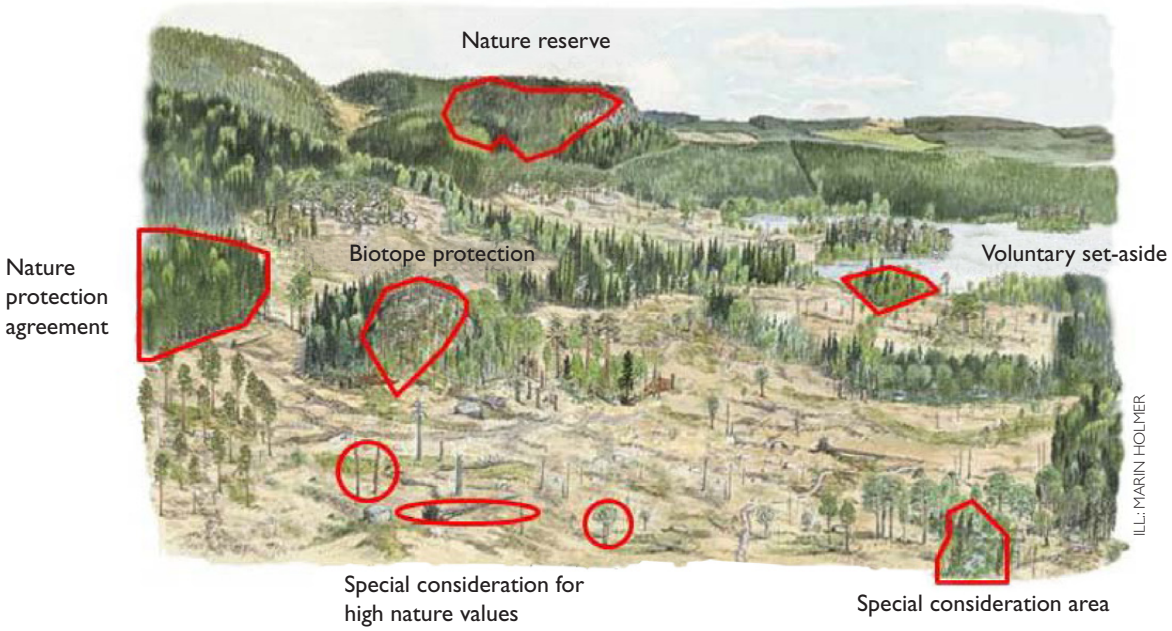
Sustainable forest management in Sweden

Management and use of forests and forest land in Sweden is performed in such a way that aim to preserve biodiversity, productivity, regrowing capacity and vitality. Management should make sure forests are able – now and in the future – to fulfill important environmental, economical and social functions on local, national as well as global levels without harming other ecosystems.

THE SWEDISH MODEL

Fifteen years ago the Swedish government put production and environmental goals in forestry on equal footing. This means that both are balanced in day-to-day forest management. A practical definition could be: limited area clear-felling with consideration to nature-values. This means that forest owners are required to take special measures to protect valuable biotopes, aquatic ecosystems in the forest landscape and cultural remnants. They are also to ensure a proper amount of dead wood in the forest. In addition, forest owners can engage in voluntary nature protection agreements. This type of environmental consideration is additional to other forms of nature protection, including: national parks, nature reserves, voluntary nature protection agreements, Natura 2000 areas and several voluntary forms of protection. Finally, especially strict rules apply to mountain-near forests. Non-productive forest land is taken out of active forestry altogether.



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FORESTRY AND REINDEER HUSBANDRY – COMPETITION FOR THE SAME LAND

The parallel use of the forest landscape in the northern parts of Sweden is an example of a multiple use commons. Over the years this has been associated with conflicts between the production goals of forestry and the needs indigenous Sámi people have for their reindeer husbandry.

Reindeer management today occurs on 40% of Sweden's area, and is conducted on both privately and state-owned land within the management area. The size of the reindeer population varies between different periods depending on available grazing and climatic conditions.

