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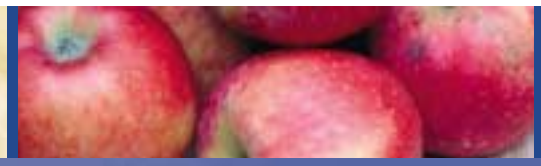


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A Safer Future for Nordic Genetic Diversity?

The Nordic activities within genetic resource management have now started on a new strategic period (2005-2008). In this period, we will jointly follow up several Nordic strategies that were revised and updated in 2004. However, action is needed to realise these visions. Reports and strategies alone will not save Nordic genes. Our efforts must be brought into the light by spreading stories about successful use of our genetic resources – stories that are abundant, but not well known. There are numerous good examples of Nordic genes that can be used for more than being stored in a freezer.

Following this winter's devastating storm in Sweden, it is being discussed if perhaps other tree species or provenances would have survived better than spruce, which had been planted extensively in the region. What about using our traditional vegetables in alternative ways? Many of these were once valued for their medicinal properties. Such knowledge has disappeared, but could perhaps be revived? The same applies to meat and milk quality: it has been shown that several of our traditional livestock breeds have unique genes, which provide the animals with specific qualities appreciated by consumers.

This year, the Danish chairmanship shall apply new insights, dynamics and cooperation to regard the Nordic region in a new era. With this issue of Nordic GENEresources, we also wish to present some of the diverse activities aimed at securing our genetic cultural heritage. While some people are utilising genes, others are freezing them and have developed data systems to enable the future use of these genetic resources.

For the first time, this year's issue of Nordic GENEresources includes articles from Estonia, Latvia and Lithuania. Our cooperation with these countries has changed somewhat after they have joined the EU. Perhaps, it is thus even more important to continue cooperation with the Baltic region, since we all are facing the same challenges.

On several occasions, the Nordic stakeholders within gene resource management of livestock, crops and forest trees have been asked to cooperate. The results of this cooperation include this magazine, M@ngfold, and recently, a joint Internet portal and joint Email addresses. We are also considering the potential for cooperation on various projects, the fruits of which presumably will ripen during 2005. This summer, forest seed will be added to the accessions of the Nordic Gene Bank for the first time ever. Hopefully, our Nordic interdisciplinary cooperation will set an example for other national and international parties to follow. We are optimistic that the future of our Nordic genes will be a safer one.

Ås 15 May 2005
Liv Lønne Dille
Editor

Setting the Standard: Nordic Cooperation on Genetic Resource Management

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Nordic cooperation has many aspects. We cooperate to learn from each other, inspire each other and jointly increase our knowledge and develop our views – all within the common framework of a Nordic spirit of friendship. However, within the field of genetic resources, Nordic cooperation has come even further – we have jointly committed ourselves to securing the management of genetic resources in our gene banks.

Genetic diversity of wild and domestic genetic resources affects the appearance of a landscape and its environmental qualities, nature conservation and food security, as well as the income potential in agriculture and the fisheries. At the same time, genetic diversity is the raw material of plant and animal breeders, and is a vital basis for global food supply and therewith for the existence of humanity.

As a result of these insights, there has been an increasing international focus on the conservation of biodiversity, expressed by such agreements as the Convention on Biodiversity and FAO's International Treaty on Plant Genetic Resources (IT-PGRFA), both committing member states to the conservation of genetic resources. In addition, the FAO initiated a process to evaluate if farm animal and forest genetic resources should be regulated in the same way as plant genetic resources are in the IT-PGFRA. So far, the question of whether such a regulation is appropriate is still an issue of debate.

"Nordic benefit"

Under the Nordic Council of Ministers, we have the Nordic Gene Bank (NGB) in Sweden, in charge of managing plant genetic resources; the Nordic Gene Bank Farm Animals in Norway, and the Nordic Council for Forest Reproductive Material, a flexibly organised network for exchange of information and experience in the forestry sector.

Nordic cooperation on genetic resource management contributes directly to the fulfilment of each Nordic country's international commitments regarding the conservation of biodiversity. Via NGB, the Nordic countries jointly solve challenges, which otherwise would require more funds if each country were to accomplish these issues on their own. Thus, NGB is a very clear example of "Nordic benefit". Gene bank cooperation also helps to achieve other

PHOTO: VERA GJERSØE

The Nordic Gene Bank operates safety storage facilities in an old coal mine on Svalbard. The storage facilities lie within the permafrost zone, with constant temperatures of about –4°C.

PHOTO: VIJAL JADAV

objectives of Nordic cooperation – such as knowledge sharing, mutual inspiration, etc.

In the field of genetic resource management, one should preferably look for other areas, in which we in a similar way could find common solutions. In general, we should systematically assess our challenges – which ones can be best solved nationally, and which of them are best tackled at a joint Nordic level, i.e., where is the greatest degree of Nordic benefit possible? By now, there are national programmes for the conservation of genetic resources in more or less all Nordic countries. Obviously, one could start by screening these programmes for areas within which cooperation could benefit all or some of the Nordic countries. Not only the tasks to be carried out by the ”gene banks” should be considered, but also such issues as joint research, on the basis of agreements on dividing responsibilities in order to rationalise the efforts and funds invested by each country.

Safety storage on Svalbard

At the latest meeting of FAO’s Commission for Genetic Resources in November 2004, Norway presented a very generous offer to the international community. Norway offered to put facilities on the Arctic archipelago of Svalbard at the disposal of gene banks throughout the world, for the storage of backup accessions of plant genetic resources. This offer evoked lots of sympathy and excitement among the participating countries.

In its explanation for this initiative, Norway emphasised the importance of conserving plant genetic resources in order to maintain global food security. Furthermore, the storage facility will represent additional safety, especially with regard to gene banks that are exposed to natural disasters or destabilised social conditions.

Norway will present its plans for such storage facilities at the next meeting of the Genetic Resource Council. There, one should obviously also start discussions on possible synergies between the operation of the new, international safety-storage facilities and the ongoing Nordic cooperation on conservation of genetic resources.

Spread the news!

When colleagues from other countries hear about our Nordic cooperation on genetic resource management, they are impressed that we are able to cooperate within the entire region on the conservation of genetic resources. Other countries and regions could also benefit from our experiences. We should thus put in an extra effort to spread the news about Nordic cooperation – nothing better than if other countries become inspired by our organisational model.

Sustainable Livestock Breeding – Food Security and Safety

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Food security is more than a concern over the availability of adequate amounts of food for our population. This simple definition is unsatisfactory because food security must be concerned about providing, in the recommended amounts, the wide range of nutrients that are considered important for the fitness and health of the population.

Quantity, quality and safety

Moreover this concern goes naturally beyond providing the necessary nutrients in forms that meet our food preferences, to keeping out of our food the array of toxins or other agents that are considered to pose risks to human health. Thus it is a short step from quantity to quality, and from quality to safety, and in its widest sense, which is the sense recognised by FAO, food security embraces all these meanings: quantity, quality and safety. Historically, livestock breeding has been much concerned with improvements in the quantity aspect of security. This has in many cases been achieved through increasing inputs to achieve greater food outputs. More recently, there has been a greater awareness of the environmental impacts of agriculture, and the need to integrate livestock production with environmental management, both in the developed and developing world. Therefore, whilst the forecasts indicate an increase in the global demand of livestock products, there will be requirements for this demand to be met whilst considering the full range of inputs and outputs, considering not only the outputs used for human food, but also the outputs of waste products. This trend will be particularly strong in Europe where food security measured by quantity has long been achieved, and the demand for livestock products is unlikely to change greatly in the future, and where policies on the environment have relatively high priorities.

