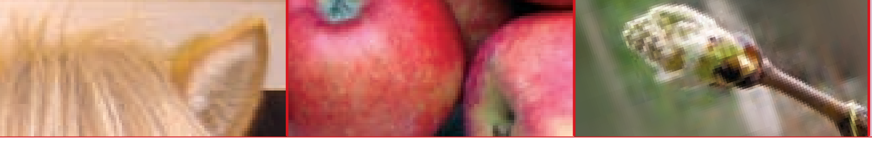

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PHOTO: TEIJO NIKKANEN

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A New NordGen Provides New Possibilities!

As of 1 January 2008, the "new" Nordic Genetic Resource Center – NordGen – is a reality, resulting from the merger of NGH, NGB and NSFP. All of us employed at NordGen are in the midst of an exciting process of identifying and implementing new forms of operational and scientific cooperation for the benefit of the conservation of Nordic crop, livestock and forest genetic resources.

So far, we have had most experience in cross-sector cooperation in the field of information services. The magazine you are holding in your hands is a good example of this. Informing the general public of the importance of genetic diversity is essential for securing public support for our work.

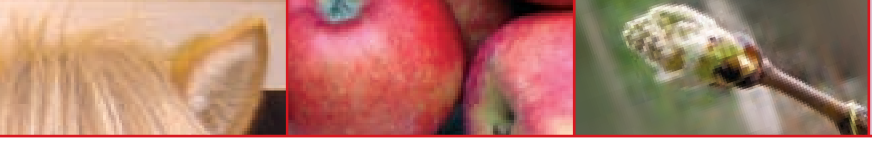
Information about the ***conservation of genetic diversity*** may seem alarming and strange to many people, since they often think of DNA, test tubes, GMOs and other dubious things. It is thus important to find an appropriate way of expressing ourselves and to give practical examples of the significance of ***biodiversity.*** It is easier to understand the importance of having access to heirloom apple varieties in grandmother's garden, or to native sheep breeds that can graze areas inaccessible to heavier breeds and that are less susceptible to predator attack. And it is also possible to understand that a highly one-sided focus on maximising milk yields in the breeding of the world's leading dairy breed, Holstein, can cause health and fertility problems throughout the global Holstein population due to inbreeding. Or that it is unwise to destroy the rain forests to grow biofuel crops, when we know how many species, and therewith genetic resources, may be lost forever.

Fortunately, many people have heard of the 1992 ***Rio Convention on Biological Diversity (CBD).*** As of writing these lines, a large CBD follow-up meeting is being held in Bonn, the so-called ***9th Meeting of the Conference of the Parties, COP9.*** The Nordic countries arranged a successful side event about the Nordic strategy and our fruitful cooperation. The Nordic side event was held on 22 May 2008, which incidentally was ***the International Day for Biological Diversity.*** There was considerable media coverage on biodiversity in this connection.

At NordGen, we also notice a lot of interest in the conservation of biodiversity following the opening of the Svalbard Global Seed Vault. The Global Seed Vault has developed into a catchy "trademark" that has caught the interest of the media, which in turn makes it easier for us to explain and market the importance of conserving and sustainably using other genetic resources as well.

We are thus experiencing times in which media coverage and general awareness of the significance of biological resources are much more obvious. We have witnessed a sudden increase in the demand for such commodities as wheat and rice, a result of the industrialised countries' wish to increase the use of biofuels in an attempt to be more environment-friendly. At the same time, economic growth in China and India has greatly increased the demand for meat. Rather suddenly, we are thus directly experiencing the global effects of food shortage. The increasing demand for food could lead to a further loss of genetic resources, e.g., through expanding monocultures of genetically modified soya on land that used to be home to considerable biodiversity (such as rain forests). HOWEVER, the same development could also result in increased global awareness for the value of maintaining nature's biodiversity for future food production in a changing climate. One way to facilitate this is correctly pricing food, species, breeds and varieties. I would thus like to conclude by repeating the familiar phrase: ***Think globally, act locally.*** which is of cource is our main task exactly!

Ås, May 2008 • Benedicte Lund, Editor



Old Pastures & Old Livestock Breeds: A Perfect Match?

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There is a diversity of cultural landscapes in the Nordic countries. Throughout the region, arable land resources are usually quite limited, especially in Norway. Thus, agriculture in Norway has been based on livestock husbandry and extensive use of the country's vast outfield resources. All kinds of forest land, salt meadows and mountain pastures have been used for grazing. In addition, a large share of the farms' fodder was often harvested in such semi-natural areas. Patches of mires and other land on which hay was harvested covered a sizeable area of land. Throughout Norway it was common to harvest foliage as winter fodder, and in some places, considerable amounts were collected. Records from 1870 in Gausdal (central Norway) show that one farm harvested 17,000 leaf bundles. In south-eastern Norway, lichen was a major winter fodder, and it was common to collect 3-6 loads (350 kg each) per cow. The farms' outfields and outlying land also provided numerous other resources, such as wood for construction and heating, birch bark, wickers, bast, coal, tar, iron, potash, berries, land for shifting cultivation and last, but not least, hunting and fishing. All these activities left their mark on the landscape. If land use was not too intensive, the resulting landscape was a patchwork of open or semi-open areas that were more or less influenced by human activity. Such landscapes were often characterised by a considerable species diversity.

SEMI-NATURAL PASTURES

Grazing and cutting keeps the landscape open and encourages the formation of grasslands. When pastures and hayfields are not tilled and seeded, and not or hardly fertilized, one gets so-called semi-natural grassland. Such areas are dominated by wild plant species, but the relative amount of the various species differs from the "natural" vegetation types. On such non-fertilized grassland, soil nitrogen and phosphorous contents are usually low. Thus, although yields are low, semi-natural grasslands often support a considerable diversity of species. The first semi-natural pastures were already established in the Stone Age, whereas haymaking probably did not come around until the Iron Age, with the introduction of the scythe. Semi-natural pastures and hayfields are often just called natural pastures and meadows, respectively, as opposed to tilled and seeded cultivated pastures and leys. Semi-natural pastures and hayfields are characterised by much of the same plant species, although pastures are often more dominated by grasses than hayfields are.

There are several types of pastures. They can be completely open, such as salt meadows, or have some scattered trees and bushes such as wooded pastures. Woodland pastures are typically covered by even denser forest growth. Pasture vegetation varies, depending on climate, soil type and native vegetation, but also on the grazing livestock species, length of grazing period and grazing pressure. Base-rich soils usually give rise to species-rich pastures, and species diversity is greater at medium than at high grazing pressure.

A «closeup» of a semi-natural grassland with a considerable diversity of species.

The old breeds may play an important role in keeping the cultural landscape as it has been for 1500 years. Here represented by three rams of the breed Old Norwegian spael sheep.

PHOTO: LISE HATTEN, BIOFORSK NORD

Salt meadows which have been used for grazing shows a large species diversity. PHOTO: NINA HOVDEN SÆTHER

GRAZING ANIMALS

Pasture plants are affected by the grazing animals in different ways, e.g., from trampling, biting or tearing. Grazing also influences the competition between different plant species. The various livestock species affect pasture vegetation in different ways. Sheep have narrow, cleft upper lips, enabling them to graze selectively. For example, they can select low herbs and specific, preferred species, and also browse extensively on leaves. Cattle prefer grass and herbs, using their tongues to gather and tear off the plants. Horses also prefer grass, but bite plants off closer to the ground than cattle, thus leaving the pasture looking more like a lawn. Goats prefer to browse on leaves and buds, and like sheep, they are also selective grazers. Thus, pastures can develop quite differently both with regard to their appearance and species composition, depending on what kinds of animals are grazed there.

BIODIVERSITY

At present, the biological diversity associated with Norwegian grazing land is threatened. Modern farming, especially in the way it has developed since the 1950s, no longer has the need for semi-natural pastures. The increasing use of such inputs as mineral fertilizers and efficient machinery has enabled farmers to move most of their grazing livestock to cultivated grassland. The semi-natural pastures, which once covered large areas in the valleys, mountains and along the coast, have been abandoned and overgrown by bushes and trees. There is not much "naturally open grassland" below the treeline. Grasslands are created when land is grazed and harvested, and the forest regrows as soon as these activities stop. Semi-natural pastures also become overgrown above the treeline, although not with trees, but with willow bushes, junipers and dwarf birches. An increasing number of the species and vegetation types associated with our cultural landscapes are in decline and at risk, and are thus being redlisted (i.e., added to the Red List of threatened species).

GRASSLAND MANAGEMENT

The best way to protect the biodiversity of the semi-natural pastures is usually to ensure the continuation of traditional grazing. In valuable areas in which grazing activities have ceased, appropriate pasture maintenance measures must be initiated if the species diversity is to be maintained. Because of the various animals' grazing behaviour, it is important to select animals according to the historical use of the area to be maintained and the plant communities to be protected. Pastures are often the product of a very long-term interaction between grazing livestock and natural conditions. Thus, a sudden switch to a different grazing animal species results in changes of the area's vegetation.

SHOULD OLD PASTURES BE MAINTAINED BY OLD, EXTENSIVE LIVESTOCK BREEDS?

Although we know of the effects of different species' grazing behaviour on grassland vegetation, we know less about such differences between breeds of the same species. However, some studies indicate that extensive and intensive breeds select different plants and vegetation types. The modern, high-yielding livestock breeds require more nutrients than the old, lower-yielding breeds. This seems to affect the animals' choice of forage plants and vegetation types when grazing. In very species-rich grazing landscapes, which contain vegetation types with varying nutrient contents and for which maintenance requires the entire vegetation to be grazed, it may thus be appropriate to use breeds that graze as non-selectively as possible with regard to the plants' nutrient contents.