To facilitate multiple land use and to avoid any problems that might arise there are consultations between forests-owners and the Sámi. These take place before regeneration felling and other comprehensive forest operations are started. Innovative tools for consultation become an essential part of functioning and sustainable forest management. The developments of reindeer husbandry plans through the use of participatory GIS has increased knowledge and understanding and improved communication between land users and thereby reduced conflicts.

The size of the reindeer population varies between different periods depending on available grazing and climatic conditions.

PHOTO: LEIF JOUGDA

RESEARCH – FUTURE FOREST

Climate change, globalization, and increased consumption of materials and energy lead to higher pressure on forest resources. The task of intensifying forestry to produce more timber, paper, and energy, while at the same time ensuring ecosystem services, such as biodiversity and recreation, is a complex one. Difficult decisions have to be made if we are to strike a balance between these demands. These decisions have to be supported by scientifically-based land-use strategies to deal with trade-offs on different scales.

Future Forest will generate new knowledge within several important areas where critical information for a sustainable development of forests and forestry in Sweden is missing, or is incomplete. These areas include adaptation to and mitigation of climate change, water quality, nutrient cycling, and biodiversity.

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Climate change – implications for Sweden

By the end of this century temperatures in Sweden could have increased 2.5-4.5 °C compared to 1990. Annual precipitation will probably increase, as will the frequency of heavy rains. Effects on tree growth in the Swedish forests will probably be positive. There are models predicting increases in the range of 25-30 % compared to 1990.

However, production models disregard calamity risks. There are indications that calamities may increase in the changing climate. Wind damage may increase, not primarily because of higher incidence of storms, which may in fact not occur, but rather because of shorter periods with frozen ground and trees being higher at a younger age. The frequency of summer periods without precipitation may increase, thus increasing the risk for wild fires. Browsing by wildlife may also increase as climate change will benefit deer populations. Further, today's economically most important pests, i.e. root rot, pine weevil and spruce bark beetle, will all benefit from a warmer climate. Finally, many other pests and pathogens, already present or not-yet introduced, may show an increasing economic threat.

PHOTO: MICHAEL EKSTRAND

The Swedish forest is hosting a range of different values – economical, environmental and social.

PHOTO: MATTIAS SPARF

Spruce bark beetle larval tunnels.

PHOTO: MICHAEL EKSTRAND

Wind damage may increase as a result of climate change.

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FORESTRY AND CLIMATE CHANGE

Consequently, risk awareness, and indeed risk management, must increase among forest owners. Forest owners may respond by actively reducing risks, or risks foreseen, through adapted management, or by spreading risks, e.g. through variation in forest management regimes or simply by improving insurance policies.

The choice of what tree species to favour, and what management regimes to employ, are important in the adaptation to climate change. Regarding tree species, provenance recommendations can be changed, and the niche for exotic species can be increased, for example by increasing the use of Sitka spruce or Douglas fir. The role of genetically improved material could become even more important. Also mixed stands could become an option on larger areas, as different species respond differently to calamities.

Adaptation of forest management could include shorter rotation periods. If trees grow faster, earlier final felling becomes economic and reduces risks of calamities, especially wind-felling. At wind exposed sites, early strong thinning or choice of more stable tree species may further reduce risks for wind-felling. Because of wetter and less frozen ground during winter, soil damage from heavy machinery will increase unless logging planning is improved and better technical systems are developed. Furthermore, road standards must be adapted to warmer winters. Finally, damage caused by pests, pathogens and through browsing can be actively prevented through various measures.

ENVIRONMENTAL CONSIDERATIONS AND INCREASED UTILIZATION OF FOREST RESOURCES

Climate change may change living conditions for species already endangered. Habitats may become unsuitable or competition may increase. Therefore it is important to facilitate northward movement for organisms.

At present, branches and tops are used for biofuels to a high degree and stump harvesting is being tried and evaluated. Extraction of harvest residues may exercise extra pressure on forest organisms, unless counteracted through using adapted systems that ensure e.g. the supply of decomposing wood of various qualities. Whole-tree harvesting may further increase soil acidification and cause nutrient depletion at many sites unless compensated through e.g. ash recycling and, in northern Sweden, also nitrogen addition.

