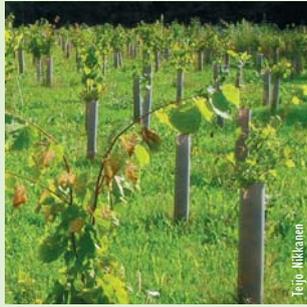




# GENETIC RESOURCES -SECURING BIODIVERSITY



Cover photo Tapio Tuomela/MTT archives,  
Mainostoimisto Synergia Oy  
Graphic Design Mainostoimisto Synergia Oy

## What are genetic resources and why are they conserved?

Genetic resources of field crops, livestock and forest trees cover the whole inherited diversity; that is varieties and breeds and other genetic variation within species. The genetic resources important for Finland's agriculture, forestry and cultural heritage are unique as they have adapted to local climate, soil and landscape over thousands of years. Conservation of genetic resources secures the availability of biodiversity for farmers, breeding and research and for the use of future generations. Adequate genetic diversity is particularly important for breeding and thereby for Finland's food security.

### Principles of conservation

International agreements and national programmes for genetic resources aim at maintaining crop varieties and animal breeds that meet the national needs of agriculture and forestry. According to the international agreement, Convention on Biological Diversity (CBD, 1993), natural biodiversity is to be conserved and sustainably used. The new International Treaty on Plant Genetic Resources for Food and Agriculture (IT, 2004) defines the legally binding global framework for conservation of plant genetic resources. The agreement includes a multilateral system for facilitated access to genetic resources, and equitable sharing of benefits accrued from their commercialisation or other use among all parties. The Constitution of Finland also states that everyone shares responsibility over nature, biodiversity, the environment and Finland's cultural heritage.

International agreements are implemented largely through national programmes for genetic resources. In Finland the national programme for plant genetic resources for agriculture and forestry was initiated in 2003, and the national programme for farm animal genetic resources in 2004. The National Board for Genetic Resources, set up by the Ministry of Agriculture and Forestry, develops and monitors the programmes.



## Agricultural and horticultural genetic resources

Genetic resources of field crops comprise crop species and their wild relatives, varieties, landraces, and genetic variation within the species. The genetic heritage of crops is stored in the different plant parts; seed and tissue.

Landraces are crop cultivars that over centuries have adapted to local growing conditions as a result of natural selection. Landraces are genetically and also by appearance very diverse populations. This diversity provided protection against pests and diseases and guaranteed harvest. Field and horticultural crops are inherently valuable as part of our cultural heritage.

Crop breeding has been practiced in Finland for about a hundred years. Old commercial varieties resulted from crop breeding, but they are no longer commonly grown. Conservation of plant genetic resources maintains genetic diversity for farmers needs and for use in plant breeding and research. Sufficient genetic diversity is particularly important for genetic enhancement and breeding of new varieties. As future requirements cannot be predicted, there is a need to maintain as diverse a selection of genetic materials as possible.

### Means of conservation of plant genetic resources

Cereal genetic resources are commonly maintained in deep freezers in gene banks (*ex situ* conservation). This allows long-term storage of, for instance, barley, wheat, oats, rye and forage grass seeds in viable condition for decades. The Nordic Gene Bank (NGB) is located in Alnarp, southern Sweden. There are approximately 1600 frozen accessions in the gene bank from Finland. It is possible to request a small amount of seed of an old variety or landrace from the gene bank. In addition to the seed collection, the gene bank maintains a Nordic potato collection.

Vegetatively propagated crop species, such as fruit trees, small fruits and berries, ornamentals and perennials are maintained in national field gene banks and laboratories (*ex situ* conservation). MTT Agrifood Research Finland with its network of regional stations is the main keeper of vegetative collections in Finland. Botanical gardens, arboretums, universities and schools also maintain genetic resources to a significant extent. The inventory of nationally valuable genetic materials has not yet been completed. Therefore current collections should not be destroyed without first contacting the programme for plant genetic resources.

The most natural means for conserving genetic resources is to cultivate the plants in their original environment (*in situ* conservation). Landraces and old commercial varieties can be conserved in their original environment on farm (*in situ on-farm*), and horticultural crops in private gardens (*in situ on-garden*).