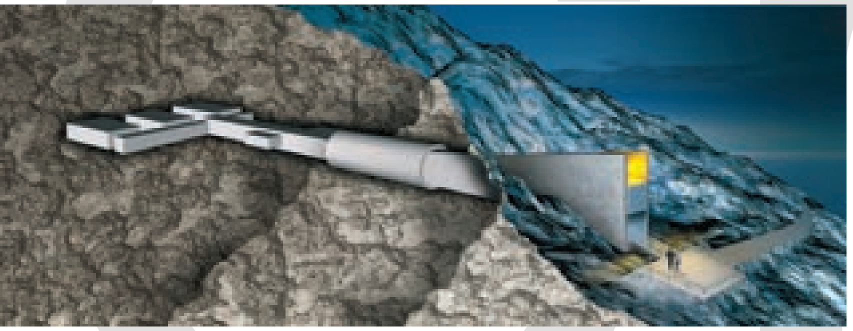
Svalbard Global Seed Vault – Symbol and Reality

Ola Westengen, NordGen • ola.westengen@nordgen.org

The Svalbard Global Seed Vault was inaugurated on 26 February 2008. The local population of the island's main settlement Longyearbyen is used to attention for their exotic home, but even they were quite surprised by the massive media presence this Tuesday before the annual Sun Festival. What is it about the Seed Vault that attracted the largest press corps to Svalbard since Roald Amundsen disappeared in the Arctic ice fields in 1928? Presumably, the explanation is linked to the site's symbolic value. The grand vision behind the Seed Vault is to safeguard the world's crop diversity for the future – a resource on which human food security relies. The Seed Vault's remote location in the Arctic, inside a frozen mountain, is a unique and safe storage site for the crop seeds of the world. This truly global vision has already made the Seed Vault an icon for the conservation of biodiversity.

It is a somewhat strange experience for an academic field used to receiving little attention from the general public to suddenly be in the limelight at prime time. The increased awareness about the importance of conserving crop diversity is definitely welcome. However, at the same time, those that are involved in the conservation and use of plant genetic resources might feel a bit uneasy about some of the popularisation and simplification that accompanies such exposure. The frequently used "Doomsday Vault" is not exactly an expression that fits in a rational, scientific context, and the importance of the seed vault may thus seem exaggerated in relation to the many other important measures established to sustainably conserve and use plant genetic resources. This is therefore a welcome opportunity to elaborate on the role of the Svalbard Global Seed Vault.

DRAWING: GLOBAL CROP DIVERSITY TRUST



OPERATION AND MANAGEMENT

The Nordic Genetic Resource Centre (NordGen) is a newly established organisation, and in many ways, the opening of the seed vault was its baptism. Whereas the Norwegian Ministry of Agriculture and Food has funded the seed vault's construction and is its responsible authority, NordGen is in charge of the vault's daily operations and management.

The Svalbard Global Seed Vault is not a gene bank, but rather a safety backup for the world's gene banks. The aim is to store "backup copies" of as much as possible of the genetic diversity found in the varieties of crops and their wild relatives world-wide. The Seed Vault can naturally only be used to store seeds, and not tubers, cuttings or other clonal propagating material. Plants that do not propagate by seed, or that produce seed that cannot be stored, must be safeguarded in other places and in other ways. However, many of our most important agricultural crops are propagated by "normal" seeds (so-called orthodox seeds), and there are many gene banks containing seed collections (called "seed banks" in the following) across the globe. The feasibility study for the Global Seed Vault pointed out that today's seed banks are vulnerable to natural disasters and man-made threats, including everything from power failures to wars, and that there thus is a need to backup the vital resources they hold. Although some seed banks have placed safety duplicates of their accessions in other seed banks, there have been no systematic attempts to safety back-up the world's unique genetic resources. The Svalbard Global Seed Vault is precisely such an attempt.

INTERNATIONAL COOPERATION

The success of the project relies on gaining trust and buy-in from the seed banks around the world. Such cooperation in the field of plant genetic resources conservation is not a matter of course. However, a turning point came on 29 June 2004 when the International Treaty on Plant Genetic Resources for Food and Agriculture entered into force, nearly 10 years after negotiations had commenced in the United Nation's Commission on Genetic Resources for Food and Agriculture. With this treaty as a legal and political framework, there is now increased focus on systemising the conservation of genetic resources.

The international organization Global Crop Diversity Trust, hosted by the FAO in Rome, has strongly advocated the establishment of a rational, effective and efficient network of ex-situ collections (conservation outside of the natural habitat). The Svalbard Global Seed Vault is seen as a cornerstone in such a network, and the Global Crop Diversity Trust is the third partner in the project, together with the Norwegian Ministry of Agriculture and Food and NordGen. The Global Crop Diversity Trust funds parts of the management and operation of the Seed Vault and also the shipment of seeds from eligible developing country seed banks. The long-term success of the Svalbard Global Seed Vault is totally dependent on international confidence in its management and operation. Such trust, in turn, depends on the Seed Vault being run according to the principles of the International Treaty and in close cooperation with important international bodies such as the Global Crop Diversity Trust.

SIMPLE PRINCIPLES

A simple concept and low-key technology are hidden beneath the great symbolic appearance of the project. Before shipment to Svalbard the seeds must be dried to low moisture content, and stored in sealed, laminated, moisture-proof foil packages. These packages are placed in standard-sized boxes, which upon arrival at Svalbard are barcoded and stored on the shelves in the vault rooms. The vault rooms are cooled to -18 °C by a compressor. In addition, cold outside air can be pumped in during the Arctic winter. In the unlikely event of a power failure, it would take years for the mountain to lose the accumulated cold, and even then, temperatures would stabilise at the natural permafrost conditions of about -4 °C.

Storage in airtight packages at a temperature of -18 °C are optimal conditions for long-term seed storage. Supposedly, the world's oldest viable seed was an Arctic lupin that germinated after 10,000 years of permafrost "storage". In spite of such stories, the Svalbard Global Seed Vault was not built to be a time capsule. On the contrary, it is meant to be part of a dynamic network of seed banks. And since seed banks regenerate their accessions, either due to decrease in viability and germination or a demand for more seed from scientists and breeders, they will be able to send new seeds to the Seed Vault to regularly replace the old samples when necessary. The Seed Vault is operated according to the "black box" principle. This implies that depositing seeds will not affect any property or other rights pertaining to the ownership of the seeds, and that only the

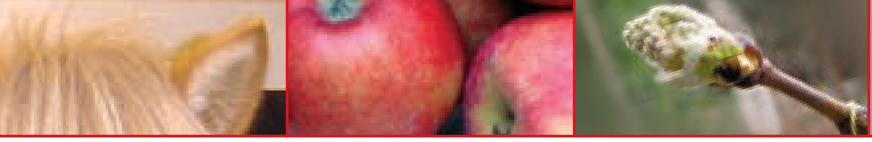
PHOTO: MARI TEFRE/SVALBARD GLOBALE FRØHVELV

institution that has deposited seed samples in the vault can retrieve them. This is crucial for avoiding the infringement of intellectual property rights, and one of the major issues of the standard agreement signed by the Seed Vault representative and the respective depositors.

Prior to the opening of the Global Seed Vault, many of the major seed banks in the world worked hard to get a substantial collection in place right from the beginning. The seed collections classified in the International Treaty as "in trust", meaning that they are global public goods held by the International Agricultural Research Centres, so far constitute the core of the Svalbard collection. Samples sent by national seed banks will eventually account for an increasing share of the collection.

Ensuring the sustainable conservation and use of the world's plant genetic resources is a formidable task – a task that requires efforts on many fronts: e.g. conservation in-situ (in their natural habitat); active gene banks that characterise, evaluate and distribute seed samples to breeders; as well as farmer-participatory breeding programmes, to name just a few. Safety storage of seeds on Svalbard is not a silver bullet, but the project is a simple and important part of the solution to the challenge at hand. Total construction costs for the Global Seed Vault amounted to NOK 48 million (approximately EUR 6 million), and annual operating expenses will be in the order of NOK 2 million (about EUR 0.25 million). As a resource, the value of genetic diversity is difficult to express in monetary terms, but most people would presumably agree that this is a reasonable insurance policy for the world's seed heritage.

Total capacity: 4.5 million seed samples
On opening day: 268,000 seed samples from all over the world, weighing more than 10 t.
The Nordic countries' safety collection has now been moved from their previous storage site in an abandoned coal mine to the new Seed Vault.
It is estimated that there are currently about 1.5 to 2 million unique accessions in the world's gene banks.
For more information:
The Global Seed Vault's official website: www.frohvelv.no • NordGen's seed portal: www.nordgen.org/sgsv



The farmers in the Andean region usually grow s many as 10 - 40 different varieties of potatoes.

Abandoned potatoe fields in Ireland

PHOTO: KERSTIN OLSSON

Hidden Treasure – 2008 is the International Year of the Potato

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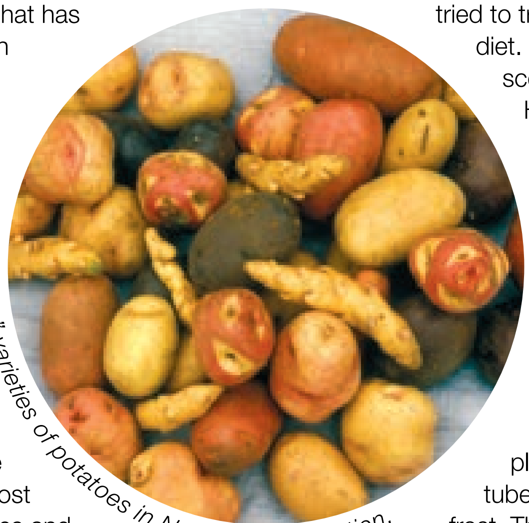
Within the Nordic countries there are countless names for the potato: Jordpärer ('earth pears'), pantofflor, patater, skomagerost, potatis (Swedish), peruna (Finnish), kartofler (Danish), poteter (Norwegian), truffel and kartöflur. Not to mention the vast number of names there are worldwide for this tuber that is being especially celebrated this year. The FAO has declared 2008 as the International Year of the Potato!