It is important to prevent soil damages when extracting harvest residues. Foto: Anja Lomander

ROLE OF THE SWEDISH FOREST AGENCY

Modeling future climate on regional level has enabled a science-based analysis of needs and options for adaptation in Swedish forestry. With a large number of forest owners making management decisions for the future, it is an important task for the Swedish Forest Agency to spread information about the climate change problem, and about various options for adaptation, among forest owners.

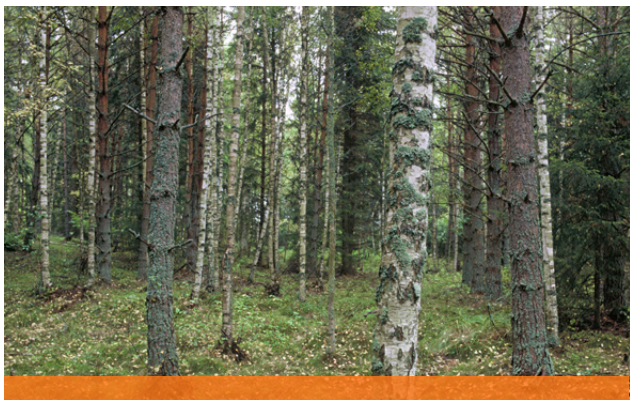

PHOTO: MICHAEL EKSTRAND

Mixed stands is a way to spread risks.

PHOTO: ANJA LOMANDER

It is important to prevent soil damages when extracting harvest residues.

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Basic facts about Sweden and its forests

Government:	Parliamentary democracy and constitutional monarchy
EU accession:	1995
Currency:	Swedish Krona (in a 2003 refe rendum the population refused the Euro)
Area:	449,964 km2 (of which water bodies constitute 8.7%)
Population:	9.2 million (density is 20/km²)

SWEDISH FORESTS

Forests cover approximately 60 percent of the land area, making it logical that the forest is our most important natural resource. It constitutes 12 % of Swedish export income and gives employment to about 100.000 people. The ancient right of public access ("allemansrätten") provides for forest multi-functionality. The growing period is 240 days in the south and 120 days in the north and normal precipitation lies between 400-900 mm per year.

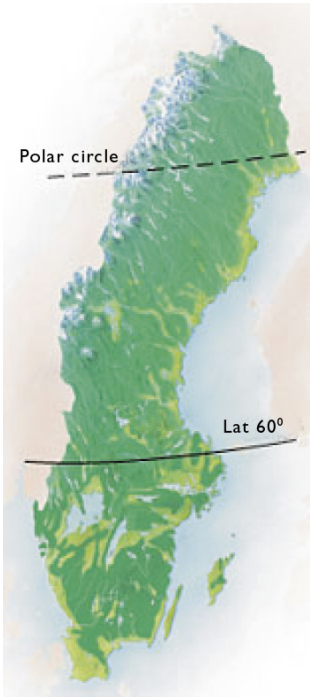
As regards forest area, Sweden totals around 29 million ha of forest land. This area can be subdivided into:

- Productive forest land 23 M ha
- Protected forest land 2 M ha
- Non-productive forest land 4 M ha

The annual cut is about 85 M m^3 per year, whereas the annual increment 100 M m^3 per year.

FOREST OWNERSHIP

51% of the Swedish forest area is owned by private, small-scale, forest-owners, often called "family forestry". Private forest companies own 24% of the forest land while the State and other public organisations own 25%. During recent years much of the State owned forest has been reorganised into companies. A massive rationalisation of agriculture has been carried through during the last 50 years. The number of farms with combined forestry and agriculture has decreased to about 30% in comparision to the mid 1950s. In total there are about 350 000 private forest-owners in Sweden, of which 70% live on their properties. One third of the private forest-owners are women. The percentage of private forest owners varies and is higher in the south than in the north of the country. The average forest area in family forestry today is 47ha.



Spruce bark beetle larval tunnels.

