved the management of forest genetic resources in the Czech Republic. The gene conservation units (also called "gene bases") harbour particularly valuable genetic material and they are often also managed for wood production or identified as seed sources. The gene conservation units represent the most valuable forest stands, which are often remnants of autochthonous tree populations. "Nature-oriented" forest management practices mimicking natural disturbances are emphasized in the management of these units.

FGMRI is a public research institution based in Strnady 136. Its main task is a research activity to the extent of the Act no. 130/2002 Coll. on support of research and development from public funds and on amendment to some related acts. FGMRI promotes above all the research that is supported from public funds according to rules given by the law of the European Union. The prevailing part of FGMRI activities lies in a research focused on forest management as well as expertise and consulting services for state administration and forest owners. FGMRI is a departmental forestry research institution.

The registration of forest genetic resources and GCUs is the responsibility of the FMI today. This institute is coordinator of the National program of the protection and renovation of forest tree genetic pool, too. The FMI is a government organization established by the Ministry of Agriculture of the Czech Republic. The FMI maintains a central database with information about forests of the Czech Republic, forest management and hunting. The FMI operates as a service of the Ministry of Agriculture for forestry.

FMI manages a database of basic material named ERMA2, only in the Czech language <http://eagri.cz/public/app/uhul/ERMA2/Uj>. ERMA2 is national register of the basic material (seed stands, clones, parents of family, seed orchards and clone mixtures). The EU compiles national registers of the basic material for all EU Member States. This information as a "National lists of the basic material of forest reproductive material" is present and available on the EU web page FOREMATIS - Forest Reproductive Material Information System <http://ec.europa.eu/forematis/>. Geographical information data on forest genetic resources will be available in the European Forest Genetic Resources Information System (EUFGIS, <http://portal.eufgis.org>) through the project FORGENIUS, too.

The FORGENIUS project (The detailed content of the project can be found here: www.forgenius.eu), funded under the Societal Challenge 2 of the EU's H2020 programme, aims at a finer, deeper, and exhaustive characterisation of all forest genetic conservation units.

More data about the Czech Republic in the form data sets can be found by topic here: https://inspire-geoportal.ec.europa.eu/theme_selection.html?view=qsTheme. Explore all Member States' INSPIRE data sets by selecting an INSPIRE data theme.

10.3 Procedure for owners, collectors and suppliers

To have genetic resources considered for entry into the ERMA2, owners should contact the FMI who will inspected the specified selection criteria by a specialist. If it is considered suitable for registration, it will be issued with a basic material number and added to the database ERMA2. If it is considered unsuitable for registration, the owner will be provided with written reasons why it cannot be registered. Licensed collectors are required to inform the FMI in writing 15 days in advance of collection, provide information on the source to be collected, and the proposed starting and completion dates. Following collection, the collectors are required to provide information on the actual amount of material collected. Upon receipt of this information, an appropriate certificate will be issued. Without this certificate, material cannot be legally marketed for forestry use.



Fig. 13. - Cone collection of *Picea abies*

Material collected from the registered seed stands must be labelled with the basic material number and kept in separate lots at all times. It must be labelled with information on the species, provenance, origin and year of ripening (seed). Under this scheme, anyone selling seed, cones or cuttings is required to provide the buyer with a Supplier's Certificate that provides information on the origin of the material (number of the basic material) as well as other information on the quality and purity of the seed, when it was collected and how it has been stored. Nurseries should retain these documents and provide

seedling buyers with a certificate providing information on the category (selected or tested), provenance, origin, year of seed ripening, and period in the nursery seedbed.

In the case of identified reproductive material of *Fagus sylvatica*, *Quercus robur* and *Quercus petraea*, collection in basic material unit in the Czech Republic must take place from at least 10 trees within the unit. In the case of selected reproductive material of *Picea abies*, *Pinus sylvestris*, *Larix decidua*, *Fagus sylvatica*, *Quercus robur* and *Quercus petraea*, collection in basic material units in the Czech Republic must take place from at least 20 trees within the unit.