This extra focus is intended to increase awareness of the potato, a tuber that has been grown in the South American Andes for the past 8000 years. Genetically, potatoes originate in the Andes, i.e., that is where the greatest diversity of potato varieties is found. The potato has 235 known wild relatives growing between sea level and an altitude of 4500 m.a.s.l. Both nature itself and the local population crossed various wild varieties with each other and planted the seeds. Through the millennia, farmers selected the tubers that tasted best, yielded most and were most resistant to diseases and pests. The potato was "tamed" in the region around Lake Titicaca, and came to be the staple food for the entire Andean population, since few other crops could be grown at such altitudes. In that region, there are more than 1000 different names for the tubers, and each farmer usually grows 10-40 different varieties. Thus, the diversity of the potatoes' appearance and nutritional qualities is maintained. Each dish is served with its own specific potato type, which increases food variety. Last, but not least, the wealth of different varieties also represents a safety strategy. With such a diversity, a part of the crop always survives in case of drought, frost or pest infestation.

When the Spaniards arrived in South America in the 16th century, they discovered "roots the size of eggs, some round and others oblong, and with white, violet or yellow flesh". They resembled truffles, smelled good and were very tasty. The Conquistadors returned home to Spain after having defeated the Incas with help from other Indian tribes, firearms and diseases. In addition to all of the stolen gold and silver, they took with them something that in the future would prove to have an even greater value – the potato.



"Tame" varieties of potatoes in NordGen's collection.

The potato then spread across Europe in the strangest ways. In Spain, the crop was at first grown as a medicinal plant. One had observed that sailors who ate potatoes while crossing the Atlantic did not develop scurvy. Monks at a monastery hospital thus tried to treat their patients with a potato diet. However, the Pope was very sceptical of this underground crop. He "excommunicated" the potato as the devil's food, and claimed that it did not cure, but rather caused ghastly diseases. So instead, the potato was spread by botanists as an ornamental plant. Its beautiful flowers were soon to be seen in castle gardens and other botanical gardens throughout Europe.

To begin with, the potato plants rarely managed to develop tubers before being killed by the frost. They had not yet adapted to the longer day length in Europe, and thus did not start forming tubers until the days had become shorter. Only in the most favourable areas with mild winters was it possible to obtain any yields at all. However, it was difficult to get people to eat potatoes, even when there were famines. In the mid-1700s, the Prussian king handed out seed potatoes and ordered his farmers to grow them. He threatened to cut off the ears and nose of anyone who did not obey, and so, potato growing got off to a start. Also, the numerous wars helped to spread the tuber – soldiers came to appreciate this filling food, and later took seed potatoes with them when returning home to their families.

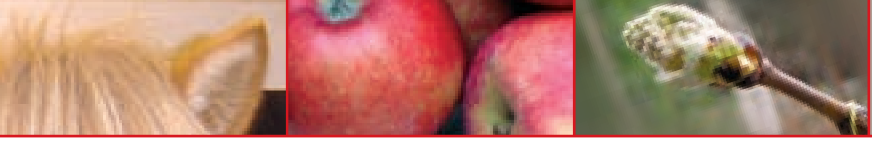
It took some cunning to start potato growing in France. A French pharmacist, Parmentier, was held as a prisoner of war in Germany during the Seven Years' War (1756-63), but survived thanks to the potato. Upon returning home, he obtained an audience with King Ludwig XIV and tried to convince him of the tubers' excellent food qualities. He even presented the showy flowers to Queen Marie Antoinette, who later often wore potato flowers in her hair. King Ludwig XIV started growing potatoes around the castle in Versailles, and at Parmentier's request, the fields were guarded by armed soldiers. Naturally, this aroused the curiosity of the surrounding farmers, who asked the guards about the strange crop and how to prepare it. The soldiers were then ordered to leave the fields unguarded at night, thus enabling the farmers to "steal" the potatoes – precisely as intended by the pharmacist.

In the Nordic countries, the potato arrived as an ornamental plant. In 1658, it was found in the Uppsala botanical garden under the name Peruvian nightshade. In Denmark, potatoes were served for the first time at a banquet at the town hall in Køge in 1687. However, cultivation did not start until the early 1700s after Danish mercenaries had taken tubers back home from England or Ireland. In Sweden, Alströmer is credited with having introduced the potato, which he started growing on his farm in 1724. He also promoted potato growing at a larger scale, but soldiers returning from the Thirty Years' War presumably took the tubers back home from continental Europe even earlier. Alströmer reported that also Finland had favourable conditions for cultivating potatoes. The plant was presumably introduced in the southern parts of the country in the mid-1720s by the Hisinger brothers, who were friends of Alströmer. Another theory is that potatoes were introduced by German smiths in the 1730s. In Norway, the first documented potato growing occurred in the 1750s, but it is possible that sailors and tradesmen had already taken tubers with them and planted them in their gardens at an earlier date. Halldorssen, a clergyman in north-western Iceland, learned about potatoes in publications from various European countries, and ordered seed potatoes from Copenhagen. In 1760 he was finally able to plant potatoes in Icelandic soil. Quite often, clergymen and public officials were the ones to spread knowledge about potato growing. Another major information channel was the almanac, which however required that the farmer could read. It was slow business convincing the Nordic population of the benefits of potato growing, and not until having experienced serious crop failures did they accept the plant. The old northern heirloom varieties are now safely in storage at Nordgen, and can be ordered there, depending on availability.

Today, the potato is the world's fourth-largest crop, cultivated on a total of 195,000 km2. More than half of the 320 million tonnes produced in 2007 were harvested in developing countries. The crop's potential is fantastic, and potatoes are now grown from Greenland to the equatorial highlands and Australia. China is the world's leading potato-growing country. Potatoes feed the poor and rich alike worldwide, and the crop's importance will increase in the future. So far, potato consumption in developing countries is only 25 % of consumption in Europe, although there are clear indications that the figure will increase considerably. The tubers, with their high content of carbohydrates, are an excellent source of energy, and their protein is of high quality. Furthermore, their vitamin C and potassium contents cover a large share of daily requirements.

There are naturally also problems associated with potato growing. The biggest threat is the potato late blight. The great famine that hit Ireland around 1850, reducing the country's population by about 2.5 million people, was caused by an outbreak of the water mould *Phytophthora infestans*. The Irish had grown just one or two extremely blight-susceptible varieties, and thus all potatoes were infested and rotted. Since the mid 1940s, commercial potato growers in Europe and North America spray fungicides to avoid the risk of losing a crop. Potatoes are one of the most sprayed crops. This is costly for the farmer and a threat to the environment, since pesticide residues can leak into the groundwater. Also, spraying presents a risk to the operator, but no pesticide residues shall be detectable in marketed potatoes. Currently, considerable funds are being invested to breed blight-resistant varieties. Certain wild relatives of the potato from South America and Mexico are naturally resistant to the mould. These plants can be used in breeding programmes to introduce the trait into cultivated potatoes, thus combining blight resistance with crop quality and high yields. Another way to develop new, resistant varieties is by using gene technology. In the future, we hope potatoes will be grown with minimal use of chemical pesticides, to the benefit of everyone.

THE WHOLE WORLD WILL DESERVEDLY CELEBRATE THE YEAR OF THE POTATO.



A 'Danish Giant' Asparagus

A landrace of asparagus was found on the Danish island of Fyn in 2007.

Gert Poulsen, Senior scientist, Department of Horticulture, Faculty of Agricultural Sciences, University of Aarhus, gert.poulsen@agrsci.dk

The use of asparagus dates back to antique Egypt and Greece. In the Roman period, Cato the Elder (234-149 BC) was the first to describe the cultivation of the plant, actually using the term asparagus: ***Asparagus quo modo seratur*** (how to plant asparagus), in his work De Agri Cultura (160 BC). In a separate chapter he thoroughly describes asparagus cultivation. Plinius writes that garden asparagus originated from wild asparagus. That sounds reasonable, and indicates that asparagus was domesticated in the ancient Rome. The natural geographic range of asparagus includes Europe, the Near East and Iran, western Siberia and North Africa.

The asparagus grown in the Nordic countries is ***Asparagus officinalis*** L. It is considered a native plant in the region, where it is found all along the coast as far north as Vaasa in Finland. In northern Europe, asparagus cultivation began in the 15th and 16th centuries, and one must assume that this also included the Nordic countries. In 1647, asparagus is mentioned as being widespread in Denmark. In Sweden, it was a familiar crop around 1650, whereas it was not introduced in Norway until about 100 years later.

Asparagus is grown as both green and white spears. The growing of white asparagus was introduced in northern Europe in the late 19th century. Shortly afterwards, commercial cultivation in Denmark experienced a boom. Extensive asparagus plantations were established at Bøtø Nor on the island of Falster, on dammed-in areas along the Lammefjord and at Slagelse near Jernbjerg. Asparagus growing was also established on the islands of Samsø and Fyn, which have sandy, porous soils that are just right for asparagus. Asparagus from Helnæs had a good reputation. On Fyn, in the area around Hårby where there used to be a considerable vegetable canning industry, asparagus was extensively grown for preservation. Asparagus growing in Denmark peaked in the mid-1960s at about 1669 ha, but due to rising production costs and competing imports from countries with lower labour costs, production has decreased dramatically. As of 2005, asparagus was only grown on a total of 70 ha, with most production centred around the Lammefjord and on Samsø. The crop is sold domestically, mainly as fresh, white asparagus.

