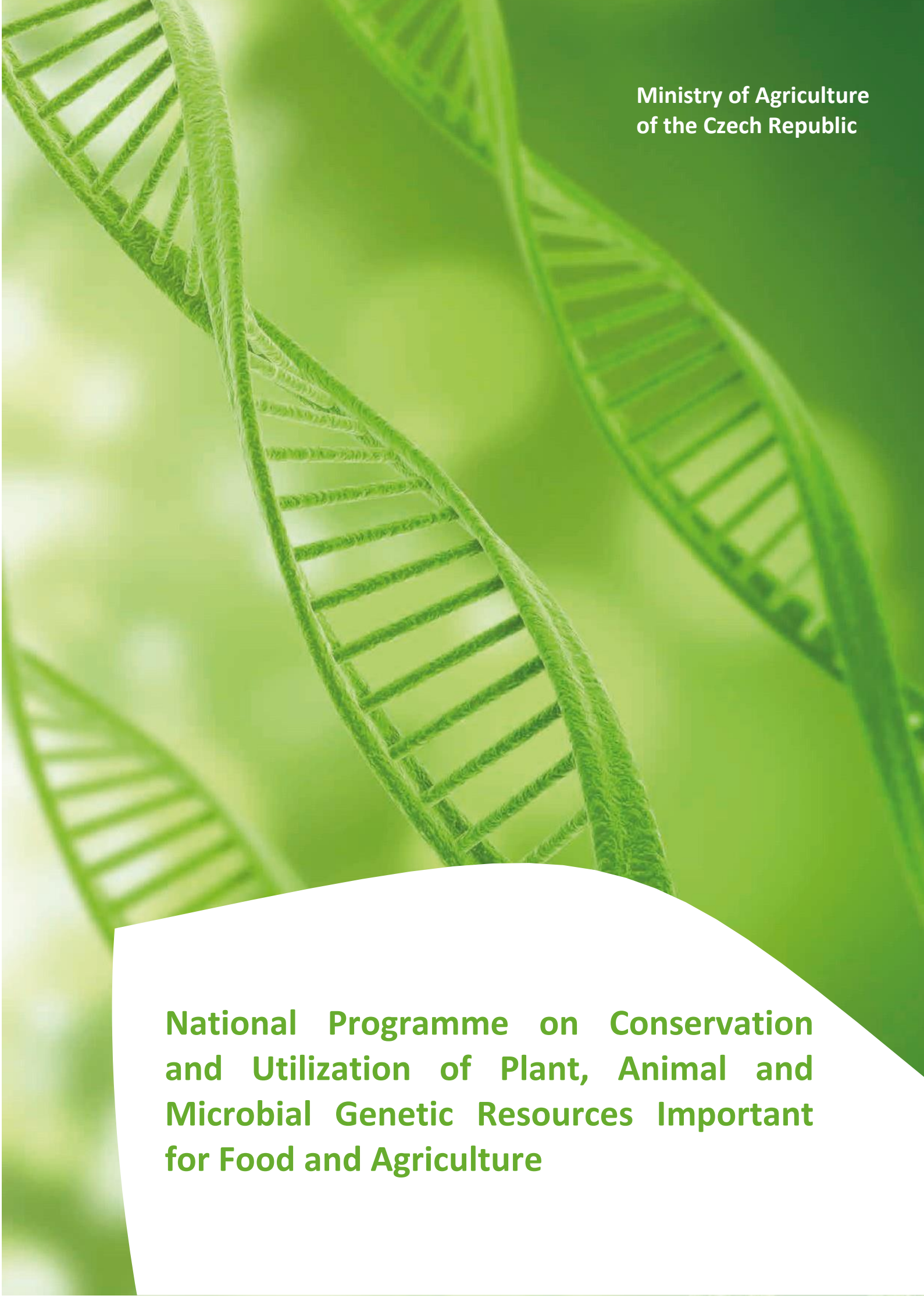

Ministry of Agriculture
of the Czech Republic

National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Food and Agriculture

The National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Food and Agriculture for the period 2018–2022 was prepared by the team of authors led by the Ministry of Agriculture, which included experts from the Ministry of Agriculture, Crop Research Institute, Institute of Animal Science and other external experts and consultants.

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Dear readers,

We are delighted to present you the updated National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Food and Agriculture for the period 2018–2022.

The intensification of agriculture since the 1950's has considerably narrowed the spectrum of plants and animals used in conventional agriculture in the Czech Republic. Modern high-yielding plant varieties and highly productive animal breeds have begun to predominate in agriculture. The current agricultural system is likewise highly dependent on man-made energy in the form of fertilizers, feeds and application of plant protection products and pharmaceuticals.

However, with the gradual globalization of agriculture and due to overall decline in natural habitats, biodiversity of crops and animals has been reduced worldwide. If we realize that the global agricultural food production currently depends on about ten species of plants and five species of domesticated animals, this low level of diversity poses a real risk for the future sustainability of agriculture.

The overall reduction of diversity of cultivated plants and farmed animals, eutrophication of the landscape and the high use of chemical inputs cause further reduction of diversity of other organisms dependent on agroecosystems, e.g. invertebrates, such as pollinators, insect antagonists, predators and microorganisms. Soil microorganisms and other edaphon play a key role in the soil-forming process and influence the properties that determine soil fertility. The impact of these negative changes on agriculture is significantly enhanced today by the effects of climate change and the deterioration of other environmental components such as the quality of soil, surface water and groundwater.

One of the answers to these current challenges is to continue with research and breeding of plant varieties and animal breeds that may have a slightly lower yield and production figures but are more resistant to the effects of climate change, new pests and diseases and do not need for their prosperity such high level inputs of chemicals and energy.

A sufficient number and a wide spectrum of genetic resources in genebanks and field collections and especially the knowledge of their properties provide a solution to the above-mentioned problems. Within the system of the National programme the genetic resources and information obtained through their evaluation can be maximally used for further research, breeding and education.

We are convinced that the long-term conservation, description and sustainable use of a wide range of genetic resources are the key elements for ensuring the future food security.

Section of Agricultural Commodities and Organic Farming

Table of contents

The National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Food and Agriculture for the period 2018–2022

1. Introduction

The Ministry of Agriculture of the Czech Republic (MoA) announces the National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Food and Agriculture (National Programme, NPGR) for the period 2018–2022.

The updated National Programme builds on previous twenty years of successful programmes for the conservation of genetic resources (GR) for food and agriculture, and in particular the preceding phase 2012–2017. In the previous period, the National Programme primarily focused on evidence and conservation of genetic resources, identification and elimination of duplication and rationalizing of the work. The new National Programme focuses on the growing need for the evaluation and characterization of genetic resources, knowledge about genetic diversity and identification of particularly valuable genotypes, especially as donors of various traits of resistance.

The National Programme for the period 2018–2022 is based on these current needs: (1) – long-term conservation of a sufficiently large diversity at the gene and properties level of organisms important for nutrition, agriculture and food security; (2) – ensuring the quality service for the recipients and users of genetic resources in the area of research, breeding, education and a number of other fields. The importance of conserving genetic resources and their practical use is increasing with rapid advances in genetics and biotechnology and, in particular, with the need to quickly respond to the adverse impacts of climate change and the changing conditions of other environmental components.

The National Programme covers a wide range of organisms. It includes over 50,000 conserved plant genotypes, including modern varieties, old cultivars and landraces and crop wild relatives. It includes selected autochthonous or domesticated animal species and breeds that were not bred for intensive production of livestock commodities and still retain valuable original properties and characteristics. The National Programme also contains pathogenic microorganisms that naturally occur on crops and livestock in the Czech Republic (CR), as well as microorganisms important for nutrition and other applications in the agricultural and food sector. The NPGR involves also specific species of insect and other invertebrates important for agriculture.

Preserving a large extent of agrobiodiversity is conditioned by the effective cooperation of state administration bodies, research institutions, universities and private and non-governmental entities. Therefore, one of the main objectives of the National Programme is to create the basic conceptual framework for the period of 2018–2022, which defines the priorities in the field of conservation and sustainable use of agrobiodiversity in the CR and sets out specific tasks and activities for entities that participate in the implementation of the National Programme.

The National Programme reacts to the growing importance of international cooperation and emphasizes the joint responsibility of states to protect the world's natural wealth. The standardization of work in accordance with the internationally adopted practices is therefore a precondition for the effective international cooperation. The National Programme is therefore linked to a number of national strategic and legal documents and its priorities take into account the existing international commitments as defined within the Sustainable Development Goals 2030, documents adopted by the UN Food and Agriculture Organization (FAO), Strategic Plan of the Convention on Biological Diversity (CBD) to 2020, EU Biodiversity Strategy to 2020, etc.

2. The definition of biological diversity

Biological diversity (biodiversity) means the variability of all living organisms including their ecosystems and the ecological complexes of which they are part; it includes diversity within species, among species and the diversity of ecosystems.

3. The role of biodiversity in the agricultural sector

The biodiversity of all organisms associated with their ecosystems and the agrobiodiversity as its component are the fundamental sources of productivity of all agricultural systems, enabling them to adapt to changing environmental conditions, develop new forms of life and maintain their basic functions. Agricultural biodiversity is also understood as the diversity of organisms used or potentially usable, directly or indirectly, in food production and agricultural non-food production.

Biodiversity and agricultural systems are closely connected. Agriculture is dependent on ecosystem services and processes, such as restoring of soil fertility, pollination, natural pest and disease control, soil regeneration or the self-cleaning ability of water resources. Their functioning is possible only if biodiversity is maintained and suported. Therefore, the most important are areas with less intensive farming systems that can act as semi-natural habitats protecting the soil, allowing the cultivation of crops and keeping the animals that still possess their characteristic properties, even though they may be less productive.

Since the second half of the 20th century the agriculture has seen a transition towards modified, simplified and intensive farming practices and most agricultural land is now managed with higher or high intensity. These systems now form the very basis of agricultural production. Nonetheless, even in the intensive farming systems it is very important to optimaly use the diversity of cultivars, breeds, species and agroecosystems in order to maintain their productivity, achieve the stable and high quality production and reduce the energy and chemical inputs. Likewise, keeping high diversity is important for reducing the negative effects of intensive farming such as soil degradation, water contamination, low resistance of crops to pests and climate change and ultimately also increasing of public expenditures to cover damages of crops and economic losses of farmers.

The biological diversity of crops and livestock plays a key role in ensuring food security and adaptation of agriculture to climate change. Its decline reduces the potential of further breeding, limits the ability to adapt to climate change and undermines the stability of agriculture production. The loss of biological and genetic diversity thus may in some areas pose a significant threat to the long-term production sustainability due to disruption of the ecosystem interactions and services on which agriculture depends, including soil processes, natural pest control and pollination.

4. Genetic resources for food and agriculture and their value

Genetic resources for food and agriculture were created in agricultural systems mainly through the intentional man-made activities, as e.g. selecting and intentional breeding. It includes modern cultivars and breeds, breeding lines, regional varieties, as well as the related wild species and primitive forms of agricultural crops and livestock, which can be used for breeding, research, education, food processing or in biotechnologies. It also involves freshwater fish, which breeding and cultivation in aquaculture is historically an inseparable part of the agri-food sector. GR include also bees, being the most important pollinators, as well as microorganisms and small invertebrates that contribute significantly to agricultural production, protection, processing and use, or act as harmful agents. Ultimately, GR supported by the National Programme are the Czech Republic's contribution to the global protection of biodiversity.

It is very difficult to determine the value of genetic resources in financial units. It is estimated that every sixth job in the EU depends to a certain extent on the functioning of natural processes, thus also on genetic resources. For example, the value of global agricultural production and the ecosystem services provided by pollinators for pollinating plants alone is estimated at $235–577 billion per year[1]. However, insect pollinators, as a certain visible and economically better quantifiable group, cannot be looked at in isolation. Insects together with soil microorganisms are in the natural environment part of a number of other ecosystem interactions and play an important role, for instance, in the nutrient cycling, the decomposition of organic matter or as a part of the system for natural control and balance preventiing outbreaks of populations of many other species. Hence the use of biodiversity is closely linked to economic performance in various areas of human activity and its decline will always have a negative impact on GDP.

GR are unique and irreplaceable source of genes for further improving of the biological and economic potential of productive organisms in agriculture. They are utilized directly in plant and livestock production, the food industry, conventional and modern breeding or gene engineering. Their importance is further growing with the rapid development of genomics and associated biotechnologies. GR also belong to the cultural heritage and are an important part of stability and quality of the countryside and landscape.

GR and their original congeneric and ancestral species are constantly threatened by the loss or degradation of natural habitats worldwide and unification of crops and animal breeds leading to genetic erosion.

Therefore, there is a constant need for their long-term conservation, study and characterization. In a number of countries the protection of GR and their sustainable use is ensured and managed by the relevant national programmes based on the principle of national sovereignty over national biological resources, i.e. the principle enshrined within the CBD. The conservation and use of various domains of GR are intensively monitored at the international level within FAO. The basic prerequisite for effective and sustainable use of GR is their availability for users together with the relevant information.

5. The international strategic and legal framework of the National Programme

The **Sustainable Development Goals 2015–2030 (SDGs)** represent the UN Development Programme to 2030. All UN member states, including representatives of civil society, business and academic, took part in their formulation. They were adopted at the UN Summit on 25 September 2015 in New York as part of the document "Transforming our World: The 2030 Agenda for Sustainable Development". Genetic resources are being dealt within the Goal 2 *"End hunger, achieve food security and improved nutrition and promote sustainable agriculture"* and specific Subtarget 2.5 *"By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed".*

The **Convention on Biological Diversity (CBD)** was internationally approved in 1992 and the CR became a party in March 1994. The Convention is kept in the Collection of International Treaties of the Ministry of Foreign Affairs under No. 134/1999 Coll. Genetic resources are primarily being dealt with by Article 15 of the Convention *"Access to Genetic Resources"*. In 2010, the Conference of the

[1] IPBES (2016): Summary for policymakers of the assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Eco- system Services on pollinators, pollination and food production. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Bonn, Germany. ISBN 978-92-807-3568-0.

Parties adopted the Strategic Plan 2011–2020 that consists of 20 global targets for protecting and improving the state of biodiversity - the so called Aichi Biodiversity Targets[2]. The area of genetic resources is addressed in Target 13: *"By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity"* and in Target 16: *"By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation"*.

The **Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization** was adopted under the framework of the Convention on Biological Diversity and establishes rules on access to genetic resources and the fair and equitable sharing of benefits from their use. Fulfiling the rights and obligations of the Protocol creates the preconditions for avoiding situations of access and utilisation of genetic resources without the provider´s consent. Such behaviour is often described as 'biopiracy'.

The **International Treaty on Plant Genetic Resources for Food and Agriculture ("ITPGRFA")** was negotiated in 2001 and its aim is the conservation and sustainable use of all plant genetic resources for food and agriculture and also, in line with the principles of the CBD, to ensure a fair and equitable sharing of benefits derived from their use for sustainable agriculture and food security. The CR became the party to the treaty in June 2004 and the ITPGRFA is kept in the Collection of International Treaties of the Ministry of Foreign Affairs under No. 73/2004 Coll.

The **FAO Global Plan of Action for Animal Genetic Resources**[3] was adopted in 2007 and has four strategic priorities: (1) – characterization, inventory and monitoring of trends and associated risks, (2) – sustainable use and development, (3) – conservation in natural conditions (*in situ*) and in genebanks (*ex situ*), (4) policies, institutions and capacity-building - establishing a policy on the use of genetic resources and building capacity for its fulfilment. The fulfilment of the programme is assessed in two-year intervals at the regular meetings of the FAO Commission on Genetic Resources for Food and Agriculture.

The **Second Global Plan of Action for Plant Genetic Resources**[4] was completed and adopted by FAO in 2012 and is divided into four priority activities: (1) – *in situ* conservation and management, (2) – e*x situ* conservation, (3) – sustainable use, (4) – building iInstitutional and human capacities. The fulfilment of the programme is assessed at two-yearly intervals in the framework of the meeting of the FAO Commission on Genetic Resources for Food and Agriculture.

Fulfilling the objectives of the National Programme is in accordance with a number of other international documents and published recommended procedures, such as the FAO Genebank Standards for Plant Genetic Resources for Food and Agriculture (FAO 2014), the European Cooperation Programme for Plant Genetic Resources (ECPGR), the Quality Management System for a European Genebank Integrated System (AEGIS) and other.

[2] CBD 2010. *The Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets.* UNEP/CBD/COP/DEC/X/2

[3] FAO 2007. *Global Plan of Action for Animal Genetic Resources for Food and Agriculture.* Rome. ISBN 978-92-5-105848-0

[4] FAO. 2012. *Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture*. Rome. ISBN 978-92-5-107163-2

6. The European strategic and legal framework of the National Programme

The **EU Biodiversity Strategy to 2020** was adopted by the European Commission in 2011. The area of genetic resources is mainly dealt with by the Target 3: *"Increase the contribution of agriculture and forestry to biodiversity"* and Action 10: *"Conserve Europe's agricultural genetic diversity – The Commission and Member States will encourage the uptake of agri-environmental measures to support genetic diversity in agriculture and explore the scope for developing a strategy for the conservation of genetic diversity"*.

Regulation (EU) No. 511/2014 of the European Parliament and of the Council on compliance measures for users from the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the Union.

Commission Implementing Regulation (EU) 2015/1866, laying down detailed rules for the implementation of Regulation (EU) No. 511/2014 of the European Parliament and of the Council as regards the register of collections, monitoring user compliance and best practices

7. The national strategic and legal framework of the National Programme

The **Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030** was approved by the Government of the CR on 2nd May 2016. Its main purpose is to set the basic framework for strengthening the development of the agrarian sector in the CR. Genetic resources for food and agriculture are in the document dealt within the connection to plant and animal commodities and in the area of agricultural research.

The **Biodiversity Conservation Strategy of the CR 2016–2025** was approved by the Government of the CR on 9 March 2016. The area of genetic resources for food and agriculture is specifically dealt with in Objective 3.6 *"Sustainable Utilization of Genetic Resources"*.

The **Strategy for Adapting to Climate Change in the CR** was approved by the Government of the CR on 26 October 2015. The document's content is based on the European Commission's White Paper "Adapting to climate change: Towards a European framework for action" (2009) and corresponds with the EU Adaptation Strategy. The adaptation strategy addresses also the area of agriculture in a comprehensive manner. Genetic resources for food and agriculture are specifically included in section 3.2.3.2. *"Genetic Resources, Research, Breeding and Agricultural Biotechnology"*.

The **National Action Plan for Adapting to Climate Change** was approved by the Government of the Czech Republic on 16. 1. 2017 and is the implementing document to the aforementioned Strategy for Adapting to Climate Change in the CR (2015). The area of genetic resources for food and agriculture is specifically dealt with in the framework of Strategic Objective 4: *"Safeguarding and conserving genetic resources in agriculture"* and Strategic Objective 8: "*Ensuring the sustainability and production function of agriculture in order to reduce the negative impacts of climate change*".

Act No. 154/2000 Coll., on breeding, stirpiculture and record keeping of farm animals and on amendments to some related laws (Breeding Act), and **Act No. 148/2003 Coll.**, on the conservation and utilization of plant genetic resources and microorganisms important for food and agriculture (the Act on genetic resources of plants and microorganisms).

Decree No. 72/2017 Coll., on animal genetic resources, and **Decree No. 458/2003 Coll.**, implementing the Act on genetic resources of plants and microorganisms.

8. The objective and goals of the National Programme

The basic objective of the National Programme:

To ensure the long-term conservation of the GR of plants, animals, micro-organisms and small invertebrates important for food and agriculture, in accordance with national legislation, international obligations and the needs of users of genetic resources, and for the sustainable development of agriculture in the CR, adapting to climate change and maintaining the quality of rural areas.