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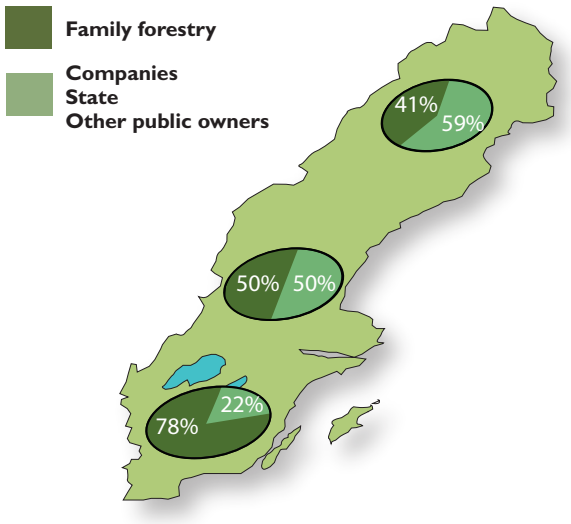
FOREST HEALTH

High winds cause damage to the forest every year. The powerful storm that swept over southern Sweden 8-9 January 2005 resulted in 75 million m3 (standing volume) of windfallen trees. Another heavy strom hit southern Sweden in January 2007. After the storms, attacks from the European spruce bark beetle (Ips Typographus) followed. The forecasts for the upcoming years are worrying.

Forest fires are generally not considered a problem in Sweden. On average, less than 1000 hectares are damaged by fire annually.

Dense game populations however, lead to severe damage, especially in pine and hardwood plantations and young forests. The browsing damages caused by local moose populations is, at some places, intensive and in excess of what can be accepted by forestry. However, the levels of damages varies considerably.

The most serious pest on Norway spruce is Root Fomes (Heterobasideon annosum). It is found throughout Sweden and causes damage estimated to about 500 million SEK annually, expressed as deteriorated wood quality and lower increment.



Forest ownership structure in Sweden. Source: Skogsstyrelsen

VEGETATION

Climate, history and biotic factors divide Sweden into different forest ecological systems.
The conifers dominate in the boreal coniferous belt, and only a few deciduous species are found here. The zone is a western extension of the Taiga that stretches all the way to Siberia.

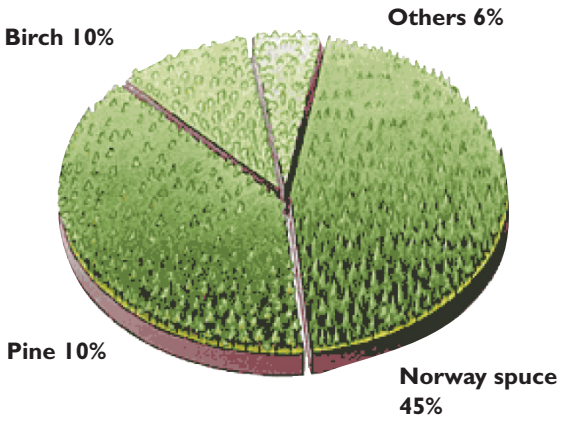
In many places in Europe the north European mixed forest region (the Boreonemoral zone) is cultivated to a much greater extent than in Sweden. Here the pine and spruce forests dominate, but there are also deciduous woodlands on the more fertile soils.

The northernmost limit of the north European deciduous forest region is found in southernmost part of Sweden, where oak and beech are typical species. Along the Scandinavian mountain chain can be found a treeless alpine zone as well as a subalpine mountain birch region.

TREE SPECIES

About 85% of the total standing volume consists of conifers. Norway spruce is more common than Scots pine throughout all Sweden except in the northernmost part of the country.

Amongst deciduous species, birch is the most common, making up two-thirds of the deciduous growing stock. The standing volume of oak and beech has more than doubled since 1945.



Tree species distribution in Sweden. Source: Skogsstyrelsen

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Forest fuels

– an important source of renewable energy

Almost 25 % of the energy consumed in Sweden is bioenergy, most of which is forest based. Forest sector contribution to energy production could still be increased. Forest based bioenergy is mainly generated by industrial residues, e.g bark and sawdust. In 2005 fuelwood cuttings and harvest residues produced 20 TWh. There is a potential for this to be doubled by 2020, and thereafter further increased.