USES

Asparagus is a delicacy that is especially desirable because it is the first fresh vegetable to be harvested in the spring. Traditionally, asparagus is prepared in a variety of ways, including boiled, sautéed, in soups, salads and stews, or au gratin. Before boiling, the spears must be peeled. The asparagus peels can be decocted and used for a soup, or dried for later use. Asparagus is boiled in lightly salted water for 20-30 minutes, although shorter boiling times are often used nowadays. Boiled asparagus spears can be preserved. A lot of green asparagus is now being imported, which has the advantage of having a less fibrous skin, and thus does not have to be peeled. The green varieties can be prepared just like any other fresh, early vegetable. Recipes in older cookbooks often recommended using the variety 'Dansk Kæmpe' ("Danish Giant"). Today, this is difficult because asparagus is not marketed under the variety name. For the time being, it is probably not possible to find 'Dansk Kæmpe' on the market.

VARIETIES

Through the years, several foreign asparagus varieties have been tested, but 'Dansk Kæmpe' has proven to be best under Danish conditions in terms of yields per hectare, as well as number and thickness of shoots. However, the Danish Giant starts growth a bit later than some of the French and German varieties in the trials, which may reflect its adaptation to late spring frosts. Dybdahl (1877) describes numerous variations of violet, white, green and giant asparagus that could not be distinguished from each other. Equally, there were many different local varieties such as Ulm, Darmstadt, Erfurt, English and Dutch giant asparagus, which also could not be considered as varieties in a modern sense, since they showed considerable variation.

Danish plant breeders developed two relatively new asparagus varieties, 'Årslev no. 136' and 'Årslev no. 270'. Both varieties performed well in comparative trials with green asparagus, and have been added to the seed bank of the Nordic Genetic Resource Centre (Nordgen). The famous, traditional variety 'Dansk Kæmpe' was finally located in summer 2007.

'DANSK KÆMPE' ADDED TO NORDGEN'S COLLECTION

A farmer on Fyn was in the process of phasing out his asparagus production, but through the grapevine, Nordgen found out about the situation and made sure that seeds from 50 plants were collected.

'Dansk Kæmpe' is interesting because it is a landrace, of which there are not many left in Denmark. It is also relevant to collect material from the other asparagus-growing areas in Denmark to see if any other 'Dansk Kæmpe' specimens can be found. By thus collecting the entire scope of variations within this landrace, one could get an impression of any differentiation between the various growing areas. To conserve and utilise 'Dansk Kæmpe' as a genetic resource, it must first be characterised, tested and propagated. Asparagus is a crop that takes time to establish. Plants must grow for three years before the first shoots can be harvested and their quality assessed. Then, another three years must pass before seeds can be harvested for deposition in a seed bank, propagation and actual use. It will therefore take some years before 'Dansk Kæmpe' can be obtained from Nordgen.

WHY IS 'DANSK KÆMPE' AN ATTRACTIVE CROP?

'Dansk Kæmpe' has been grown in Denmark for more than 100 years and is thus adapted to our climate. It develops many thick shoots and a thin peel, which means less waste during preparation. The variety is also suitable for freezing. New trends, such as regional food culture and Slowfood, contribute to conserving old varieties with a focus on food quality and food stories. Nowadays, people appreciate a tasty meal with a good story linked to it. Asparagus is absolutely best when eaten fresh, and thus highly suitable for local production. At the same time, local food production can contribute to maintaining rural livelihoods.

REGIONAL APPROVAL OF LAMMEFJORD ASPARAGUS

An application for regional origin labelling of Lammefjord asparagus has been submitted to the EU. Freshness is a predominant characteristic of this regional label, since the Lammefjord asparagus shall be sold within five days after harvest. Furthermore, to be marketed under this label, the asparagus must have been grown and packed in the Lammefjord area, and only soil can be used for bleaching the white asparagus.

This is a good initiative, and I hope that the re-discovery of 'Dansk Kæmpe' is only the beginning of an increased use of locally grown asparagus and further developments in this field.

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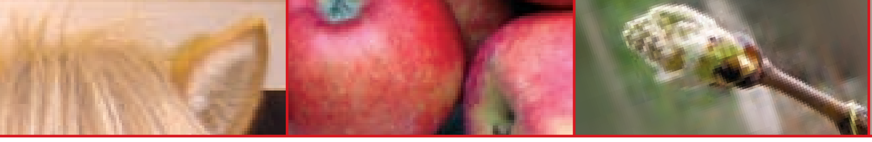
PHOTO: GERT POULSEN



Climate Change – A Challenge for Plants!

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Climate change poses a tremendous challenge to plants. They cannot simply get up and leave if conditions become unsuitable!

Species distributions are changing and although our native flora is now experiencing frequent and more extreme weather events, plants are often slower to respond than many other types of wildlife (Sutton, 1991). Some predictions suggest that species will migrate northwards and upwards in altitude as their climatic space moves. However, this migration of plants will be challenging.

A temperature increase in the northern region of Scandinavia by about 4 0C in the next hundred years, as was predicted by Schlyter et al. in 1993, would create a very rapid change, relative to previous changes experienced by natural populations in this area. Plant populations can respond in various ways to environmental change. During evolutionary history, most species have become extinct, often due to environmental changes. Some species are so plastic that they can withstand environmental changes. However, other species migrate to more suitable conditions (Philips, 2007).

Many species of plants show evidence of having genetically adapted to local conditions. Local adaptation means that, for instance, a northern population has higher fitness in its original location than other populations. The northern population may well have higher absolute fitness in a more southern location, but essentially, in relation to the southern local population, it will fare worse. Earlier studies have shown that many northern species may at least initially benefit from warmer climates, whereas in the southerly range limit, the temperatures may become too high or precipitation too low to favour existing species, which presumably would result in a northward migration (Veteläinen et al., 2006). Thus it seems possible that evolutionary change can take place within some populations so that they adapt to the new conditions.

Environmental change places different demands on populations in different parts of the range. Plant species with fragmented small populations with little migration may presumably not be able to evolve rapidly enough to adapt to the environmental change (Watt et al., 1998). The environmental change is so rapid that small marginal populations may not have enough genetic variation.

The importance of ex situ conservation is increasing in step with the changing climate, if we are to maintain the variation within our plant genetic resources. The irony here is that plant breeders will be relying on wild relatives and their genetic variation more than ever as they work to develop domesticated crops that can adapt to changing climate conditions. Yet because of climate change, we could end up losing a significant amount of these critical genetic resources at precisely the time they are most needed to maintain agricultural production, if we do not conserve them under ex situ conditions.

The Nordic Genetic Resource Center (NordGen) conserves (ex situ) the cultural plant genetic varieties from the Nordic countries, covering the area between the southern parts of Denmark to areas north of the Artic Circle. The collected plant genetic material in the far north of Scandinavia (i.e., collected at latitudes of 64 0N or higher) consists currently of 737 accessions (i.e. seed samples) accepted for long-term storage at NordGen. Of these 737 accessions; 146 accessions are from Finland, 225 from Iceland, 117 from Norway, 390 from Greenland and 249 from Sweden (Figure 1). The majority of this material (98 %) consists of different kinds of forage crop accessions. The rest are vegetable and cereal accessions.

The future challenges for NordGen and its users are indeed to increase the present ex situ collection for the Nordic countries, with special focus on the threatened species which already run a high risk of disappearing from our native fauna. Based on an extensive research project initiated by the Nordic Council of Ministers (NMR), focussing on the Nordic research collaboration within climate change and its consequences in the Artic area (TemaNord, 2007), the NMR is now investing 20 mill DKK to help secure our Nordic ecosystems in facing the non-stopping climate change evolution. With an extra effort, we can insure the continuation of our existing plant genetic variation under ex situ conditions when survival is no longer possible under natural conditions.