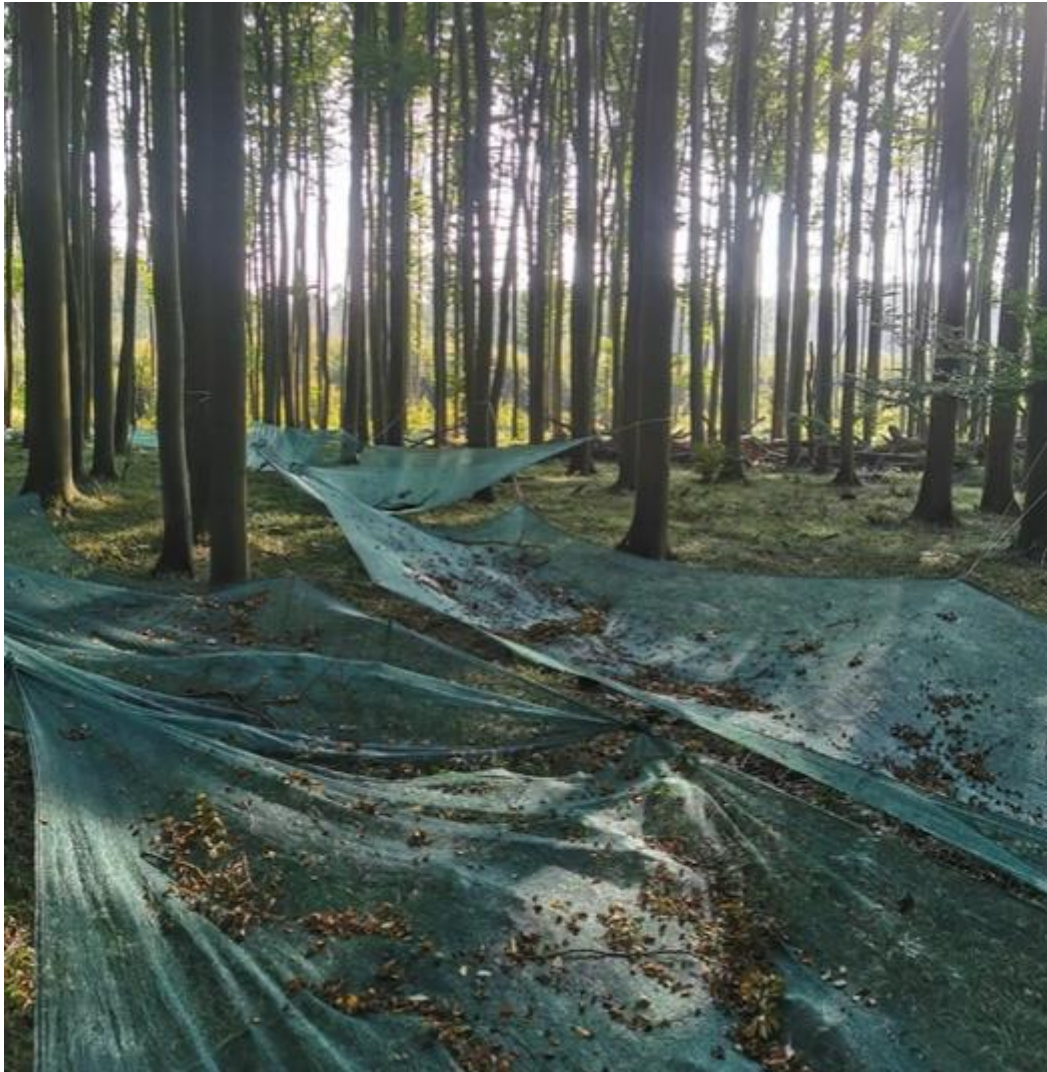


Fig. 14. Collecting seed material into a net placed under the trees

In the case of seed orchards in the Czech Republic, harvesting may be carried out only if at least 50 % of the clones in the seed orchards of *Pinus sylvestris*, *Larix decidua* and *Picea abies* and at least 30 % of the clones in the seed orchards of other forest tree species have been fertile.

The unpredictability of nature and the importance of obtaining the best quality seed requires making the most of good seed years. This means building up a stock of the best available seed for several years to come. Given current knowledge, most seed, with the exception of oak and beech can be stored for several years without a loss viability. Use of this scheme provides for a very simple way to improve the genetic and productive quality of Czech forests. Most seed are processed and stored in the State-owner Company, Seed Plant Centre at Týniště nad Orlicí. Seed plant provides all forest owners with professional services in conifer extracting, deciduous tree processing, seed cleaning, sorting and

dressing, short-term and long-term seed storing including pre-sowing preparation and laboratory analyses. The seed remains in clients 'ownership all the time. They are responsible for its origin which shall be documented by Master certificate of origin at seed delivery.