In order to achieve the basic objective, the following goals have been set:

1) To ensure the protection and long-term storage of GR included in the National Programme using appropriate and up-to-date conservation methods.
2) To collect historical, present and new GR important for food and agriculture that are located in the CR, including the repatriation of original Czech materials from abroad, and to rationally enlarge collections of GR with new material from abroad in accordance with the needs of their users.
3) To enhance the evaluation and characterization, i.e. to gain the knowledge of properties, traits and genetic diversity of GR and to assess their use for improving the biological potential and utility value of plant varieties, species and breeds of animals and strains of microorganisms.
4) To keep clear records and documentation on the GR conserved and provided, including the international exchange of information.
5) To guarantee the availability of GR stored in the CR for users and provide both the GR and relevant information to domestic and foreign users in accordance with national and European legal requirements and other international obligations.
6) To create the conditions for the efficient and sustainable use of GR in line with the needs of agricultural practice, commodity processors and consumers and to support the environmental functions of agriculture and adaptation to climate change.
7) To guarantee the international commitments of the CR in this area and thus participate globally in protection of agrobiodiversity and the fair and equitable sharing of benefits resulting from its use.

9. The substance of the National Programme

The National Programme is implemented by the following activities:

1) Collecting of GR

Collecting of GR is one of the core activities. The obtained samples of plant, microbial and small invertebrate GR are usually categorised into collections by species, genus or groups of GR. The participants to the National Programme are responsible for management of specific collections, whilst the overall coordination is ensured by the authorized persons for plant and microbial GR and the designated person for animal GR[5].

[5] See the section Structure of the NPGR

2) Recording and documentation of GR

The authorized person, designated person and NPGR participants are responsible for keeping the records and documentation of GR within the respective information systems and in accordance with the requirements, standards and methodological procedures established for these systems. The authorized and designated person is also responsible for data preparation, creation of databases and the overall functionality of the information system, as well as for its development and compatibility with relevant international information systems. The authorized and designated persons perform annual inventories of GR samples, the result of which is part of the Annual Report.

3) Characterization and evaluation of GR

The characterization of GR is the key area and is based on their detailed description and clear identification. Besides the basic biological characteristics and taxonomic classification, it also contains selected morphological, phenological and other features, especially traits of resistance to pests and diseases. The evaluation focuses mainly on biologically and economically significant features, is specific to the species and methods of utilization and is oriented towards the users needs. The characterization includes molecular-genetic characteristics (e.g., detecting alleles of important genes and proteins) that are of great importance for verifying the identity of a material and for breeding. The characterization and evaluation of the plant and microbial GR is ensured continuously by the NPGR participants responsible for individual collections. For animals, the evaluation is carried out at the level of the animal owner, the respective breeders' association and the designated person. The obtained data are transferred to the authorized or designated person and to the relevant information systems. Detailed information on characterization and evaluation are described in the respective methodologies[6] and corresponding legislation.

4) Conservation of GR

The conservation of the plant and microbial GR is mainly ensured in *ex situ* conditions, i.e. in genebanks and culture collections, field collections, *in vitro* collections, cryobanks and in collections with living arthropods and invertebrates. Where possible, *in situ* (some wild species) and on-farm (regional varieties) conservation is used. The animal GR are primarily preserved in *in vivo* conditions as live animals at the owners´ facilities and reproductive or biological material is conserved *ex situ* in genebanks. The aim of conservation is maintaining the viability and genetic basis of GR, keeping the regeneration ability and to limit genetic erosion as much as possible.

5) Utilization and availability of GR

Genetic resources are used in breeding, research, education, protection of crops against diseases and pests, nature protection and landscape formation, museum management, etc. The authorized person, designated person and NPGR participants provide samples of the GR to users in accordance with the domestic regulations and internationally accepted principles. The relevant information (passport data, descriptive data or other information) is also transmitted along with the GR samples.

6) International cooperation and implementation of accepted international commitments

Meeting the international obligations is addressed on the basis of adopted agreements, research, information and educational projects and other requirements that are set by international organizations.

[6] The Framework Methodology of the National Programme on Conservation and Utilization of Plant Genetic Resources and Agrobiodiversity, the Framework Methodology of the National Programme on Conservation and Utilization of Genetic Resources of Microorganisms and Invertenrates of Agricultural Importance, Conservation Methodologies for Animal Genetic Resources

7) The use of GR for preserving agrobiodiversity and supporting agriculture to address climate change.

Genetic resources and the associated genetic diversity play an increasingly important role in research resulting in new or more resilient plant varieties and animal breeds. GR are thus the part of the efforts to reduce inputs of agrochemicals and energy into agriculture, adapt agriculture to climate change and reduce its negative impacts. GR held within the National Programme are also a contribution of the CR to the global effort to preserve biodiversity and agrobiodiversity.

10. The structure of the National Programme

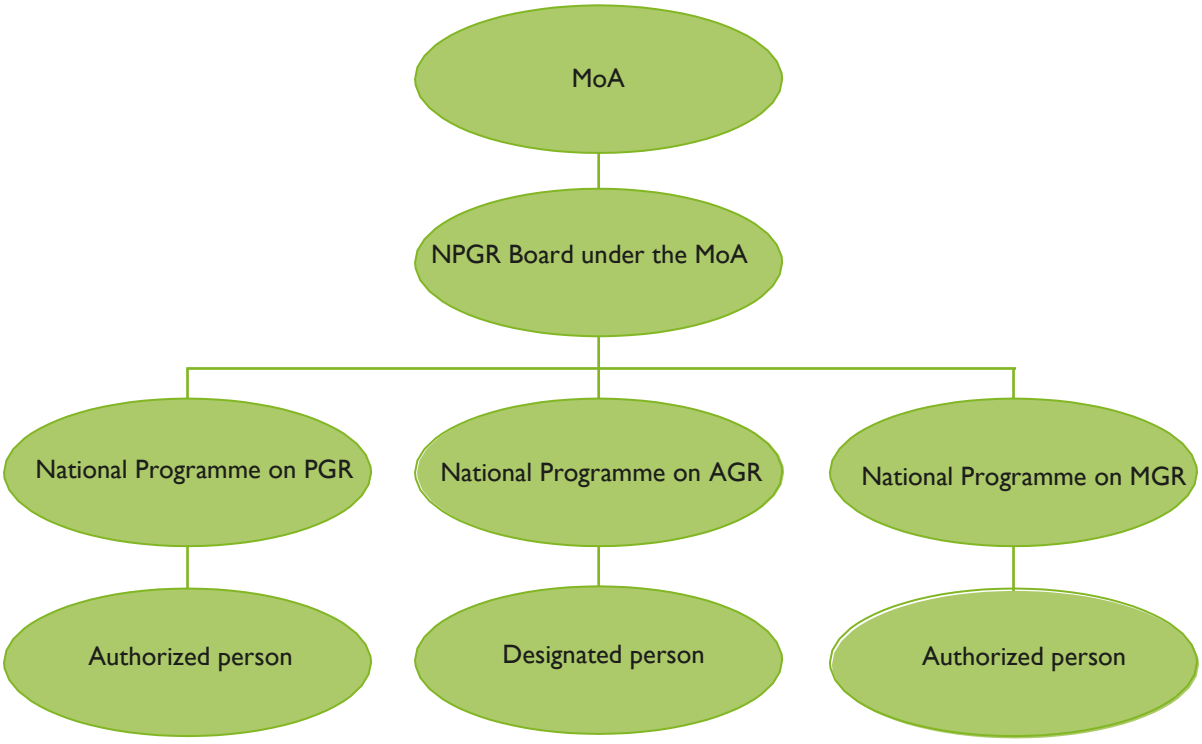
Due to biological specificities of the GR used in agriculture and the specific procedures for their management, the objectives of the National Programme are implemented in three separate sub-programmes for the GR of plants, animals and microorganisms:

1) **The National Programme on Conservation and Utilization of Plant Genetic Resources and Agrobiodiversity** (National Programme on Plant GR; NPPGR), which is governed by Act No. 148/2003 Coll., on Plant Genetic Resources and Microorganisms.

2) **The National Programme on Conservation and Utilization of Animal Genetic Resources Important for Food and Agriculture** (National Programme on Animal GR; NPAGR), which is governed by the Breeding Act No. 154/2000 Coll.

3) **The National Programme on Conservation and Utilisation of Microorganisms and Invertebrates of Agricultural Importance** (National Programme on Microorganism GR; NPMGR), which is governed again by Act No. 148/2003 Coll., on Plant Genetic Resources and Microorganisms.

Fig. 1: The structure of the National Programme and division into sub-programmes



11. The organization of the National Programme

The Ministry of Agriculture (MoA) carries out the state administration role in relation to the National Programme. It is guided by the applicable laws and international obligations. The MoA assesses the National Programme every year mainly on the basis of the information in the annual reports that are submitted by each sub-programme. The final reports are usually available by 31 March for the previous year and primarily include the information on:

- quantity of the preserved collections (numbers of conserved, newly acquired and GR included in the NPGR, numbers of characterized, evaluated and regenerated GR, or data on the size of populations and the conservation status of animal GR);
- number and character of GR and information provided to users in the CR and abroad,
- data transferred to the GR information systems,
- monitoring and evaluation of populations preserved in *in situ* conditions and the management of varieties in on-farm conservation,
- the results of international cooperation,
- public awareness activities and education on the use and protection of GR,
- the use of financial support provided by the MoA to implement the National Programme.

The Board of the National Programme (NPGR Board of the MoA) manages the National Programme and is composed of the representatives of the MoA and coordinators of the sub-programmes. Its mandate is given by the Statute and the Rules of Procedure and its task is to create the necessary organizational framework to ensure the work with genetic resources important for food and agriculture. It decides on the priorities, factual contents, coordination steps and the allocation of approved funds to individual sub-programmes. The NPGR Board of the MoA determines and approves the priority activities of the individual sub-programmes, updates them and brings them into full compliance with the aforementioned legal standards and international obligations. It also serves as an arbitrator body in case that any dispute arises.

The **authorized person** (for the National Programmes on Plant and Microbial GR) and the **designated person** (for the National Programme on Animal GR) guarantee the quality of the sub-programmes and they submit to the MoA proposals for the respective person to carry out the role of the **coordinator** and its deputy.

The National Programme is open and non-discriminatory; its **participants** may become natural persons or legal entities and public organizations conserving genetic resources. It is possible to continuously include new species (groups) of GR into the National Programme as required. The detailed procedures for becoming a participant are set in the Breeding Act and the Act on Genetic Resources of Plants and Microorganisms. The organizational structure of individual sub-programmes differs in certain points and is described in detail in the “Structure and Organization” sections for each sub-programme.

12. Financing

Maintaining the functionality and effectiveness of the National Programme requires its stable and long-term financing. Funding to support the National Programme is provided from the state budget by means of the MoA, in the form of subsidies. The total amount is approved by the Government of the CR and the Chamber of Deputies of the Parliament of the CR as part of the annual budget approval. The conditions for providing and using the financial support are laid down within the annually published Principles by the MoA.

The National Programme does not favour any of its participants in a competitive environment and GR registered in the National Programme are not primarily intended for generating the economic profit. The financial support is aimed at partial cover of the operating costs of activities covered by this programme, for compensating the economic losses caused by conserving GR that have limited competitiveness, for the additional work related to meeting the requirements of the relevant methodologies and for ensuring the activities concerning the long-term conservation of GR, documentation, characterization, database management, raising public awareness and compliance with the international obligations. NPGR participants accept a commitment to cover the rest of the operating costs from their own financial and human resources.

The funds are provided to the individual NPGR participants annually upon their applications, after discussing the priorities in the respective sub-programme Boards and recommendations made by the authorized or designated persons. All requests for funds are subject to standard control mechanisms set by the MoA. In addition, the relevant state and European control authorities and tax authorities can inspect both the financial and material aspects of the National Programme.

13. Duration of the National Programme

The MoA has set the National Programme for a period of five years, i.e. from 1 January 2018 to 31 December 2022. If needed, the MoA may update the National Programme as necessary and publish its modifications or additions to it in the form of addendum.

14. Action plan for implementing the National Programme

Based on the structure and content of the FAO Action Plans, specific activities were identified for each sub-programme that are relevant to addressing the issue of GR in the CR. A detailed description of the activities will be elaborated in the subsequent Action Plan, which will include more detailed specification of the activities, the responsibility for their implementation, expected outcome, form of processing, critical assumptions for implementation and the timetable for the individual actors involved in carrying out these activities.

The National Programme on Conservation and Utilization of Plant Genetic Resources and Agrobiodiversity

1. Mission and aims

Plant genetic resources (PGR) used for food and agriculture are an important part of global genetic diversity. Besides the small interspecific diversity of species used in agriculture, there is an extraordinarily large intraspecies genetic diversity that is a source of genes and gene complexes for improving crops used by humans. PGR are cultivated varieties and landraces, breeding materials, genetic lines and related wild species and ancestral species to agricultural crops; the sum of these materials is referred to as the gene pool of a species (crop). Plant genetic resources are of extraordinary value to humans, whether they are used in traditional agriculture, breeding or gene engineering or in biotechnology in general. PGR are a unique and irreplaceable source of genes for further improving the biological and economic potential of agricultural crop varieties.

Besides the safe long-term conservation of already collected PGR, the attention is paid to a qualified and rational expanding of the collections. The initial activity is identifying the missing PGR in the collections (gaps). Depending on the crop or species, e.g. the lost regional forms or primitive varieties are sought. The losses can be generally supplemented by repatriation of crops from genebanks outside the Czech Republic. In addition, NPGR participants collect new varieties or the breeding results of mainly Czech origin, taking into account the crop, species, local and geographical priorities and, in particular, if the traits represent possible resistance to biotic and abiotic stresses. Collecting expeditions mainly focus on crop wild relatives and other PGR, especially from places with high plant diversity (hot spots).

In the following years, the National Programme for Plant GR will be more focused on evaluation and characterization of PGR (field trials, laboratory tests) with the aim to increase the value of PGR for users. The number of traits assessed is species-specific, on average it is up to thirty traits. The growing attention is dedicated to characterization of GR using genetic and protein markers. With respect to climate change and its impact on agro-ecosystems, it is desirable to pay attention to traits such as length of the growing season, resistance to abiotic (especially drought resistance) and biotic stresses. The obtained experimental data are processed and presented in relevant PGR in the information system so that they are available to users, especially research, breeding, and educational/academic institutions.

In line with domestic and international priorities, the important part of the NPGR is also the promotion of agro-biodiversity for the sustainable development of agriculture, including its non-productive functions. Practical activities in this area are mainly focussed on increasing the species diversity of agro-ecosystems (e.g. agro-environmental measures to extend species diversity, collecting wild GR for the use of regional species-rich mixtures for grassing), creating a wider genetic base for newly bred varieties, selecting of suitable varieties for alternative uses of production and improvement of soil fertility, selecting and using regional landraces, etc. While the GR for these purposes are obtained mainly by collecting expeditions, the information is gathered by monitoring of the populations in natural locations. The National Programme for plant GR thus creates the basic source of experimental materials and information for the related agricultural research projects.

The implementation of *in situ* and on-farm conservation methods has been so far underestimated. However, in the case of on-farm conservation, several activities were already implemented primarily in cooperation with the national park administrations and non-governmental organizations. On the other hand, there are no extensive data gathered on this type of conservation and the information systems are still not connected. The new GRIN Czech information system allows the inclusion of

these data as well as the connection of databases. This work is planned to be gradually carried out.

2. The state of the collections

The Czech collections now include 56 474 PGR, from which 54 709 PGR are available to users with the dominant groups of cereals, vegetables, fodder crops, legumes and fruit plants. The seed propagated crops represent 82 % and the vegetatively propagated 18 %. This ratio remains stable over the years. Considering the species diversity, the Czech collections include 1 173 species of plants.

The largest group in the crop and species composition are cereals – especially wheat (14 197 accessions, including related wild species) and barley (5 115 accessions). Other extensive collections include vegetables – lettuce (1 416 accessions), cucumber (837 accessions), squashe (662 accessions), garlic and onion (817 accessions), garden peas (1001 accessions), been (923 accessions) and tomatoes (1 421 accessions). The collections of aromatic and medicinal plants include 1 026 accessions and are focused mainly on collecting domestic species and ecotypes. The collections of fodder crops consist of clover (2 447 accessions) and field legumes (2 845 accessions). The extensive and internationally significant are collections of flax (2 226 accessions) and potato (2 550 accessions). Other significant collections belong to vegetatively-propagated species and contain fruit trees (apple 1 114 accessions, plum 260 accessions, cherries and sour cherries 446 accessions, apricot 381 accessions and peach 292 accessions). The collection of vegetatively propagated *Allium* species (garlic, shallot) at the Centre of Applied Research of Vegetables and Special Crops in Olomouc, which is the part of the Crop Research Institute (CRI), is kept as an international collection and its cryopreservation and characterization are the subject of international cooperation under the framework of ECPGR. The collection of hop, which is kept at the Hop Research Institute in Žatec, is rather small but internationally significant.

The strategy for expanding the collections with new PGR focuses mainly on PGR of domestic origin and sources of new genetic diversity, as required by users or induced by changes in the conditions of agroecosystems. For example, in 2016, there were 2 229 new PGR, from which 72 % were obtained from domestic and foreign donors and 28 % from collecting expeditions.

Table 1: Structure of crop accessions held in collections

Crops	% in collections
Cereals	40
Vegetables	13
Food legumes	9
Fruit woody plants	6
Grasses	5
Potatoes	5
Industrial plants	5
Flowers	4
Fodder plants	4
Oil plants	3
Zea and alternative cereals	2
Aromatic and medicinal plants	2
Rhododendron, Rosa	1
Grape	1
Beta and other seed root crops	<1
Miscelaneous	<1

3. Structure and organisation

The **authorized person** is the Crop Research Institute, which pursuant to Act No. 148/2003 Coll., on the Conservation and Utilization of Plant Genetic Resources and Microorganisms Important for Food and Agriculture ensures the coordination of the National Programme for Plant GR and related activities. The authorized person has the right to conclude contractual agreements with NPGR participants and other entities with the aim of implementing the NPGR and its objectives.

The coordination of the NPGR for plants is carried out by the **coordinator**, who manages the sub-programme and the relevant activities of its participants, is responsible for the progress of its implementation and the results achieved, represents the sub-programme in relation to the MoA and other entities and acts also as a representative of the CR in the field of PGR and agrobiodiversity in international negotiations. The coordinator is appointed by Minister of Agriculture.

Participants to the National Programme for Plant Genetic Resources are holders of **collections of crops or their parts**. Individual collections of crops are represented by their curators as the **responsible persons (guarantors)**.

The advisory and consultation body of the authorized person and all participants is the **NPPGR Board.** The Board members include representatives of NPPGR participants and interest groups and are appointed by the authorized person's statutory representative. The mandate of the Board and its members is given by the Statute and the Rules of Procedure. It is chaired by the coordinator or its deputy. The Board also functions as the expert group for the needs of the MoA and other public administration authorities, it discusses the expert methodologies, evaluates the activities of NPGR participants, comments on the applications of new applicants for participation in the NPPGR, discusses and approves budget issues and expresses its views on international cooperation and other topical issues in the area of PGR.

The NPPRG implementation is general guided by the Framework Methodology that also incorporates the internationally approved procedures and standards. It is supplemented by special working methodologies for individual groups of crops. The Framework Methodology was updated in 2015, including special methodologies for all groups of crops, terms of operation of the main genebank and coordination of the NPPGR. It is available online at CRI website (at the Czech language only)[7]. Detailed up-to-date information on the National Programme for Plant Genetic Resources and other domestic and foreign activities can be also found at the same webpage.

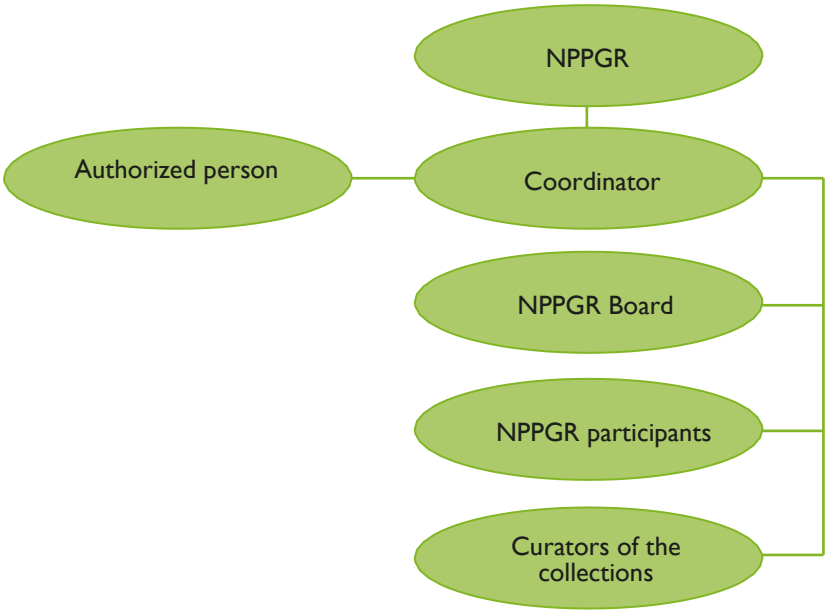
Special crop methodologies are usually valid for the duration of the National Programme (5 years); if needed, they can be updated at any time, in particular with regards to meeting the international requirements and standards. The NPPGR methodologies are binding for the programme participants as are the provisions of this National Programme.