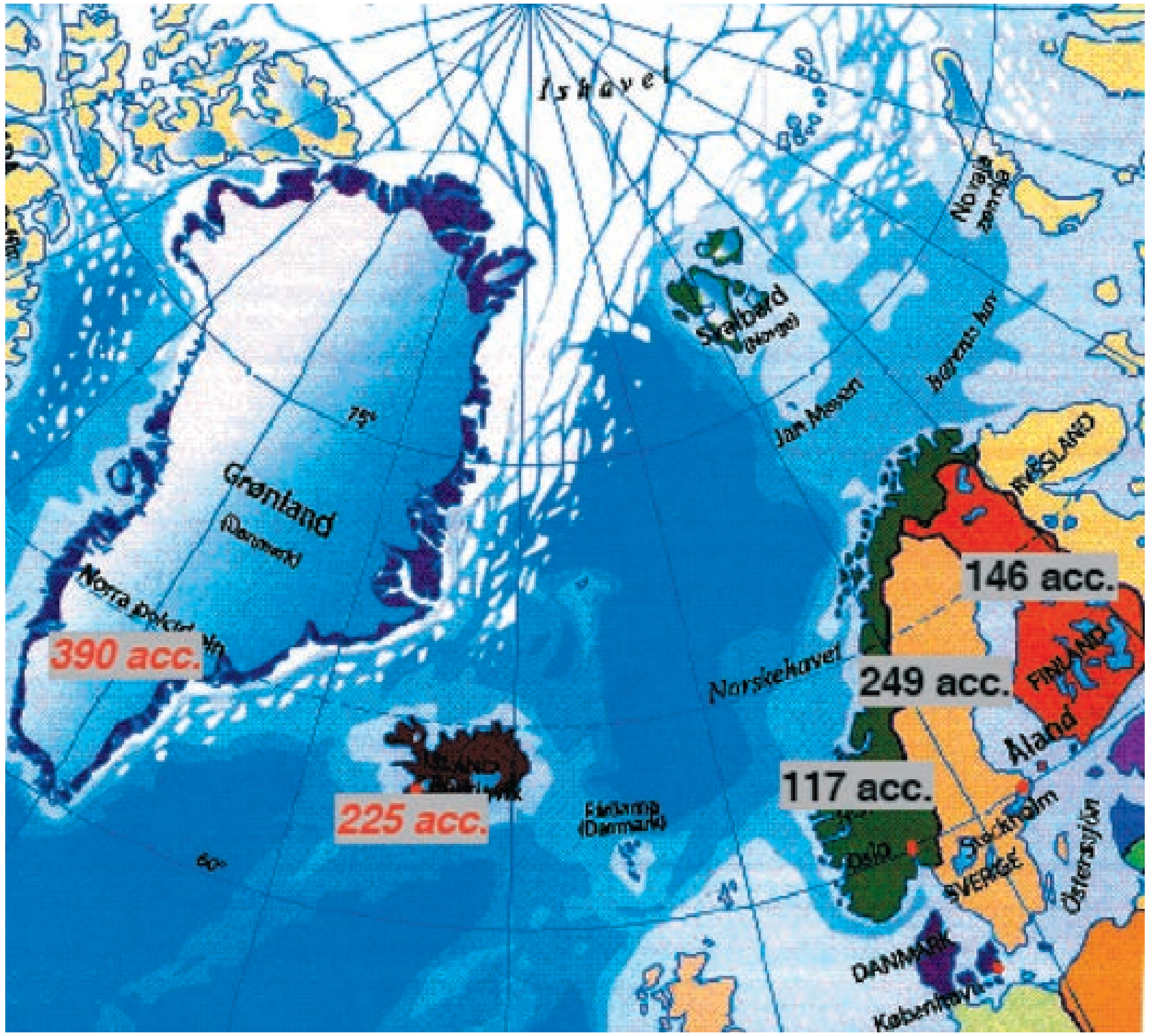

Figure 1: The number of accessions collected north of the Artic Cirle, which are stored (ex situ) at the Nordic Genetic Resource Center (NordGen) in Alnarp, Sweden.

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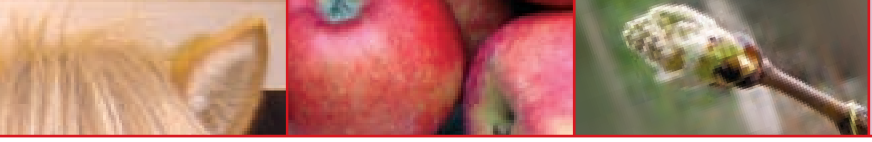

Nordic Cooperation on Genetic Resources under Sweden's Chair of the Nordic Council of Ministers in 2008

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THE NEW NORDGEN AS A COMMON PLATFORM

Nordic cooperation in the field of genetic resources is mainly performed within the framework of the Nordic Genetic Resource Centre (NordGen) and its strategy for 2008-2012. Increased interaction between Nordic cooperation and national activities in the field of genetic resources benefits the entire Nordic region. Furthermore, NordGen provides a platform for international involvement in genetic resource management.

SWEDEN IS CHAIRING NORDIC COOPERATION IN 2008

As chair of the Nordic Council of Ministers in 2008, Sweden gives priority to making contributions that enable NordGen's first year as a newly established organisation to be successful. In the autumn of 2007, a new 5-year strategy, the budget, contracts and statutes were prepared, and a new director recruited. Such extensive preparations made the start of Sweden's chairmanship easy, and together, the documents provide a solid foundation for our common Nordic vision.

Genetic resources are the basis of human existence, and of animals' and plants' adaptation to changing conditions, including climate change, the need for increasing production, new environmental regulations and changing consumer demands.

Nordic cooperation on plant, farm animal and forest genetic resources aims to secure diversity for future generations in order to safeguard land-based businesses, food production and our cultural heritage. Emphasis is placed on the conservation and sustainable utilisation of genetic material.

Sound and efficient management of genetic resources lays the foundation for future plant and animal breeding. To facilitate the use of genetic resources, information and knowledge transfer must be further developed, e.g., regarding legal aspects of genetic resource utilisation.

Sweden supports the vision and the goals expressed by NordGen's new strategy:

VISION

NordGen shall secure the livelihood of present and future generations.

GOALS

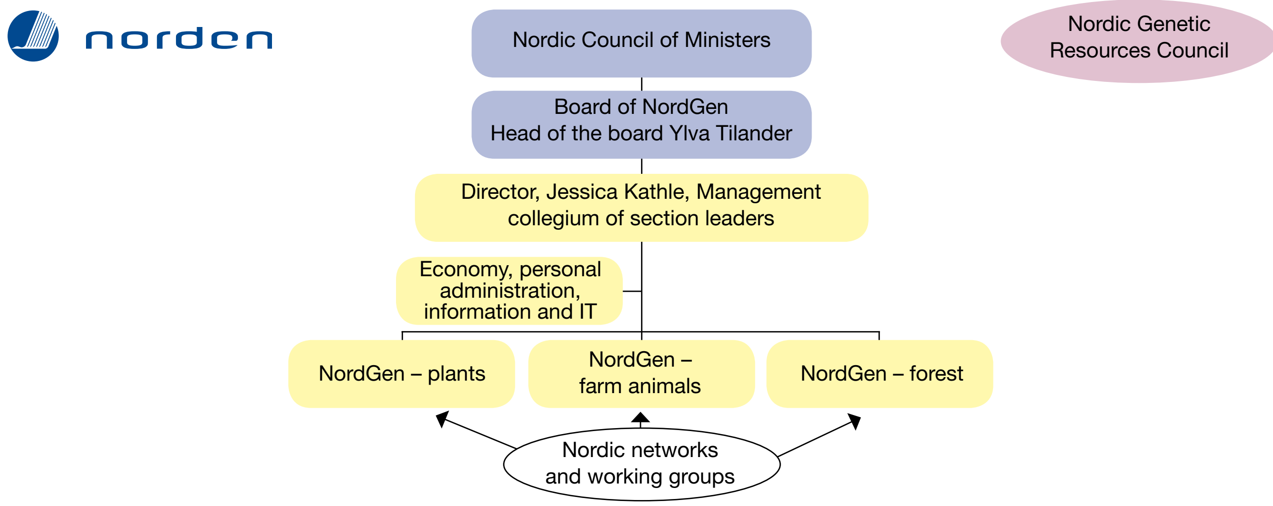
- NordGen shall contribute to securing and utilising genetic diversity in agriculture and forestry in the Nordic countries.
- NordGen shall clearly, actively and effectively promote Nordic cooperation on sustainable use and conservation of genetic resources that are beneficial to agriculture, horticulture, forestry and food production.
- NordGen shall increase general awareness of the social and cultural-historical values of genetic diversity within and between species.
- NordGen shall be among the leading international service and knowledge centres for the management of plant, farm animal and forest genetic resources.
- NordGen shall become a distinguished and highly-profiled public knowledge and service centre, and an important expert body for decision-makers.
- NordGen shall through its member states contribute to international transparency and cooperation and to the fair and equitable sharing of global genetic resources.

SCHEDULE FOR 2008

This spring, a schedule for NordGen's work in 2008 was completed. The schedule focuses on how the organisation's goals for 2008 shall be achieved. A highly important task is the integration of the three sectors plants, farm animals and forests within the newly established organisation. These activities were previously operated as separate organisations, and have thus developed different traditions, strengths and weaknesses. From a Swedish perspective, we see a considerable potential for improving quality, enabling synergies and increasing cost-effectiveness by integrating the three sectors and learning from one another.

FOREST GENETIC RESOURCES

In the field of forest genetic resources, Sweden is especially looking forward to the conference to be held on Iceland in August 2008 in connection with a meeting of the Nordic forestry ministers. The conference will focus on forestry and the issue of climate change and the role of forests as carbon dioxide sinks. From a Swedish perspective, climate change is a major issue, as is underlined in Sweden's chairmanship programme.



FARM ANIMAL GENETIC RESOURCES

With the adoption of FAO's Global Plan of Action for Farm Animal Genetic Resources in Interlaken in 2007, a milestone was achieved in international cooperation on farm animal genetic resources. In 2008, it is important for the Nordic countries to jointly discuss how we shall successfully meet our commitments. Even though the implementation of the Global Plan of Action is mainly a national responsibility, we do believe that there are benefits to be achieved from Nordic cooperation. Continuous measures in this context include improved exchange of knowledge about our activities, support to the various livestock species groups, education, conferences and general information services. In light of international developments, such measures become even more important.

PLANT GENETIC RESOURCES

From a Swedish perspective, nearly 30 years of cooperation on plant genetic resources, first as the Nordic Gene Bank and now within NordGen, have been both successful and valuable. In this connection, the working goups play a major role. The national programmes are important, as are the extensive mutual contacts with each other and with NordGen. Sweden will make sure that the conservation of plant genetic resources continues with the same high quality, while at the same time making an extra effort to develop the sustainable use of these resources, especially within the context of climte change. An important issue for the future is to increase outreach activities, e.g., by focusing on providing information and educational services.

SVALBARD AND COOPERATION WITH INTERNATIONAL GENE BANKS

NordGen's international activities in the field of plant genetic resources include a number of considerable challenges in 2008. On the top of the list: fulfilling the responsibility that NordGen has taken on as the operator of the Svalbard Global Seed Vault. Other important international tasks include the participation in the final phase of the nearly 20 year-long cooperation with various national seed banks in southern Africa, and the start-up of a new joint project with seed banks in central Asia.