Figures 15. - Seed Plant Centre at Týniště nad Orlicí, watch the video guide on Youtube:
https://www.youtube.com/Seed_Plant_Center_CZ

11 Institutional framework for the conservation, use and development of forest genetic resources

11.1 National coordination

Description of the current state of capacities and policies such as regulations and other instruments related to the conservation, use and development of forest genetic resources in the Czech Republic. Some of the capacities and tools have been covered in previous chapters in this report:

- National program of the protection and renovation of forest tree genetic pool
- Principles establishing the conditions for granting aid for the protection and reproduction of forest tree genetic resources based on §2j of the Act No 149/2003 for the period 2019 – 2027
- Supports for forestry from EU resources
- Supports for forestry from Ministry of Agriculture resources



Fig. 16. - Bark beetle gallery

- The Concept of the State Forestry Policy until 2035

In 2020, the Government of the Czech Republic approved the Principles of State Forestry Policy and the conceptual document the "Concept of State Forestry Policy until 2035". This Concept of the State Forestry Policy responds to the current state and situation and it presents the basic strategy of the forestry sector. The material has been approved by the Government and it focuses on the Czech forestry as a whole. The concept itself was prepared by a working group composed of members of the Ministry, forestry associations, universities, regions, municipalities and non-governmental organisations. The aim of the concept is to set priorities in forest management so that the forest continues to fulfil its economic, environmental and social functions. The concept will be used e.g. for the preparation of legislation, subsidies, or to identify common tasks of ministries and professional

institutions. The concept reflects the current challenges arising in particular from the bark beetle calamity and the current situation on the raw timber market.

11.2 Main institutions

The Czech forest sector in the broad sense consists of a large number of actors and can be described in several ways, for instance: forest owners, government agencies, non-governmental organizations, universities and research institutions.

Tab. 11.2.1 The main institutions involved with conservation and use of forest genetic resources in the Czech Republic

<p>Ministry of Agriculture Těšnov 17 117 05 Praha 1 info@mze.cz www.eagri.cz</p>	<p>The Association of Municipal and Private Forest Owners in the Czech Republic K Silu 1980 393 01 Pelhřimov info@svol.cz; www.svol.cz</p>
<p>Forest Management Institute Nábřežní 1326 250 01 Brandýs nad Labem podatelna@uhul.cz www.uhul.cz</p>	<p>Ministry of the Environment Vršovická 1442/65, 100 10 Praha 10 info@mzp.cz www.mzp.cz</p>
<p>Forestry and Game Management Research Institute, v. v. i. Strnady 136, 252 02 Jíloviště admin@vulhm.cz www.vulhm.cz</p>	<p>Nature Conservation Agency of the Czech Republic Kaplanova 1931/1 148 00 Praha 4 - Chodov aopkcr@nature.cz http://www.nature.cz</p>
<p>Forestry and Game Management Research Institute, v. v. i. The Forest Research Station at Opočno Forest nursery control, accredited laboratory Na Olivě 550; 51773 Opočno info@vulhmop.cz</p>	<p>The State Agricultural Intervention Fund (SZIF) Ve Smečkách 33 110 00 Praha 1 info@szif.cz https://www.szif.cz/en</p>
<p>Forestry and Game Management Research Institute, v. v. i. Department of Reproductive Sources in Kunovice, Seed testing accredited laboratory Na Záhonech 601; 686 04 Kunovice kotrla@vulhmuh.cz</p>	<p>Lesy České republiky, s. p. (Forests of the Czech republic) Přemyslova 1106/19 500 08 Hradec Králové lesycr@lesycr.cz www.lesycr.cz</p>
<p>Czech University of Life Sciences Prague Faculty of Forestry and Wood Sciences Kamýcká 1176, 165 21 Praha 6 – Suchbátka http://www.fld.czu.cz/ rinn@fld.czu.cz</p>	<p>Vojenské lesy a statky ČR, s. p. (Military Forests) Pod Juliskou 1621/5 160 00 Praha 6 info@vls.cz www.vls.cz</p>
<p>Mendel University in Brno Faculty of Forestry and Wood Technology Zemědělská 3; 613 00 Brno www.ldf.mendelu.cz/ info.ldf@mendelu.cz</p>	<p>The National Forest Tree Seed Bank The National Bank of Forest Tree Species Explants Contact: =Forestry and Game Management Research Institute</p>