Apart from coordination and associated activities, the CRI provides service activities for all NPPGR participants, namely operating the national information system GRIN Czech and the long-term conservation of all seed samples in the main genebank. Genetic resources of vegetatively propagated species are held at the institutions responsible for the relevant collection and conservation of these species. They also independently distribute the PGR samples and information to users on the basis of a Standard Material Transfer Agreement (SMTA). Altogether, the NPPGR consists of 16 legal entities that belong to 12 institutions from the sphere of public research (CRI; the Silva Tarouca Research Institute for Landscape and Ornamental Gardening in Průhonice; the Institute of Botany of the Academy of Sciences Průhonice), universities (Mendel University in Brno; Faculty of Horticulture at

[7] http://genbank.vurv.cz/genetic/nar_prog_rostlin/index.php#

Mendel University in Lednice) and private research institutes (Agricultural Research Institute Kroměříž; AGRITEC Šumperk; Potato Research Institute Havlíčkův Brod; Hop Research Institute; Research and Breeding Institute of Pomology Holovousy Ltd.; Research Institute for Fodder Crops, Ltd. Troubsko; OSEVA PRO Zubří Research Station for Grasses and OSEVA Research Institute of Oilseeds, Opava; AMPELOS Znojmo-Vrbovec). For detailed contact information, see the Annex.

Fig 2: The organizational chart of the National Programme for Plant Genetic Resources



4. Specific methodological activities

In accordance with international standards (FAO Second Global Plan of Action for Plant Genetic Resources, Genebank Standards for Plant Genetic Resources[8]), the activities for the conservation and utilization of plant GR are divided into the following stages:

1) Extending the collections

The strategy of rational extending of collections with new GR has not changed fundamentally in recent years and focuses on:

a) domestic GR, based on their monitoring and conservation strategy of the CR's genepool,
b) new genetic diversity, based on the needs of research and breeding, as well as the requirements for extending of crop diversity in agricultural practice,
c) acquiring donors of economically and biologically valuable traits for use in breeding and research.

Every year, 1 000 –2 500 new accessions are acquired for the NPPGR, although a slowly decreasing trend has been observed. The collections are enlarged with a prepared strategy and aims, emphasizing quality and the need for newly acquired genetic resources. Limiting the extension of the collections and the subsequent regeneration and evaluation of newly acquired PGR allows to transfer the part of the funds to other necessary activities. The reason is also that it is more difficult to obtain

[8] FAO. 2014. *Genebank Standards for Plant Genetic Resources for Food and Agriculture*. Rev. ed. Rome. E-ISBN 978-92-5-108262-1

PGR from potential donors from abroad, especially with regard to newly bred varieties and already assessed germplasm with great interest of users.

The most important group of newly acquired material are GR provided by foreign donors and through exchange with foreign genebanks, material provided by domestic breeders, researchers and other donors. Likewise, domestic and international collecting expeditions are a significant source of new genetic diversity. In line with the NPPGR methodology, collections focus on obtaining better quality and more comprehensive samples that improve the diversity coverage of the initial population. Although there are limits to collecting expeditions and not all the samples gathered are included in collections, collecting expeditions are a significant source of new genetic diversity, especially for forage crops, medicinal plants, certain vegetables and fruit trees.

2) Documentation and recording system

The NPPGR participants are involved in the European Virtual Genebank project – AEGIS, where in cooperation with the collections' curators, original Czech accessions become European Accessions as soon as they are flagged so in EURISCO database by the National Inventory Focal Point. As of 31.12.2018, 1 341 Czech accessions were marked as AEGIS accessions. In April 2016, the administrator of the GRIN Czech database was elected as a member of the EURISCO Advisory Committee.

The information system for the National Programme for Plant Genetic Resources is the GRIN Czech. It is based on the US GRIN Global system, which was modified and optimized for the conditions of the Czech Republic. All accessible data and information related to PGR are available at: https://grinczech.vurv.cz/gringlobal/search.aspx. There is also a Q&A section for curators working with the system where they can directly fill in their queries.

Passport data are recorded for all PGR in national collections. Descriptive data that are of fundamental importance for users are available to approximately 37 000 PGR (i.e. 70 % of all active accessions). These data are the result of the evaluation and characterization of the PGR (field trials, laboratory tests). Other characteristics are added, e.g. identified genes and genetic markers, that further increase the utility value of PGR. The range of the morphological and agronomic traits assessed is different for each species and crop, with an average of about 30 traits.

At present, the GRIN Global system is used in nine countries (e.g. USA, Chile, Bolivia, Mexico, Portugal), by the CGIAR[9] centres and some other countries are considering its introduction. The CRI regularly provides trainings on this information system for collection curators. In addition, the genebank repeatedly hosted the GRIN-Global Workshop in Prague, organized by The Crop Trust and the European Cooperative Programme for Plant Genetic Resources.

3) The study and evaluation of GR

Characterization and evaluation of the PGR is a basic prerequisite for their further utilization and is therefore one of the core activities of the National Programme. In order to build a database of descriptive data for the GRIN information system, PGR are characterized and evaluated in two- or three-year field tests in accordance with the national standard sets of descriptors specifically developed for each crop or genus. The preparation of new standard sets of descriptors (or just minimum set of descriptors) is a prerequisite for broadening the description of the collections. Results from the field observations are complemented by laboratory tests, depending on the crop species and the current needs. The number of traits assessed are crop-specific and increase with the

[9] Consultative Group for International Agricultural Research

importance of the crop. At present, there is a significant increase in the need to assess PGR for the presence of traits for resistance to biotic and abiotic stresses (resistance to drought, resistance or tolerance to pathogens and pests).

Detailed passport and characterization data enabling clear PGR identification as well as detecting genetic diversity are becoming increasingly important for the management of collections. Besides morphological features, genomic and proteomic approaches and methods are increasingly used for this purpose.

Within the given financial and technological possibilities the NPPGR keeps pace with the rapid international developments, especially in utilizing of molecular methods for characterisation of PGR. The creation of "core" collections, the selection and description of donors of significant traits, collaboration with users when assessing genetic resources and the expansion of information databases are encouraged to further improve the management of collections and services for users. However, most of these activities cannot be funded under the NPPGR and their implementation is largely dependent on individual grant projects. Nontheless, the topic of genetic resources does not appear very often in the priorities of the Czech grant agencies, and therefore, there is a growing lack of experimental background for working with genetic resources in the CR.

4) Conservation of PGR

The precondition for the conservation of PGR is their periodic regeneration. Maintaining viable seeds is achieved by slow drying of seeds at a temperature of 20 °C and their long-term storage at -18 °C. Of a total number of 44 401 available generatively propagated PGR, 42 558 are recorded in the main CRI genebank, i.e. 96 %. DNA samples and standards (2 245 accessions) are also stored in the genebank. Vegetatively propagated species are stored in field genebanks (75 %), in *in vitro* cultures (potatoes, ornamental flowers, 25 %); for selected species the cryopreservation (3 %) is used for the safety duplication.

The most commonly used method of conserving vegetatively propagated PGR (10 000 accessions), are field genebanks, i.e. permanent plantings of orchards, vineyards and hop fields, where the permanent cultures are kept in a required number of individuals and regenerated as needed. It is the most common conservation method of permanent vegetatively propagated PGR collections, which enables at the same time their characterization throughout their entire life. However, there are several challenges connected to it, namely, the safety of the collections due to pathogens, abiotic stresses and weather extremes and the demands on material and human labour. Only a small part of the plant genetic resources in the field collections are one-year or two-years vegetatively propagated species. The conservation process of these species is species-specific; it may include overwintering of the plants in suitable storage conditions.

A safer and cheaper method is *in vitro* preservation using the "slow growth" method of explant cultures. Naturally, this method does not allow the assessment of PGR during conservation and thus independent field tests are necessary for their evaluation. *In vitro* conservation is used either as a single method (potatoes) or in combination with field collections (some ornamental plants and vegetables, hops, grapevines, and other species to a limited extent). The technology used is species-specific, as are the intervals necessary for regeneration. Standard methodological approaches for the *in vitro* conservation of particular species are part of the Framework Methodology.

One of the perspective and safe conservation method is the cryopreservation of seeds, plant parts or *in vitro* cultures in liquid nitrogen. The main advantage of this method is a safe and practically timely unlimited conservation without any major risk of damage to the PGR during storage. Moreover, it is possible to conserve healthy materials for species where rapid contamination by pathogens

(especially viruses and phytoplasmas) occurs in the field conditions. The method is mainly used for conserving the vegetative parts of plants (*in vitro* cultures, dormant buds). Certain limits exist in terms of the requirement for technical equipment, labour and material costs, and the need to develop species-specific cryoprotocols. This method is not commonly usable for distributing PGR samples to users due to high cost and specific transport requirements, the need for compatible equipment and knowledge of the cryoprotocol for revitalising the frozen samples. However, stored samples may be used for exchanges between existing cryobanks. The cryobank provides technical services for these needs, guarantees the status of conserved samples and the methodical and technological development of cryopreservation.

The cryobank does not provide regular services to users of PGR in the sense of applicable legal standards. It is rather an internal service within the NPPGR framework and international cooperation (safety duplication).

5. Conditions for inclusion in the National Programme for Plant GR

A general condition for participation in the National Programme is the ownership of plant GR that have not already been dealt with as a collection (or part of a collection) by another NPGR participant. If a collection of the same crop (species) already exists in the CR, the owner of the PGR is requested to hand over such resources to the collection in the manner and under the conditions agreed upon with the curator of the collection concerned. This procedure eliminates duplications, saves public financial resources and guarantees compliance with international standards. A general condition is also the applicant's consent with the organizational and methodological procedures resulting from being part of the National Programme, inclusion of its PGR in the national information system as well as the guarantee of the availability of PGR concerned for users.

The specific requirements for participation in the National Programme are given in Act No. 148/2003 Coll., on the Genetic Resources of Plants and Microorganisms, and implementing Decree No. 458/2003 Coll.

6. International cooperation

Activities related to the monitoring, conservation and use of biodiversity have a global character and international co-operation is therefore essential. The basic document for safeguarding the protection and sustainable use of biodiversity is the Convention on Biological Diversity (CBD, 1992) and, in the case of plant genetic resources used for agriculture, the **Second FAO Global Plan of Action for Plant Genetic Resources**. Both documents are continuously updated and set out the basic strategy for monitoring, studying, conserving and using of plant genetic resources around the world.

One of the tasks of the FAO is to guarantee the international system of agreements and measures that support global conservation and use of PGR. The Czech Republic has been involved in FAO activities, including collecting data and preparing the necessary information for the FAO, working in the FAO Commission for Genetic Resources for Food and Agriculture and through its expert activities.

The Czech Republic is Party to the ITPGRFA since 2004. In accordance with this agreement it provides PGR to other users on the basis of the SMTA for the purpose of research, breeding and education. The use of SMTA streamlines and accelerates the transactions of genetic resources between providers and users and also ensures that the benefits of using GR are shared in line with the requirements of the Nagoya Protocol on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits from their Use.

Another important organization with a global sphere of activity is Bioversity International.

Organizationally, it is one of the international centres of the CGIAR with a focus on genetic resources for food and agriculture and the conservation and use of agrobiodiversity. Bioversity International cooperates with the FAO and Global Crop Diversity Trust (GCDT). GCDT focuses on collecting funds from a wide range of donors. These funds are then used for the safequarding and conservation of PGR around the world, especially in developing countries.

The key project in Europe is the European Cooperative Programme for Plant Genetic Resources (ECPGR). It was established in 1980 as the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) on the basis of the recommendations of the United Nations Development Programme (UNDP), FAO and the Genebank Committee of the European Association for Research on Plant Breeding (EUCARPIA). The Czech Republic became a participating member to the ECPGR in 1983. The strategic objective of the ECPGR is to ensure that national, sub-regional and regional programmes and projects in Europe provide rational and effective conservation of PGR in *ex situ* and *in situ* conditions and effectively contribute to the sustainable use of PGR and their availability to users. The ECPGR's organizational basis is formed by the working groups for crops and the thematic working groups (documentation, technical assistance to other regions, *in situ* and on-farm conservation). The main objectives are: (a) ensuring the full functionality of the virtual European genebank project (AEGIS); (b) increasing the volume and quality of data in the EURISCO database, including data from *in situ* and on-farm conservation and providing services to users according to their needs; (c) preparing and adopting a pan-European management concept for the *in situ* conservation of crop wild relatives and landraces; (d) strengthening the cooperation between genebanks and PGR users.

The AEGIS project is an opportunity for National Programmes for Plant Genetic Resources in Europe to participate in ensuring their safe conservation, availability and efficient use. The Memorandum of Understanding (MoU) was signed by 34 European countries, while the association agreement was signed by 57 institutions from 27 European countries. Associated membership allows to participate in the ECPGR activities and propose original European accessions to AEGIS.

The Czech experts are involved in the ECPGR work especially through the crop and thematic working groups. Some institutions have undertaken additional responsibilities, e.g. the management of selected European crop databases and guaranteeing international collections. NPPGR participants guarantee the following specific activities for the ECPGR:

- The CRI coordinates the participation of NPPGR institutions in the ECPGR,
- The CRI genebank ensures the development and activities of the largest European crop database – the European Wheat Database (EWDB) (http://www.genbank.vurv.cz/ewdb/),
- OSEVA PRO, Zubří represents the CR in the working group for fodder and is the author of a database of three grass species (*Arrhenatherum*, *Trisetum* and *Poa*),
- AGRITEC Šumperk, Research, Breeding and Services, Ltd. coordinates the cooperation in the framework of the sugar, starch and fibre crops network. The responsible person is responsible for managing and updating the European flax database, which also includes data from non-European genebanks,
- The CRI genebank actively participates in the development and maintenance of the EURISCO European Catalogue of Genetic Resources (National Contact Point, EURISCO Advisory Committee),
- The CRI team for vegetables and special crops in Olomouc is the guarantor of the international collection of vegetatively propagated garlic and shallot crops (*Allium sp.*) and ensures the international cryopreservation of European garlics from the EURALLIVEG project.

The NPPGR institutions have also recently cooperated on a number of international projects. In 2016, there were 7 such projects related to PGR:

- HealthyMinorCereals: An integrated approach to diversify the genetic base, improve stress resistance, genomic management and nutritional/processing quality of minor cereal crops for human nutrition in Europe (coordination, 2013–2018),
- NatFruit 7F14122 Conservation and breeding potential of native fruits in the Czech Republic and Norway (coordination, 2015–2017),
- EUREKA LF 1520 The commercialization of specific aromatic European hops suitable for cultivation on low constructions in the Czech Republic and the United Kingdom in order to satisfy the increasing global brewing demand (coordination, 2015–2017),
- NIBIO Diagnosis, virus cleaning and cryopreservation of raspberry, blackberry and shallot (Rub&Al), Norway (resolved jointly, 2016–2020),
- ECPGR project: Identification and updating data of eligible AEGIS accessions in both wheat and rye species (resolved jointly, 2016–2017),
- ECPGR project: Common ECPGR protocols and tools available for characterization and evaluation of *Malus/ Pyrus* genetic resources (resolved jointly, 2016–2017),
- COST FA1104 Sustainable production of high-quality cherries for the European market (resolved jointly, 2012–2016).

In addition, there are also agreements and bilateral cooperation programmes between various Czech and foreign institutes, which focus on plant genetic resources (Memorandum of Understanding with CRI and VIR St. Petersburg, with the Russian Federation and the genebank in Kazakhstan). The cooperation agreement between the National Programmes on Conservation and Utilization of Genetic Resources in the CR and Slovakia is of particular importance. It focuses on mutual ensurance of the safety duplication of certain PGR and cooperation on their regeneration and evaluation.

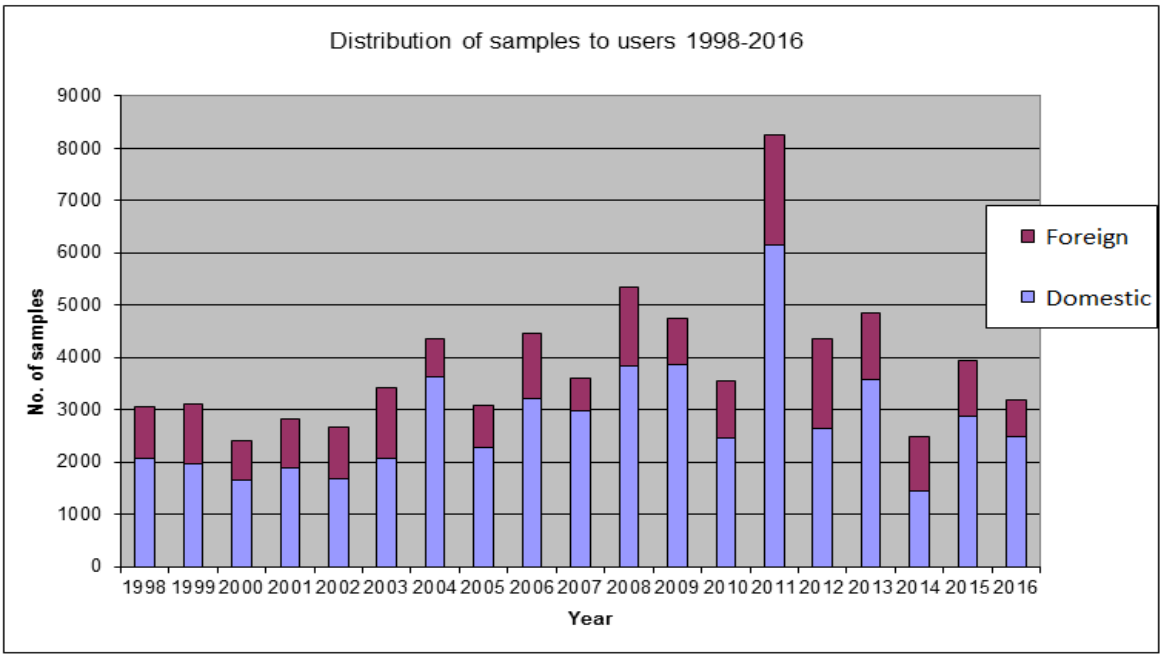
7. Utilization of GR and the services provided

According to Act No. 148/2003 Coll., on Genetic Resources of Plants and Micro-organisms, samples of plant genetic resources are provided to users free of charge for breeding, research and education, but not so for direct commercial use. This principle is in compliance with the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The conditions for transfer and use of PGR are governed by the SMTA. The safe conservation of European collections, availability of samples and relevant information on PGR for users are also important objectives of the AEGIS project.

With the transition to the GRIN Czech information system, users order plant genetic resources on-line upon their registration. They usually accept the SMTA conditions electronically at the time of ordering - using the “click-wrap” procedure for signing the agreement. The signing of SMTA is the basic precondition for any distribution of PGR samples. The SMTA is given a serial number and is sent back to the user together with the ordered PGR samples. The user is obliged to utilize PGR samples only for purposes defined within the SMTA.

All NPPGR participants provide users with samples of plant genetic resources: the seed genebank, the field and *in vitro* genebank and collection curators through their direct contacts with PGR users. The distribution of PGR depends on user´s requirements and varies in different years. For example, a total of 3 196 samples were distributed in 2016. The most commonly distributed crop was traditionally wheat.

