Establishing new broadleaved forest in Söderåsen National Park!
In order to enhance the natural prerequisites of a more diverse flora and fauna in the national park, we have since year 2002 started to phase-out Norway spruce and treat clearcut areas.
In more than 1000 hectares, we have been cutting spruce and other foreign tree-species, scarified clearcut areas, fenced against game and created future forests by planting oak, beech, hornbeam, maple, ash, lime and cherry, and by sowing beechnuts.
The overall objective is that deciduous forests, mainly broad-leaved forest, should be established in all these areas in 20 years.
To create new broadleaved forests is a long-term commitment.
The initial phase consisted of a LIFE-project that was co-financed by EC environmental fund LIFE, Swedish Environmental Protection Agency and County Administrative Board of Skåne.
This book presents the LIFE-project in Söderåsen National Park.
Read more at www.nationalpark-soderasen.lst.se/life
Restoration of deciduous forest in Söderåsen National Park

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The County Administrative Board of Skåne has between June 2002 and December 2006 run the LIFE-Nature project “Restoration of deciduous forest in Söderåsen National Park”, which is one of the largest nature conservation projects in Sweden.

The purpose of the project was to take initial measures in order, in the long term, to establish and maintain semi-natural deciduous forests in areas with spruce forest and in clearcut areas. The project was co-financed by EC environmental fund LIFE-Nature, the Swedish Environmental Protection Board and the County Administrative Board of Skåne.

**Why was the project initiated ?**

*International responsibility*

In Europe, naturally developing broadleaved forest with a large proportion of large trees and dead wood is nowadays in very short supply. The Swedish broadleaved forest is in many ways different from lowland forests of central Europe. The exploitation pressure has been comparatively low. Placed outside Europe’s larger industrial centres, south Swedish broadleaved forests suffer less from air pollution than those in central and western Europe. This render south Swedish forests a high value to from an European perspective.

No environment in Sweden is so diverse and accommodates so many endangered species as the southern Swedish deciduous forest, in particular the broadleaved forest, which consists of pedunculate and sessile oak, beech, Wych elm, ash, small-leaved lime, Norway maple and wild cherry. The larger part is managed leaving roughly only 5% that is protected and can develop naturally. Cutting of old-growth broadleaved forests is continued, and wide areas have been replaced by primarily Norway spruce. It is therefore essential to protect the mature deciduous forest that remains and increase the area of semi-natural deciduous forest habitats in the future.

*Söderåsen National Park*

Söderåsen national park is one of the largest continuous areas of species-rich broadleaved forest and other deciduous forest in northern Europe. The protection and management of such large area as Söderåsen national park mean that those habitats and species favoured in old broadleaved forests will have a better chance of surviving and developing in the future.

Norway spruce (*Picea abies*) has, because of economic reasons, been planted on Söderåsen ridge since the beginning of the last century. Furthermore, the spruce had spread into large areas of broadleaved forest...
Broadleaved forests with large dead trees have high natural values.
that caused an undergrowth of spruce in different ages. Since spruce is here planted south of its natural distribution, it is regarded as a foreign tree-species. Consequently, it should be removed from the national park.

Other foreign tree-species had also been planted into several areas of the national park. The most common were sycamore maple (*Acer pseudoplatanus*) and northern red oak (*Quercus rubra*). Also larch (*Larix decidua*), thuja (*Thuja occidentalis*), Douglas fir (*Pseudotsuga menziesii*) and Nordman fir (*Abies nordmanniana*) existed. These tree-species should also be removed.

When the national park was founded, much spruce had been felled and left behind wide open clearcut areas. Many of these were invaded by wavy hair grass which, together with temperature fluctuations, frost, draught, browsing game and rodents, prevented natural forest regeneration. On others, dense brushwood of silver birch (*Betula pendula*) sprung up. In order to enhance and rush the regeneration of broadleaves, one decided to plant trees and also favour natural regeneration. Since ordinary hunting is not permitted in the national park, the plantations ought to be protected against browsing with fences.