This challenge to livestock breeders over providing quantity whilst simultaneously minimising the environmental impact is made much more complex by the demands for quality and safety. Throughout the EU and Nordic countries, the question is posed - how can we minimise the risks from zoonoses, such as salmonella, E. coli, potential zoonoses such as bovine TB, or para-tuberculosis, and other transmissible disease agents such as BSE? With reductions in subsidies, and with large rises in the cost of long-distance transport unlikely, local producers will need to compete on the added value from quality, either quality of the product or qualities associated with the brand e.g. regional associations, or perhaps welfare standards, or perhaps a breed.

Why change objectives?

It is reasonable to ask whether livestock breeding needs to change to achieve the desired outcomes, and whether or not the complicating factors could be easily dealt with by other development strategies: why change objectives, why change methods of testing and selection? The general answer is that livestock development works best if all the strategies are co-ordinated and working in the same direction. For example, fertility in dairy cattle tends to decrease as milk yield increases, and an established consequence of infertility is an increase in greenhouse gas emissions from the production system per litre of milk produced; the effectiveness of any management solution will be compromised if selections are made to increase yields without reference to the genetic merit for fertility and the overall utility of the system will not be optimised. What this argues for is the recognition that genetics can play important roles, more important in some issues than others, but in all cases it is important to have an informed view of the dynamics of the populations caused by the genetic selection and to use genetic options, where they exist, as part of the solution. Therefore what can be done to allow livestock breeding to play a positive role in meeting the future challenges? This is answered below in the context of quantity and safety; the challenges related to quality will either have similarities to those of quantity or safety.

Sustainable breeding

Firstly let us examine the issue of quantity. Sustainable livestock breeding will need to address how best to

PHOTO: VERA GJERSØE

advance or maintain the quantity of products whilst restricting the environmental footprint of the system as a whole. There are at least 3 complimentary approaches that can be advanced with current technology. (A) Information collected from the production environment can be used more directly in genetic evaluations, avoiding reliance on data from elite herds where constraints on inputs and waste management may be more easily overcome. Depending on species, this may be done routinely or periodically to assess genotype by environment interactions on both fitness and performance. (B) Where quantifiable information on constraints faced by individual herds/flocks is available (e.g. a nitrogen budget), these can be built into genetic evaluation using models called reaction norms. In these models the genetic merit is related to the environmental constraint, and selections can then be made to maximise merit at the appropriate level of the constraint for the farm. (C) Review the weighting on traits that are currently evaluated in relation to their potential for wastage, e.g. longevity in dairy cattle, since longer-lived cows require less frequent replacements. This is favourable for reducing the environmental impact, allowing quantity to be optimised in a procedure that accounts for the environmental impact. Whilst these options are aimed at the developed world, they apply equally to the developing world: select breeds and individuals in relation to their potential for lifetime productivity in the production environment, not on the yield of primary products in unrepresentative environments.

With only a few notable exceptions, food safety has not been a major component of livestock breeding objectives, mainly because the relevance of the one to the other has not been clear. However the heightened awareness surrounding zoonoses has provided fresh impetus to breeding for disease resistance, both in research and in practice. For example, in the EU there are major initiatives to eradicate alleles that confer susceptibility to scrapie in sheep – not because scrapie itself is transmissible, but to simplify the monitoring of spongiform encephalopathies that could be transmissible (such as BSE). What limits progress in our livestock in relation to zoonoses is the difficulty of obtaining sufficient data to make reliable conclusions on how to breed for resistance. Thus databases on the incidence of zoonoses and possible zoonoses need to be designed to allow genetic information on the livestock to be extracted. In its simplest form this information is the pedigree (even just the sire), but as DNA technology advances and researchers and breeders start to talk about genotypes at € 0.01 each, we are at the stage where surveillance systems should routinely include sampling livestock disease casualties for DNA typing together with some controls.

In conclusion, meeting the challenges to food security arising from the increased global demand and the threats from global warming, will need livestock breeding as a component of the solution. Livestock breeding can evolve in a sustainable way to meet such challenges, helped by a new generation of breeding technologies ranging from evaluation models to DNA typing methods. The opportunities they provide may be far reaching if the infrastructure for gathering data allows the best use to be made of them.

A Rather Special Cattle Breed

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Meat tenderness is clearly the most important palatability attribute for consumers. However, inconsistent meat tenderness has been identified as the major cause of consumer dissatisfaction with beef worldwide. In 2002, the Department of Animal and Aquacultural Sciences at UMB and the Norwegian Food Research Institute (Matforsk) jointly carried out a project to study hereditary variation of tenderness in Norwegian beef. At the same time, the breed association for Sided Trønder and Nordland Cattle (STN) and the Norwegian Food Branding Foundation (Matmerk) wished to conduct an objective study of tenderness in the STN breed, following positive market feedback regarding the meat quality of the breed.

Less systematic breeding

From a scientific viewpoint, STN is valuable in investigations of genetic factors that affect beef quality, since the breed in past decades has not been systematically bred in the same way as Norwegian Red (NRF) and various beef breeds. Numerous studies have shown that Jersey, a small-sized dairy breed, has more tender meat with finer muscle fibres and a higher content of intramuscular fat than many other cattle breeds. It was thus interesting to see if the same applies to STN. Similar meat quality characteristics may also be found in other old Norwegian cattle breeds, but only STN was included in this study. Data were collected from 17 animals from various farms, slaughterhouses and slaughter times. After ageing for seven days, one filet was used to analyse the following parameters: intramuscular fat, colour and Warner-Bratzler (WB) shear force measurements (the higher the WB values, the tougher the meat), whereas another filet was used to analyse tenderness using sensory evaluation.

PHOTO: VERA GJERSØE

In the study, meat from 82 % of the STN animals was classified as tender or very tender. In addition to the high percentage of tender meat, it was also surprising that the WB figures were so consistent, especially since there were considerable variations regarding the animals' age and weight, herd and slaughter conditions, as well as slaughter time. All of these factors normally affect tenderness. It is common to find much greater variation in WB-determined tenderness than was the case in this study, e.g., as shown in preliminary results from an ongoing project on genetics and tenderness in NRF bulls. Thus, one could have expected the same degree of variation of meat tenderness in the samples from the STN breed. The results of the WB analysis were also confirmed by the results of the sensory evaluation.

Muscle characteristics enable tender meat

The results indicate that STN may have biochemical muscle characteristics that are extremely favourable for giving tender meat. One possibility could be that STN has one or several gene variants that strongly affect tenderness (e.g., natural tenderising enzymes), which additionally may have been fixed in the STN population. However, these are merely qualified speculations, and more comprehensive studies are needed before we are able to make more reliable statements.