Marjatta Huuskainen



Marjatta Huuskainen



Paola Hietaranta

In addition to seed and field gene banks, genetic resources can be maintained in the laboratory in tissue culture under slow growth conditions or deep frozen in liquid nitrogen (cryopreservation). Long-term cryopreservation of horticultural crops is currently being investigated. This would allow reduction of field collections and reduce conservation costs. Cryopreservation is a particularly attractive form of storage for crop species that are susceptible to diseases.

## National programme for plant genetic resources

The national programme for plant genetic resources was established in 2003 to facilitate the conservation of agricultural and forest genetic resources in Finland. MTT Agrifood Research Finland is responsible for the coordination of the programme and for running the programme for field and horticultural crop genetic resources. The Finnish Forest Research Institute is responsible for the conservation of forest genetic resources. Through this programme, the availability of genetic diversity is secured also for the needs of future generations.

The plant genetic resources working groups at MTT Agrifood Research Finland have organisational responsibility for managing the collections. The following working groups operate: 1) Landscape gardening; 2) Fruits and berries; 3) Vegetables, herbs and medicinal plants; 4) Field crops. Genetic material representing species-specific diversity and regional diversity is included in long-term storage. Research and training on and utilization of genetic resources are part of the implementation of the programme for plant genetic resources, in addition to conservation ■



Kristina Anonius-Klemola



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# Forest genetic resources

Compared with agricultural crops, forest trees remain close to their wild forms. Although man has utilised forests for thousands of years, human influence has been rather limited on the genetic make-up of forests. Currently, approximately one quarter of the reforestation is through natural regeneration whereas three quarters are artificially regenerated either through planting or through direct seeding. Bred material is commonly used in planting. Most commonly used seed orchard material contains ample genetic variation, but is, however, of better quality and grows better than non-selected material.

The purpose of forest genetic resources conservation is to ensure that species and forest stands maintain their adaptability to changes in the environment. The principal aim is to make sure that forest stands have ample genetic diversity and that this diversity is transferred to the next generation, thereby representing the basis for evolution. Traditional nature parks and ecotypes protected through the Finnish Nature Conservation Act also contribute to forest genetic resources conservation to some extent. However, as they primarily serve to protect endangered species and ecosystems, which demand old trees, they cannot simultaneously ensure the maintenance of forest genetic diversity. This has made it necessary to establish a specific programme for genetic conservation of forest trees, and the Finnish Forest Research Institute is responsible for its implementation. The two main components of the strategy are conservation of genetic resources in the original environment (*in situ*) and conservation in special collections established outside the original environment (*ex situ*).

## ***In situ* conservation, gene-reserve forests**

Forest tree species with wide and continuous distribution area usually contain abundant genetic diversity within each stand. Finland's main forest trees: pine, spruce, silver birch and downy birch are such species. Wind pollination and the light weight of seeds allow transfer of genes from one stand to another over long distances, and therefore single stands contain a large part of the entire genetic diversity of the species.

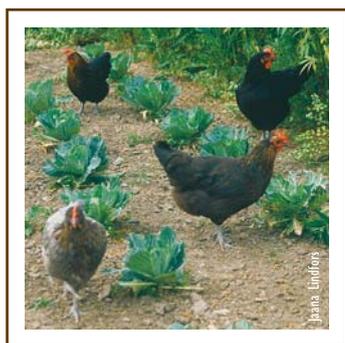
Establishing gene-reserve forests is the principal method of genetic conservation of our main forest tree species. A gene-reserve forest is a kind of a living gene bank, which is allowed to develop through evolution. In terms of adaptation, each gene-reserve forest represents natural evolution of the site. Most of Finland's 39 gene-reserve forests are located on state-owned land, belonging to The National Board of Forestry or to the Finnish Forest Research Institute.

Gene-reserve forests are naturally regenerated and managed following best forest management practices. It is essential for conservation that as many trees as possible produce seed, resulting in a new generation that is genetically diverse and able to adapt to changes in the environment.