Since we don’t want to create new clear-cuts, the spruce will gradually be phased out over a 20-year period. Fences shall function and be maintained in 10 years. This LIFE-project involves only the initial measures of
Long term vision

The main part of Söderåsen national park consists of a deciduous forest with a blend of tree-species, varying in size and age, and – above all – wide-spread woodlands, without spruce plantations, clearcut areas or roads. The mix of tree-species, gaps and fallen trees make the forest varied in light and structure. Visitors can in all parts of the national park experience as close as one could come to natural old-growth forest in Skåne County. The previously threatened birds, insects, molluscs, fungi, lichens, mosses and other animals and plants that have been reduced to the ravine forests, can spread over larger areas. Science has got a reference area for research and monitoring.

Objectives

Overall project objective

The overall objective of the project is to, in 1070 hectares of Söderåsen National Park, start the restoration and enlargement of the area of semi-natural deciduous forest, especially broadleaved forest, to conserve existing deciduous forests and use as environmentally friendly forest management techniques as possible.

Specific long term goals:
– All spruce is phased-out in 20 years.
– Through game fencing, soil scarification, planting and sowing, and through repeated cutting of competing vegetation, the establishment of broadleaved forests with oak, beech, hornbeam, maple, lime, ash and cherry has been initiated in 212 hectares of forest land.
– At least 500 planted trees per hectare has survived and within 10 years grown above game browsing height, which is higher than 3 meters.
– More than 50 km of fence has been protecting plants in 10 years.
– Natural regeneration of broadleaved tree-species but also birch, rowan, sallow, alder, aspen and other species have been favoured.
– No foreign tree-species is dominating or form stands.
– Through information and experience exchange there is a broad awareness about the project, LIFE and Natura 2000.

The project group

Project success depends mostly on its good members of the staff. Thus, it was of greatest importance to recruit skilled people with wide, but also different competence to the project group. Both practical and theoretical forest knowledge was important. Since many actions should be carried out by subcontractors, project staff with abilities to control and supervise subcontracted work was needed. As project measures should be executed in a national park, comprehension of natural and cultural values was demanded. A significant part of an EC-project is economy, hence knowledge of European financial administration were especially important to be able to realize the project. The social dimension, or how people get together, is of course essential when compiling a group; the staff should both get on well and function under stress.

The project group has consisted of project manager Oddvar Fiskesjö, national park
manager, biologist and administrator, Christer Borglin, financial manager and administrator with EC-project experience, Roland Larsson and Hans Wieslander, both foresters with long experience from staff management in forest works and employments in forest production and nature conservation.

Awareness of each others skills has been a cornerstone of the project work. Different experiences and background has given separate opinions about which actions and means should be used in attaining results, which has made the project go ahead. Theorists and practicians have met in a fruitful coopera-

Planning and reality

A project plan was of course at hand when starting the project, but plans are always altered according to conditions in reality. In some areas, spruce should be thinned and deciduous trees be planted, others should be naturally regenerated after spruce cutting. Some areas should be planted without soil scarification, others be scarified before planting. Goals and objectives have not been altered, but the planned management has been changed within areas following new natural conditions. Methods have also been changed as a result of early experiences in the project if it was obvious that planned actions didn’t work or took to much time. This adaptive management has been a core feature of the project.

Example

The areas that would be managed were mapped already the year 2000. By the start of the project, birch forests had established on some clearcuts, while others were aggravated with dense grass layers and lacking natural regeneration, leading to new conditions. We then had to plan for cutting more birch, change areas for soil scarification and sometimes plant another tree-species than planned.
tion, where ideas were realized and problems solved. Bringing in their own network from former employments, project members have promoted efficiency and well-founded decisions. The responsibility for project implementation has been distributed among the project staff, where each member has had tasks according to skill and interest. Consequently, a cooperative responsibility for project success arose. In this team work, one of the tasks for the project manager has been to make progress through listening to project members and encouraging their creativity and initiative.

The work of the project group has not always followed structures and rules that govern the organisation to which we belonged. Sometimes we were forced to make urgent decisions within the scope of the project and in these cases it was very important to know we had understanding and reliance from the County Administration leadership.

**Working with subcontractors**

Several subcontractors have contributed to the project. All hired work has been bought in according to Swedish law and the rules of the County Administrative Board. In the beginning it was hard for tenderers to understand our terms and conditions, but even if the buying took some time, it lowered our costs. Afterwards, we have found out that most services and consumables have been bought from local companies, which means that the local trade also have benefited from the project.