Fuelwood cutting is mainly done by forest owners for private consumption, mainly heating. Energy input from fuelwood cutting has been stable for a good number of years, and is unlikely to increase any time soon.

Harvest residues in the form of tops and branches are mainly extracted in connection to clear-cutting. Forest owners are required to notify the Swedish Forest Agency in advance if harvest residues are to be extracted. The increased rate of notifications suggests a rapidly increasing interest in residue extraction (Figure 1). Residues were reported to be extracted on 17 % of the area clear felled in 2002. Corresponding figure for 2007 was 38 %. Both figures are probably on the high side, as a notification does not require residues to be removed.

Interest in stumps for energy production is on the increase. Stump harvesting is in the cradle phase, but has shown great promise.

EXTRACTION METHODS

Tops and branches are stashed in stacks, 1 to 1,5 m high. Stacks are located along skid trails and left to dry. Thereafter, stacks are extracted to roadside landings using forwarders. The stacks should be placed in open, dry places where they can continue to dry up. Chipping is typically carried out at the landing and chips are transported by trucks equipped with demountable body systems and containers.

Integrating forest fuel extraction with thinning and/or spacing is a relatively new practice. Machines equipped with accumulating multi-

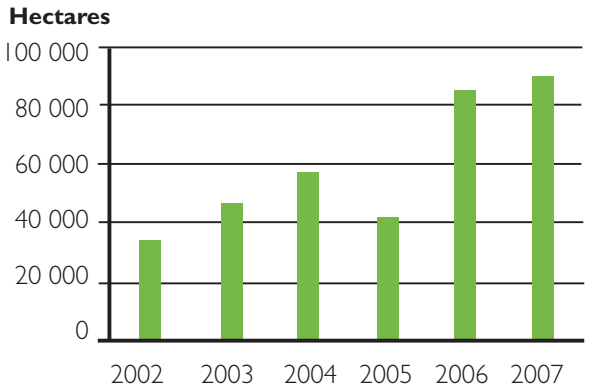

Figure 1. Areas with harvest residue extraction scheduled in connection to clear-cutting, based on notifications to the Swedish Forest Agency

Tops and branches are left to dry in stacks.

PHOTO: MICHAEL EKSTRAND

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tree harvester units are suitable. These units cut trees, accumulate them in the unit and put them in bundles alongside the skid tracks for further hauling to landing.

ENVIRONMENTAL CONSIDERATIONS

Extraction of biomass removes nutrients and acid-buffering capacity from the soil. Such substances are more abundant in tops and branches than in stemwood. Nutrient export typically doubles over the rotation period when whole trees (excluding stumps) are harvested. This exceeds the natural compensation at many sites. If extraction of large amounts of biomass is performed without compensation, soils may become more acidic, with time possibly affecting quality of the run-off water. There are several organisms that are sensitive to acidification, for example trout. Further, soils may become deficient in nutrients in the long term, affecting site productivity as well as conditions for other species. Ash recycling is a good way of compensating for losses of acid buffering substances and nutrients. Nitrogen is missing, as it evaporates with flue gases, and nitrogen could therefore be added separately in north Sweden where nitrogen deposition is low. For other parts of the country nitrogen evaporation is compensated by deposition.

Some harvest residues should always be retained to reduce harvesting impact and promote biodiversity. Harvesting technology chosen, and timing of operations, should be designed to minimize soil

The Swedish Forest Agency has published recommen The Swedish Forest Agency has published recommendations for sustainable extraction of forest fuels. dations for sustainable extraction of forest fuels.