Chart 1: Distribution of PGR samples to users 1998–2016



8. Plan of specific activities

The National Programme on Plant GR and especially the Plan of specific activities are based on the FAO Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture (GPA). GPA contains priorities reflecting the current state of conservation and use of PGR with regards to changes in society and the environment (e.g. urbanization, the globalization of the trade in seeds, differences in the management of agricultural producers in developing and developed countries, climate change, etc.). Considering the decreasing genetic diversity of globally used crops, emphasis is placed on the *in situ* and on-farm conservation of crop wild relatives and underutilized crops. In the area of sustainable development of *ex situ* conservation, the need for the characterization of PGR through effective scientific procedures and the availability of information on the properties of these resources is emphasized in order to facilitate the use and promote the diversity of cultivated species.

The activities of the GPA are devided into four priorities: *In situ* Conservation, *Ex situ* Conservation, Sustainable Use of PGR and Development of Human and Institutional Capacities. These priorities are further elaborated into 18 Priority Activities that address all possible challenges and opportunities connected to PGR issues. However, some of the activities are not relevant for the Czech Republic and therefore are not part of the following Plan of specific activities. For instance, GPA Priority Activities 3, 11 and 12 (Assisting farmers in disaster situations to restore crop systems; Promoting development and commercialization of all varieties, primarily farmers' varieties/landraces and underutilized species; Supporting seed production and distribution) have not been included. On the other hand and above the framework of the GPA, two additional priorities suitable for the conditions of the Czech Republic were added to the following plan – "P5 - Strengthening the public awareness about PGR importance" and "P6 - The International Cooperation".

Table 2: Plan of specific activities for plant genetic resources for food and agriculture

Priority/Activity	Specific activities
P1 *In situ* conservation	
1. Surveying and inventorying	
**	1.1 Update and optimize the methodology for *in situ* conservation for the conditions of the CR
**	1.2 Inventory of populations of PGR suitable for *in situ* conservation
2. Supporting on-farm management for conservation	
*	2.1 Update the methodology for on-farm management for the conditions of the CR
*	2.2 Support of on-farm conservation of PGR
4. Promoting *in situ* conservation of crop wild relatives and wild food plants	
*	4.1 Monitoring and management of *in situ* conserved crop wild relatives and other wild food plants
P2 *Ex situ* conservation	
5. Supporting targeted collecting	
**	5.1 Optimize the methodology for identifying gaps in collections
**	5.2 Optimize the strategy for rational extending of collections with the preference for expeditions in locations with high plant diversity
**	5.3 Create a list of PGR suitable for repatriation and a list of institutions for dealing with potential repatriation
6. Sustaining and expanding *ex situ* conservation	
**	6.1 Monitor the annual increase of new accessions to sustain the *ex-situ* collections
**	6.2 Collect PGR identified in the outputs of activities 5.1.–5.3.
**	6.3 Support the inclusion of new Czech varieties into collections
**	6.4 Complement the safety duplication of generatively propagated PGR (Slovakia, Svalbard)
**	6.5 Preserve the safety duplications of selected vegetatively propagated PGR incryobanks
**	6.6 Review older accessions in collections to identify duplications and ensure corrections
7. Regenerating and multiplying	
**	7.1 Fulfill the regeneration plan of accessions according to monitoring the minimum stocks or other requirements
P3 Sustainable use	
8. Expanding characterization, evaluation and further development of specific collections to facilitate usage	
**	8.1. Continuously evaluate the conservated PGR based on the review of descriptive data in the GRIN information system
*	8.2 Expand the PGR characterization based on the follow-up projects
**	8.3 Develop the descriptors thar are missing in the information system
**	8.4 Map the type of users and their interest in PGR
9. Supporting plant breeding, genetic enhancement and base-broadening efforts	
*	9.1 Analyse the breeding activities of NPPGR participants
**	9.2 Analyse the interest of breeding companies in pre-breeding programmes

10. Promoting diversification of crop production and broadening crop diversity	
*	10.1 Identify the underutilized PGR the collections and verifying their inclusion to agriculture production systems (e.g. grasses, forage crops, minority species, aromatic plants)
*	10.2 Identify the minority and perspective fruit PGR in the collections and verifying their inclusion to agriculture production systems
P4 Building sustainable institutional and human capacities	
13. Strengthening the National Programme	
**	13.1 Continue with the assessment of activities of the National Programme for PGR
**	13.2 Assess the activities of the collections (expertise, efficiency, cooperation, provision of PGR)
**	13.3 Continue with the inspections of the participants and take the conclusions of these checks into account in further development of the NPPGR
*	13.4 Prepare the amendment of Act No. 148/2003 Coll. on Genetic Resources of Plants and Micro-organisms
14. Promoting and strengthening networks	
*	14.1 Strengthen the cooperation of NPPGR participants and other entities dealing with PGR
15. Strengthening information systems	
**	15.1 Ensure the routine operation of IS GRIN Czech by the authorized person the participants
**	15.2 Revise and complement the existing passport, descriptive and stock data on PGR
**	15.3 Supply the data obtained from research projects
16. Strengthening systems for monitoring and safeguarding genetic diversity and minimizing genetic erosion	
**	16.1 Deposit the safety duplications for PGR of Czech origin
17. Strengthening human capacities	
*	17.1 Ensure the ongoing training for curators of the collections
*	17.2 Analyse the number of *ex situ* accessions regenerated and multiplicated annually, including the analysis of the funding sufficiency
P5 Strengthening the public awareness	
18. Promoting and strengthening public awareness of the importance	
*	18.1 Continuously update the NPPGR website - calendar of events and other information
*	18.2 Accept the excursions of schools interested in PGR
*	18.3 Increase the general interest in traditional species and varieties through public presentations
*	18.4 Enable the training of Ph.D. and other students in cooperation with universities and NPPGR participants
*	18.5 Include new information about conservation of the plant biodiversity into the curriculum of students at secondary schools and universities
P6 Strengthening the international cooperation	
19. Enhancing the involvement in international activities and information systems	
**	19.1 Ensure the implementation of international obligations that are defined in Act No. 148/2003 Coll., ECPGR, FAO, ITPGRFA and SMTA

**	19.2 Present the PGR accessions in EURISCO and integrating the unique Czech PGR accessions in AEGIS
*	19.3 Strengthen the cooperation and involvement of NPPGR participants in joint research international projects
**	19.4 Actively participate in ECPGR working groups and other activities
**	19.5 Promote the international conservation of rare PGR on the basis of mutual reciprocity
**	19.6 Implement the tasks arising from the CBD and the Nagoya Protocol

** activities that are directly or indirectly supported by national law or international treaties
* activities that ensure the development of work with genetic resources and effective implementation of the National Programme

The National Programme on Conservation and Utilization of Animal Genetic Resources Important for Food and Agriculture

1. Mission and aims

Livestock farming is an essential part of a number of agricultural ecosystems. The conservation of the genetic diversity of breeds and species is crucial to the resilience and flexibility of these systems. Although the livestock breeding in the CR and other European countries has concentrated over the last decades mainly on a rapid increase in production and productivity, it concerned only some of the most suitable species and animal breeds. Highly productive genetic material was subsequently introduced into less intensive farming systems, often at the expense of locally adapted and genetically highly variable breed populations.

Highly productive animal breeds are often achieved only at the cost of losing other characteristics, such as longevity, resistance to diseases and adverse environmental effects or natural reproductive abilities. In other words, some historically older breeds of animals, which did not go through the intensive production breeding, have retained a number of valuable features such as adaptability to the environment, resistance to climatic conditions and certain diseases, good reproductive and maternal characteristics or the ability to make the best use of local food sources.

The mission and aim of the National Programme on Animal GR is to pay more attention to those livestock species and breeds that are historically native in the CR, have adapted to the local conditions over the long period of time, are not numerous and are endangered. The aim is to map their traits and characteristics and their use in alternative and non-productive agricultural activities, landscape and nature conservation or improving the health and resistance of other breeds, thus helping them to adapt to ongoing changes in the environment.

Working with genetic resources is by nature long-term, conservative and based mainly on maintenance breeding in order to preserve original genes and characteristics. Nevertheless, new methods such as molecular genetics, genomics, advanced information systems and cryopreservation are now used as well.

Work procedures and measures aimed at the long-term conservation of genetic resources stem from the relatively detailed monitoring of the development of populations as well as certain individual animals. The settings for the protection regime depend on the population's size and development trend and ranges from monitoring support for *in situ* breeding, via *in vivo* or *ex situ* controlled breeding to regeneration in the form of targeted individual mating using cryopreserved material and embryo transfer. *In vivo* breeding is continuously replenished by creating a deposit of cryopreserved material.

The overall responsibility for meeting the objectives, including the implementation of the international obligations, is the task for the MoA, the National Reference Centre for Animal Genetic Resources at the Institute of Animal Science (IAS) and the NPAGR Council.

2. The current state of animal GR

In contrast to plant GR, most animal GR are privately owned by a large number of owners and breeders. Animal GR are mainly kept in family smallholdings and hobby farms. Their attitude is strongly influenced by social and economic development and the number of small breeders is therefore constantly decreasing. The number of breeds is also very variable, whilst each individual animal represents a separate genetic resource. Breeding and selection is managed by the collective decisions of breeders' associations. Keeping animal GR is not economically competitive compared to similar productive breeds and hybrids and thus is dependent on certain compensations from the state for economic losses.

The genetic resources of fish are kept in the form of permanently renewed nucleic shoals consisting of 120 individuals. Each species is kept in two or maximally three nucleic shoals. The renewal is carried out exclusively by artificial spawning by specific breeding techniques, e.g. by incubating the eggs in a separate incubation environment or in the different period of time than the incubation of eggs for production purposes.

Similarly, the genetic resource of honey bee colonies is continuously maintained in seven breeding farms in recognized locations. Special insemination techniques of the queen bees are used for the renewal of the colonies.

1) *In vivo* conservation of GR

Cattle
Both breeds of cattle – Česká červinka (Czech Red) and the original unbred type of Český strakatý cattle (Czech Original Red-Pied) have been regenerated. From their original state of being critically endangered they now ceased to be directly threatened. The regeneration projects will continue also in the future, mainly in the form of embryo production, rearing breeding bulls from embryo transfer, placement of bulls at insemination stations, collection of semen, cryopreservation of insemination doses and the increase of female population.

Sheep and goats
Both breeds of sheep are stabilized. Valaška (Valachian Sheep) was even successfully regenerated within the original colour variants. The status of both goat breeds is now stable. However, the development of farm cheese production and the import of intensive milking breeds poses a threat especially to the white breed. Therefore, it will be necessary to focus more on cryopreservation.

Pigs
The size of the Přeštické Černostrakaté (Přeštice Black-Pied pig) population has been stabilized while the main focus is now on measures related to preservation of the breed's structure (genetic diversity), health and the economic use of its positive qualities.

Table 3: The current status and development of animal GR populations

Species/breed	Number of individuals registered as GR							No. of farms	
	2010	2011	2012	2013	2014	2015	2016	subsidized in 2016	total
Czech Red Cattle	162	112	123	145	184	198	246	22	25
Czech Original Red-Pied Cattle	20	34	36	39	45	60	83	6	7
White Shorthaired Goat	1 902	1 912	1 964	2 067	2 176	2 253	2 307	111	~ 120
Brown Shorthaired Goat	870	788	909	956	1 022	1 074	1 111	101	~ 110
Valachian Sheep	376	451	441	564	657	803	902	53	~ 60
Šumava Sheep	2 530	1 942	2 040	2 142	2 244	2 169	2 241	24	~ 30
Přeštice Black-Pied Pig	209	228	262	394	476	357	366	22	?
Kladruber Horse	414	410	405	399	393	391	378	19	232
Hucul Horse	164	160	158	161	156	168	166	13	48
Bohemian-Moravian Belgian Horse	444	452	508	471	503	479	521	61	585
Silesian Noriker Horse	281	285	329	311	343	334	337	71	342
poultry:									
Czech Gold Brindled Hen	212	180	210	222	221	214	208	8	?
Czech Goose	187	198	195	193	187	170	159	21	?
rabbits:									
Moravian White of Brown Eye	110	108	65	82	74	100	115	20	?

Czech Solver	66	48	68	94	95	94	85	9	?
Moravian Blue	144	135	139	150	154	173	160	12	?
Czech Spotted	293	270	291	290	298	305	343	27	?
Czech White	155	130	147	161	173	157	155	16	?
Czech Gold	133	119	139	152	117	72	102	13	?
Czech Black Guard Hair	35	41	55	43	43	42	53	9	?
Standard Nutria	117	112	98	85	96	107	103	7	?
Moravian Silver Nutria	73	58	55	40	43	42	39	5	?
Přeštice Multicolour Nutria	72	88	71	76	49	56	50	4	?

breed below its sustainability limit

Table 4: Number of nucleic shoals of fish

Species/year	2010	2011	2012	2013	2014	2015	2016
Common Carp	15	15	13	13	14	13	13
Tench	8	8	2	8	8	8	*4*
Wels Catfish	2	2	0	2	1	2	*4*
Rainbow Trout	4	4	4	4	4	4	*8*
Brown Trout	4	4	4	4	4	4	2
Maraena Whitefish	1	1	1	1	1	1	1
Northern Whitefish	2	2	2	2	2	2	2
Sterlet Sturgeon	3	3	3	3	2	2	2
European Sturgeon	1	1	1	1	0	0	1
total number	**40**	**40**	**30**	**38**	**36**	**36**	**37**

Table 5: Number of breeding Carneolan Honey bee queens

Year	2010	2011	2012	2013	2014	2015	2016
Number of bees	383	373	368	336	406	379	383
No. of holdings	7	7	7	7	7	7	7

Horses

The population of conserved breeds is stable, although it is necessary to focus on several current issues. The Hucul horse shows low reproductive activity and the average age of mares is increasing. These factors are rather unsatisfactory as they do not give favourable prospects for the future. For cold-blooded breeds the issue of precise differenciation of the Noriker sub-populations (Noriker – Silesian Noriker) and the absence of a breeding system based on the basic principles of working with small populations, is still not resolved. A separate problem is also the lack of system settings for the practical use of cold-blooded workhorses.

Poultry

The supported breeds (Czech Goose and Czech Gold Brindled Hen) are fully maintained in hobby farms. Therefore, several problems caused by this traditional breeding system persist, such as determining of breeding priorities and keeping a pedigree of the population. Cryopreservation has not been fully methodically developed and the poultry populations are posed to several threats, such as the avian influenza infection. One of the measures will therefore need to be the establishment of isolates to protect the most valnurable parts of the population.

Since 2008, the National Programme has also included closed initial poultry lines used within the recognized breeding farms in the CR. It concerns a total of 19 lines of egg-laying hens, 7 lines of ducks

and 5 lines of geese, as well as 20 inbred lines and 3 outbred lines of chicken. The main reasons of their inclusion into the NPAGR are the ongoing potential risk of incidence of dangerous poultry diseases and the protection of this breeding material against its possible destruction.

Small animals

Rabbit and nutria breeds are also fully maintained in smallholdings in the *in vivo* form. Breeds originally protected for their fur due to their unique colour genotypes are also partly usable as a source of meat and the programme also focuses on the characterization and genotyping of these characteristics. Cryopreservation has yet to be methodically developed.

The fish GR in aquaculture are stabilized, maintained in the form of *in situ* nucleic shoals and with developed cryopreservation methodology. In connection with the FAO aquaculture programme currently being formed, other necessary activities will be formulated in this sector in the future.

In addition to livestock animals, the NPAGR also includes animal populations of selected fish species and Carniolan Honey Bee that are important for nature conservation, ongoing research and the provision of ecosystem services. The bees GR are maintained in the form of controlled breeding (insemination) with performance checks at breeding farms. Currently, the state of genetic diversity within these farms is being mapped.

Table 6: Extent of cryopreserved material as of 31. 12. 2016

Species/breed	Embryos	Seminal doses	
	number	no. of donors	no. of doses
Czech Red Cattle	436	13	17 042
Czech Original Red-Pied Cattle	1 254	33	18 598
Kladruber Horse	0	42	2 238
Hucul Horse	0	6	340
Silesian Noriker	0	11	614
Bohemian-Moravian Belgian Horse	0	15	781
White Shorthaired Goat	0	29	1 815
Brown Shorthaired Goat	0	13	380
Šumava Sheep	0	58	1 131
Valachian Sheep	0	15	283
Přeštice Black-Pied Pig	0	104	12 100
Czech Meat Pig (extinct after 2005)	0	8	668 French straws
Common Carp (10 breeds/lines)		228	4 296
Tench (8 breeds)		401	901
Wels Catfish (3 breeds)		31	170
Sterlet Sturgeon		51	662
European Sturgeon		6	840
Brown Trout		43	414
Rainbow Trout		45	500
Maraena Whitefish		16	150
Northern Whitefish		17	143

2) Storing GR *ex situ* – cryopreservation

Within the framework of the National Programme for Animal GR, breeds of cattle, pigs, sheep, goats, horses and fish are included in the cryopreservation programme. The aim of the preservation programme is also to extend the type of genetic material stored (oocytes and somatic cells) for those species, where there is not yet developed a sophisticated cryopreservation method for gametes (rabbits, coypu, poultry).

By engaging expert in characterization and cryopreservation, new sets of information are generated and further used to enhance the preservation programmes. It is therefore necessary to support the funding of research activities.

Currently, the priorities for selecting breeds for cryopreservation are determined by their risk status (see *in situ* conservation) and conservation value.

Apart from cattle and pigs, the selection of individuals and the collection of samples of genetic material for cryopreservation is primarily given by their availability or the willingness of their owners to provide such samples. Therefore, it will be necessary to work together with the breeders' associations to develop a system of targeted selection of individuals for cryopreservation and to strengthen capacities for routine use of methods of sampling and cryopreservation and the subsequent application of the genetic material.

Table 7: Collection of genomic material

Species and breed	No. of samples
Czech Red Cattle	718
German (Hessen and Westphalian) Red Cattle; Polish Red Cattle	43 25
Czech Original Red-Pied Cattle	564
Přeštice Black-pied Pig	59
Šumava Sheep	2 462
Valachian Sheep	458
bred Valachian Sheep	161
White Shorthaired Goat	1 629
Brown Shorthaired Goat	846
Kladruber Horse	732
Silesian Noriker	430
Bohemian-Moravian Belgian Horse	534
Hucul Horse	285
Czech Gold Brindled Hen	574
Czech Goose	217
Moravian Blue Rabbit	6
Czech Spotted Rabbit	6
Czech Solver Rabbit	6
Standard Nutria	24
Přeštice Multicolour Nutria	6
Moravian Silver Nutria	3

Genomic collections of biological material are primarily intended for use in GR research. It will also be necessary to develop a targeted collection system in order to enlarge this material.

At present, the following genebanks are involved in the NPAGR:

- the cryobank operated within the Czech Moravian Breeders´ Corporation in Hradištko, which stores deep-frozen insemination doses and the embryos of cattle, horses, pigs, sheep and goats,
- the cryobank operated within the University of South Bohemia– Research Institute of fish Culture and Hydrobiology in Vodňany, which stores deep-frozen insemination doses of fish,
- the bank operated within the Institute of Animal Science in Uhříněves, which stores DNA, somatic cells and animal tissues and contains also the work-deposit of deep-frozen insemination doses of pigs, sheep and goats in Kostelec nad Orlicí,
- the bank operated within the Czech Academy of Sciences - Institute of Animal Physiology and Genetics, which stores blood samples of fish for DNA studies.

3. Structure and organization

The **Designated person and coordinator** is the Institute of Animal Science in Uhříněves (IAS) that pursuant to § 14 (4) (a) of the Breeding Act No. 154/2000 Coll. ensures the overall coordination of the National Programme for Animal GR. The National Reference Centre for Animal Genetic Resources operates within the IAS and is responsible for coordinating activities and implementation of measures aimed at achieving the objectives of the NPAGR. This Centre is represented by the coordinator, whose duties are also the international activities, cooperation with the MoA, carying out checks and addressing possible problems. The designated person also assesses the NPAGR annually in accordance with the provisions of the aplicable legislation.

The Board of Animal Genetic Resources is the advisory body of the designated person. The Board is chaired by the coordinator or his/her deputy and acts in accordance with its Statute and the Rules of procedure. The Council consists of representatives of breeders' associations, experts for relevant animal species or breeds, representatives of the MoA and other invited persons.