It is a natural procedure that you hire special knowledge and machinery from subcontractors, but our experience is that you always

Many spruce stands will be successively phased-out.
need to have precise supervision and close contact between foreman and entrepreneurs. This is most important when work is to be done in another way than you are used to. Our certain demands and ideas were sometimes very hard to implement by hired workers. For example, we hired a local company that used workmen from the Baltic States, who couldn’t speak Swedish or English. When we was able to hire the same subcontractor for some years, a common interest, understanding and responsibility have evolved which has been very rewarding to the project. Those involved in that way have contributed with new ideas and solutions to problems.

Financial management

EC projects have a high level of financial management. Already in applying, an organisation has a high need of financial management to support and understand financial information for what is eligible and calculation of different financial tasks. According to experiences from our project, we want to advice new projects to be careful with the following tasks in the financial area:

• Bring financial competence into the team/core, working with the project.
• Interpret rules and guidelines, what is possible or not.
• Make models and verifications for accountancy.
• Work carefully with follow-up of budget and recommend directions for the project, depending of the interpretation of rules/guidelines from your specific programme.
• Have somebody who can keep the project together from an administrative point of view.
• Resources will be more efficient as persons in the project group are specialists of his/her working area.
• Make contact with other projects within the same programme for networking and problem solution.

In most projects, the knowledge of the technical or biological area has a high level of

When the spruce is felled, the broadleaved forest can spread to larger areas.
representation. However, you nearly never find any representation from the financial area. With financial competence, the risk for losing contribution is much reduced. It is not enough to involve your financial department briefly; you need somebody from the financial area to work part time in the project. This is well invested resources.

Norway spruce phase-out

Our conditions for felling spruce and extracting wood are adapted to nature conservation, and the used methods for phasing out the spruce are rather different from conventional forestry. Elder, homogenous stands were thinned during the project and will be successively phased out through the gradual process of more thinning and cutting off forest edges, gaps and corridors. This extensive cutting period will help the beech plants to grow properly and enable deciduous forests to naturally spread throughout spruce dominated areas. In the mixed clumps of trees, young spruces are cut down and chopped into wood chips. No cutting was carried out in the period April – June, paying attention to nesting birds, other animal and plant life and public requirements. Cutting is otherwise commonly executed all year round.

Part of the timber has been extracted to roadside by horses. This provided interesting experience. From an environmental point of view, there are special cases where extracting with horses are superior and consequently are economically defendable. In our project, this was the case where large machinery was unsuitable, for example along hiking trails and close to ancient remains, stone walls, ruins and steep slopes. Ideally, the ground should not be stony or wet and the distance to the road should not be long.

Using horses, ground damage is often slight or none. Nevertheless, since horses have to walk many more times to transport the same amount of wood, ground wear can occur. Long distance to roads mean also much higher extracting cost per cubic meter wood. It’s also hard for the horses to pull a fully loaded carriage when it’s slippery or wet.

We had to find an alternative to both the more expensive motor-manual cutting and, especially in sensitive areas, to the heavier machinery, and compensate for the lack of forest workers and horses. We then found a
Planning and reality

Example
The original project plan stated that half of the wood should be cut with chainsaws and extracted to roadside by horse, and the rest of it be harvested and extracted by machines. This plan soon had to be changed. There are few companies extracting wood with horses, and forest workers were hard to get hold of. That's also the reason why we have worked much more than planned cutting spruce ourselves. The extraction capacity is for natural reasons much lower with horses. With respect to these conditions, we could not have followed our time-schedule if so much spruce would've been cut with chainsaws and the wood extracted by horses. Consequently, most of the spruce was cut by machinery.

Most felling and thinning were executed by middle-sized machinery as harvesters and forwarders. The work has been very effectively and well performed, and few ground damages did occur. Most important was that machine drivers were interested, skilled and thoughtful. For example, extraction roads in stands were not made straight but winding,

local company that executes cross-cutting and trimming with a small, remote controlled eight-wheeled tool carrier. The trees were felled with chainsaws. Since the carrier often works with winching in tricky surroundings, it was also convenient to use when cutting spruce in steep slopes. The task was fulfilled fast and considerate to the surroundings.
gaps were made around clumps of deciduous trees and cairns were left untouched.