This trial was conducted on a limited number of STN animals. One should thus take care not to draw too far-reaching conclusions on the basis of the results, which may also be due to 'favourable' coincidences. However, the trial has not been able to disprove the positive indications that have been frequently submitted regarding this breed's excellent meat. The results are so promising that it is desirable to extend this work in a more extensive study of the STN breed. In such a study, one should focus more intensively on the breed's muscle characteristics, and test between-breed differences with regard to genetic factors that affect beef tenderness.

PHOTO: BIRGIR ENNI

The Man and the Sea

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Even though all Nordic countries have close ties to the sea, hardly anyone has been so profoundly influenced by the sea as the inhabitants of the Faroe Islands. With the advance of modern times these ties have been weakened. Recently, however, a number of people have started to revive old maritime traditions, but perhaps none as persistently and convincingly as Birgir Enni from Suderöya, the southernmost island of the Faroese archipelago.

Versatile – just like the weather

The weather on the Faroes is known to be rather «versatile» – and one could say the same of Birgir Enni. He is co-owner, captain, crew, tourist guide and cook on the Norðlýsið («Northern Lights»), the 60 year-old schooner forming the hub of his multi-faceted commitment to spreading knowledge about the wealth and diversity of the Faroese maritime resources.

In the summer, the Norðlýsið goes on daily cruises with up to 50 passengers at a time. Birgir takes his guests on fishing or diving trips, out to the bird cliffs or one of the many sea caves on the islands. The highlight of these cruises, however, takes place below deck – in the ship's galley. At the end of most trips, an elaborate meal is served, and naturally, seafood is always the main dish. For Birgir, the cruises are not only about presenting Faroese nature and culture, he also wants to show that the sea contains a large variety of food – healthy, unpolluted and tasty ingredients.

Worked his way up

Birgir Enni's story is like a Nordic version of the «American dream». As a young man, Birgir started way at the bottom, with professional training as a commercial diver. For 30 years, he conducted underwater work on docks and harbours throughout the entire Nordic region. Birgir spent countless hours in the sea, and gradually discovered the unused resources just off the Faroese coast: schools of countless fish, vast kelp forests and a diversity of shellfish.

He realised that he would have to surface from the deep in order to tell others about what he had seen. Together with nine equally-minded persons, Birgir bought an old, worn-down schooner. He says it was 'an old dream', and eventually, the boat was in «shipshape» and ready to receive passengers. The Norðlýsið adventure started to take form.

Food is culture

When Birgir talks about food, he does so not only as a cook, but also as a Faroese cultural ambassador. It is obvious that «food» means more to him than the meal itself. For Birgir, the choice of raw materials for a meal is also an issue of identity. And when you are Faroese, your identity is inseparably tied to the sea.

After a study trip to the Far East, Birgir began composing Asian Sushi and Wok dishes, but using Nordic crabs, sea urchins, cod, wolffish and seaweed instead. One of his favourites is the horse mussel (*Modiolus modiolus*), the «big brother» of the blue mussel, earlier often used as fishing bait. Horse mussels grow well in the strong ocean currents along the Faroese coast, and once on Birgir's boat, they are transformed into a variety of haute cuisine dishes.

Beyond doubt, this approach has been successful. Birgir has acquired a reputation as the man «who taught the Faroese how to eat fish again». Even though he has served dinner to Denmark's Crown Prince as well as the country's Prime Minister, it obviously means even more to him that the Faroese people have started to appreciate his efforts.

Creative genetic resources

In other words, it takes a lot of creativity to utilise marine resources from a group of islands far to the North, and even more so, to pass this knowledge on to people in other countries far away from home. But all of this does not seem to be a problem for Birgir, who says that a kind of «creative enthusiasm» is what inspires him and keeps him going.

In connection with the efforts aimed at the conservation of genetic resources in the Nordic countries, we usually discuss livestock, crops, fish and trees. For some reason, we never mention people, who beyond doubt also represent an important genetic resource – perhaps the most important. People like Birgir Enni from the Faroe Islands, however, are solid proof that the Nordic countries have quite a lot to offer.

Conservation and Sustainable Use of Animal Genetic Resources in the Baltics

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The production systems in Baltic countries have gone through different stages in their development. Up to the post-war period, until about 1947, small-scale production on small family farms dominated. During the following period great changes took place. The small family farms were dissolved and the large-scale collective farms (kolhozes) and state farms (sovkhozes) were established. The introduction of market economy in the Baltics in 1990 resulted in a rapid transformation of the public sector into a private sector in agriculture. The breakdown and ownership changes of state and cooperative farms led to a dramatic decrease of the Baltic livestock population. Due to a liberal market and dumping prices, a lot of farms founded in the early 1990s have stopped farming and currently there is a tendency to form larger farms again, breeding animals of modern, high-yielding breeds. As a result, native farm animal genetic resources are being lost.

State of farm animal biodiversity

Several breeds are kept within each species, although the contribution of some of them to the total population is very low. The native Baltic farm animal breeds are low in number and most of them are endangered (Table 1). The common species of farm animals in Baltic countries are cattle, pigs, sheep, horses, poultry and goats. At present, there are 12 local breeds in Estonia, 13 in Lithuania and 7 in Latvia. Active import of breeds or exotic species started in the mid 1990s - beef cattle breeds, horses of warm-blooded breeds and ponies and reindeer. During the last years, ostrich farms have become very popular, and the ostrich population is steadily increasing in Estonia and Lithuania.

World-wide trends can be followed in the Baltics, as well. The introduction of more profitable breeds has influenced the share of native breeds – e.g., the share of the Estonian Red cattle breed was 68 % in 1964, yet by the end of 2003, the breed accounted for only 25.9 % of the total number of cows in the milk recording scheme. During the same period, the share of Estonian Black-and-White/Estonian Holstein has increased from 32 to 73.6 %. The number of purebred Holstein cattle in Lithuania is constantly increasing. Lithuanian Black and White cattle are crossbred with Holstein cattle. Currently, bulls used in Lithuania have an average of 70 % Holstein genes. The situation makes the conservation of the old type genetic pool of these breeds very difficult.

At present, horses are mainly used for leisure time activities. The role and importance of horses in family recreation, agro-tourism, hippotherapy, sports, and landscape management is increasing. The number of Estonian native horses has been increasing since 1995 due to implementation of State support to this breed. The successful conservation programmes resulted in stabilizing and even increasing the Zemaitukai and large type Zemaitukai horse population size over the last years in

Table 1. Local farm animal breeds in Estonia, Lithuania and Latvia

Species	Estonian Breeds	Lithuanian Breeds	Latvian Breeds
Cattle	Estonian Red	Lithuanian Red	Latvian Brown
	Estonian Holstein	Lithuanian Black and White	Latvian Blue*
	Estonian Native*	Lithuanian Whitebacked*	
		Lithuanian Grey*	
Pigs	Estonian Landrace	Lithuanian Native*	Latvian Landrace*
	Estonian Large White	Lithuanian White	Latvian White
Horses	Estonian Native*	Zemaitukai*	Latvian Heavy Draught*
	Estonian Heavy Draught*	Large type Zemaitukai*	
	Tori*	Lithuanian Heavy Draught*	
Sheep	Estonian Blackhead	Lithuanian Blackhead	Latvian Darkhead
	Estonian Whitehead	Lithuanian Coarsewool*	
Goats	Estonian local goat	Lithuanian local goat	Latvian native goat
Poultry	Estonian quail*	Lithuanian vistines geese*	

* - *endangered*

PHOTO: L. BATRENAITE

PHOTO: H. VIINALASS

PHOTO: L. BATRENAITE

Lithuania. The Latvian Heavy Draught horse breed is in a different situation – there is no demand for it in local or foreign markets. Due to that, the horses are low-priced and of no interest for farmers. Western European horse breeds are used for breed improvement and there is a risk of loosing the gene pool of the Latvian Heavy Draught horse.