The policy area concerning keeping of forest genetic resources variability began in 1993 with the Convention on Biological Diversity. By this step, it was created the foundation for individual states to

take responsibility themselves to conserve and sustainably use genetic resources. In 2014, the Nagoya Protocol came into force, together with an EU regulation on measures for compliance of owners and users with the Nagoya Protocol. There are also national provisions of genetic resources. The fulfilment of the conclusions of the Forest Europe Ministerial Conferences, objectives of the updated State Environmental Policy of the Czech Republic, the Strategy for the Protection of Biological of the Czech Republic for the period 2016–2025 and the Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030, it is ensured by the National program of the protection and renovation of forest tree genetic resources 2019–2027.

11.3 Legal basis for the protection and reproduction of forest tree genetic resources

- Act No 149/2003 Coll., on p (in Czech *"Zákon č. 149/2003 Sb., o uvádění do oběhu reprodukčního materiálu lesních dřevin"*);
- Decree No 29/2004 Coll. as the implementing decree of the Act No 149/2003 Coll.
- Decree No 393/2013 Coll. on lists of forest tree species (in Czech *"Vyhláška č. 393/2013 Sb., o seznamech druhů lesních dřevin"*);
- Decree No 132/2014 Coll., on protection and reproduction of forest tree genetic resources (in Czech *"Vyhláška č. 132/2014 Sb., o ochraně a reprodukci genofondu lesních dřevin"*);
- Act No 218/2000 Coll., on budgetary rules (in Czech *"Zákon č. 218/2000 Sb., o rozpočtových pravidlech"*);
- National program of the protection and renovation of forest tree genetic resources 2019–2027 (in Czech *"Národní program ochrany a reprodukce genofondu lesních dřevin na období 2019–2027"*);
- Principles establishing the conditions for granting aid for the protection and reproduction of forest tree genetic resources based on §2j of the Act No 149/2003 for the period 2019–2027 ("Principles") (in Czech *"Zásady, kterými se na základě § 2j zákona č. 149/2003 Sb., o obchodu s reprodukčním materiálem lesních dřevin, ve znění pozdějších předpisů, stanovují podmínky pro poskytování dotací na ochranu a reprodukci genofondu lesních dřevin na období 2019–2027"*),
- Act No. 289/2005 Coll. - Forestry Act (in Czech *"Zákon o lesích"*),
- Act No. 114/1992 Coll. on nature and landscape protection (in Czech *"Zákon o ochraně přírody a krajiny"*),
- Act No. 326/2004 Coll., on plant health care, as amended (in Czech *"Zákon o rostlinolékařské péči"*), and related Decree No. 215/2008 Coll., on measures against the introduction and spread of harmful organisms of plants and plant products (in Czech *"Vyhláška o opatřeních proti zavlečení a rozšiřování škodlivých organismů rostlin a rostlinných produktů"*),
- Act No. 78/2004 Coll., on the handling of genetically modified organisms and genetic products (in Czech *"Zákon o nakládání s geneticky modifikovanými organismy a genetickými produkty"*).

11.4 Forest Certification

One of the most effective market-based instruments designed to promote the principles of sustainable forest management, it is Forest Certification. This is a process whereby an independent organisation issues a certificate confirming that forest management meets predefined criteria for sustainable forest management. Through the certificate, the forest owner declares its commitment to manage according to the predefined criteria. The current requirements for forest use are not just about timber harvesting, but about the broad complex of social, ecological and economic functions of forests related to the sustainable use of natural resources. In the Czech Republic, this concerns two certification systems - the FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification schemes).