Young spruce was partly cut with a rebuilt harvester that clips off and lay down the whole tree to be chopped to wood chips. This brought out all spruce biomass, which made the areas very well fit for planting. On the other hand, the wood chopping caused some ugly tracks, especially when it was raining. This indicates that it’s generally better to place the brushwood on the forest roads to spare the ground. Where this was done, damages were very few. In order to protect especially sensitive areas, wheels were supplied with tracks to diminish ground pressure. However, these tracks can themselves cause wear, primarily when turning the vehicle.

When cutting spruce with machines, modern technique and highly skilled workmen provide good cost-efficiency. Environ-

We felled the most part of the spruce undergrowth in broadleaved forests ourselves.
mental influence per cubic meter is low because of the high capacity. Nevertheless, it’s important that the machine drivers are interested and understand the special demands and directions that are needed in areas with high conservation values. Therefore, when inviting tenders, you must always be precise with these demands.

Another big task for the project was to remove all spruce that had spread outside pure stands all over the project area. Otherwise, this spruce undergrowth threatened to form the next generation in deciduous forests, wetlands and ravines. Every square meter of the project was searched for spruces, and those found were cut and left to decay on the spot.

The clearing and reparation after the storm in January 2005 changed our plans in many ways.

The storm in 2005
The 8th January 2005, southern Sweden was struck by a storm that caused much damage, mainly by felling huge amounts of spruce forest. In the project area, about 6000 forest cubic meters of spruce were felled, but almost no deciduous trees.

The storm affected the project in many ways. Game fences were damaged in several places. Project members became occupied with coordinating subcontractors and participating in clearing the storm-felled timber. Many areas were not possible to manage, where scarification, planting or sowing should have taken place. A forest company was able to help us in a very early stage, leav-

Planning and reality
Example
The storm felled more or less trees in most spruce stands. Some stands that were planned to be regenerated naturally were totally felled. To prevent dominance of grass and birch, we changed our plans and chose to fence and plant these areas with oak.
ing the areas free from storm-felled timber already early in April. After that, reparation and replacement of fences had to begin. Thus, the storm contributed towards delaying the project. On the other hand, the storm helped us to a certain extent, through thinning out some of the spruce forests, and through creating gaps and corridors and fell edges in a somewhat “natural” way.

Cutting of other foreign tree-species

Other foreign tree-species had been planted in many small scattered areas, and especially sycamore maple had spread to adjacent areas. Sycamore and northern red oak are the most difficult to exterminate. Stools of red oak sprout heavily, but they are also to some extent browsed by game. Except from cutting most of these stands, we also experimented with other controlling methods.

With good light conditions, sycamore sprouts abundantly from seeds, stumps and roots. Consequently, it can be a problem in ash and alder forests, along roads and in clearcut areas. However, sycamore is not as invading as we thought from the start. It is mostly disturbed environments that trigger mass existence. Beneath large sycamores, there is seldom any regeneration. In some places it has been browsed by game and it is also shade-intolerant. We have tried to ringbark some stands. The ringbarking has to be done rather deep into the bark; otherwise the tree will repair the injury and survive. Other experiments of ours are placing salt on the stumps and cutting high stumps. The long-term effect from these experiments will be experienced some years ahead.

Soil scarification

Soil scarification, making patches of bare soil, was carried out in order to make planting easier, favour natural regeneration and enhance plant survival. We mostly scarified areas cov-
The old “Linderöd” breed of pigs has been used for a long time to regenerate deciduous forest.

...erected by a dense wavy hair grass layer. The grass otherwise prevents tree seeds from reaching the ground and compete with plants on primarily water.

Following our project plan, most scarification should be performed by old-breed pigs. We therefore hired pigs during the first two summers. However, we faced several problems. The pigs didn’t scarify the dry and harsh clearcuts in a way that made planting easier. In large areas they did not roam at all, most certain because of lack of edible things. This demonstrates that pigs should be used for regenerating trees on better soils under a shelterwood, which is the most common way. The used pigs were also rather young but, above all, too few. Much more working time than planned was used for daily supervision and water transport. If the pigs would have done the work, we had not managed in time.

New solutions had to be found. Scarifying the conventional way was out of the question because of natural but also cultural values. Almost half of the national park area is classified as ancient remains, mostly ancient arable land, which is protected by law and could be severely damaged by heavy machinery. We again used the eight-wheeled tool carrier, which also could be used for scarification. Using this carrier, we could scarify larger areas and direct it more exactly compared to using the pigs, which also had been much more expensive.