The Lithuanian native pig is also at risk, due to an extremely small population. There are attempts to establish new herds for breed conservation, as currently the pigs are kept only in a single herd.

Regarding sheep, the Lithuanian Blackhead, Latvian Darkhead, Estonian Whitehead and Estonian Blackhead breeds are not endangered, contrary to the Lithuanian Coarsewool. As there is no market demand for wool, all sheep breeds are improved for meat quality, except for Lithuanian Coarsewool, which because of its unique phenotype has found a place in agro-tourism.

State of conservation of farm animal diversity

Genetic diversity of farm animals in the Baltic countries is conserved in various ways: *in situ* and *ex situ* conservation of indigenous breeds and conservation by development and sustainable use of active breeds. The best guarantee for conserving and maintaining farm animal genetic resources is to use them. An increasing number of breeds that were formerly of primary importance for food production can now only be conserved if the animals fulfill different functions or if they are supported by *in situ* or *ex situ* conservation programs. Better marketing of specific products obtained from native breeds provides another possibility of increasing profitability of their production. It seems necessary to find alternative utililization of some native breeds, e.g., in landscape management services or in agro-tourism. In Lithuania during the last few years, the agro tourism sector showed a lot of interest in keeping the Zemaitukai horse breed, the Lithuanian Coarsewool sheep, and the vistines goose.

All Baltic countries initiated AnGR activities quite long ago and have established respective structures, such as animal genetic resource committes, National AnGR coordinators, etc. Today AnGR activities are integrated in national strategies for farm animal genetic resource conservation. The conservation of endangered breeds is supported by the national governments. Due to the state support the number of animals of endangered breeds in increasing.

State of dissemination of information about AnGR

In recent years, a lot of attention has been paid in the Baltic countries to raising public awareness and to the problems related to management and conservation of genetic resources. Every year, several exhibitions and shows have been organised to present farm animals to the public. Most of them have become traditions, like “Breeding Animals”, “Agricultural Exhibition”, “Farm Days” in Estonia, “Agrobalt” and “Breeding Animals“ in Lithuania. These exhibitions and shows are very popular. To raise public awareness, two films about Estonian Native horses and one about Estonian Native cattle were released. Since 2003, a journal “Our Own Horse” has been published by the Estonian Native Horse Conservation Society. The teaching course “Farm Animal Genetic Resources” was introduced for students at the Lithuanian Veterinary Academy and the Estonian Agricultural University. Various national and international seminars, workshops, and conferences are constantly being organized.

The Lithuanian, Latvian and Estonian farm animal breeds have been included in several international research projects for their genetic evaluation and genetic distancing of breeds - Origin and Diversity of North European Sheep Breeds, Analysis and Comparison of Genetic Diversity in Cattle Breeds of the Northern European Area.

Future demands and trends

Social, economic and environmental factors have always influenced the use and diversity of AnGR and undoubtely will continue to do so in the future. Joining the EU enlarged potential markets for the Baltic countries, but also generated more competitivness in the region’s agricultural environment. This will accelerate trends favouring the breeds that are economically most efficient and thus negatively affect animal genetic diversity. However, there will also be opportunities to find market niches for specific species or breed products if good marketing systems are developed. European agricultural policy has direct and indirect consequences for the conservation, development and use of animal genetic resources in the Baltic countries. The recently introduced EU subsidies for endangered native breeds could influence the number of animals.

Angelica: 1000 Years of Cultivation

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Angelica (*Angelica archangelica* L.) is our oldest cultivated plant of Nordic origin, and used to be an important food and medicinal plant. It has deep roots in Norway's cultural history, and was already mentioned in the Norse sagas and in Norway's oldest provincial law, the Gulatingslov. Angelica was at times an important export commodity, and is perhaps the only Nordic contribution to international medicine and vegetable cultivation. The plant is the origin of numerous Norwegian place names.

Angelica belongs to the Umbelliferae family, and grows naturally throughout the entire Nordic region. There are two subspecies: the one discussed in this article is *A. archangelica* ssp. *archangelica*, in Norway called 'mountain angelica' (fjellkvann). This is an Arctic alpine species found throughout Scandinavia, as far east as Siberia, and on Greenland and Iceland. It also occurs in the mountains of central Europe, but in those regions, the plant was traditionally not used. The other, *A. a.* ssp. *litoralis*, called 'coast angelica' (strandkvann) in Norway, grows along the entire Norwegian coast and along the Baltic Sea. The coastal subspecies is smaller and quite bitter, and has almost never been used. The plant can grow and develop for several years, thus gathering strength before flowering. Depending on site conditions and nutrient supply, this can take from two to seven years. After flowering and seed maturity, the plant dies. It prefers moist soil, and is often found along streams and rivers. In the Nordic countries, angelica is called kvan (in Danish), väinönputki (Finnish), hvönn (Icelandic), kvann (Norwegian) and kvanne (Swedish). In each language, numerous synonyms are found.

Use

Mountain farmers and hunters have always been collecting and using wild angelica. Eventually, angelica plantations were established on mountain farms and alpine summer dairy farms, thus facilitating access to the plant. This was obviously a rather common practice, since old Norwegian and Icelandic laws mention that those who walked through someone else's *kvanngard* (angelica plantation) should be punished.

We know that angelica stems were a common trade commodity in Norway as early as 900 AD. Snorre's saga of the kings mentions that Olav Trygvason bought large angelica stems on the market in Trondheim to please his Danish queen Tyra – without being too successful. At times, the authorities ordered farmers to grow angelica, and such plantations have been in use until recently, mainly on mountain summer farms in the area around Voss in western Norway. Angelica and turnips were probably major food plants until as late as the 19th century, when they were replaced by rhubarb and numerous new vegetable types.

The coastal subspecies was also an important source of food for the Sami, as described by Linné in his report of his travels throughout Lapland in 1732. The Sami used the plant fresh and preserved in reindeer milk.

Export

Angelica is one of the few Nordic plants that has been

PHOTO: EVEN BRATBERG

The coastal subspecies A. archangelica ssp. litoralis.

PHOTO: EVEN BRATBERG

Her Majesty Queen Sonja planting angelica, assisted by Jon Fløistad of the Norwegian Garden Society. Looking on is Lars Sponheim, Norway's Minister of Food and Agriculture.

PHOTO: EVEN BRATBERG

Angelica is used to flavour several monastery liquors, but also such light liquors as gin.

spread southwards. Already in the 12th century, Iceland exported angelica. It is assumed that the Vikings had the plant along on their voyages to Ireland, Shetland and other places they raided. Another story goes that when Hans Egede came to Greenland, the word 'kvann' was one of the few Norse words he discovered in the Inuit language.