THE SUMMER CONFERENCE OF THE COUNCIL OF MINISTERS

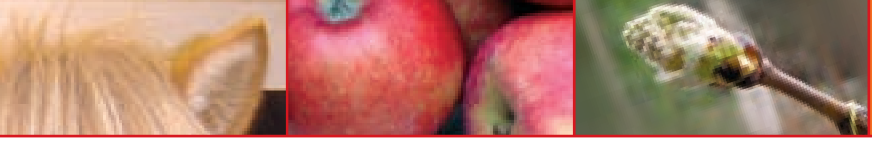
Sweden proposes to include genetic resources as an issue for discussion at the summer conference of the Council of Nordic Ministers for Fisheries and Aquaculture, Agriculture, Foodstuffs and Forestry (MR-FJLS) in June 2008. The ministers should be informed of the start-up of NordGen, which in our opinion has been successful, and of the opening of the Global Seed Vault on Svalbard. In addition, the ministers should discuss the declaration on Access and Rights to Genetic Resources from 2003 ("Kalmar Declaration"), in light of the current developments of the International Treaty on Plant Genetic Resources for Food and Agriculture.

In 2008, Sweding is coordinating the completion of a new action plan for cooperation within MR-FJLS. Sweden aims to integrate issues related to genetic resources in the new action plan, which thus would function as a follow-up of the current Nordic strategy for the management of genetic resources (2005-2008).

NORDIC GENE RESOURCE COUNCIL

Over the years, the Nordic Gene Resource Council has played a valuable role, especially through the theme-based projects it has initiated. The Committee of Senior Officials for Agriculture and Forestry decided to discuss the status of the Nordic Gene Resource Council at the committee's meeting in May 2008. Sweden finds it important to evaluate the Nordic Gene Resource Council's responsibilities in light of NordGen's recently adopted strategy, and wishes to promote the discussion of this issue in the current year.

To sum up, I would like to underline that we have an exciting year ahead of us. Already at this early phase of the year, it is pleasing to assert that the new organisation got off to a very good start and thus can look to the future with confidence.



The Finnhorse – A Versatile All-rounder

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The Finnhorse is Finland's only native horse breed. With regard to its conformation and utility traits, the Finnhorse is a versatile all-round horse. It's a medium-sized horse, well-postured and of a rather solid build.

The Finnhorse is cooperative, humble, aspiring and honest. Even horses with an exterior primarily suited for trotting or riding can, if necessary, be used to pull a load of timber or a wedding carriage. There are records of one and the same horse that participated in both harnessed and saddled trotting races, set a gallop record, participated in an international team driving competition, timber hauling and other utility driving competitions, as well as national dressage competitions, steeplechases and hunt races. In addition, the same horse also participated in a show and was used on riding tours.

However, maintaining respect for the Finnhorse has not always been a matter of course. With increasing industrialisation and globalisation, the continued conservation of the breed has required a serious effort. In the 1950s, the Finnhorse population amounted to nearly 500,000. Two decades later, there were fewer than 15,000 Finnhorses remaining.

Today, the Finnhorse population is about 20,000. They are bred as four different types: trotters, riding horses, work horses and small, pony-type horses. Originally, horses were selected for their driving or pulling ability. Fast and tenacious horses that were able to utilise feed efficiently were best suited for the rough, Nordic conditions.

STUDBOOK ESTABLISHED IN 1907

As a defined breed, the Finnhorse only dates back to 1907. Before then, the lineage of Finnish horses was unclear. The horses grazed freely on large common pastures, where no specific breeding records were kept. The aim of establishing the studbook was to "... by using purebreeding principles, develop a native horse breed adapted to the conditions [in Finland], first and foremost for use in agriculture". In the first year, 113 stallions were admitted to the studbook.

Since then, the studbook regulations have been changed many times. In 1924, separate studbooks were established for work horses and for the lighter-bodied universal horse, which better suited the needs of the military. As of 1929, utility traits were included in the studbook records in addition to conformation traits. Utility traits were measured in driving, walking and trotting tests. Exterior scores were introduced in 1932. In 1965 the military's need for horses was more or less non-existent, and thus the multipurpose horse studbook was transformed into a studbook for trotters.

Then, in 1970 the State completely gave up maintaining the studbooks. The task was taken over by the Finnish Trotting and Breeding Association (Suomen Hippos), which wanted to include all horses in the records. At the same time, the Finnhorse's studbook was divided into the four different types that still are in use.

INBREEDING COEFFICIENT OF 4 %

The introduction of artificial insemination in the 1980s led to such an increase in the number of mares sired by popular breeding stallions that one had to seriously focus on maintaining the genetic diversity of the Finnhorse. In 2004, the inbreeding coefficient of the Finnhorse was nearly 4 %, which is less than half of the corresponding figure for warm-blooded trotters.

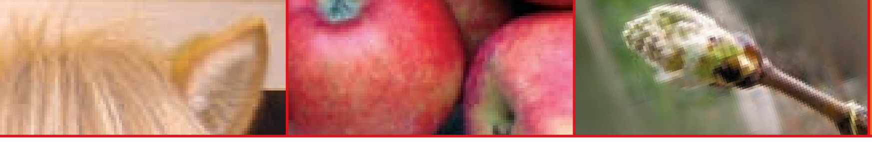
PHOTO: MARGIT TICKLEN

Rarer family lines have been mainly preserved as sire lines for riding and pony-sized horses. The number of their progeny is increasing, although with about 250 births a year it is still a small population compared to the total number of Finnhorses. To achieve significant genetic improvement, a breeding population of 3000 mares covered and 2000 foals would be necessary. The actual figures for the Finnhorse are currently 2000 and 1400, respectively.

In general, one could say that the future of the Finnhorse is an open field: full of opportunities that can be realised if action is taken. In support of marketing the Finnhorse and to promote competitions, four associations have been established since the early 1970s, each focusing on one of the horse's different uses. The Association of Finnish Riding Horses (Suomenratsut) promotes the use of the Finnhorse as a riding horse. The Finnish Trotting and Breeding Association is working to generally improve the Finnhorse's reputation, especially as a trotter, increase the scope of its uses and ensure the conservation of the breed's genetic resources. The Finnish Work Horse Association specialises on the breeding, raising and use of the Finnhorse's work horse type, whereas the Pony-sized Finnish Horse Association focuses on conserving the pony-sized Finnhorse.

A MODERN IMAGE

As a result of a tight supporting network of individuals and organisations, trotting races with a modern image and significant prize money have been established, including the Olympic Trotting Races and the National Trotting Championships. Accordingly, the riding horse section introduced breeding competitions, and for work horses there are now new forms of competition, which are based more on technique than on strength. Luckily, increasing numbers of people are devoted to the Finnhorse in one way or another. About one-third of all horses competing in Finnish trotting races each year are Finnhorses. In riding events, the breed represents about one-fourth of all competitors.



Norwegian Red (NRF) – Enjoying International Success

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As a breed, Norwegian Red (NRF) can be dated back to 1935, the year in which the NRF breeding association was established. For a long time, the breed was looked upon as a "synthetic" crossbred population, as it was based on many of the old Norwegian cattle breeds, as well as on horned lowland cattle of shorthorn and ayrshire stock, and crossbred with Swedish Red and White Cattle (SRB) and Finnish Ayrshire. With various Holstein populations and Swedish Lowland Cattle (SLB) tested during the 1970s, approximately 30 % of the NRF cattle today is black and white. Norwegian Red has only been recognised as a breed in the classical, international breed encyclopedias since the 1980s.

Since the 1970s, NRF has distinguished itself by having a broader breeding goal than most other dairy breeds - a breeding goal in which health, fertility, functionality and growth performance are weighted (see Figure 1). Efficient breeding work for health and fertility with progeny groups of 250 daughters was possible because a national health registration system was already introduced for Norwegian herds in the mid-1970s. Since the early 1980s, significant genetic improvement has been documented for mastitis and fertility, in addition to the more traditional production traits.

There have been sporadic exports of NRF genes since the 1970s; to begin with, on a more idealistic basis and as export of purebred material to sister populations in Australia, Sweden and the USA. In recent years, however, there has been considerable international interest in the breed, mainly with regard to crossbreeding with various Holstein populations. In the FAO report "The State of the World's Animal Genetic Resources for Food and Agriculture", NRF is mentioned as a positive example of breeding for health, fertility and functional traits.

In the past few years, major comparative tests and crossbreeding trials have been performed between NRF and Holstein cattle in Canada, Hungary, Iran, Ireland, Israel, Northern Ireland and the USA. The trials show that the use of NRF semen significantly improves female fertility, and also gives less calving difficulties, improved calf survival, fewer days open (calving-to-conception interval), improved longevity and better health than with Holstein sires. For example, the frequency of mastitis among Holstein cattle in Ireland is 15.3 %, whereas crosses were closer to the figure for NRF, which is 11.2 %. Survival from first to third lactation was 78 % in NRF, compared to 67 % in Holstein. In Canada, the calf mortality rate in first calvers was 11.9 % in Holstein cows, but only 6.3 % in NRF-Holstein crossbreeds. Holstein cows in California had 17.7 % calving difficulties and 14.0 % stillbirths, whereas the figures for crossbred dams (Scandinavian Red x Holstein) were 3.7 % and 5.1 %, respectively.