Animal species or breed experts are appointed by the statutory body of the designated person upon a proposal from the relevant breeders' association and upon consultation with the MoA. The expert guarantees that all information about the particular species/ breed is up-to-date, is responsible for the Methodology for the conservation of the particular species/breed, participates in meetings of the Board, communicates with the programme participants, submits data and information about the current status and possible problems of the species/breed to the coordinator, creates annual reports, provides on-line access to up-to-date information and, within its remit, addresses current issues.

The relevant **Breeders' Association** looks after each breed or species of animal GR in the course of its day-to-day activities. The association's rights and obligations are given by the Breeding Act and Decree on animal genetic resources and to one of the core activities belong keeping the herd book or similar breeding evidence.

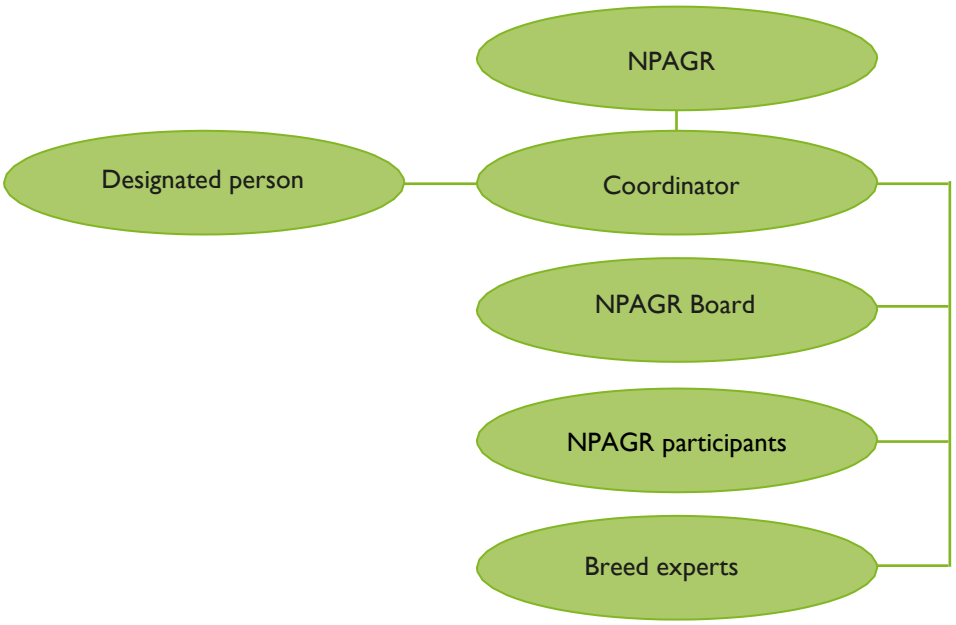
NPAGR **participants** are most often owners of animals, breeders' associations, the legal entities operating the genebanks as well as the designated person. Participants voluntarily undertake to meet the conditions stemming from the relevant legislation and the methodologies for conservation of particular animal species/breed.

The administration process enabling the inclusion of animal species/breed into the NPAGR, the inclusion of new programme participants as well as the recording of animals as genetic resources in herd books or breed evidence books are governed by the Breeding Act and related methodologies for

conservation of particular animal species/breed.

The Ministry of Agriculture issues a formal decision for including a new participant into the NPAGR or for extending of such existing decision. The relevant applications must be approved by the designated person and delivered to the MoA no later than 31 July of the given year.

Fig 3: The structure of the National Programme on Animal Genetic Resources



4. Specific methodological activities

1) *In situ* conservation

The aim of *in situ* conservation is a dynamic way of conservation in normal production conditions, which allows the natural development of populations, their coevolution with pathogenic microorganisms, adaptation to changing climatic and natural/living conditions and minimalization of the effects of modern technologies (dehorning, early weaning and artificial calf nutrition, caged poultry breeding). In contrast to normal breeding, the conditions required for breeding genetic resources are those most similar to the conditions in which the breed evolved, for example, allowing a natural paddock or grazing for the Přeštice Black-Pied Pig and the Czech Gold Brindled Hen; the relevant amount and quality of nutrition, which must correspond to the normal dynamics of the growth and development of animals. These requirements are usually incompatible with modern production technologies.

The aim of selection is not to enhance the production traits, the main aim is to stabilize the utility traits (maintenance breeding) or to change them to the original state – for example, the original degree of fattening in the Přeštice Black-Pied Pig, which changed significantly under the influence of selection in the 1980's.

For groups of individual animals included in the conservation nucleus, the breeding is organized according to the principles of breeding of small populations in order to preserve a specific genetic diversity within the breed. Individuals undergo pure-breed mating in accordnace with the set plan. The aim is to gain offspring with the characteristics that would enable to include them again into the group of GR, taking into account a wider set of utility traits during their selection. For some genetic

resources, e.g. workhorses, it is therefore necessary to insist on the original manner of use or at least to verify their genetically based talents for this manner of use - character, manageability, willingness to work, etc.

For every breed included in the NPAGR there is a designated expert that develops in cooperation with the relevant breeders' association a methodology for the conservation of genetic resource. This methodology stipulates inter alia:

- the breeding method, performance check, assessing traits and selection, which may differ from approved classic breeding programmes,
- the recommended way and technology of keeping animals,
- the recommended way of assessing the population's state and trend (monitoring),
- the extent and manner of keeping documentation on the genetic resource by the owner,
- the bodies responsible for implementing the procedures set out in the methodology.

The contents of the methodology is written in the annex to Decree No. 72/2017 Coll., on animal genetic resources. On the basis of an annual assessment, the reccomendations could be specified or modified according to the current development of the given species/breed.

2) *Ex situ* conservation

The *ex situ* conservation strategy aims to preserve genotypes threatened by elimination as a result of selective pressure and the spread of "the best" individuals. The combination of *in situ* and *ex situ* approaches is the best approach for the conservation, or possible regeneration or reconstruction of breeds with large or small population numbers.

The development of genebank is a long-term project involving several processes. The current state and knowledge of the dynamics of the conserved population, determining the purpose of the genebank and, last but not least, the financial stability allowing its operation are crucial. Mapping and recording the cryopreserved genetic material in domestic genebanks and their integration into the European genebank network EUGENA will contribute to the optimization and utilization of national genetic material.

The main purposes of a genebank are the following:

- safety deposit - for reconstructing the breed in case of any unforeseeable event or catastrophe,
- active support for *in vivo* conservation programmes – cryopreserved insemination doses are used to minimize inbreeding,
- conserving rare or important genotypes – use for corrective mating or developing utility traits according to market demand,
- conserving biological material for research and development, especially in the form of genomic collections.

5. Monitoring and evaluation of animal GR

1) Classification of breeds/populations according to their adaptation to local conditions

Locally adapted breeds are considered to be those breeds that have been in the CR for a sufficiently long time to have genetically adapted to local production conditions. A sufficiently long time is considered to be 40 years plus six generations, that is, approximately 80 years for cattle and horses, 60 years for sheep and goats and 50 years for pigs. If it concerns a relatively closed population, i.e. with no or minimal crossing with another breed, which has developed into a distinctly different type

from the original breed during that time, then it can be considered a new (purebred) breed.

Autochthonous or native breeds can be defined as originating and initially recognized in a given country (i.e. in the country of origin) and existing in the country where they were bred. In 2009, the FAO Commission on Genetic Resources for Food and Agriculture established a timetable and format for reporting on the state and development of animal genetic resources based on the GPA. The report is based on CBD indicators for trends in the genetic diversity of domesticated animals and is processed every two years. Examples of diversity indicators are the number of locally adapted breeds, the percentage of the locally adapted breeds in the total population of the species and the number of breeds classified with the status of endangered, unknown and with no risk.

At the same time it is desirable to monitor animals that are not registered in herd books (with no pedigree) because they could be used to reconstruct a breed in case of any unforeseen situation.

2) Identifying endangered breeds – indicators used

The primary indicator is the total population capable of reproduction (number of animals). However, the data on the immediate population size need to be addressed in relation to time, i.e. the trend of the population's numerical development.

Moreover, the effective population size indicator (Ne), which is often used as a measure of the threat, requires data on the number of breeding males (including any cryopreserved insemination doses) and is not fully accurate in systems with controlled reproduction (systems with no random mating).

The decisive indicator is thus the number of females, which is used for classification of the threat status. The most serious is "critical" status signalling a direct threat and the need for immediate active conservation measures. It is followed by "action" needed, which requires a managed regeneration programme, and "warning" status, which should be the reason for elaborating further management measures for the breed.

Table 8: Criteria for determining the risk of threat – number of females[10]

Threat status	species			
	sheep and goats	horses and donkeys	cattle	pigs and poultry
Critical	300	200	150	100
Action	3 000	2 000	1 500	1 000
Warning	6 000	4 000	3 000	2 000

It is essential to assess the values of all these indicators in relation to other factors affecting the population's reproductive potential: fertility rate, the generation interval, the ratio of males and females and, last but not least, the extent to which the breed is used for purebred breeding. Apart from population size and trend, the status of the breed could be also influenced by other factors such as limited number of herds (breeds) and/or concentration of animals on a limited territory. This factor is particularly important for the Czech Republic due to its size, and with regards to the fact that in case of an outbreak of a serious epidemic disease, the remedial (elimination) measures could affect extensive areas of the country. For similar conditions, a concentration of 75 % of the breed within a 25 km radius is considered as critical and a 50 km radius is considered as warning.

[10] Breeds at Risk. Criteria and Classification. Report from a seminar 16-17 February 2010, Lawrence Alderson http://www.ela-europe.org/ELA%20teksten/home/breeds%20at%20rosl.pdf

The FAO Guidelines for the Conservation of Genetic Resources *in vivo*[11] provide for the determination of the endangerment category a more detailed table , taking into account more factors.

Another important factor is the rate of genetic erosion that can arise as a result of inbreeding, genetic drift, the introgression of foreign genes, etc. Among these factors, the most serious is the rate of increase in inbreeding between generations rather than the absolute level of inbreeding, because the degree of severity of inbreeding differs among species/breeds. The introgression of foreign genes is classified as critical if it exceeds 12.5 % in any generation, a level of 2.5 % indicates the warning status.

In addition to these measurable indicators, it is necessary to consider other causal factors, such as the overall trend in developing livestock production, the socio-economic situation, demographic developments – the proportion of the population engaged in breeding (including hobby breeders) and the age of breeders.

Table 9: Recommended FAO criteria for determining the risk of endangerment

reproduction capacity	no. of males	number of breeding stations						
		≤100	101–300	301–1000	1 001–2 000	2 001–3 000	3 001–6 000	>6 000
high*	≤5							
	6–20							
	21–35							
	>35							
low**	≤5							
	6–20							
	21–35							
	>35							

critical endangered vulnerable no risk

high reproduction capacity * = pigs, rabbits, poultry
low reproduction capacity ** = horses and donkeys, cattle, sheep and goats

Table 10: Indicators of endangered breeds

Summary overview of indicators of endangered breeds				
category	numerical indicator*	geographical concentration indicator **	genetic indicator of inbreeding ***	genetic indicator of introgression****
Critical	< 100-300	< 12.5	> 3	> 12.5
Action	< 1000–3000	< 25	> 2	> 7.5
Warning	< 2000–6000	< 50	> 1	> 2.5

* the number of females able to reproduce by species (see Table 7)
** radius where 75 % of the breed is found
*** increase in inbreeding per generation
**** % occurrence of foreign genes

[11] FAO 2013. In vivo conservation of animal genetic resources. FAO Animal Production and Health Guidelines. No. 14., Rome (http://www.fao.org/docrep/018/i3327e/i3327e.pdf)

6. Inventory, characterization and documentation

1) Documenting of breeding data

The data for the global monitoring and development of AGR are stored in the FAO Global Databank – the Domestic Animal Diversity Information System (DAD-IS)[12]. The European Federation for Animal Science (EAAP) created a database to monitor a wide range of European breeds. These are data describing breeds in general, including the size of populations and their structure over time. Both databases are interconnected and countries are obliged to update data on their breeds every year.

DAD-IS currently contains data from 182 countries on 36 species (19 mammal species, 17 bird species) and two fertile inter-species crosses (dromedary x Bactrian camel and the domestic duck × Muscovy duck). The total number of national populations recorded is 15 008 (as of 1st September 2017), of which more than 8 500 are described as local breeds (i.e. reported only in one country).

2) National database of breeds

A comprehensive list of breeds represented and used in the CR, documenting their immediate status (published in the DAD-IS system) contains 22 breeds of cattle, 8 breeds of goats, 36 breeds of sheep, 21 breeds of horses, 9 breeds of pigs, 6 breeds of rabbits, 3 breeds of turkey and geese, 2 breeds of ducks and Guineafowl and one breed of hens. The inventory is based on data registered by relevant breeders' associations. A number of other breeds of small animals and poultry kept in unregistered hobby farms are not included here; therefore it is not possible to estimate their range and diversity. The data are updated on the basis of information provided once a year to the coordinator by the relevant breeders' association. The format of the data provided below.

Basic data set

- breed name – consolidated international name according to EFABIS catalogue,
- identification of the subject managing the breed (recognized breeders' association),
- description of the basic morphological features,
- information on performance,
- Information on existing *in situ, ex situ* (*in vitro*) conservation programmes

Table 11: The format used to fill in data to the national breeds database

Extent of the population (if a numeric value is not known, give the range from – to)	Origin of data (Central register, census, estimate, etc.)	Data reliability in %
Extent of purebred breeding in population in %		
Number of females intended for reproduction		
of which females registered in Herd Book		
No. of breeding males		
of which males used in reproduction		
of which males used for insemination		
No. of farms (breeds)		
No. of animals per farm (breed) (range from – to)		

[12] http://dad.fao.org/

3) Description and characterization of breeds[13]

Its aim is to measure and describe the genetic diversity of genetic resources as the basis for their understanding and sustainable use. The description (phenotypic characterization) identifies the diversity of populations and describes their external and production characteristics. Information on the population's geographical distribution is an integral part of the phenotypic characterization. Data objectivity must be ensured by obtaining realistic data for at least 30 males and 100 females.

Additionally, molecular-genetic characterization data are used to clarify the genetic basis of phenotypes, inter-breed variability and similarities between breeds. The objectivity of the results depends on the selection of individuals used for the analyses – the minimum number should be at least 40 individuals and include the widest spectrum of the population, if possible geographically dispersed and with no connection by blood. To ensure compatibility and the possibility of integrating these data at the international level, it is necessary to use ISAG[14] standards and markers. The rapid development of molecular methods requires their continuous implementation (for example SNP chips).

Knowledge of the production environments in which performance is achieved is essential for the correct interpretation of their values. Therefore, a set of descriptors of the production environment was developed[15]. This makes it possible to assess their current, but especially, potential future uses in various production systems.

4) Early warning and response system

The basis for the system will continue to be the number of reproductively active females and males, the trend of the inbreeding value and the trend in the number of herds/breeds. For breeds with a strong local tie to the geographical range will also be taken into account. The introgression of foreign genes is practically irrelevant, because only individuals with a value below 12.5 % are recognized as a genetic resource and in all cases, measures have been taken to permanently reduce this value.

However, many breeds of small animals and poultry are not registered, so the total population range can only be estimated. Thus, thus the conservation regime covers only registered purebred individuals of these populations and it is as such considered to be the breeding nucleus and genetic resource. Regarding small numbers of these breeds, they all fall into the category of critically endangered. Revitalization projects have been processed, implemented and are continuously evaluated for all critically endangered breeds.

To assess the status and development of populations of genetic resources and the effectiveness of the National Programme, the breed expert submits data to the coordinator (if possible for the entire breed population), on the basis of which the information is evaluated pursuant.

The effective population size of 50 individuals is generally considered to be the critical limit for the long-term survival of a species, while 400 individuals (males and females) participating in breeding for a given year can be considered the small-size population. In small-size populations, the breeding should be managed along the following principles.

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[13] Phenotypic characterization of animal genetic resources. Animal Production and Health Guidelines. No. 11. Rome (www.fao.org/docrep/015/i2686e/i2686e00.pdf).

[14] FAO 2011. Molecular genetic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No. 9. http://www.fao.org/docrep/014/i2413e/i2413e00.pdf

[15] FAO/WAAP. 2008. Report of the FAO/WAAPWorkshopon Production Environment Descriptors for Animal Genetic Resources, held in Capralola, Italy, 6–8 May 2008, edited by D. Pilling, B. Rischkowsky & B.Scherf. Rome (http://dad.fao.org/cgi-bin/getblob.cgi?sid=-1,593).

Principles of breeding in small populations:

- making use of the largest possible number of breeding males; the proportion of breeding males in the population is maintained at a minimum of 10 %; for one generation interval it is necessary to have at least 15 breeding males for mammals and 25 for poultry,
- breeding males with the genetic relationship at the maximum of 25 % are used for breeding during natural mating, while in case of insemination it is only 12.5 %,
- at least one son from each breeding male is included into the breeding programme, while not more than one son from the same father is included into the breeding programme from the same mother,
- mothers are used for reproduction as long as possible, while all daughters from each mother are used for reproduction,
- in case of insemination, an even number of mothers inseminated by particular breeding males is maintained,
- the smaller the population size, the smaller is the number of females mating with the same male,
- setting of the maximally allowed level of genetic relationship (usually 6.25 %).

Table 12: Data for assessing the state of populations of AGR

Requested data	Evaluated indicators *
number of active breeding males in a given year (with the record keeping about reproduction)	length of active use of breeding males (in years)
	percentage of active breeding males in population (% of all included)
number of breeding males used in the form of insemination doses	insemination intensity (% of the total reproduction)
number of active breeding females in a given year (with the record keeping about reproduction)	length of active age of females (in years)
age of females at first birth (in months)	generation interval (in months)
number of births and number of offspring produced at one birth	
Summary indicators:	
number of newly included breeding males in the given year	
number of newly included breeding females in the given year	
number of included daughters per mother	
number of included daughters and sons per individual breeding males	
number of registered breeds/farms	
size of genetically effective population Nef*	
increase in inbreeding factor per generation	

- * Nef = 4 x M x F / (M + F), where M = number of males used in breeding in the given year and F = number of females reproduced in the given year.

7. International cooperation

The protection, conservation and use of biodiversity are global in nature and therefore international cooperation and coordination of activities is absolutely essential. It is also a prerequisite for ensuring

the availability of GR.

The Global Plan of Action (GPA) was adopted by the international community at the FAO International Technical Conference on Animal Genetic Resources for Food and Agriculture held in Interlaken, Switzerland in September 2007. The GPA established 23 Strategic Priorities aimed at addressing the threat of genetic erosion of animal genetic resources and ensuring their sustainable use. The countries thus confirmed their joint and individual responsibility for the sustainable use and development of these resources. They also committed to ensure access to these resources and fair and equitable sharing of the benefits arising from their use. In addition, there were developed measurable and time-restricted targets in order to assess progress and achievements in implementation of the GPA.

The Czech Republic has been involved in FAO activities for a long time, including collecting of data and preparing of information, working in the FAO Commission on Genetic Resources for Food and Agriculture and through its expert activities.

A key FAO project in Europe is the European Regional Focal Point for Genetic Resources (ERFP)[16], which has been successfully running since 1996, with the CR as the founding member. Its operational programme is funded by contributions from participating countries. The Working Groups (WGs) provide the technical and advisory information needed to implement the GPA and were established with the long-term programmes. In contrast to WGs, Task Forces (TF) are platforms being set up only temporarily in order to discuss and address specific issues, where the common approach of the European region is needed as a response to urgent issues in the sector of animal genetic resources.

Since 2016, another cooperation model has been carried out, the European Genebank Network (EUGENA) project. The Memorandum of Understanding (MoU) is in the signing phase. It is further assumed that the NPAGR will need to address additional specific issues that will arise from the ratification of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity and from membership of the Czech Republic in the newly established Working Group for Aquaculture Genetic Resources at the FAO Commission on Genetic Resources.

8. Use of animal GR and the services provided

The conservation and utilization of animal genetic resources means specifically the management of those genetic resources that are not currently commonly used, are endangered or neglected and will be used in the future as a source of specific genes. In the broader sense, it includes all activities related to the management of genetic resources such as inventorying, monitoring and characterization of these resources, their sustainable development, and allows the access to a wider range of these resources, in particular for research and development. The information about individual breeds, methodologies for their conservation and data on their development are published in the annual reports at www.genetickezdroje.cz.