- In 2020, 35.8 million m³ of wood under bark have been harvested in the Czech Republic. Almost all of the timber harvested comes from incidental logging (94.8%), which includes the elimination of bark beetle calamity in the forests of the Czech Republic. Coniferous trees were mainly harvested (96.5 %). The most important species were Norway spruce (90.3 %), Scots pine (4.2 %) and European beech (1.6 %). The area of afforestation (planting and sowing) also increased significantly. Compared with the previous year, there was an increase of 5 000 ha to 33 671 ha. Norway spruce (30.7 %), E. beech (23.8 %), oaks (16.4 %) and S. pine (7.4 %) were the most used species for afforestation. 205.6 million seedlings were used for planting (62.6 % of which were deciduous trees). The area under natural regeneration increased by 1 391 ha to 6 615 ha (+26.6 %), with slightly predominating conifers (53.1 %).

12 Cooperation on forest genetic resources

12.1 National or regional cooperation

National or regional cooperation in the field of forest genetic resources includes research, development of new projects, new research methods and analyses, publishing activities, presentation of research results, forest pedagogy and participation in seminars. National and regional organizations of forest genetic resources owners and managers also support each other in control activities, services, pest monitoring and the mutual provision of digital data and the sharing of research statistics.



Fig. 17. - Thies tree (*Pseudotsuga menziesii*) was damaged by a deer *Cervus nippon*

The regional cooperating institutions also provide important strategic documents or documents presenting the status of forest genetic resources in the Czech Republic for further activities and planning by the government. National cooperation on forest genetic resources is generally good.

12.2 International cooperation

Cooperation with one or a few countries in smaller research studies is common in the field of forest genetic resources research. Realization of research projects and measures aimed to both gene pool conservation and forest tree species biodiversity conservation in the international field, this is included among activities of the FGMRI Jíloviště (<https://www.vulhm.cz/en/>) and Universities in particular. For more information on the projects, see Chapter 9 and the websites of the institutions:

<https://www.vulhm.cz/en/activities/research-projects/>

Within the EU and OECD, there are cooperation and a continuous harmonization of regulations and definitions concerning the production and trade of forest reproductive material.

12.3 Benefits of the cooperation

Support and cooperation in the field of forest genetic resources, this is important for decision-making on national policies for sustainable management of forest genetic resources. The intention is to implement and communicate these policies to enable more sustainable use of forest genetic resources, e. g. through advisory services for forest owners.

The need for cooperation is becoming more important as adaptation to climate change and to the occurrence of harmful agents is integrated into forest policy, forestry and forest genetic resources at EU, European and global level. The Czech Republic will also welcome the input of knowledge from other countries.



Fig. 18. - Technology in a large production forest nursery

12.4 Providers of research projects

Funding for projects can come from a variety of possible sources. Ongoing projects have the following providers:

- Ministry of Agriculture
- GS LČR - Grant Service of the State Forests of the Czech Republic - support from the Forests of the Czech Republic directs towards the practical application and use of the results of the research projects, and possibly towards full financing or partial coverage of the required contractual co-financing rate set by the providers.
- NAZV (National Agency for Agricultural Research) - ensures the complete preparation and announcement of the Ministry of Agriculture's departmental research programmes, the announcement and conduct of public tenders and the subsequent administration of funded projects in the field of agricultural, food, forestry and water management research.
- TA ČR - The Technology Agency of the Czech Republic simplifies the state support of applied research and experimental development

Tab. 12.4.1 Actual research projects

Project Code	Name of Project	Provider	Year
SOD O-1/2019	Differentiation of forest sites and management of pine, oak and beech stands to reduce unfavourable impacts of the environmental changes	GS LČR	2019–2021
QK21020386	Categorization and optimization of management of hydromelioration districts to increase the retention function of the forest	Ministry of Agriculture	2021–2023
QK21020371	Sustainable management in small-owner forest estates	Ministry of Agriculture	2021–2023
02-6670	Ensuring long-term monitoring of small forest catchments	Ministry of Agriculture	2019–2022
QK1920184	Research and verification of the effectiveness of available technical and biological means and procedures for the prevention of African swine fever spread in the wild boar population in the Czech Republic	Ministry of Agriculture	2019–2021
QK21010335	The potential how to employ European larch in the Czech forests under GCC	NAZV	2021–2024
QK1910292	Approaches for supporting silver fir in managed forests in the Czech Republic	NAZV	2019–2023
QK1920406	Biotic aspects of pine forest dieback in areas affected by drought	NAZV	2019–2021
QK1920328	Complex solution of forest restoration and silvicultural management in regions with fast large-scale forest decline	NAZV	2019–2021
QK1920163	Development and verification of spatial models of forest soil properties in the Czech Republic	NAZV	2019–2021
QK1920433	Influence of protective measures to populations bark beetles according on population density	NAZV	2019–2021
QK1810415	Influence of forest stands species composition and structure on the microclimate and landscape hydrology	NAZV	2018–2022
QK1810258	Proposal of alternative tree species composition for forest ecosystems with reduced ecological stability due to physiological dryness	NAZV	2018–2022
QK1810129	Proposal of methodological procedures for implementation of the control system for declared origin of reproductive material by DNA analysis for selected important forest tree species used for artificial forest renewal in conditions of the Czech Republic	NAZV	2018–2022
QK1820091	Forest Management in Areas Affected by Long Term Drought	NAZV	2018–2021