With Christianity came the monks, who started to use angelica and took the plant back to central Europe. In the 16th century, angelica was actually a common means of payment, and an important export commodity from Norway and Sweden to southern Europe, where it eventually became a popular vegetable and medicinal plant.

The reason for angelica's tremendous popularity and widespread use is the entire plant's content of essential oils. These oils are especially concentrated in the roots and seeds, and give the plant its characteristic spicy aroma and taste. Roots, leaf stalks and the stem were eaten raw as a vegetable, preferably young shoots that had been peeled. Angelica was also harvested and dried for various uses throughout the winter.

Medicinal plant

The plant's unusual Latin name is derived from a legend, which states that an archangel (Greek: archangelica) revealed to a monk that angelica was a miracle cure against the plague. At the time, Europe was riddled by diseases, and angelica became an important medicinal plant. According to popular medicine, the plant could not only cure the plague, but nearly any other disease as well. There was some element of truth in this, since angelica contains substances (especially angelicine) that stimulate the digestive system. Monks used the plant both as a vegetable and as a medicine. Thus, angelica was already in use all over Europe in the early Middle Ages.

Presumably, angelica was also cultivated in central and southern Europe. In 1740, Linné criticised Swedish pharmacists for using imported angelica, instead of domestically grown plants, which he also considered to be much better: "Nowhere does Archangelica grow so isolated and so lush as in the clear air of the Laplandic mountains".

Liquor

In the 16th century, the Benedictine monks started to use angelica to flavour liquor. Mainly, the roots and seeds were used, and thus the famous liquor D.O.M Bénédictine was created. In Norway, angelica is used as a flavouring in St. Hallvard, which has been produced since 1896. The monastery liquor Sankta Sunniva was introduced as late as 1991. It is named after Holy Sunniva from the monastery in Selje, and is also flavoured with angelica. Even gin contains angelica, along with juniper berries.

A regional variant

According to the Norwegian botanist Knut Fægri, there is an angelica variant in the area around Voss in western Norway with filled/massive stems and a sweeter, better taste. Botanists now believe that this is the result of the local farmers' continuous selection and cultivation. Fortunately, there are still a few people in and around Voss following up this tradition, thus helping to maintain the so-called Vossakvann population.

Norway's wild angelica population has been significantly reduced. The largest angelica population is now found on Iceland.

Commercial growing

Since angelica is extensively used for numerous purposes, the plant is commercially grown in many countries. In England, France and Spain, it is grown for its stems and roots; and in Belgium, Germany and Hungary, it is grown for extraction of essential oils. In Norway, there have been a few attempts at commercial

Germination of «Dead» Seeds

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When collecting seeds of heirloom varieties, either as the result of public mobilisation or through traditional collection, one often ends up with seeds of quite varying quality. Unfortunately, not all of the collected seed will be able to germinate, but with some patience, it is possible to activate germination in seemingly dead seeds.

Germination test

In many gene banks, germination tests are done by placing seeds on moist paper or sand for one to two weeks. After this period, the germination percentage is determined. It is generally known that more seeds germinate if one prolongs the incubation period beyond two weeks. At the same time, prolonging germination leads to problems with bacteria, fungi and yeasts, which are either found on the seed surface or within the seed. It was therefore necessary to inhibit or remove the seed-borne microorganisms. This was done by carefully sterilising the seed in order to destroy the harmful organisms on its surface. The microorganisms within the seed, however, cannot be destroyed without damaging the seed at the same time.

To inhibit the growth of these organisms, we chose as a growth medium to use a gel, to which a small amount of inorganic plant nutrients was added. Any microorganisms originating from inside the seed will grow faster on the surface of the gel than at the bottom. It is thus important to completely immerse the seeds in the gel. This also helps to keep the seeds moist during the prolonged germination period. To inhibit the growth of these organisms, we submerged seeds in a gel, which served as germination medium and support. Any microorganism originating from inside the seed will proliferate much slower than if grown on the surface of the medium. Simultaneously, the gel helps to keep the seeds moist during the extended germination period.

This method was first developed with seeds of the Danish turnip variety 'Milan Hvid Revita'. The Nordic Gene Bank received the seeds in 1997, and already then, a germination percentage of zero was measured. By applying the above-described method, we managed to germinate 15 out of 1000 seeds during a period of six months. Most of these sprouted after about 60 days. Some of the seedlings showed abnormal growth, and eight survived and grew into intact plants. These were vernalised, flowered and developed seeds. It was thus possible to save a vegetable variety, that otherwise would have become extinct. Similarly, an accession of the old Swedish winter rape variety 'Emil' was saved on the basis of 17 seed-producing plants. The method also functioned well with the meadow fescue variety 'Winge Pajbjerg'. Finally, we tried to germinate seeds of the old Swedish parsnip variety 'Tribut' in the same way. One out of 1000 seeds germinated after 6 months, after which the experiment was aborted.

PHOTO: GERT POULSEN

Abnormal seedling growth of a turnip, with small cotyledons and first true leaves.

Germination ability

According to some, seed longevity is genetically selective, so that some genotypes survive better than others. It would therefore be interesting to conduct genetic comparisons between the original accession and the regenerated, fully viable sample to see if any changes have occurred in the material's genetic traits during its regeneration. If the decline of a plant's germination ability has no effect, it would be most relevant to determine the minimum number of plants necessary to preserve the accession's genetic diversity.

Agar Gel based medium has been used to germinate submerged seeds with a low germination ability and seeds from gene bank accessions that have been kept too long without having been regenerated. The method should also be suitable for seeds with a generally low germination vigour, as well as for seeds of wild relatives. The latter often germinate poorly or unevenly since they have developed under natural conditions, which are not always optimal.

Our hypothesis was that the methods developed and used to test and secure the quality of viable, commercial seed are not necessarily suitable for old seeds or seeds that have developed under sub-optimal conditions. The hypothesis was confirmed in the illustrated examples. We therefore recommend to use the method when working with valuable plant genetic resources.

Regional Nordic-Baltic Database Cooperation

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The Nordic Gene Bank (NGB) is the centre for a distributed regional network on conservation and utilization of plant genetic resources (PGR) in the Nordic countries. The NGB working groups bring together crop experts from all Nordic countries. The new Nordic and Baltic national programs on biodiversity are also parts of this network. A central part of the conservation work is providing good documentation. One of the main priorities for the regional cooperation is the development of a common online information platform for plant genetic resources. The regional approach to documentation will reduce overall costs and improve documentation quality. The northern region shares many unique natural conditions, and thus a joint regional conservation strategy makes sense.

SESTO

To analyze PGR material and decide on the correct conservation strategy you need correct and complete data presented in a useful way. Most gene banks around the world have developed their own local documentation systems to meet these demands. SESTO, the regional gene bank documentation system, was developed at NGB. The application is now under expansion to serve the gene banks of the whole region. The main function of SESTO is management of data on the plant material conserved by the gene banks. The application is published online as a public-domain website. Please visit us at http://www.ngb.se/sesto/.