[16] European Regional Focal Point for Animal Genetic Resources

9. Plan of specific activities

The FAO strategic document Global Plan of Action on Animal Genetic Resources was taken into consideration when developing the the National Programme for Animal GR. The document aims at addressing the threat of genetic erosion of animal genetic resources and ensuring their sustainable use. It includes 4 strategic areas: (1) Characterization, inventory, monitoring of trends and risks of animal GR, (2) Sustainable use and development of GR, (3) Conservation and (4) Policies, institutions and capacity building. The individual areas are broken down into 23 priorities with proposed measures.

The Czech Republic fulfils the GPA by means of this National Programme. For the needs of the National Programme, the activities concerning the conservation and use of animal GR are not organized according to the GPA structure, but according to individual species and breeds of GR that are included into the National Programme.

Table 13: Plan of specific activities for coordination and individual livestock breeds and species

Activity	
Coordination	
*	Monitor the amendment to the Breeding Act based on the adopted Regulation of the European Parliament and of the Council (EU) 2016/1012 on zootechnical and genealogical conditions for the breeding, trade in and entry into the Union of purebred breeding animals, hybrid breeding pigs and the germinal products thereof and amending Regulation (EU) No 652/2014, Council Directives 89/608/EEC and 90/425/EEC and repealing certain acts in the area of animal breeding ('Animal Breeding Regulation')
**	Determine the current status of endangerment of breeds included in the NPAGR
**	Continually assess the status of populations of animal GR in terms of numbers and genetic diversity
**	Continually update the information in DAD-IS
**	Develop a system of targeted collection of biological material for genebanks
*	Support the research projects focusing on characterization of GR, cryopreservation and use of animal GR
**	Implement the tasks arising from the CBD and the Nagoya Protocol
**	Implement the tasks arising from the FAO Commission on Genetic Resources for Food and Agriculture.
*	Ensure the membership of the Czech Republic in the European genebank network EUGENA

Czech Red Cattle	
**	Complete the National Health Programme for Rhinotracheitis Infectiosa Bovum
**	Start the health tests for paratuberculosis
**	Continue with the embryo production and rearing of breeding bulls from embryo transfer (for the production of cryomaterial)
Czech Original Red-Pied Cattle	
**	Continue with the embryo production and rearing of breeding bulls from embryo transfer (for the production of cryomaterial)
**	Increase the number of animals through contract breeding and by means of embryo transfer
Přeštice Black-Pied Pig	
**	Modify the subsidy system to ensure greater differentiation and support in favour of nucleus breeds
**	Analyse the possibility of establishing a system for producing PRRS-free animals from PRRS positive animals
**	Develop and use the software for monitoring of Fx index from pedigree information or DNA analysis
Valachian and Šumava Sheep	
**	Increase the amount of cryopreserved material
**	Prepare the differentiation of support in favour of producing breeding rams of Šumava Sheep
**	Review the rules for selecting animals as a genetic resource
**	Raise the awareness among breeders about the possibilities of breeding maedi-visna-free herds of Šumava Sheep
**	Establish the exception procedures in the area of breeding and veterinary rules in case of acute risk of eradication of animals
Brown and White Shorthaired Goats	
**	Increase the amount of cryopreserved material
**	Develop and use the software for monitoring of Fx index from pedigree information or DNA analysis
**	Review the rules for selecting animals as a genetic resource
**	Modify the rules for performance checking
**	Prepare the system for verifying the origin of breeding males and gradually all individual animals recorded as the genetic resource
Hucul Horse	
**	Implement the measures aimed at increasing reproduction, allowing for normal turnover of the stud, while maintaining an acceptable inbreeding coefficient
**	Restore the dual level of performance tests in order to increase the number of mares in the NPAGR

**	Actively cooperate in the implementation of the European Hucul horses registry in the framework of the HIF, including its use for the Czech breeding, especially in the male part of the population. In addition, ensuring the transfer and continuous update of data from the Czech Republic.
**	Continue with the verification of paternity and maternity of all individuals recorded in the NPAGR in the form of DNA testing
Kladruber Horse	
**	Slow down the process of increasing the inbreeding coefficient (based on the results of research project No. QJ1330189)
**	Expand the artificial insemination with fresh and frozen semen
**	Carry out closer cooperation between the National Stud Kladruby nad Labem and private breeders of Kladruber Horse
**	Optimize the subsidy schemes to strengthen measures in order to promote the population's diversity and quality (based on the results of research project No. QJ1330189)
Silesian Noriker Horse and Bohemian-Moravian Belgian Horse	
**	Ensure a greater degree of targeted cryopreservation
**	Modify the breeding programme (conditions for choosing colts for breeding, including stallions at a later age, creating and setting up a system for lifelong monitoring of horse performance)
**	Analyse the results of the research project No. QJ1510141 aimed at determining the genetic diversity of Noriker Horse and Silesian Noriker Horse populations
**	Create a genetic breeding nucleus within the particular breeding facility
**	Map the use of cold-blooded horses in forestry and addressing the problem of not having an integrated system to support the practical use of cold-blooded horses
**	Ensure the comprehensive monitoring of Summer Equine Dermatitis
Czech Goose and Czech Gold Brindled Hen	
**	Propose a cryopreservation methodology
**	Prepare a crisis plan for the event of the large-scale spread of serious diseases and to analyse the conditions for setting up isolates of breeds
**	Specify of breeding priorities in order to maximize the support for pedigree population management
Rabbits	
**	Verify the possibilities for the practical cryopreservation of genetic material
**	Carry out the characterization and genotyping of meat yield characteristics
Coypu	
**	Address the adopted Regulation of the European Parliament and of the Council (EU) No. 1143/2014 on Invasive Species
**	Assess the population's health status and further monitoring of meat yield
Carniolan Honey Bee	
**	Assess the mapping of the genetic diversity within the population

**	Examine the possibilities that could in practice ensure the protection of a defined vicinity of genetic resource breeds, i.e. the legal, subsidy and targeted education options
Fish	
**	Ensure the breeding of fish genetic resources in at least two locations in different river basins - creating the breeding duplicates
**	Ensure the operation and continuous refilling of the safety duplicates of the cryopreserved material within the cryobank of animal genetic resources at Hradištko pod Medníkem
**	Ensure the participation in and fulfilment of tasks of the Working Group on Aquaculture Genetic Resources of the FAO Commission on Genetic Resources for Food and Agriculture
**	Ensure the continuous monitoring and evaluation of the risks and, if necessary, addressing the problems connected with the vulnerability of the fish population, specificity of fish farming in ponds or reservoirs, possible losses due to diseases, poisoning or pollution of the water, poaching, predation pressure from the cormorant and otter, inappropriate modification of river beds, worsening of the hydrological situation, unsuitable fisheries management, but also reduction in the carrying capacity of the aquatic environment and increasing contamination by polluting substances

** activities that are directly or indirectly supported by national law or international treaties
* activities that ensure the development of the work with genetic resources and the effective functioning of the National Programme

The National Programme on Conservation and Utilization of Microbial Genetic Resources and Invertebrates of Agricultural Importance

1. Mission and aims

Microorganisms open up solutions to such issues as health and nutrition, the environment and poverty for the global population. They represent the largest proportion of global biodiversity with great ecological and economic value. They are the foundation of all ecosystems, decomposing plant and animal debris in the soil to release the basic nutrients for plant growth, creating mutually beneficial relationships with agriculturally important as well as wild plants. They have direct benefits for humanity, as drug producers, bioagents in the fight against pathogens and pests and for decontaminating and decomposing waste. Their conservation, identification, characterization and sustainable use is crucial if we are to exploit the potential of global microbial diversity.

Ensuring the safe and sustainable use of microbial diversity for the future is essential for human health. The potential for discovering new antibiotics or detection of organisms for industrial utilization is significant. Culture collections play an important role in providing biological material for further research and development. Their task is demanding; it includes genomics, post-genomics and other emerging disciplines in bioinformatics, which puts high demands on the qualifications of human resources and the technical equipment of the collections.

Besides the safe, long-term conservation of microbial GR according to international standards, attention is paid to setting the priorities for the rational expansion of the collections, forming sets of phytopathogens and zoopathogens and other microorganisms typical for a given area or host (crop, animal) or substrate, and the description and conservation of variability within a particular group of microorganisms. The primary activity is to identify missing microbial GR in culture collections, an inventory of the accessions and to assess the scope of species coverage within the sub-programme.

Another key activity is to deepen the evaluation and characterization of microbial GR to understand their genetic diversity and utilization in phytopathology, veterinary medicine, breeding and biotechnology. Obtaining of the characterization data is, to a great degree, dependent on both basic and applied research and development projects, the output of which are not only research articles but also utility models and patents.

In connection with the increasing information base on the held microbial GR, it is necessary to ensure the insertion of new data into the databases and their availability to users together with the genetic resources.

2. The current state of collections

The NPMGR culture collections maintaine an extremely wide range of organisms. The number of actively held accessions varies in the long term between **7 000 – 8 000 strains** (7 636 strains in 2016), which corresponds to nearly 1 200 species or lower taxonomic ranks. The strains can be classified into all the biological kingdoms, namely Archaebacteria, Bacteria, Chromista, Fungi, Plantae and Animalia and include also non-cellular organisms such as viruses and viroids.

Most microorganisms gathered in the frame of NPMGR are important for humans, either as pests in agriculture (phytopathogenic and zoopathogenic viroids, viruses, rickettsia, mycoplasmas, bacteria, fungi, insect pests, mites and nematodes) or, on the contrary, as beneficial agents in agriculture and food industry (bacteria including rhizobia, fungi including yeasts and others).

From the group of beneficial microorganisms, the culture collections mainly contain industrially

useful microorganisms such as bacteria and yeast taking part in the biotechnological fermentation process (brewing, distilling, yeast-making and dairy yeast and bacteria), fungi producing significant enzymes or dietetics, bacteria usable for food analytics or the degradation of difficult to degrade substrates (e.g. keratinolytic or cellulolytic bacteria).

A large part of the accessions are viruses and viroids pathogenic to agricultural crops such as potatoes, ornamental and fruit trees, hops and other plants. In culture collections, other pathogens of cultivated plants are kept including obligate and facultative biotrophic and necrotrophic phytopathogenic and saprotrophic fungi, phytopathogenic and saprotrophic bacteria, phytopathogenic mycoplasmas, and tools for their detection and diagnostics (antibodies, antibody-producing hybridomas). Another group of pathogenic microorganisms are zoopathogenic viruses and bacteria including the tools for their diagnosis (antibody-producing hybridomas).

An important group included in the NPMGR are autotrophic microorganisms (algae and cyanobacteria). These conserved strains are a source of knowledge, among other things, about the production of technologically significant secondary metabolites or biomass rich in nutrient components. Cyanobacteria, as one of the dominant autotrophic group of microorganisms, colonize virtually all habitats, including manmade ones. Thus, they are also found on growing areas, in the aquatic environment, they are also known from breeding facilities, but can even act as significant contaminants of food or agricultural products. The strains kept in the culture collection serve as reference strains and, in specific cases, as bioindicators of the state of environment.

A distinct group of genetic resources represent the agriculturally important arthropods (stock cultures of storage mites and insects, stock cultures of insect pests), and other phytophagous invertebrates (nematodes, molluscs). Stock cultures of storage pests and phytophagous insect pests with no pesticide resistance are indispensable for further research when testing new plant protection products or for use in food and agricultural warehouses.

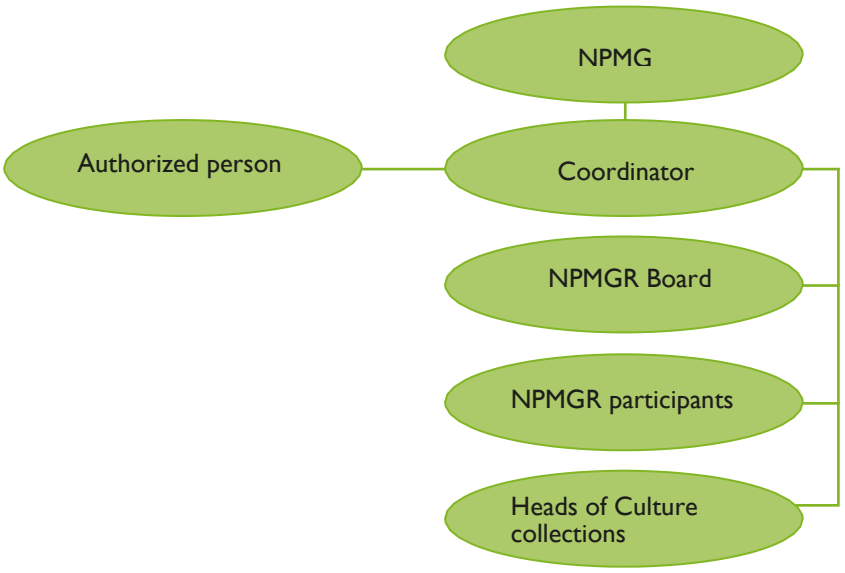
3. Structure and organization

The **authorized person**, which ensures pursuant to § 6 (2) of the Act[17] the coordination of the National Programme for Microbial GR and related activities, is the Crop Research Institute in Prague Ruzyně (CRI).

The coordination activities are carried out by the **coordinator** who manages the sub-programme and relevant activities of its participants, is responsible for the progress of its implementation and the results achieved and represents it in negotiations with the Ministry of Agriculture and other entities. The coordinator is appointed by the Minister of Agriculture.

[17] Act No. 148/2003 Coll., on the Conservation and Utilization of Plant and Microbial Genetic Resources Important for Nutrition and Agriculture

Fig 4: The structure of the National Programme for Microbial Genetic Resources



The **individual collections** are kept by the **participants** of the National Programme of Microorganisms, represented by the **heads of the collections** as the **responsible persons (guarantors)**. Other people may be entrusted with the responsibility for sub-collections – **curators**. The head of a collection can also serve as the curator of a collection.

As of 31 December 2016, there were 20 culture collections of microorganisms and small invertebrates located at 12 legal entities, which are organizations engaged in research activities within the agricultural sector and in education in agricultural and related fields.

The authorized person has the right to conclude independent contractual relationships with NPMGR participants and other entities with the aim of implementing the NPGR and meeting its objectives.

The consultative and advisory body of the authorized person (CRI) and the NPMGR participants is the Board of the NPGR of Microorganisms. The Board members are proposed by statutory representatives of the participants and other entities and are appointed by the authorized person's statutory representative. The mandate of the Board and its members is given by the Statute and the Rules of Procedure. The Board is chaired by the **coordinator** of the sub-programme or its deputy. The Board is a platform for scientific and professional discussions on microbial GR, biodiversity and contributes to the promotion of GR. It also fulfils the function of an expert group for the needs of the MoA; mainly commenting on professional matters and international issues. The opinions of the NPMGR Board have the character of recommendations.

The activities of the collections are carried out in accordance with internal guidelines or work procedures that comply with international standards for working with microorganisms. The activities are governed by approved expert methodologies for individual collections, which are part of the overall **Framework Methodology for NPMGR**. The Framework Methodology is available in electronic form at https://www.vurv.cz/mikroorganismy/Metodiky.html

Conditions for inclusion in the National Programme for Microbial GR

A general condition for including a new participant in the National Programme is ownership of microbial GR that have not already been dealt with as a collection, group of microorganisms or individual microorganisms in the NPMGR. The culture collection must contain a significant number of

microbial GR significant for food and agriculture.

If such a group of microorganisms already exists in the NPMGR, a set of unique GR may be included in an existing NPMGR culture collection that is the nearest materially and methodologically, in a manner and under the conditions agreed upon with the head of the relevant collection and the coordinator. This procedure eliminates duplication and saves public financial resources. A general condition is also the applicant's consent to include the relevant GR in the public system, including a guarantee of their availability for users and respect of the organizational and methodological procedures resulting from participation in the National Programme.

The specific professional and technical requirements for taking part in the National Programme are given in Act No. 148/2003 Coll., on the Genetic Resources of Plants and Microorganisms and its Implementing Regulation No. 458/2003 Coll.

4. Specific methodological activities

Currently, the long-term conservation of most microbial genetic resources is carried out by several procedures with a preference of cryopreservation (deep freezing in liquid nitrogen or at temperatures below -140 °C) and lyophilization (freeze-drying). These conservation methods are the best for minimizing the risks of genetic changes. In cases where only one conservation method can be used (e.g. cryopreservation for cell lines), accessions should be duplicated and the duplicates stored in self-contained technical equipment (e.g. two different freezers, Dewar vessels). If the first two methods cannot be used to conserve the strains, microbial strains are maintained under reduced temperature or in a form of live and active cultures under ambient temperature. Different types of microorganisms often require specific conservation methods to ensure their optimal viability, stability, regeneration and purity. The optimal conservation methods are known for many groups of microorganisms, however, there are still a number of genera and species that are not kept in the culture collections over the long-term. This presents the room for optimizing the protocols on long-term storage.

Furthermore, emphasis is placed on ensuring that the conserved microbial genetic resources are not threatened by unexpected events, such as electric power failure, failure of technical equipment, or natural disaster. For this reason, strains (including their associated documentation) should be safely conserved in self-contained technical equipment, in another building or, ideally, in another location (a safety deposit, e.g. contractually at another legal entity, in the authorized person's central laboratory). A high amount of information and financial value is accumulated in the conserved genetic resources, which needs to be taken into account when protecting the genetic resources against damage, loss of its properties or physical loss.

A wide range of organisms are the subject of preservation and conservation within the NPMGR. The high heterogenity of geathered microorganisms is reflected in the methodology that is often specific for a given higher taxon. Moreover, within lower taxa there are also different conservation and characterization procedures. All accessions of microorganisms are conserved solely in the *ex situ* form. Methodological approaches and technological demands are also conditioned to the fact, whether the collection accessions are included in any risk groups and subject to legal measures and constraints.

Strains of microorganisms can be divided according to their mode of life and nutrition, being obligatory/facultatively parasitic (biotrophic, necrotrophic), saprotrophic and autotrophic. The mode of nutrition determines the options for conserving the strains. Saprotrophic and facultatively parasitic strains could be usually cultivated on artificial or semi-natural media. Biotrophic parasitic organisms are usually maintained and propagated exclusively on living intact hosts or host cells.

1) Conservation

To maintain the strains' optimum long-term vitality, viability and genetic stability, it is essential to keep the strains in a metabolically inactive state. The preferred methods of preserving strains in a metabolically inactive state are lyophilization and cryopreservation. Conserving strains in a metabolically active state is only permitted if the given strain cannot be conserved otherwise or as a supplementary method for short-term conservation. Among the specific procedures for conserving microbial GR are:

- **Lyophilization**

Dehydration the cell samples reduces their metabolic activity, which is a basic prerequisite for the long-term storage of the strains without changes to their properties. This method is used as the method of first-choice for bacteria and fungi producing a sufficient amount of spores. These strains can be conserved for several years in the lyophilized state.

The lyophilization of individual species differs by the use of the protective medium, the speed and temperature of freezing prior to lyophilization. The freezing (sublimation of ice at low pressure and low temperature) takes place in a freeze-dryer. The resulting lyophilisates are conserved in a vacuum in glass ampoules, in a varying number of duplicates. The lyophilization ampoules with the lyophilisate are usually stored at about 4 °C. The viability of the lyophilisates is always checked after lyophilization. The next check takes place according to the plan of regeneration.

- **Cryopreservation**

The term cryopreservation is generally understood to be the preservation of organisms at temperatures below -20 °C. For the preservation of biological material, cryopreservation is considered to be the storage of living cells or organisms at ultra-low temperatures, in liquid nitrogen (-196 °C) or its vapours (at a maximum of -140 °C)[18]. Cryopreservation involves freezing and storage at temperatures below -140 °C, and thawing (melting) to the optimal temperature, so that the particular organism can multiply, which is a key role for the viability of the biological material. Inert materials, protective media or simply cultivation media are used as cell carriers. The prepared samples are frozen in programmable or other equipment pursuant to specific protocols, which differ for different groups of microorganisms, and are subsequently stored in a container with liquid nitrogen. Reactivation is then carried out through solid agar medium, liquid medium or through the inoculation of host cells.