## ***Ex situ* conservation, genetic collections**

Rare forest tree species in Finland, including many valuable broad-leaved trees, occur as single, scattered trees or in small, widely separated stands. With these species, gene migration from one stand to another as seed or pollen is limited. As the environment is not favourable for these species, few of the trees flower and seed yields are seldom abundant. In addition, seedlings may be poor competitors against better adapted species.

The genetic diversity of these broad-leaved trees is conserved by collecting material from several stands into specific conservation collections, which are intensively managed. The collections are fenced and trees protected with tubes during early growth. These collections do not contain selected types representing particular characteristics, but they represent random samples of the genetic diversity of each species in its distribution area in Finland. It is expected that the collections of these broad-leaved species in the long run produce genetically more diverse seed than would be produced in the small natural stands. ■



## Animal genetic resources

Dog was the first animal man domesticated. Man started domesticating the wolf, the dog's wild ancestor, some 14 000 years ago. Other early domesticated animals included goat, sheep, cattle and pig. Animals were moved long distances from the areas where they were originally domesticated. Development of genetically distinct animal populations, so termed breeds, was influenced by their geographic separation. Animals adapted to the circumstances in their new environments. Moreover, selection by man led to changes in their physical appearance and productivity traits.

The genetic variation between breeds, types and individuals that has been generated over thousands of years forms the basis of our current animal genetic resources. Domestication of wild animals and development of breeds for different purposes is one of the most significant developments in the history of mankind. There are over 40 animal species that produce milk, meat, eggs, honey and wool for human use. Animals have been used for draft, riding and guarding, and they can also represent religious and symbolic value.

### Conservation of Finnish native animal breeds

In Finland sheep have been shorn and cows milked for at least 4000 years. The Finnish native breeds were derived from our first domestic animals. The threatened native breeds and types in Finland include eastern Finncattle, northern Finncattle, the Kainuu Grey sheep of north-eastern Finland, Åland's sheep, and the working type of Finnhorse. A breed is considered threatened when it contains fewer than 1000 breeding females and 20 males. Breeds that have become rare include western Finncattle, Finnhorse in general, Finnsheep and the Finnish Landrace goat. The population size of the Finnish Landrace chicken has increased due to conservation measures and this breed is no longer in immediate danger of becoming extinct. Finnish native pigs, of which there were two geographic types, have become extinct.

The Finnish Hound, the Karelian Spitz and the Finnish Spitz are Finnish hunting dog breeds. Lappish reindeer dogs have traditionally been bred in northern Finland. There are some 50-100 swarms of the Nordic Dark bee. Old Finnish native breeds are replaced by more popular imported breeds, of which the Ayrshire cattle have over a 100 year breeding history in Finland, while thoroughbred trotters were first imported only some ten years ago.

Genetic diversity and traits characteristic to difference breeds will be needed in the future animal production environments, because production circum-



stances, breeding goals, and consumer requirements will change. For example, the Finnsheep has exceptional fertility and mothering ability and it has been exported for breeding purposes because of these characteristics. Maintenance of different breeds makes it possible to develop new breeds and utilize heterosis, i.e. hybrid vigour, in improving health and fertility traits.

Diverse material is required for both research and breeding. Native breeds are indispensable for research on evolution of domestic animals and in many other areas of biological and agricultural research. In addition, livestock are part of the living cultural heritage; and an important part of the national memory and history of agriculture.

## National programme for farm animal genetic resources

Collection of animal genetic resources is strengthened through the new national programme for farm animal genetic resources, which is implemented through collaboration between MTT Agrifood Research Finland and the Ministry of Agriculture and Forestry. The programme aims at preventing extinction of endangered native animal breeds and facilitating their conservation in a sustainable manner. The measures also aim at maintaining the genetic diversity in animal breeds bred in Finland and at enhancing development of resistance and health traits in addition to productivity traits. The programme for animal genetic resources emphasises that animal genetics, breeding, know-how and awareness related to genetic resources are maintained and strengthened.