Cooperation

The Nordic Gene Bank has a long history of cooperation in PGR documentation between the Nordic (Denmark, Finland, Iceland, Norway and Sweden) and the Baltic countries (Estonia, Latvia and Lithuania). The collaboration started in 1994. NGB has received economic support from the Nordic Council of Ministers (NMR) for development of the regional database cooperation with Estonia, Latvia and Lithuania from the NMR program on the Nordic Regionís Adjacent Areas. The entry of the Baltic countries in the European Union has resulted in new opportunities for funding for the database cooperation. In many respects, our Nordic-Baltic region shares a common culture and common economic interests, and should be well in line with the strategy of the EU for promoting regional activities.

The EU regional strategy called the 'The Northern Dimension' also includes Russia (particularly Northwest Russia) in addition to the Nordic and Baltic countries. The experiences from the Nordic-Baltic database cooperation are useful and interesting if the regional cooperation on gene bank documentation is going to be extended further to include Northwest Russia. The Vavilov Institute (VIR) in St Petersburg has attended all the training workshops at Alnarp and has also been active in the discussions on developing the regional SESTO system. The VIR germplasm collection is however more than 10 times the size of the NGB collection. The huge size of the corresponding dataset has turned out to be a challenge for implementation of SESTO at VIR, but work is in progress to find robust solutions.

PHOTO: LOTTE HASSING POVLSEN

Onion Growing in Finland

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Nowadays, growing and using various types of onions is so widespread, that it is hard to understand why the cultivation of this crop developed so slowly in Finland. The earliest written documents mentioning onions date back to the 16th century, but common cultivation and use did not start until the late 18th century. To begin with, onions were used as medicinal plants, since they were introduced to our country by monks, as were many other cultivated plants. Onions were not used as a basic food commodity until people started using other vegetables than turnips together with bread, meat and fish. At first, vegetables were mainly grown on large farm estates, parish farms and in the gardens of wealthy city dwellers. Eventually, poorer people also began growing vegetables, which represented a nutritious supplement to their previous, rather monotonous fare.

Onions (*Allium spp.*) are among the most versatile and useful of our vegetables. The genus consists of more than 500 species.

All onion species have a strong, spicy flavour, partly due to their contents of various sulphur compounds. In some species, also the leaves can be used as food, and in certain cases, the leaves themselves are the desirable part of the plant. Onions improve the taste of many foods, and enhance the flavour of other ingredients. Today, there is also a lot of focus on the medicinal qualities of onions. Garlic, for example, has an antibiotic effect, and bulb onions, especially the red and yellow-coloured varieties, contain numerous flavenoids, which function as antioxidants.

The versatile onion

The species *Allium cepa* contains many different groups of commercially successful onions. The most important is the bulb onion (*Allium cepa L. Cepa* group), one of the most common commercially grown field vegetables in Finland. In 2003, it accounted for 11 % of the total production of field vegetables in Finland. There is a wide range of different bulb onions, with varying demands to growing conditions and cultivation methods. They also differ with regard to texture and taste. The varieties making up the red onions also belong to the Cepa group, but have a distinctive red flesh.

The potato (or multiplier) onion (*Allium cepa* L. *Aggregatum* group) and shallots (*Allium cepa* L. *Ascalonicum* group) are smaller and spicier than bulb onions. The potato onion was traditionally grown in northern and eastern Finland, and was the most important commercial onion in Finland until the 1950s, when it was replaced by the bulb onion as the country's number one onion. The strains used in production gave poor yields and propagating material was infested with diseases. The potato onion is still being grown for home use, mainly in northern Finland.

The potato onion is easy to grow and keeps well throughout the winter at room temperature. It is therefore popular among home growers, even though it can be difficult to find good, local onion sets. There are many different potato onion strains, with different taste, skin colour, bulb shape and yield. The onion's mother bulb divides during growth, and can form a cluster of up to 15 new bulbs, depending on variety and mother bulb. The same is true for shallots. Some of the Finnish potato onion strains are seemingly crosses between shallots and potato onions.

Pickling onion, silver onion, giant onion and green onion all belong to the same group of onions. These are commonly used, but are cultivated on a lesser scale in Finland.

Demanding leeks

Leeks (*Allium porrum* L.), which are distinctly different than the bulb onion described above, are rather difficult to grow in Finland. The extent of commercial leek production has decreased due to the crop's long growing season and high costs. Nevertheless, there is still a relatively large area of commercial leek production. Leeks have a mild taste, and the plant's leaves and its stem can be used as food. Leek stems can be blanched by ridging. Leeks require fertile soil and a fair amount of warmth, but on the other hand, are not sensitive to low temperatures in autumn. Leeks can be harvested after the onset of autumn frosts.

Chives grow wild in Finland, and are a common sight in many household gardens.

PHOTO: TERHI SUOJALA-AHLFORS

Due to their mild taste, leeks are extremely versatile as a food ingredient. They can be eaten both raw and cooked, and are also easy to dry or freeze.

Healthy onions

Garlic (*Allium sativum L.*) is a widely grown crop, although only few growers produce garlic on a large scale. Of all onion types, garlic – with its strong taste and odour – is surely the one most strongly associated with being healthy. It is generally considered that garlic cures ear aches and colds, and increases our resistance to disease.

Chives (*Allium schoenoprasum L.*) grow wild in Finland's coastal areas. Commercially, chives are field-grown on a small scale, whereas Finnish greenhouse chives are marketed throughout the year. Its taste is milder and the leaves more tender than of field-grown onions, but chives are a good supplement to our winter diet. Clumps of chives can be found in nearly every garden, and chives are an inseparable part of any summer meal in Finland.

Chives are perennial, and form clumps that increase in size from year to year. Shoots come up as soon as the spring warmth sets in. Chives can be propagated by dividing clumps or from seed.

In addition to the already mentioned onion species, garlic chives (*Allium tuberosum* Sprengel) and Japanese bunching (or Welsh) onions (*Allium fistulosum* L.) can also be grown in Finland. However, these species are grown to a much lesser extent, usually as pre-packaged bunching onions under the name green onions.

There is thus a wide variety of onions, that can be grown to satisfy all kinds of food uses. However, the diversity of the genus *Allium* is not exhausted as a food plant, since it also contains many different flowering ornamentals, which spread their beauty every spring or early summer here in Finland.

PHOTO: HANNU KAIRIKKO

Traditional potato onion strains are kept at the Nordic Gene Bank.

Past, Present and Future of Estonian Forest Genetic Resources

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The first practical steps in the field of forest tree breeding in Estonia were taken in the mid-1950s. The guidelines for selection of plus trees were compiled, and after that the active fieldwork and phenotypic selection of high quality plus trees in Estonian forests started. Main emphasis was given to Scots pine (*Pinus sylvestris*), but altogether 10 tree species were included (Table1). The next step was collecting the scions and grafting, and in 1965 the first seed orchards in Estonia were established.

Table 1.
Number of selected plus trees in Estonia 1959-2002.

Scots pine - *Pinus sylvestris*	513
Norway spruce - *Picea abies*	200
Silver birch - *Betula pendula*	124
Curly birch - *B. pendula var. carelica*	6
European larch - *Larix decidua*	13
Black alder - *Alnus glutinosa*	73
Pedunculate oak - *Quercus robur*	21
Common ash - *Fraxinus excelsior*	12
Wych elm - *Ulmus glabra*	49
European white elm - *Ulmus laevis*	14
Norway maple - *Acer platanoides*	43
Total	**1068**

Establishment of field trials

The selection of plus trees was soon followed by the establishment of field trials. Altogether 92 ha of trials were established between 1959-1988. The most important species were Scots pine (524 trials, 51 hectares) and Norway spruce (16 trials, 41 hectares). These trials were used mainly to design the seed collection zones in Estonia. There are 4 zones for pine and 2 zones for spruce, and one zone for each of the other species. The zones are also used as the regions of provenances in the trade of forest reproductive material.