Storing certain groups of microorganisms (above all bacteria) in liquid nitrogen is well managed and there is a high probability that the culture will survive. For other groups (some ascomycetes, basidiomycetes in general) it is necessary to carry out further research and verify suitable protocols for safe and long-term storage.

- **Replication in host organisms**

  - **Storage on intact host organisms**

Phytopathogenic viruses that cannot be stored outside the living host plant due to their instability are regularly inoculated or kept *in vivo* in perennial woody plants in the technical isolation facilities or in indicator plants in the greenhouse cubicles of a phytotron. Carriers (Auchenorrhyncha or aphids) with a precisely defined time for uptake and inoculation suction are used to trasmit them

[18] Benson, E. E., Johnston, J., Muthusamy, J., & Harding, K. (2008). Physical and engineering perspectives of in vitro plant cryopreservation. In *Plan Tissue Culture Engineering* (pp. 441-476). Springer Netherlands.

into a new host, or they are transmitted mechanically by sap of infected plant with the addition of various transfer buffers or by cutting and grafting.

Biotrophic pathogens from the orders Erysiphales (mildews) and Perenosporales are inoculated into the tissues of host plants, either into plant seedlings (*Bremia lactucae, Hyaloperonospora parasitica, Plasmopara halstedii, Golovinomyces orontii, Podosphaera xantii*) or on the leaves of the host plants (*Blumeria graminis, Pseudoperonospora cubensis, Golovinomyces cichoracearum, Oidium neolycopersi*) at intervals that are determined by their life cycle. The conservation of these biotrophic strains takes place in climate boxes in a controlled light and temperature regime.

Phytoplasma strains are maintained on host plants grown under standard greenhouse conditions or in a technical isolation facilities. The trasmissions of pathogens are carried out by grafting onto healthy plants at intervals that differ according to the pathogen species.

These traditional practices for conserving biotrophic microorganisms are not only demanding on energy, space and labour but, in particular, they expose the materials being conserved to the real possibility of undesirable contamination by other isolates and pathogens. Likewise, in contrast, they may represent a potential source of infection for other materials. This is particularly serious when the work is done with any quarantine pathogens.

- **Conserving and replicating viruses in host tissue cultures**

The preservation of viruses in plant tissue cultures is a very effective method for preserving the viruses of trees and soft fruit that are difficult to trasmit mechanically or cannot be mechanically transmitted at all. In the framework of the NPMGR, all isolates of potato viruses and viroids and some fruit tree viruses are stored in explant cultures. These cultures are further continuously kept in *in vitro* conditions.

The propagation of animal viruses takes place by inoculating selected cell cultures or chicken embryos that are susceptible to infection by the given virus. In rare cases, it is necessary to experimentally infect susceptible animals.

- **Conservation of arthropods and invertebrates**

The conservation of animal pests of agricultural crops, warehouse commodities and their antagonists vary for individual groups (type of artificial diet, nutrient plants, standard conditions for the entire life cycle).

Sucking arthropod pests of crops are primarily conserved on living plants (e.g. cereals, beans, tomatos, potatoes, etc.), which ensure optimal conditions for their development. In addition, commercially available artificial, holidic diets are used for chewing pests. Pests are reared under conditions of controlled temperature and photoperiod to ensure the best conditions for reproduction. In the case of species requiring a diapause for a certain part of the year, this is ensured by placing the resting stages in conditions with low temperatures and constant darkness (climabox).

The conservation and propagation of phytoparasitic nematodes (Nematoda) is carried out on the original host plants. The accessions of stem nematode (*Ditylenchus dipsaci*), a phytoparasitic quarantine organism, are kept cryopreservated.

Stored product pests and their natural enemies are kept in a metabolically active state. Stored product insects are kept in rearing containers at the optimal temperature and humidity on diets, which vary according to the requirements of each species. A wide variety of different kinds of raw materials and food products (e.g. wheat, barley, oat flakes, glycerine, groats, yeast, textiles, dried milk, fur, etc.) are used for their diets and are mixed in varying combinations and proportions

according to the specific requirements of each species.

Stored product mites are propagated in special closed rearing chambers. The rearing chambers are placed in desiccators at varying levels of relative air humidity (typically 75–85 % relative air humidity), the optimum for a particular species. Air humidity is maintained using saturated salt solutions. The temperature in the rearing chambers is kept in the range of 20–27 °C and is ensured by means of air-conditioned rooms or thermostats.

The predators and parasitoids of stored product insects and mites that have the potential to be used in biological pest control are reared on their natural hosts, according to individual species preferences. To facilitate this, certain insects and mites are propagated in large quantities as a source of natural food.

2) Characterization

Strains are continuously revived according to the plan of regeneration and their microbiological homogenity, viability, vitality and the stability of those properties for which the strain has been stored are monitored (macroscopically and microscopically). It is clear that the properties of cultures kept on solid media at a high metabolic activity need to be verified more frequently than during cryopreservation or lyophilization.

The standard characterization procedures for NPMGR strains are based on determination, morphological description, determining the biological, biochemical, molecular-biological and technological properties. Culture collections are characterized using tests of required properties (for beneficial microorganisms), pathogenicity and virulence (for harmful microorganisms) and other specific tests.

3) Recording and documentation

The central database for the NPMGR allows keeping and updating the information on the collection accessions through the web interface. It also allows searching for stored information by the public. Documentation on the genetic resources of microorganisms, which is recorded by the National Programme participants in accordance with § 17 of the Act, is kept for each accession of the culture collection (collection strain). Data on individual accessions of all collections are stored in the public central database available at the website http://www.vurv.cz/collections/vurv.exe/search?lang=cz. The documentation on the stored collection accessions is regularly updated, at least once a year.

The documentation on a genetic resource contains data that unambiguously identifies the collection accession(e.g. the registration number of the collection strain/culture, the valid scientific name of the taxon, the history of the strain, data on the strain's determination and origin, specific cultivation conditions , the conditions for providing the strain to other subjects) and other suitable information defining and characterizing the given strain of the microorganism (e.g. metabolite production, resistance to active biotic substances, host pathogenicity, presence of specific genes, technological properties). The documentation on preserved strains also contains, for example, photos, molecular analyses and information on changes in taxonomic classification. Last but not least, data required by legal requirements relating to stored collection accessions are also recorded.

Concurrently, some collections also keep records in the form of an incremental workbook and a card index of the strains. Data on collection strains can be recorded in registration, diagnostic and stock cards and various protocols (lyophilization protocol, storage protocol for cultures in liquid nitrogen and at -80 °C).

5. International cooperation

Collections of microorganisms and small invertebrates generate activities at the international level, including membership in international organizations, the provision and exchange of strains and information, participation in specialized conferences and workshops. The researchers are members of national and international professional expert and scientific organizations (International Society for Horticultural Science, EUCARPIA, PVY-Wide organization, International Council for the Study of Virus and Virus-like Diseases of the Grapevine, International Working Group on Vegetable and Vegetable Viruses (IWGLVV), European Foundation for Plant Pathology, Czech Phytopathological Society, Czech Scientific Society for Mycology, Czechoslovak Society for Microbiology).

In many cases the collections are members of national (Federation of Czechoslovak Collections of Microorganisms, National Library of Medicine Database Maintenance Project) and international organizations associating collections of microbial genetic resources such as the World Federation for Culture Collections (WFCC) with records in the World Data Centre for Microorganisms and the European Culture Collections´ Organisation (ECCO).

6. Utilization of GR and the services provided

The NPMGR culture collections store characterized strains of microorganisms and invertebrates that serve as reference samples for a number of users, especially in state administration laboratories. They serve further in developing detection methods and veterinary bio-products. A wide spectrum of pathogens is used by breeders to find new genes and verify existing ones for resistance in crop genetic resources. Stock cultures of storage pests and insect pests with no pesticide resistance are indispensable for further research when testing new plant protection products or for use in food and agricultural warehouses.

The right to use a given genetic resource is free of charge for the purposes of breeding, research and education. The costs associated with manipulating a genetic resource, reactivation, dispatching and other costs associated with providing a genetic resource may be charged.

Upon request the strains of microorganisms and small invertebrates kept in the framework of the NPMGR are provided to domestic and foreign scientific institutions for basic and applied research as well as breeding institutes, universities, colleges and secondary schools and state administration bodies. Thus, 700-900 strains are sent to both domestic and foreign users every year (see Chart 3). In the framework of international cooperation and information exchange, the collections provide foreign institutions with data on the accessions stored, catalogues and the strains.

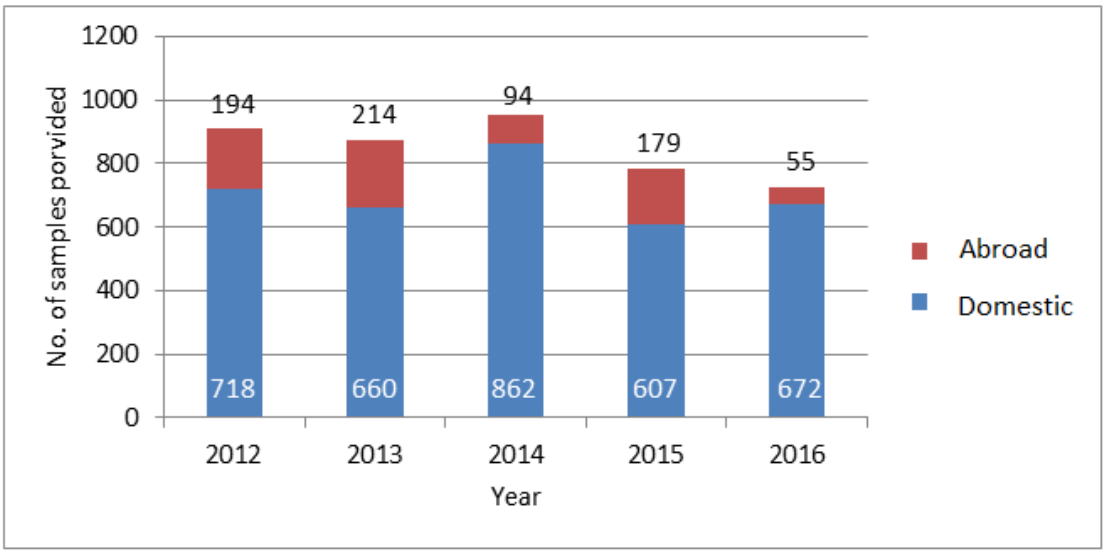
The bulk of the accessions provided is used for research projects and as study materials. Every year the strains of microorganisms are used to resolve dozens of basic and applied research and development projects whose outputs are not only scientific publications, but also utility models and patents. The last two types of outputs were acquired by the collection of industrially useful microorganisms. These were strains bred for, e.g. whey fermentation for the ethanol production.

Every year, through the provision of genetic material, the collections contribute to the compilation of a large number of original scientific papers, professional publications, methodologies and contributions to proceedings, as well as information on strains of microorganisms used to make contributions for the professional public and in practice, presented at conferences, workshops and seminars.

The collections serve directly as support for breeding and plant health, for diagnostics and arbitration proceedings. The collections provide characterized strains of phytopathogenic and zoopathogenic

viruses, bacteria and fungi that serve as reference strains for identification as well as the preparation of detection tools (specific primers, optimized PCR methods, specific antibodies, protein profiles), as reference strains - positive controls for state administration laboratories, also for routine testing during the certification of the health status of agricultural crops in CISTA diagnostic laboratories for plant health care and reference laboratories, for quality control. Strains of microorganisms are provided, for example, to laboratories involved in serial tests for assessing the health status of propagating material and seed potato certification (e.g. PRI Laboratory Centre, the Vesa Velhartice Laboratory). A broad spectrum of strains of phytopathogenic viruses, bacteria and fungi is delivered in the framework of cooperation with crop breeding organizations in the CR and the CISTA.

Chart 2: Distribution of microbial GR to users



1) Procedure for ordering and distributing of genetic resources

Strains are distributed on the basis of a written order delivered by conventional mail, electronically or in person. The collections are governed by their internal administrative regulations when handling orders. Upon receiving an order, the communication between the applicant and the collection follows in order to agree on the form of the genetic resource provided, the delivery date and, where appropriate, the signature of a declaration on the use of genetic resources and consent to the conditions for providing the strains (MTA). Some collections have a declaration of use and consent to the terms of the provision incorporated into the Protocol/Confirmation of Receiving Strains, other collections only require a written order – further communication with the client then takes place informally. The provision of zoopathogenic microorganisms from the CAPM collection, both within the CR and abroad, is administratively more demanding.

The form of distributing the MGR depends on the possibilities of its cultivation, conservation, legal requirements and the collections' internal regulations. Phytopathogenic viruses are usually delivered in the form of fresh, dried or lyophilized leaves or other plant parts of the host plants. Potato virus isolates are distributed to users only in the form of *in vitro* plants. The viruses of fruit trees and ornamental plants are provided upon agreement with the applicant in the form of infected herbal indicators or host plants. In this case, the time required to process such an order is up to 2 months. Live or dried plant material containing the requested strain of viruses is usually handled within five working days.

Zoopathogenic microorganisms (viruses and bacteria) are usually provided in the form of a lyophilisate. In exceptional cases, the Collection of Zoopathogenic Microorganisms can also deliver cultures in either a frozen or an active form, or provide only isolated nucleic acid.

Culturable microorganisms are delivered either metabolically inactive or in active form after regeneration. Delivering metabolically inactive strainsof microorganisms allows orders to be dealt with in days, usually five working days.

Applicants are provided with phytopathogenic rusts in the form of urediniospores in micro test tubes or cellophane bags (propagated inoculum from multiple isolates for field infections).

Arthropods and other small organisms are provided in an appropriate form according to the organisms' taxonomic group and the purpose of use. Live individuals are packaged in plastic test tubes (booklice and mites) and in larger plastic packages for beetles, moths and cockroaches. The collections provide samples of 50–150 individuals for study purposes; a composite population (tens to hundreds of individuals depending on the species) is supplied for research.

2) Information associated with genetic resources

Applicants are always provided with basic information about the strains (data on the strains' isolation, cultivation and origin). Most collections provide additional information upon request in line with the stated purpose of using the strain. Applicants are usually alerted to this option in the protocol. Other provided information considers the strains' characterization (mostly in the form of citations of the publication where the required information is presented), growth properties, macro- and micro-characteristics, taxonomic data, formation of a specific metabolite, etc.

3) Number of microbial GR provided and sample size

Culture Collections usually do not limit the amount of microbial genetic resources provided as long as their number corresponds to the purpose of the use stated in the application. Some collections limit one order with a maximum number of strains, that being in the range of 10-20 strains. The curator of the culture collection determines the number and size of the sample of the microbial genetic resource in accordance with § 11a of Decree No. 458/2003 Coll., which implements the Act on the Genetic Resources of Plants and Microorganisms.

4) Records on the genetic resources provided

The provision of MGR is not recorded in the NPMGR central database. Ongoing records on the GR provided are kept by the collections' curators. Records are usually kept in both written and electronic form. A list of the strains provided, their use in research and presentation in publications are all part of the annual report.

5) The microbial GR most often provided to users

Over the last 4 years, the strains most frequently provided to users were:

- dairy microorganisms (864 strains provided),
- brewing microorganisms (755 strains),
- phytopathogenic and other agriculturally important fungi from the CRI collection (413 strains),
- zoopathogenic microorganisms (369 strains),
- agriculturally significant basidiomycetes (283 strains).

7. Plan of specific activities

Activities for the sub-programme of micro-organisms important for food and agriculture are divided into six priorities: *In situ* Conservation, *Ex situ* Conservation, Sustainable Use of MGR, Development of Human and Institutional Capacities, Raising Awareness of the Importance of MGR and International Cooperation. The structure of activities is similar to those presented for plant genetic resources. A total of 12 activities have been defined for the priority areas mentioned above (see Table 14).

Table 14: Plan of specific activities for microbial genetic resources for food and agriculture

Priority/activity	Specific activities
P1 *In situ* conservation	
1. Surveying and inventory of genetic resources	
*	1.1 Survey of *in situ* occurrence of edible and medicinal fungi species that occur less frequently in the territory of the CR, their isolation and *ex situ* conservation
P2 *Ex situ* conservation	
5. Support for the targeted collection of genetic resources	
**	5.1 Prepare a methodology for identifying the missing genetic resources and the priorities for a rational expansion of the culture collections of microorganisms
**	5.2 Elaborate a study of the gaps in the conserved GR and a strategy for expanding individual culture collections of microorganisms and small organisms
**	5.3 Add the missing taxa of microorganisms and small invertebrates to culture collections
**	5.4 Prepare or update the plan to revitalize the collections of MGR
**	5.5 Update the expert methodology for conserving MGR, update the Framework Methodology of the sub-programme
6. Sustainable *ex situ* conservation and priorities for rational expansion	
**	6.1 Evaluate the diversity of the conserved MGR at the level of the culture collections and the entire sub-programme, take into account the priorities of the conserved MGR and, if necessary, redefine the focus of individual culture collections
**	6.2 Make an inventory of accessions, identify and remove duplication at the level of individual culture collections and the sub-programme
*	6.3 Determine the culture collections' capacities and their development on the basis of an analysis of resources and needs
**	6.4 Ensure the conservation of MGR according to WFCC standards
7. Regeneration and multiplication of genetic resources	
**	7.1 Regenerate and propagate accessions conserved *ex situ* to ensure the conservation of MGR, provision to users and safety duplication
**	7.2 Prioritize the conservation of genetic resources from cereal rusts
**	7.3 Prioritize the conservation of genetic resources from lettuce moulds, cucumber moulds, squash moulds and powdery mildews
**	7.4 Prioritize the conservation of genetic resources from fruit tree viruses
**	7.5 Prioritize the conservation of genetic resources from vegetable viruses
**	7.6 Prioritize the conservation of genetic resources from quarantine bacteria
P3 Sustainable use of genetic resources	
8. Developing the characterization, evaluation and further development of selected collections to facilitate their use	
**	8.1 Provide both the GR and relevant information to domestic and foreign users in accordance with national and European legal requirements and other international obligations.
**	8.2 Prepare a plan to develop a targeted characterization of MGR based on users requirements
**	8.3 Obtain genetic information on significant genes in selected accessions
**	8.4 Monitor the resistance of invertebrate populations to the active substances in pesticides

**	8.5 Obtain reference strains of fungi to assess fungal resistance to the active substances in fungicides
**	8.6 Obtain reference strains of zoopathogenic microorganisms to check the evaluation of antibiotic resistance
**	8.7 Determine the susceptibility to antibiotics in selected zoopathogenic bacteria
10. Support for the diversification of crops grown and expanding the spectrum of crops usable in agriculture	
*	10.1 Support the diversification of the bio-agents used
P4 Developing human and institutional capacities	
13. Strengthening and developing the National Programme	
**	13.1 Provide the assessment of the activities of the National Programme annually
**	13.2 Assess the collections' activities (expertise, efficiency, cooperation, provision of GR)
**	13.3 Check the activities of NPMGR participants and take into account the conclusions from the checks in further development
*	13.4 Prepare the amendment of Act No. 148/2003 on Genetic Resources of Plants and Microorganisms
**	13.5 Clarify the question of ownership to GR in the framework of the NPMGR
15. Expanding and maintaining a GR information network	
**	15.1 Modernize the NPMGR databases
17. Strengthening human capacities	
*	17.1 Increase the professional level of staff taking part in NPMGR activities
P5 Strengthening public awareness of the importance of MGR	
18. Raising public awareness of the importance and need for conserving genetic resources	
*	18.1 Prepare lectures and other educational materials for the public on the conservation and use of microorganisms
*	18.2 Prepare supporting materials and other educational materials to teach microbiology and phytopathology at schools
*	18.3 Continuously update the NPMGR website – a calendar of events, contributions from participants
P6 International cooperation	
19. Involvement in international activities and information systems	
*	19.1 Incorporate other collections into international organizations (WFCC, ECCO)
**	19.2 Develop a sample MTA for the non-commercial and commercial use of MGR and introduce its use by the end of 2019
**	19.3 Meet the tasks arising from implementing the CBD and the Nagoya Protocol within its remit

ANNEXES

1. Participants to the National Programme on Plant GR

Participant, address	Activities, collections
Crop Research Institute **Gene Bank Prague** Vojtěch Holubec, CSc. Drnovská 507 161 06 Praha-Ruzyně e-mail: holubec@vurv.cz	NPPGR Coordination National Gene Bank; long term, medium-term conservation of seeds of all generatively propagated species in the active collection and also selected PGR as duplication in the basic collection, PGR information system, providing services to collection investigators and users of PGR, collection of wheat (including wild species), winter wheat barley, triticale, buckwheat, amaranth, millet, setaria and other alternative cereals, maize, sunflower, sugar beet and mangold, ECPGR – European Wheat Database (EWDB), associated
Crop Research Institute **Genetic Resources of Vegetables and Special Crops, Olomouc** Miroslav Hýbl, Ph.D. Šlechtitelů 11 783 71 Olomouc-Holice e-mail: vurv@genobanka.cz	Collection of vegetables, spice, aromatic and medicinal plants, field GB – vegetatively propagated species; activities within the Haná Region Centre, international garlic collection (Allium sp.); associated membership in AEGIS.
Crop Research Institute **Viticulture Research Station Karlstejn** Radmila Střalková, Ph.D. 267 18 Karlštejn e-mail: stralkova@vurv.cz	Part of grapevine collection; field GB – grapevine; associated membership in AEGIS.
Crop Research Institute **Physiology and Cryobiology of Plants** Miloš Faltus, Ph.D. Drnovská 507 161 06 Praha-Ruzyně e-mail: faltus@vurv.cz	Safety duplication of selected species for active field or in vitro collections; or international exchange of PGR with other cryobanks. Collaboration with foreign cryobanks.
Agricultural Research Institute Ltd., Kroměříž Marta Zavřelová, Ph.D. Havlíčkova 2787 756 41 Kroměříž e-mail: zavrelova@vukrom.cz, vukrom@vukrom.cz	Collection of oats, rye and spring barley; associated membership in AEGIS
AGRITEC, Research, Breeding & Services, Ltd. Miroslava Prokopová, Ph.D. Zemědělská 16 787 12 Šumperk e-mail: vrbova@agritec.cz	Collections of peas, beans, vetches, beans, lupins, other legumes; collection of flax and other fibre crops. International Flax Database (ESCORENA), associated Membership in AEGIS.