The result of the machine scarification was very satisfying with very few damages on surrounding vegetation and ancient remains. The carrier has a low ground impact and can be steered between obstacles. Placement, size and depth of scarification patches can be adapted to actual needs. The equipment is easily lifted over cairns and stony ground. The carrier was also able to drive irregular to avoid straight lines in the plantations.

Still, the pigs were excellent marketing. They were very popular with the local inhab-
itants, who often visited them in the field, and with media, that for example highlighted when we let the pigs out in spring.

Collecting seeds and raising plants

Good luck is always a good companion in a project. The year 2002 was unusually good regarding tree-seed production, and we collected a large amount of oak, (mostly pedunculate oak, *Quercus robur* and a small amount of sessile oak *Q. petraea*), beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*) and Norway maple (*Acer platanoides*). The seeds also showed excellent quality. In spite of that, we did not get as many maple plants as expected. Fertile, mature seeds of small-leaved lime (*Tilia cordata*) are hard to find because autumns are often too cold. Some lime stands can be found in the Skäralid rift valley but none of them produced mature seeds. A small amount of lime was nevertheless collected on some other trees. Wild cherry (*Prunus avium*) was collected the year after but yielded very few plants. Ash (*Fraxinus excelsior*) did not produce seeds until the end of the project.

All seeds were collected in the national park or its immediate surroundings. Acorns and cherries were collected by hand when they had fallen to the ground; beechnuts were collected in large nets placed in the beech forest in autumn, while all other tree-seeds were picked directly from the trees. After the germination was started, which took long time especially with lime and ash, the plants were raised in a nursery until they were set out in the action areas. All delivered plants have been superior with a well-developed root system.

Cooperating with the plant nursery has been educating while we have learned new

The eight-wheeled scarifying carrier was also rebuilt as a sowing-machine.
things by using unconventional methods. The nursery has shared knowledge on how to handle seeds and plants, which has been of great importance for our planting success. A prerequisite for good results of sowing and planting is that seed collection and treatment to start the germination as well as raising and storing of plants is done in a professional way.

Planting

Our planting models should try to imitate natural regeneration. Consequently, the plants were set out in groups or widely and irregularly scattered to spread them in the area. This of course makes supervision and management more difficult. A hired company planted mostly oak and beech. The other tree-species we wanted to plant ourselves, since there were not so many of them. We wanted to treat them extra careful, and they should also be planted in many already planted areas, which by experience would have confused the hired planters.

Oak was chosen as the most frequent planted tree-species in order to diminish beech dominance in the national park. However, beech is the most suitable tree-species in many areas. Hornbeam was planted especially with oak. Maple and lime were planted in some pure small stands, but have also been blended with other trees. Close to Skäralid Visitor’s Centre, there is a natural grown small-leaved lime, whose seeds earlier years had germinated in the surrounding area. These a couple of hundred plants were dug up and replanted in different areas, for example in steep slopes. Cherry was planted in many areas to increase tree variation, and ash was primarily set out in wet and light areas.

Survival and growth is highly dependent on nursing and storing of plants as well as on some seeds, like maple, should be collected directly from the tree.
correct handling and careful planting. In order to provide for the needs of different tree-species one should also choose the right spot for planting. Because our planting goals are rather different from those in conventional planting, much time was used to instruct and supervise the planters. Oak and beech were mostly well planted, especially in the beginning of the project. Some problems were encountered, such as plants were not planted deep enough or in other wrong ways. Since the plants were stored improperly, and had been lying too long before being planted, we both found plants that got mouldy and those that put forth shoots. We had better control when we kept close contact with the planters, enabling us to correct mistakes before the damage grew too big.

About a fifth of the plants have been set out in autumn instead of in spring, which is the most common planting season. It is important that plants are totally prepared for winter, which means planting sometimes was not carried out until early December. The conditions in the national park are not always ideal; small-leaved lime is here planted in a steep slope.