For gene conservation purposes, 10 strict genetic reserves for pine, spruce and birch were established in 1985. These reserves were maintained as strictly protected conservation areas until the mid-1990s, when the high age of the stands required a change in the policy. Specific management plans, including proper silvicultural measures, were created for each area, and the reserves were renamed as gene pool forests. In 2002, the total area of *in situ* -gene reserves was 2648 ha. These gene pool forests, as well as the seed orchards and plus trees will be checked at five years intervals, which will help to update the management plans.

Plus trees in seed orchards

In 2002, the selection of Scots pine seed collection stands was started to meet the demand of seed for the nurseries. Today, about 1200 hectares have been selected and the process continues. There is a plan for the establishment of seed collection stands also for Norway spruce, but so far it has not been necessary to implement the plan. In the future, seed orchards are planned for production of the seed used in the nurseries, and stand seed will then only be used in direct sowing.

Nearly two-thirds of the Estonian plus trees (Table 1) are represented in seed orchards or clonal archives. Most of the plus trees of deciduous species have been selected during the last decade. The trees from these new selections are not yet propagated and included in the seed orchards or clone archives. A project has been initiated to collect scions from the remaining plus trees in 2005 and 2006, and to establish some new seed orchards. According to the data of the last inventory the number of original plus trees yet to be collected is 330 trees from 8 species plus curly birch (Table 2).

Securing forest genetic resources

The total area of managed seed orchards is 201 hectares (Scots pine 168 ha and Norway spruce 33 ha). All active seed orchards, seed stands and gene pool forests are managed and owned by the State Forest Company (RMK). Also, most of the plus trees are located in state forests. The oldest seed orchards are now more than 35 years old and in need of regeneration. The increasing need for good quality

PHOTO: HEINO KALJURAND

seed for nurseries and the age of the orchard form the basis for new plans and activities.

A programme for securing a constant supply of high quality seed with good genotypes for forestry until 2030 was compiled in 2002. The plan sets the common goals for management and use of forest seeds and gene resources. The nurseries' entire seed supply should be provided by seed orchards by 2030. Seed from forest stand collections will cover the need for seed for direct sowing. Progeny testing of the selected plus trees will be carried out. The managed gene pool forests will be maintained for preserving original populations.

To achieve these goals, new seed orchards must be established, and the old ones managed as to extend their utilization time. Also, more seed collection stands need to be selected. A seed bank for securing the preservation populations in the gene pool forests will be established. The seed bank will also secure the supply of acceptable seed for regeneration in gene pool forests if natural regeneration is not possible.

Table 2.
Number of un-propagated plus trees in Estonia 2004.

Scots pine - *Pinus sylvestris*	112
Silver birch - *Betula pendula*	71
Curly birch - *B. pendula var. carelica*	6
Black alder - *Alnus glutinosa*	38
Pedunculate oak - *Quercus robur*	11
Common ash - *Fraxinus excelsior*	1
Wych elm - *Ulmus glabra*	49
European white elm - *Ulmus laevis*	14
Norway maple - *Acer platanoides*	28
Total	**330**

The Origin of Nordic Elms

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Sweden participated in a European joint project on the elm. Nine countries from northern to southern Europe collected material, conducted genetic analyses, established a number of elm archives throughout Europe, tested resistance to fungal attack and analysed recolonisation after the last ice age.

Dutch elm disease

The Dutch elm disease, a fungi spread by the elm bark beetle, has been devastating elm populations throughout the entire European continent. The disease often kills the trees, and since one is reluctant to replanting, the species is threatened. For this reason, the EU allocated funds to this elm project, in which Sweden participated via the National Board of Forestry.

Swedish-Norwegian collection

Interestingly, Sweden has Dutch elm disease-free areas. Such areas without the pathogen include the islands in the Baltic Sea, Öland, where the European white elm (*Ulmus laevis*) is found, and Gotland with populations of field (or smooth-leaved) elm (*Ulmus minor*). In the mountains of Jämtland (central Sweden) and Västerbotten residual populations of wych elm (*Ulmus glabra. var montana*) are found. This is considered to be very interesting, and thus material from these areas, as well as from healthy elms in Mälardalen and Skåne, is being collected for inclusion in the European elm-archive network. We also arranged to cooperate with Norway, and therewith received help in collecting reference material from North-Norwegian elms.

PHOTO: BJØRN RØRSLETT/NN/SAMFOTO

Planting gene archives

In the Swedish gene archive, we wanted to have identical individuals from our collected mother trees. For that reason, scions were used from elm trees that often were several hundred years old in order to graft and produce ”younger” shoots, which then were later propagated by cuttings. These cuttings were brought back to Sweden from Hessen in Germany, where they were produced, and planted in November 2004 on Tånnö Island in the Värnamo region in southern Sweden. This part of Sweden, the highlands of Småland, has a low frequency of the Dutch elm disease. Duplicates of our elms are kept in Germany, and in this way, all of the project’s archives have a ’back up’.

Testing

DNA analysis has shown that, even though they look quite different, the elms growing under the extreme conditions of the Swedish mountains are not a separate elm species, other than being wych elm (*Ulmus glabra*).

Furthermore, the sampling of the North-Norwegian elms and the work of tracing the origins of the elms back to the last glacial refugium have given interesting results. It was shown that the Norwegian elms originated in Spain and Portugal and migrated northwards via a westerly colonisation route across regions close to the Atlantic. In contrast, the Swedish mountain elms had their refugium in the Balkans, and thus colonised via southern Sweden after the ice age, and not from the west (Norway).

Next spring, our clones kept in Hessen, Germany, will be inoculated (infected) with Dutch elm disease to test the resistance of our elms. It would be very exciting if it is shown that the Swedish elms could be crossed with other elm populations, and thus contribute to increasing resistance to the devastating disease.

PHOTO: TOR MYKING

The Genetics of Yew – Quite Unique

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According to genetic theory, species consisting of small populations with limited exhange of pollen and seeds are more differentiated than tree species with a more continuous distribution range. In the Nordic region, yew (*Taxus baccata*) is a rare species with a scattered occurrence, thus being quite different from the common Nordic conifers, spruce and pine. However, to what degree are the yew's life history traits reflected in its genetic structure?

Distribution and ecology

Yew is widely found in the lowlands of moist coastal and fjord areas in southern Norway and southern Sweden. In Finland, yew grows on the islands of Åland, and in Denmark, the tree can be found in Jutland (see map). This geographic range reflects the tree's twofold demand for both mild winters and warm summers. Although yew tolerates some cold, it is very frost-sensitive. It can grow on poor soils, but there is little doubt that it prefers a well-structured, deep mould. In sum, these rather specific ecological requirements are the reason for the limited and scattered distribution of yew, occurring as many small, separate populations.