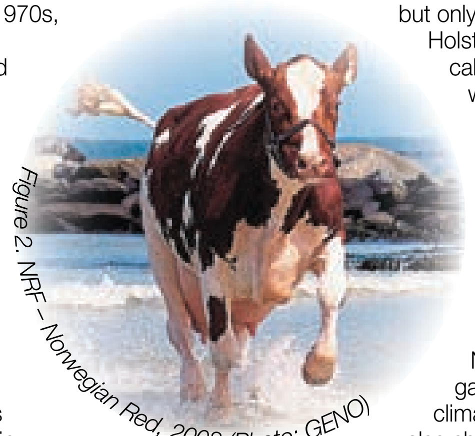

Figure 2. NRF – Norwegian Red, 2008 (Photo: GENO)

Regarding milk yields, there is only slight differences between crossbreeds and purebred Holstein, whereas NRF cows yield 5-8 % less. In a trial with grass-fed dairy cows in Ireland, crossbreeds gave 99 % of the Holstein milk yields, whereas NRF cows under the same conditions gave 95 % of the Holstein yields. Warm-climate testing in California and Madagascar also shows that NRF is more robust and tolerates heat better than Holstein.

Developments in international dairy cattle breeding have been dominated by Holstein breeding for decades. Considerable improvements have been achieved for milk yields and conformation, since these are moderately to highly heritable traits. However, problems related to functionality, calving difficulties, calf mortality, health and survival have been thoroughly documented in recent years. These problems are due to a combination of: lack of weighting of these traits in the breeding goal, insufficient system for registration of health traits and unfavourable genetic correlations between milk yield and functional traits. Also, due to other problems such as increased inbreeding and close breeding in the Holstein breed internationally, breeders in many different countries have been searching for alternative breeds or breeding schemes. Thus, the Nordic red cattle breeds have come to represent one alternative. Most of the international focus on NRF and SRB is linked to their use in crossbreeding, both as a way to "repair" the drawbacks of purebred Holstein breeding and to utilise heterosis in crossbreeds. NRF is now marketed internationally as part of a TWOPLUS system, including rotational crossbreeding with Holstein.

These are interesting future scenarios, in which Nordic cattle populations could provide important genetic contributions to the world's dairy cows, either as an alternative to, or by crossbreeding with Holstein – the world's dominant dairy breed.

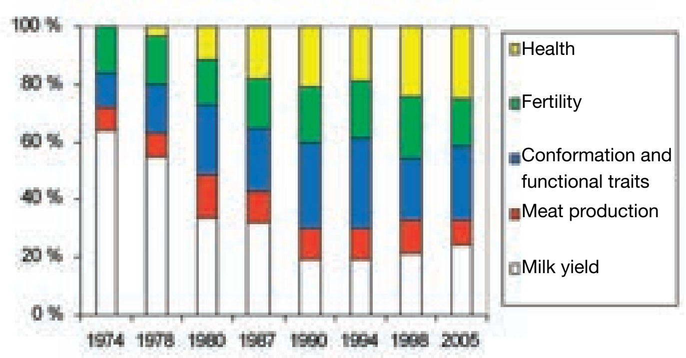

Figure 1. Weighting of traits in NRF breeding from 1974 to 2005 (GENO, 2008)

Contingency Flocks for Poultry

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PHOTO: KIM CONRAD PETERSEN/CONDIDACT

Due to the threat from avian influenza (bird flu) in the past few years, Denmark has also introduced certain restrictions on poultry breeding and small-scale poultry farming. Numerous poultry breeders have phased out their operations due to the stricter regulations, which in turn has considerably diminished the breeding lines of Danish national poultry breeds.

To secure a reasonable number of breeding animals and thus conserve the genetic resources of the national poultry breeds, the Danish Committee for the Management of Farm Animal Genetic Resources (Committee) set aside funds in 2007 for the establishment of a special contingency flock for threatened waterfowl.

Prior to signing the contract, the Committee's chairman and vice-chairman of the Danish Poultry Breeding Association, Niels Rasmussen, the breeder from Herning, and the Committee's secretary held a meeting with veterinarians from the Danish Veterinary and Food Administration, which is responsible for, among other things, preparing contingency plans for poultry diseases. At the meeting the Veterinary and Food Administration was informed of the breed conservation efforts, and of the specific challenges regarding waterfowl - challenges that have arisen in the wake of the restrictions that primarily were introduced to prevent the outbreak of the bird flu in Denmark.

The result of the meeting was that the Danish Veterinary and Food Administration will incorporate a passage about contingency flocks in the contingency plans for infectious poultry diseases. This will ensure that all parties involved in combating disease outbreaks are aware that the waterfowl of this specific flock are part of the Committee's work. Thus, it is intended that this flock – if possible in any way – is not culled as part of preventive measures against the spreading of infectious poultry diseases, but that it is isolated and tested for possible infection.

At the end of the year, the Committee signed a contract with a breeder near Herning on the management of a contingency flock.

The contingency flock will be established in May 2008. The 5-year contract with the Committee commits the breeder to making sure that such issues as fencing, cover and feeding comply with the current livestock regulations issued by the Danish veterinary and animal welfare authorities. Furthermore, the breeder is committed to admitting and purchasing healthy animals of Danish duck and goose breeds that are in need of conservation to the greatest possible extent. Such animals should originate from flock owners who are completely phasing out their production and where there are no other alternatives than slaughter for the birds in question.

At its April 2008 board meeting, the Committee decided to establish a second contingency flock in 2008, preferably again in an area in which the risk of contact with wild waterfowl is low.

Swedish National Action Plan for the Management of Farm Animal Genetic Resources

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To ensure their survival and as a means for material and cultural development, humans have for ages lived in close relationship with and depended on domestic animals. Sustainable utilisation and conservation of this resource have thus been natural for both the individual animal owner as well as for society at large. The *Convention on Biodiversity* (CDB or Rio Convention) from 1992 and FAO's recently adopted Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration (September 2007 in Interlaken, Switzerland) clearly show that the countries of the world realise the importance of this work.
In 1995, Sweden presented its *Action Plan for the Conservation and Sustainable Utilisation of Farm Animal Biodiversity* (Swedish Board of Agriculture, Report 1995:13). The report presents a number of specific goals and measures aimed at the sustainable utilisation and conservation of all native farm animal breeds in Sweden. A few years later, the Swedish Board of Agriculture issued a *Proposal for a National Programme for the Management of Farm Animal Genetic Resources* (Report 2003:13). The 2003 proposal then resulted in two additional reports, the first one dealing with the threat to farm animal genetic resources and the need for contingency measures and the second one with the need for systematic collection and storage of farm animal genetic material. These reports were also followed up by the establishment of the Swedish Board of Agriculture's reference committee (Farm Animal Genetic Council) and the Joint Committee for Information about Threatened Native Farm Animal Breeds.

The evaluation of the Swedish environmental objective as described in "A Varied Agricultural Landscape" also included an extensive discussion of the status of the animal material for which Sweden is responsible in terms of conservation.

The extensive work that has been carried out in specific areas within the past years has shown that there is a need to summarise the various proposed measures in one document. One aim of such a document would be to provide a general overview of the situation and to present the total needs. Thus, the Swedish Biodiversity Centre (CBM) at the Swedish University of Agricultural Sciences and the Swedish Board of Agriculture jointly initiated the preparation of an Plan of Action *for the Management of Farm Animal Genetic Resources* in cooperation with involved parties. Work on the plan began in 2006, and there have been numerous discussions with the Farm Animal Genetic Council and the Joint Committee for Information about Threatened Native Farm Animal Breeds.

The current draft version (as of April 2008) of the Plan of Action focuses on efforts within the five following areas:
- Documentation and characterisation
- Conservation and sustainable utilisation
- Information and education
- Research and development
- International cooperation

In addition, the plan includes a brief historical overview, a list of breeds for whose conservation Sweden is responsible and a presentation of the stakeholders proposed to participate in the implementation of the Action Plan.

Within each area, proposals for several measures are made. For each measure, there is a brief presentation of objectives, aims, status quo, activities, implementation, follow-up and time schedule. It is also intended to provide cost estimates and to rank the measures according to priority.

So far, the Plan of Action is still an internal document within CBM, the Swedish Board of Agriculture and the Farm Animal Genetic Council, who are continuously following the work and have approved of its outline in general and the proposals that have been made.

Looking ahead, the work will involve active and thorough discussions and cooperation with the various stakeholders in order to gain approval for and develop the proposed measures. Stakeholder involvement is the only way to ensure that the various measures become meaningful and the goals actually achieved. The idea is that the stakeholders become involved in the plan, which in this way becomes a truly national plan that is backed by all parties, and for which all parties feel responsible. There is a still lot of work to be done before the plan is complete and ready for implementation, but we are making headway.

Finally, it should be mentioned that in some areas, activities have already been established; and in others, activities are in preparation. However, our ambition is to do considerably more, seeing that there is a need. Hopefully, the Plan of Action will be a practical and efficient tool for the achievement of these goals.

The Icelandic leadersheep

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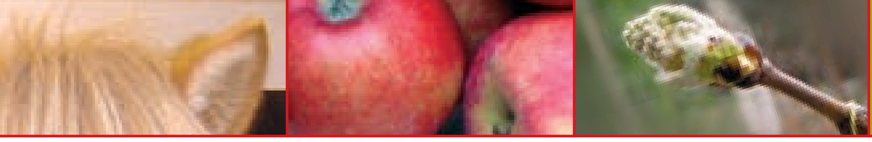
The only breed of sheep in Iceland is the native North-European short-tailed sheep brought to the country by the Nordic settlers over 1100 years ago .Without their sheep the Icelanders would not have survived throughout centuries of hardship on an isolated island just south of the Arctic Circle. In addition to the 455.00 winterfed sheep now kept in Iceland, overseas populations of the Iceland breed number some 45.000 and it is worth noting that the estimated total breeding population of Icelandic sheep, 500.000, appears to be more numerous than any other purebred population of North-European short-tailed sheep in the world at present.