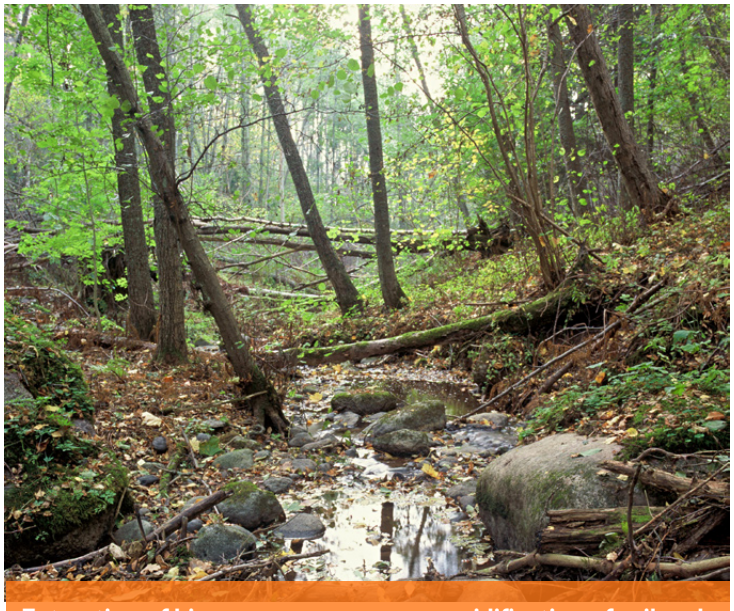

PHOTO: MICHAEL EKSTRAND

Extraction of bioenergy may cause an acidification of soil and water.

PHOTO: STEFAN ANDERSSON

In order to compensate for losses of acid-buffering capacity and nutrients, ash could be recycled. Foto: Stefan Anderson

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The experience of Swedish forests

– an asset for public health as well as local development.

The right of public access is unique and the most important base for recreation in Sweden. It allows people the privilege to collect berries, mushrooms and flowers, or to camp for one night on private land. The obligation for the visitor is not to disturb the environment and respect the privacy of the landowner.

The interest for nature tourism is increasing. The most popular activities include fishing, hiking and kayaking.

One of Sweden's environmental objectives is that forest management shall take into consideration the many uses that people may make of the forest within the framework of the legal "right of public access". Forestry shall also help to make the forests accessible. Valuable historical remains and settings are preserved and made visible. The forests are full of interesting places to visit, both for local residents and tourists from afar. Given the aesthetic values and accessibility of the forest landscape, the right of public access becomes a valuable asset, which enhances the potential of the forest to contribute to the well-being of the population as well as local and regional development.

WHAT IS GOING ON IN SWEDEN?

Identification of forests of high social value is a job initiated by the Swedish Forest Agency. The main objective is to meet people´s needs; forests for a good living environment and recreation, bearing in mind connected health aspects as well as the basis of these values for nature tourism and other sources of income. The identification is carried out through dialogue with forest owners, municipalities and other relevant parties.

The interest for nature tourism is increasing. The most popular activities include fishing, hiking and kayaking.

PHOTO: SOFIA BLOMQVIST

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DIALOGUE ON MULTIPLE USE

Since 2004 Vilhelmina Model Forest has been accepted as a member of the international concept of Model Forests. The objective of Vilhelmina Model Forest is to achieve a sustainable use of the forests in Vilhelmina from a landscape perspective. The Model Forest is an arena for local interest groups to discuss how the natural resources should be used to prevent conflicts. Website http://www.vilhelminamodelforest.se/.

RESEARCH

Outdoor recreation in change is an interdisciplinary, national research program for the study of outdoor recreation and nature-based tourism in Sweden. The overall aim of the program is to present a broad picture of the dynamics of outdoor recreation and nature-based tourism in Sweden. The program is a network project, involving about 15 researchers from seven universities and colleges in the country. The research is supported by the Swedish Environmental Protection Agency. Website: http://www.friluftsforskning.se.

Forest and health is a research program that puts the findings of recent research concerning rehabilitation in green environments into a forest perspective. It seeks to answer if forests can be used for rehabilitation of stress syndromes and if forest management can enhance such effects by creating an optimal forest environment for rehabilitation. http://www.seksko.se/index.php?option=com_content&view=article&id=136&Itemid=75&lang=en.

RURAL DEVELOPMENT PROGRAM

Forest's multiple functions is a capacity building project aiming at giving advice to forest owners on how to conserve and enhance nature values as well as cultural and social values on their forest estate. A forest owner can also apply for compensation if she or he wants to enhance these values through management.

PHOTO: SOFIA BLOMQVIST

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