Its reproduction biology is also quite special. Yew is dioecious, meaning that male and female flowers occur on different trees. Thus, cross-pollination is secured, which may be vital for the maintenance of genetic diversity in small populations. Yew pollen is dispersed by wind, whereas the fruit – the red berries – is spread by birds. Furthermore, no other European tree species can become as old as yew. It is estimated that the trees can reach an age of close to 2000 years.

Genetics and species management

It is commonly known that the distribution pattern and the pollen and seed dispersal ability of a tree species affect its genetic variation. Researchers at Skogforsk in Norway and at Metla in Finland have recently conducted genetic studies of yew. The studies showed that there is relatively little exchange of pollen and seed between yew populations in western Norway. As a result, the individual populations show a greater genetic difference than can be found in such common species as spruce and pine. In the northernmost yew populations in Norway, there were also signs of inbreeding. The genetic structure of yew in Central and Southern Europe is quite the same as was found in Norway.

What consequences should this have for the management of this tree species? When the overall genetic variation is divided among many populations, as is the case with yew, it is important to maintain the various populations. Thus, genetic conservation in reserves is an important contribution, especially since the coastal areas are subject to substantial urban development pressure. Long-term conservation also depends on sufficient regeneration, which in many areas is threatened by large red deer, and probably also roe deer, populations. These animals browse extensively on all age classes of yew. In order to reduce browsing pressure, it may thus be necessary to cull a number of red deer and roe deer in certain areas.

In the Nordic countries, yew is mainly found in the coastal areas of southern Norway and southern Sweden.

The largest yew in northern Europe is found in Norway. It has a stem girth of 5 metres. The tree consists of several "false" trunks, probably having grown from buds on the original trunk, which has rotted away. Thus, the tree is hollow, and its age difficult to determine.

PHOTO: TOR MYKING

The Big Storm and its Effect on Forestry in Southern Sweden

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On 8 January 2005 and in the following night, a storm felled approximately 70 million m^3 of timber in southern Sweden. About 80 % of the uprooted trees were spruce. The percentage of spruce in the forests of this region is about 50-60 %. About 160,000 ha forest have thus been so damaged by the storm, that either all trees are uprooted or the stands are so impaired that the remaining trees will have to be felled in the next few years. Worst hit were southern Småland, southern Haland and northern Skåne, but all of southern Sweden was heavily affected by the storm.

One million people without power

On Friday, 7 January 2005, a low pressure was formed west of Ireland, and moved in a north-easterly direction. This low pressure system developed into an extremely strong storm due to the collision of very cold air from Greenland and very warm air from the south. On Saturday, the low pressure arrived in south-western Norway. From there, it moved across central Sweden and southern Finland, and disappeared into Russia on Sunday. The strongest winds, with hurricane-force gusts, occurred about 400-500 km south of the storm centre. The population in southern Sweden experienced extensive and disastrous damages. As many as 415,000 households (about 1 million people) were without electricity. Intensive efforts, however, brought this figure down to about 50,000 households within one week. Most main roads were opened again after about a week, but it took about one month to clear all railroad lines and to restore all power and telephone connections. Over a significant area, a totally new power grid had to be established. In the night of the storm, nine people were killed, but the number of casualties during the following clean-up efforts is not yet known.

An average annual cut

The volume of timber that was uprooted in one night is equal to an average annual cut for all of Sweden. In the hardest hit areas, the losses correspond to 5-10 annual cuts. Increasing the capacity for felling, transport, storage and industrial processing of such enormous amounts of timber is nearly impossible, but nevertheless a necessity. The work can be described as a race against time in order to salvage fallen timber, reduce the risk of massive pest attacks, and in the worst case, prevent disastrous forest fires in case of a warm and dry summer. Present estimates indicate that the windthrown timber will have been processed by mid-2006. Due to increased storage costs, damages to the wood and a surplus of timber on the market, the price of storm timber will fall significantly. Presently, most timber buyers will avoid committing themselves to a final

After the storm.

PHOTO: CARINA STÖMBERG

The clearing of roads was given top priority.

PHOTO: PATRIK ANDRÉ

price. Timber payments will be based on a storm price list, with prices that will be determined later. However, it already seems clear that this price will be in the order of 60-70 % of the pre-storm rate. As a result of low timber prices and the considerably higher costs of timber processing, forest owner net income will be minimal.

After the timber has been removed from the forest, reforestation begins. Also in this respect, the capacity needs to be increased many times. However, it takes about 4-5 years before the post-logging vegetation starts to dominate. Within this period, the production of seedlings, ground preparation and planting logistics must be substantially increased. Technically, reforestation will be more complicated, e.g., ground preparation will be extremely difficult or even impossible in many areas.

According to experiences from previous large storms, it can be expected that the focus in 2005 will be on hauling and processing windfall, thus rather risking a surplus of seedlings. In 2006, however, one would expect a considerable shortage of seedlings, whereas the nurseries will be able to meet the demand for seedlings in 2007 and beyond, as long as the forest owners submit their orders. The 'ordering willingness' of forest owners is a factor that is difficult to predict. Reforestation morale is usually high, but how will it be affected by the fact that enormous areas need treatment? Forest owners usually fund reforestation by setting aside part of their harvesting profits. What will now happen when net logging profits dwindle, and any surplus probably is needed to cover various other costs, such as interest payments? In many cases, we may be talking about years or even decades before forest owners can expect satisfactory profits from forestry again. At present, it is being discussed if public funding should be provided to support the reforestation of the forest areas devastated by the storm. At the time of writing, it is not yet decided if such support will be provided at all, and if so, how it should be designed.

Storm-prone forests due to human activities

In the aftermath of the storm, there has been a lively debate on the issue of whether or not, and to what degree, forestry and/or human environmental impact have contributed to the extent of damages. The widespread planting of spruce has been especially criticised, and many people find it probable that there would have been fewer damages if a larger share of the affected forests had consisted of deciduous, pine and mixed forest. The forest sector has also been accused of neglecting the risk of storm damage by not sufficiently thinning young stands, and then thinning too late and too harsh when finally doing so. Forest owners are also criticised for having built up too many old, dense and storm-prone spruce stands. Poor harvest management has been considered to have resulted in far too many wind-prone forest edges. Some of the participants in the debate also claim that the use of foreign and non-local spruce provenances has contributed to additional damages, since these are considered to be more sensitive to wind than local spruce provenances. In addition, there are many other views about how the forest sector's lack of foresight has made matters even worse. Some even think that large-scale environmental problems, such as climate change, nutrient surplus and soil acidification, might have caused additional damage. Some also claim that such factors play a role in combination with poor forest management.

It is presently impossible to reliably evaluate the correctness of these accusations and opinions. The Swedish government appointed the National Board of Forestry to analyse what factors caused the tremendous extent of the damages, and to discuss measures aimed at reducing the risk of experiencing a similar disaster in the future. The evaluation committee shall consist of representatives from public authorities, research institutes and forest organisations. The results of the evaluation will presumably have consequences for future developments in the forestry sector in southern Sweden.

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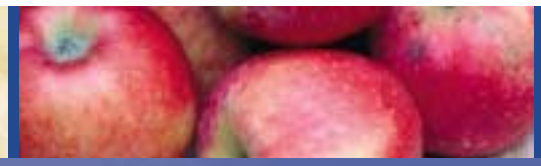

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