Conservation plans are drawn up for endangered landraces and existing plans are made more effective. The prison farms of Pelso and Sukeva are overseen by the Ministry of Justice and play a vital role in conserving eastern Finncattle, northern Finncattle and Finnsheep. Native breeds are also conserved on private farms and in some agricultural college farms. A specific financial subsidy, which is part of the environment subsidy for agriculture in Finland, is paid for protecting the genetic resources of native breeds. For securing the future of these breeds and preventing negative effects of diseases and accidents, embryo and semen banks need to be established.

Finland collaborates with The Nordic Gene Bank for Farm Animals (NGH) of the Nordic Council of Ministers in information exchange and research. Modern DNA-techniques are used in studies on animal genetic resources and in assessing the value of different breeds from a conservation perspective. MTT Agrifood Research Finland undertakes international research in collaboration with Baltic, Nordic and Russian research teams in particular. ■

## Conservation of genetic resources and Nordic collaboration

Agricultural and horticultural plant genetic resources are conserved as seed or as live plants either in their natural environments or in collections. Since 1979, seeds of Finnish origin have been stored in the Nordic Gene Bank (NGB). Fruit trees, berries and ornamental plants are stored mainly as living stands in national field gene banks and archives.

As far as the main forest species are concerned, their genetic resources are conserved in gene-reserve forests, which comprehensively represent the diversity of the species in their areas of distribution. Genetic resources of valuable broad-leaved trees and other rare tree species are conserved in collections specially established for this purpose. Finland is involved in international collaboration in the European EUFORGEN programme and at Nordic level in the Nordic Network for Forest Tree Gene Conservation, under the Nordic Council for Forest Reproductive Material (NSFP)

Animal genetic resources are conserved as living animals and in embryo and semen banks. The Nordic Gene Bank for Farm Animals was established in 1984. The farm animal gene bank does not, however, conserve genetic resources, but it functions as a coordinating and information organisation which serves the administrative bodies, animal breeding organisations and associations specialised in conservation of rare breeds to facilitate conservation of livestock genetic diversity.

The gene banks functions under the Nordic Council of Ministers, which was established in 1971 to facilitate the collaborative activities among the Nordic governments.

## Active partners and additional Information



**MTT Agrifood Research Finland**

[www.mtt.fi/english](http://www.mtt.fi/english)

Coordinator for plant genetic resources Mia Sahramaa

([mia.sahramaa@mtt.fi](mailto:mia.sahramaa@mtt.fi))

Coordinator for animal genetic resources Juha Kantanen

([juha.kantanen@mtt.fi](mailto:juha.kantanen@mtt.fi))

Internet site for MTT genetic resources

[www.mtt.fi/ajankohtaista/tietopaketti/veenivarat](http://www.mtt.fi/ajankohtaista/tietopaketti/veenivarat)

(only in Finnish)



**Metla** (Finnish Forest Research Institute), [www.metla.fi](http://www.metla.fi)

Coordinator for forest genetic resources Mari Rusanen

([mari.rusanen@metla.fi](mailto:mari.rusanen@metla.fi))

**METLA**

### **The National Board for Genetic Resources**

Chairperson Leena Hömmö ([leena.hommo@mmm.fi](mailto:leena.hommo@mmm.fi))

Secretary Mia Sahramaa ([mia.sahramaa@mtt.fi](mailto:mia.sahramaa@mtt.fi))

## Nordic cooperation



**Nordic Gene Bank (NGB)**

Director Bent Skovmand ([bent@ngb.se](mailto:bent@ngb.se)), [www.ngb.se](http://www.ngb.se)



**NGH**

**Nordic Gene Bank for Farm Animals (NGH)**

Director Erling Fimland ([erling.fimland@nordgen.org](mailto:erling.fimland@nordgen.org)),

[www.nordgen.org](http://www.nordgen.org)



**Nordic Network for Forest Tree Gene Conservation**

Chairperson Lennart Ackzell

([lennart.ackzell@svo.se](mailto:lennart.ackzell@svo.se)), [www.nsfp.nu](http://www.nsfp.nu)

Coordinator Leena Yrjänä ([leena.yrjana@metla.fi](mailto:leena.yrjana@metla.fi))