SS03010134	Tree-ring database as a tool for description and prediction of responses of the main forest tree species to climate change	TA ČR	2021–2024
SS01020076	Preservation of genetic resources of Ore Mountains resistant Norway spruce variants in the context of implementing measures to mitigate drought effects and ongoing environmental changes	TA ČR	2020–2024
SS01020260	Research and protection of the genetic diversity of the valuable remaining populations of Norway spruce in relation to adaptation to increased climate extremity	TA ČR	2020–2024
SS01010574	The quantification of the effects of drought on forest tree species across climatic gradient of the Czech Republic	TA ČR	2020–2023
TH04030217	Fertilizers with zeolite for forestry industry	TA ČR	2019–2022
TH04030524	Model of conservation and development of habitat and population of <i>Tetraonidae</i> in the Králický Sněžník area	TA ČR	2019–2022
TH04030346	Optimization of fertilization and management systems of forest nursery soils – second stage	TA ČR	2019–2022
TH04030444	Tools and measures to minimise damage to the roots of nursery plants after planting caused by wild boar	TA ČR	2019–2022
TJ02000217	Characterization of selected poplar species and their drought resistance using next generation sequencing	TA ČR	2019–2021
TJ02000128	Determination of the vertical mobility of heavy metals in forest soils as a basis for the optimization of tree species composition to reduce the risk of their transfer to edible mushrooms	TA ČR	2019–2021
TO01000345	Forest functions in the past, present and future – what can society expect from forests under climate change?	TA ČR – Kappa, Norwegian Funds	2021–2024

13 Recommended actions for the future

13.1 The action needs

- Ministry of Agriculture still should address and integrate forest genetic resources in future policies, strategies and extension activities concerning sustainable forest management and biodiversity conservation. Financial support for forest owners is essential if they are to follow the strategies in their management. Address to the government, universities and research institutions should be research needs concerning the use and management of forest genetic resources.
- Forest management institute will manage database of basic material, national register of forest genetic material, named ERMA2.
- FGMRI will develop forest tree breeding programs for additional tree species and work actively with the issue of resistance to problematic forest pests and for facilitate the choice of suitable forest reproductive material for a changing climate. The activities, strategies and support of the Ministry of Agriculture, together with the findings of the FGMRI, should result in the interest of forest owners to adapt forests to better cope with predicted climate change and increased forest damage.
- Forest owners should promote biodiversity by establishing and planting forests with a greater diversity of tree species. For reforestation and afforestation, forest owners will select the right forest reproductive material for the site conditions. To make the right choice, there should be enough basic material with information on them and on the availability of material in the ERMA2 database.
- When collecting material, growing in forest nurseries and trading material, there have to be kept compulsory prescribed legislation. Information on the origin contributes the forest reproductive material evaluation in terms of production, environmental aspects and such information has great value for forest owners, tree breeders, researchers and authorities.

13.2 Everyone working together for resilient forests

For the future, it is still necessary to search for new high quality and valuable genetic resources, to protect them in situ, to conserve ex situ, to promote research, to carry out information collection and database maintenance on genetic resources and to use the right reproductive material for reforestation and afforestation. All this have to be kept in line with strategies and knowledge leading to sustainable forest management, biodiversity conservation, adaptation and mitigation of climate change impacts.

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Photos are from the FMI and FGMRI photo collection.