OSEVA PRO Ltd., **Grassland Research Station Rožnov-Zubří** Martin Lošák 756 54 Zubří 698 e-mail: losak@oseva.cz, zubri@oseva.cz	Collection of grasses, including wild ecotypes, flowering meadow phytocoenosis, ornamental grasses. ECPGR – European database – Trisetum flavescens, Arrhenatherum elatius; associated membership in AEGIS.
OSEVA PRO Ltd. **Research Institute of Oil-seed Crops Opava** Andrea Rychlá Purkyňova 6 746 01 Opava email: opava@oseva.cz, rychla@oseva.cz	Collection of oilseed rape, field mustard, mustard, poppy and other oil plants apart from sunflower.
Research and Breeding Institute of Pomology Holovousy Ltd. František Paprštein, CSc. 507 51 Holovousy e-mail: fp@vsuo.cz, info@vsuo.cz	Collection of fruit trees: cherries, sour cherries, plum, apple, pear and other berry fruits, field GB – vegetatively propagated fruit trees and bushes, associated membership in AEGIS.
Mendel University in Brno **Faculty of Horticulture** Tomáš Nečas, Ph.D. Valtická 337 691 44 Lednice na Moravě e-mail: tomas.necas@zf.mendelu.cz	Collection of apricot trees, peach trees, almonds, grapevine (part of the collection); selected vegetatively propagated species of vegetables and and ornamental species, field GB – vegetatively propagated fruit trees, grapevine and selected vegetable species; associated membership in AEGIS.
Research Institute for Fodder Plants, Ltd. Daniela Knotová, Ph.D. Zahradní 1 664 41 Troubsko e-mail: knotova@vupt.cz, vupt@vupt.cz	Collection of fodder crops: alfalfa, clover, other fodder crops (including prospective wild species) – except grasses; associated membership in AEGIS.
Potato Research Institute Havlíčkův Brod, Ltd. Jaroslava Domkářová, Ph.D., MBA, LL.M. Dobrovského 2366 580 03 Havlíčkův Brod e-mail: domkarova@vubhb.cz, vubhb@vubhb.cz	Collection of potatoes (including wild and related species), collection of potatoes.
Hop Research Institute Co., Ltd. Vladimír Nesvadba, Ph.D. Kadaňská 2525 438 36 Žatec e-mail: patzak@chizatec.cz	field GB – field collection of hops.

The Silva Tarouca Research Institute for Landscape and Ornamental Gardening Hynek Urbánek Květnové nám. 391 252 43 Průhonice e-mail: vukoz@vukoz.cz, urbanek@vukoz.cz	Ornamental plants, field GB – vegetatively propagated decorative plants.
AMPELOS a.s., Viticulture Research Station Lukáš Kilián Vrbovec 274 67 124Vrbovec e-mail: info@ampelos.cz, kylian@ampelos.cz	Collection of grapevines, field GB – grapevine, thermophilic cultivars.
Institute of Botany of the Czech Academy of Sciences Pavel Sekerka Zámek 1 252 43 Průhonice e-mail: ibot@ibot.cas.cz	Collection of materials from irises, peonies and day-lilies (selected genetic resources of domestic origin), field GB – Iris, Paeonia and Hemerocallis.

2. Participants to the National Programme on Animal GR

Species	Breed	Expert	Breeders' associations and other responsible bodies
cattle	Czech Red Cattle	**Doc. Ing. Ivan Majzlík, CSc.** Czech University of Life Sciences Prague Kamýcká 129 165 21 Prague 6 e-mail: majzlik@af.czu.cz	**Czech Fleckvieh Breeders Association** U topíren 2 170 41 Prague 7 e-mail: svaz@cestr.cz www.cestr.cz **Institute of Animal Science** Přátelství 815 104 00 Prague Uhříněves tel.: 267 009 612 e-mail: matlova.vera@vuzv.cz www.vuzv.cz www.genetickezdroje.cz
	Czech Original Red-Pied Cattle (native type)	**Ing. František Hřeben, CSc.** Ke Džbánu 1 161 00 Prague 6 email: hrebenf@gmail.com	
horses	Kladruber Horse	**Ing. Zuzana Šancová** National Stud at Kladruby nad Labem Kladruby nad Labem 1 533 14 Kladruby nad Labem e-mail: sancova@nhkladruby.cz	**National Stud at Kladruby nad Labem** 533 14 Kladruby nad Labem e-mail: kladruby@nhkladruby.cz www.nhkladruby.cz
	Bohemian-Moravian Belgian Horse	**Ing. Václav Ročeň** Radčice 3 539 73 Skuteč v.rocen@seznam.cz	**Association of Unions of Horse-breeders** U Hřebčince 479 397 01 Písek e-mail: info@aschk.cz www.aschk.cz **Institute of Animal Science** Přátelství 815 104 00 Prague Uhříněves tel.: 267 009 612 e-mail: matlova.vera@vuzv.cz www.vuzv.cz www.genetickezdroje.cz
	Silesian Noriker		
	Hucul Horse	**Ing. Jaroslav Jelínek, CSc.** jelineking@seznam.cz	**Association of Hucul Horse Breeders** Pražská 607 530 02 Pardubice tel.: 466 335 302 e-mail: jelineking@seznam.cz
pigs	Přeštice Black-Pied Pig	**Ing. Jan Stibal** e-mail: stibal@schpcm.cz www.schpcm.cz	**Pig Breeder´s Association** Bavorská 856/14 155 41 Prague 5 e-mail: info@schpcm.cz www.schpcm.cz **Institute of Animal Science - Pig Breeding Department** Komenského 1243 Kostelec nad Orlicí Ing. Miroslav Rozkot, CSc. e-mail: vuzvkostelec@tiscali.cz www.vuzv.cz

Species	Breed	Expert	Breeders' associations and other responsible bodies
goats	White Shorthair Goat	**Ing. Richard Konrád** Samcova 1 110 00 Prague 1 e-mail: pkkoz@schok.cz	**Association of Sheep and Goats Breeders Flock book for goats** Samcova 1 110 00 Prague 1 e-mail: pkkoz@schok.cz www.schok.cz
	Brown Shorthair Goat		
sheep	Šumava Sheep	**Dr. Ing. Michal Milerski** Institute of Animal Science Přátelství 815 104 00 Prague 10 – Uhříněves e-mail: milerski.michal@vuzv.cz	**Association of Sheep and Goats Breeders Flock book for sheep** Ptašínského 308/5 602 00 Brno e-mail: pko.schok@atlas.cz, info@schok.cz www.schok.cz
	Valachian Sheep		
rabbits	Czech Spotted	**MVDr. Miloslav Martinec, PhD.** Czech Breeders Association Havlíčkova 31 602 00 Brno e-mail: mimartinec@seznam.cz	**Czech Breeders Association** Maškova 3 182 53 Prague 8 – Kobylisy e-mail: kralici@cschdz.cz www.cschdz.cz
	Czech White		
	Czech Red		
	Czech Solver		
	Czech Black Guard Hair		
	Czech Gold		
	Moravian Blue		
	Moravian White of Brown Eyes		
coypu	Standard	**Ing. Tomáš Němeček** Institute of Animal Science Přátelství 815 104 00, Prague 10 – Uhříněves e-mail: nemecek.tomas@vuzv.cz	**Nutria Breeders Association** Dlouhá Ves 24 582 22 email: neubauerdv@seznam.cz
	Moravian Silver		
	Přeštice Multicolour		
poultry	Czech Gold Brindled Hen	**Ing. Eliška Stejskalová** Czech Breeders Association Maškova 3 182 53 Prague 8 – Kobylisy e-mail: stejskalova@cschdz.eu	**Czech Breeders Association** Maškova 3 182 53 Prague 8 - Kobylisy e-mail: drubez@cschdz.cz www.cschdz.cz
	Czech Goose		
	experimental line of hens	**RNDr. Milan Tyller** DOMINANT CZ Voleč 119 533 41 Lázně Bohdaneč e-mail: tyller@dominant-cz.cz	**DOMINANT CZ** RNDr. Milan Tyller Voleč 119 533 41 Lázně Bohdaneč e-mail: tyller@dominant-cz.cz www.dominant-cz.cz
	source populations for hybridization programmes		

Species	Breed	Expert	Breeders' associations and other responsible bodies
fish	Common Carp (11 lines)	**Prof. Ing. Martin Flajšhans, Dr. rer. agr.** University of South Bohemia in České Budějovice Faculty of Fisheries and Protection of Waters Zátiší 728/II 389 25 Vodňany e-mail: flajshans@frov.jcu.cz	**Czech Fish Farmers Association** Pražská 495/58 371 38 České Budějovice
	Tench		
	Rainbow Trout		**Reserch Institute of Fish Culture and Hydrobiology** University of South Bohemia in České Budějovice Faculty of Fisheries and Protection of Waters Zátiší 728/II 389 25 Vodňany e-mail: sekretar@frov.jcu.cz www.frov.jcu.cz
	Brown Trout		
	Wels Catfish		
	Maraena Whitefish		
	Northern Whitefish		
	Sterlet Sturgeon		
	European Sturgeon		
bees	Carniolan Honey Bee	**Ing. Dalibor Titěra, CSc.** Bee Research Institute at Dol Máslovce-Dol 94 252 66 Libčice n. Vltavou e-mail: titera@beedol.cz, beedol@beedol.cz www.beedol.cz	**Czech Beekeepers Association** Křemencova 8 115 24 Prague 1 e-mail: info@vcelarstvi.cz **Bee Research Institute at Dol** Máslovice-Dol 94 252 66 Libčice nad Vltavou beedol@beedol.cz www.beedol.cz

3. Participants to the National Programme on Microbial GR

Crop Research Institute **Coordination of the sub-programme** Petr Komínek, Ph.D. Drnovská 507 161 06 Prague-Ruzyně e-mail: kominek@vurv.cz	Coordination of sub-programme, administering the MGR information system, operating the Central Laboratory.
Crop Research Institute **Collection of Plant Pathogenic Viruses** Jiří Svoboda, Ph.D. Drnovská 507 161 06 Prague-Ruzyně e-mail: jiri.svo@vurv.cz	Viruses and phytoplasmas of fruit trees, grapevine, cereals and vegetables, 83 strains.
Crop Research Institute **Collection of phytopathogenic bacteria** Iveta Pánková, Ph.D Drnovská 507 161 06 Prague-Ruzyně e-mail: pankovai@vurv.cz	Phytopathogenic, economically significant and other accompanying bacteria (e.g., the genera Agrobacterium, Clavibacter, Dickeya, Erwinia, Pantoea, Pectobacterium, Pseudomonas, Streptomyces, Xanthomonas), 249 strains.
Crop Research Institute **Collection of rhizobia** Lenka Kabátová Drnovská 507 161 06 Prague-Ruzyně e-mail: kabatova@vurv.cz	Bacteria from the genera Rhizobium, Bradyrhizobium, Sinorhizobium and Azotobacter, 521 strains.
Crop Research Institute **Collection of phytopathogenic and other agriculturally important fungi** David Novotný, Ph.D. Drnovská 507 161 06 Prague-Ruzyně e-mail: novotny@vurv.cz	Phytopathogenic, potentially phytopathogenic, mycotoxinogenic and potentially toxinogenic fungi, edible and medicinal fungi, 508 strains.
Crop Research Institute **Collection of rusts and powdery mildew** Alena Hanzalová, Ph.D. Drnovská 507 161 06 Prague-Ruzyně e-mail: hanzalova@vurv.cz	Phytopathogenic fungi Puccinia triticina, Puccinia striiformis, Puccinia graminis and Blumeria graminis, 872 strains.

Crop Research Institute **Collection of invertebrate crop pests and their natural enemies** Pavel Saska, Associate professor Drnovská 507 161 06 Prague-Ruzyně e-mail: saska@vurv.cz	Species of animal pests from the classes Insecta, Diplopoda, Acari, Isopoda, Mollusca and Nematoda, 48 strains.
Crop Research Institute **Collections of stored product pests, mites and fungi** Radek Aulický, Ph.D. Drnovská 507 161 06 Prague-Ruzyně e-mail: aulicky@vurv.cz	Insect and mite species (the most represented groups: Coleoptera, Blattodea, Acarina, Psocoptera, Lepidoptera), 178 strains.
Crop Research Institute **Collection of edible and medicinal macromycetes** Petrželová Irena, Ph.D. Šlechtitelů 11 783 71 Olomouc-Holice e-mail: petrzelova@genobanka.cz	Species of edible and medicinal basidiomycetes and ascomycetes, 19 strains.
Potato Research Institute Havlíčkův Brod, Ltd. **Collection of potato viruses** Martin Kmoch, Ph.D. Dobrovského 2366 580 01 Havlíčkův Brod e-mail: kmoch@vubhb.cz	Potato viruses and viroids (potato spindle tuber viroid, potato virus Y, potato virus A, potato virus M, potato virus X, potato virus S and other viruses), 546 strains.
Research and Breeding Institute of Pomology Holovousy Ltd. **Collection of fruit trees and small fruit viruses** Markéta Bohunická, Ph.D. 507 51 Holovousy Tel.: +420 493 692 821 e-mail: marketa.bohunicka@vsuo.cz, info@vsuo.cz	Viruses, viroids and phytoplasmas of fruit trees and soft fruit, 113 strains.
The Silva Tarouca Research Institute for Landscape and Ornamental Gardening **Collection of ornamental plant viruses** Josef Mertelík, CSc. Květnové nám. 391 252 43 Průhonice e-mail: mertelik@vukoz.cz	Viruses and viroids of ornamental plants, 130 strains.

The Silva Tarouca Research Institute for Landscape and Ornamental Gardening **Czech collection of phytopathogenic oomycetes** Marcela Mrázková, Květnové nám. 391 252 43 Průhonice e-mail: mrazkova@vukoz.cz	Phytopathogenic oomycetes (genus Phytophthora and Pythium), 377 strains.
Hop Research Institute Co., Ltd. **Collection of hops pathogens** Petr Svoboda, CSc. Kadaňská 2525 438 46 Žatec e-mail: svoboda@chizatec.cz	Pathogenic viruses and fungi for hops, 93 strains.
Veterinary Research Institute, Brno **Collection of animal pathogenic microorganisms** MVDr. Markéta Reichelová Hudcova 70 621 32 Brno e-mail: reichelova@vri.cz	Zoopathogenic bacteria and animal viruses, 2026 strains, ECCO member, record in WDMC.
Milcom a.s. **Collection of dairy microorganisms Laktoflora®** Ing. Petr Roubal, CSc. Soběslavská 841 390 01 Tábor e-mail: sbirka@vum-tabor.cz	Lactic fermentation bacteria, fungi including yeasts, and other bacterial dairy cultures, 932 strains, record in WDMC.
Research Institute of Brewing and Malting **Collection of brewery microorganisms** Dagmar Matoulková, Ph.D. Lípová 15 120 44 Prague 2 e-mail: matoulkova@beerresearch.cz	Brewer's yeasts and bacterial contaminants of brewery production, wild and wine yeasts, 373 strains, record in WDMC.
Food Research Institute Prague **Collection of industrially utilizable microorganisms** Marian Urban, Ph.D. Radiová 7 102 31 Prague 10 Tel.: +420 296 792 202 e-mail: marian.urban@vupp.cz	Fungi including yeasts and bacteria suitable for fermentation processes, the production of enzymes or dietetics and other applications, 150 strains.

Palacký University in Olomouc **Faculty of Science – Department of Botany** **Collection of phytopathogenic microorganisms** Aleš Lebeda, Professor Šlechtitelů 27 783 71 Olomouc e-mail: ales.lebeda@upol.cz	Phytopathogenic fungi, selected phytoplasmas, viruses and economically significant cyanobacteria and algae, 234 strains.
Institute of Microbiology of the Czech Academy of Sciences **Culture collection of basidiomycetes economically significant for agriculture** Ivana Eichlerová, Ph.D. Vídeňská 1083 142 20 Prague 4 – Krč e-mail: eichler@biomed.cas.cz	Basidiomycetes (especially from the order Agaricales and Polyporales), 354 strains, Record in WDCM.
Charles University, Faculty of Science **CCF Culture Collection of Fungi** Alena Kubátová, CSc. Albertov 6 128 43 Prague 2 e-mail: kubatova@natur.cuni.cz	Food contaminants, toxigenic fungi, plant pathogenic fungi, entomo- pathogens and fungi of bio- technological potential. 325 strains, ECCO member, record in WDMC.

4. List of acronyms and abbreviations

AEGIS	A European Genebank Integrated System
AGR	animal genetic resources
BRI	Bee Research Institute
CBD	Convention on Biological Diversity
CISTA	Central Institute for Supervising and Testing in Agriculture
CMBC	Czech-Moravian Breeders´ Corporation
CR	Czech Republic
CRI	Crop Research Institute
CT	Crop Trust
DAD-IS	Domestic Animal Diversity – Information system
ECCO	European Culture Collections´ Organisation
ECPGR	European Cooperative Programme for Plant Genetic Resources
EFABIS	European Farm Animal Biodiversity – Information system
ERFP	European Regional Focal Point
EUCARPIA	European Association for Research on Plant Breeding
EUGENA	European Gene Bank Network for Animal Genetic Resources
EURALLIVEG	Vegetative Allium, Europe´s Core Collection, safe and sound
EURISCO	European Search Catalogue for Plant Genetic Resources
EVIGEZ (PGRD)	Plant Genetic Resources Documentation
FAO	Food and Agriculture Organization of the United Nations
GB	genebank
GPA	Global Plan of Action
GR	genetic resources
GRIN	Germplasm Resources Information Network
IAS	Institute of Animal Science
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MGR	microbial genetic resources
MoA	Ministry of Agriculture
NPGR	National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Nutrition and Agriculture
PGR	plant genetic resources
RIFCH	Research Institute of Fish Culture and Hydrobiology
SDGs	Sustainable Development Goals
SMTA	Standard Material Transfer Agreement
WDCM	World Data Centre for Microorganisms
WFCC	World Federation for Culture Collections