Leadersheep, a unique strain within the Iceland breed possesses certain genetically based behavioural characteristics, confirmed last autumn by a preliminary joint study of the Leadersheep Society of Iceland (Ólafur R. Dýrmundsson), the Farmers Association of Iceland (Jón Vidar Jónmundsson) and the Agricultural University of Iceland (Emma Eythórsdóttir). Somehow this small population of sheep, now numbering only some 1000-1500 winterfed animals, evolved through selection in certain flocks, displaying outstanding behavioural abilities to aid the management of the flock at extensive range pastures, particularly during the wintergrazing period. The main characteristics of leadersheep are expressed by walking or running in front of the flock, even in very bad weather conditions, and they seem to be able to foresee or predict climatic events such as snowstorms.They are generally very alert and attentive and leadersheep clearly differ considerably from other sheep in many aspects of intelligence. This is in fact what they are bred for and it has been well established that the leading characteristics are not linked to sex, age, colour and other external traits. Neither are they caused by a single gene, rather a set of genes. Most of the leadersheep are coloured and horned, looking more like the primitive ancestors than modern Icelandic sheep mainly selected for meat production. Thus they have slender body conformation, long legs and bones, being normally of lighter weight than other Icelandic sheep. Both ewes and rams have strong sexual instincts and good reproductive performance, the ewes are excelent mothers and their lambs are normally very robust at birth.

Leadersheep are only kept on some Icelandic farms, normally in small numbers, even only one or two, and their distribution is facilitated by artificial insemination. Fortunately, steps were taken in the 1950s to conserve leadersheep and for nearly 50 years farmers have been able to obtain semen from leaderrams kept at AI centres. Leaderwethers are still kept in some flocks but this was more common in former times. Wintergrazing is now only practiced on a few farms due to dependence on indoor feeding and the leadersheep have lost one of their most important roles. However, these highly intelligent sheep may still have roles to play in flock management under extensive pastoral conditions. In fact, they can, for example, still be seen leading flocks of sheep being driven from the rangelands for sorting in September. Their alertness can perhaps help to protect flocks against predators and one can speculate on other possible uses of such genes in the future. Fortunately, there is considerable public interest in conserving the unique Icelandic leadersheep, partly due to the fact that no comparable sheep are found elsewhere in the world, but not least for cultural reasons and as a contribution to maintaining biodiversity.



Spruce Memory Enables Rapid Adaptation to Climate Change

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Global climate change can affect the geographic range of tree species. Species that mature late have long generation intervals. Spruces generally do not flower and set abundant seed until they are 20-40 years old. We wondered if the long generation interval could impede spruce's adaptation to the rapid increase in temperature we are currently witnessing.

Trees cannot hide from the cold in wintertime. Instead, millions of years of natural selection have enabled spruce to tolerate the prevailing natural conditions. Spruce trees notice that days get shorter in the autumn, and thus start preparing for winter. The gradual decline of temperatures in the fall stimulates the tree's cold tolerance. In spring, when temperatures rise and the days get longer, buds break. Growing shoots die of frost, and it is therefore important that trees grow when the frost risk is minimal. In autumn, spruce from higher altitudes or northern latitudes stop growing and start developing cold tolerance earlier and faster than trees grown from seeds produced in the lowlands or further south. These so-called provenances thus show different growth rhythms and frost hardiness dynamics, depending on the location of the seed trees.

We have shown that spruce regulates the period between growth and dormancy by remembering the conditions during embryo developing in the seed. If the embryo was formed at low temperatures, the tree will later synchronize growth as if it originated from northern latitudes or high-altitude forest. Cessation of growth and the development of hardiness will occur earlier than if the embryo had developed at higher temperatures in the lowlands or further south. Also, the buds break earlier in spring if seed development occurred at low temperatures. Such physiological changes can actually last for more than 20 years.

To test if plants can "remember" temperatures, we exposed cultured embryos to different temperatures. Such embryos can be produced in large numbers using a method called somatic embryogenesis. A seed's embryo is transferred to a growth medium containing certain plant hormones. After two months, large numbers of new embryos develop. Then other hormones are added, which stop cell division and inducs each embryo to further develop into small plants. This results in many new embryos, all of which are like the original one. All such embryos originating from the same seed are thus genetically identical, and are called clones.

Somatic embryos are able to remember the temperature that prevailed when they were developing in culture. Plants that developed under low ambient temperatures formed buds earlier in autumn, and started shoot growth earlier the following spring, equivalent to what is observed in provenances from northern latitudes and high-altitude regions. Embryos that were exposed to high temperatures developed into plants that showed the exact opposite reactions, even though they were genetically exactly identical. Thus, much of the variation between provenances must be due to a kind of memory that enables the rapid adaptation of progeny to the climate of the mother tree's site.

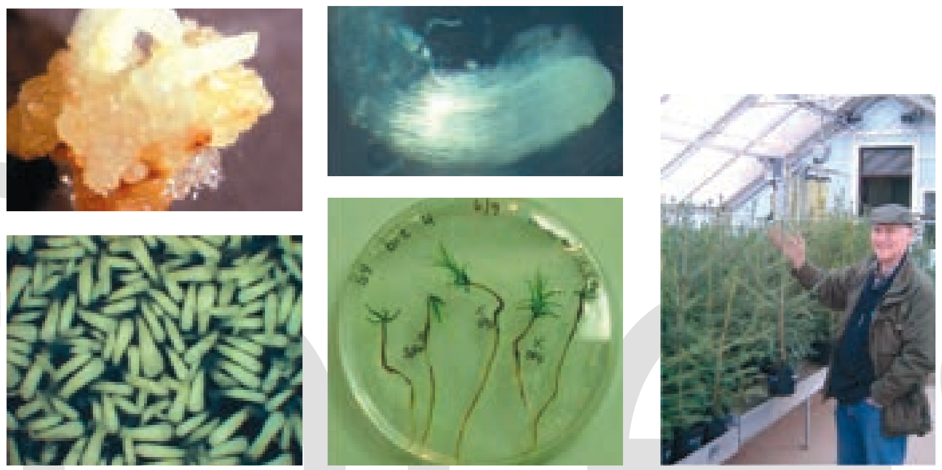

Figure captions
A. (upper left). Formation of embryogenic tissue (yellow arrow) on a zygotic embryo taken from spruce seed and cultivated in a growth medium. B. Close-up of a somatic embryo in the multiplication phase. C. Somatic embryos developing in a liquid medium. D. Plants on a germination medium. E. Two-year old spruce plants produced from somatic embryos.

Special Tree Forms – A Poorly Utilised Forest Genetic Resource

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Among the normal trees in our forests there are, as rare whims of nature, a variety of peculiar tree forms: golden and weeping spruces, dense dwarf spruces, pyramid pines, witches' broom pines, red and golden birches, cutleaf birches and alders. These special forms of our common tree species spruce, pine, birch and alder are often real rarities that are worth being protected in the same way as other rarities in nature.

The greatest variety of special tree forms is found in spruce. Many of these are perfectly suited as ornamentals, such as the golden spruce (Picea abies f. aurea) and the weeping spruce (Picea abies f. pendula) growing in the Haapastensyrjä special tree park.

CAUSED BY MUTATIONS

If you find a tree with characteristics that clearly deviate from the norm, and the differences cannot be explained by environmental or other external factors, the phenomenon is caused by a mutation in its genetic material. If the mutation has already occurred in the gametes prior to fertilisation, the change will be passed on to all cells and result in an altered genetic code. Examples of such mutations are the golden spruce and the cutleaf birch. However, if the mutation occurred in the buds, the change will be limited to that part of the tree, which is developed from the genetically altered buds. The witches' brooms found in spruce and pine are considered to be the results of bud mutations.

In its forest genetic register, the Finnish Forest Research Institute has records of 1300 individual trees that are genetic deviants of our native tree species. Many of these have also been conserved in clone archives, of which the best-known is the Haapastensyrjä special tree park in Loppis in southern Finland.

FROM GENETIC CONSERVATION TO UTILISATION OF GENETIC RESOURCES

Such divergent tree forms increase the genetic diversity of our forests. Although the effect of these special tree forms on the overall appearance or the genetic structure of the forest may not be significant, they are nevertheless valuable as unusual deviants and should therefore be protected. Naturally occurring deviant forms should always be left in peace, as long as they for some reason are not directly threatened. In Finland, such whims of nature can also be reported to the forest genetic register. Furthermore, very rare forms can even be officially protected in accordance with the Nature Protection Act.

However, special tree forms can also be utilised. The curly birch is a widely known example of such a peculiarity. So far, the most common way to use special tree forms is as ornamental trees. The best-known forms used as ornamentals include weeping spruces, compact globe spruces, golden spruces and hardwoods such as red and cutleaf birches.

The utilisation of special tree forms usually requires vegetative propagation. In this way, the traits of the parent tree are passed on to the cloned offspring. Vegetative propagation includes the use of grafts, cuttings and tissue culture. When using seed propagation, it is not always possible to reproduce the traits of the mother tree, since the desired deviation often is recessive. However, one has managed to naturally reproduce globe spruces and cutleaf birches by seed propagation.

Tree nursery operators and landscape architects have already been interested in special tree forms for many years. However, the supply and demand of hardy and domestic special tree forms have not always been balanced. In Finland, as in the entire Nordic region, the market now demands the consistent and sustainable production of at least a small selection of decorative ornamental conifers. These could replace imports from Central Europe and would be suitable for use in parks, gardens and green spaces under the harsh Nordic conditions.