Planning and reality

Example

The larger part of the young spruce forest was cut as whole trees and chopped to energy wood. When the trees had been removed, the needle-covered ground and the sparse shelterwood of remaining deciduous trees revealed excellent conditions for planting. The plan for planting was then reconsidered, so we used these areas instead of less suitable ones, which were treated with other methods.
advantage with planting in the autumn is that plant growth starts early in spring before competition with surrounding vegetation is too high. Disadvantages can be cold winters and drought, not forgetting gnawing by rodents under the snow that can kill many plants. Spring planting can be delayed by frost and heavy rain, and was some years in the project not finished until the end of May. In that case, trees planted in autumn are favoured, and these plants have managed very well.

During summer 2004, plants in open clearcuts were struck by frost, and the new leaves went black. However, this won’t kill the plant but delay growth. In the years 2003, 2004 and 2005, it rained a lot after planting, which helped plant establishment. Summer 2006 was much warmer and drier, and this killed a lot of newly set out plants.

In spite of all problems, most plants have managed beyond expectancy. In most areas monitored by scientists (see Monitoring), survival rate is over 80 %, often more. Plants in unscarified areas seem to manage just as well as those set out in scarification patches. Oak has in most areas grown better than beech the first years, and some of the first planted oaks are already over one meter high. One explanation to this can be that beech was planted in too dense shelterwoods with birch and spruce. These shelterwoods have now been thinned, and they must be even more thinned to guarantee plant survival and growth. Hornbeam, lime and cherry are very vivid, but lime has been severely browsed in unfenced steep slopes. Maple, known as a “weed” once it has established, had more difficulties to grow in height.

Plant maintenance

During their first years, plants are especially sensitive for competitive vegetation. Consequently, in many areas with better soils, we performed yearly cuttings of grass, herbs and shrubbery to help plants through this critical phase. Young birch, that often grows very dense in clearcut areas, can also shade out the plants, why vast areas with birch have been

We planted totally 512402 plants. These are 290425 oak, 171875 beech, 25500 hornbeam, 17350 maple, 4850 ash, 1682 lime and 720 cherry.
It was sometimes hard to find the new plants, that were between 10 and 40 cm, in the high grown surrounding vegetation that should be cleared.

The result of sowing is very varying but the small beeches are very vivid in some patches three years from sowing.
thinned a first time in the project. Thinning must be repeated during coming years, creating a widely scattered birch forest which can be of help in regenerating the broadleaved forest.

Sowing

Sowing on forest land has not been executed on a wider scale in Sweden before. For us, sowing was a new experimental task where we wanted to test several different alternatives in small areas.

The first year we sowed beechnuts by hand in some spruce forests. Almost no seeds germinated but we gained valuable experience. Before the second year, the scarifying carrier was rebuilt as a sowing-machine. We also chose to sow some clearcuts and young birch forests instead of spruce forests. This gave a much better result. Three year after sowing, beech plants are growing in many of the scarification patches. The sowing-machine, constructed by the subcontractor, is unique and it was the first time beech was sowed in forest land by machine in Sweden. This product development has been received with great interest amongst scientists and forest owners.

As far as we experience, the most serious threats against sowing success is drought, shade, competitive vegetation and rodents eating the seeds. Research in the area also shows that mice are a big problem when sowing. Getting the beechnuts thoroughly into the mineral soil can be another problem if sowing by hand. A shelterwood of spruce used for sowing must be thinned hard to let in much light and enhance water supply.

A determining factor is handling of beechnuts. The seeds have to be immediately sowed, since germination deteriorates soon after.

The difference between browsed and fenced areas can be dramatic.
after they have been moved from the refrigerator, where they are stored during winter. It's also important that seeds are dry and to remove small twigs, seed-cases and other litter before sowing by machine, otherwise seed transport will be stopped.

Natural regeneration

Natural regeneration is an important part of forest restoration. In some clearcuts, regeneration is very rapid; others are dominated by grass for a long time. The first tree-species that establish are birch and rowan (*Sorbus aucuparia*). Then comes sallow (*Salix sp.*), black alder (*Alnus glutinosa*) and aspen (*Populus tremula*). Raspberry (*Rubus idaeus*) and blackberry (*Rubus fruticosus*) are early colonisers together with scarlet-berried elder (*Sambucus racemosa*) which are followed by bushes like alder buckthorn (*Frangula alnus*), hazel (*Corylus avellana*) and guelder-rose (*Viburnum opulus*). The natural regeneration was favoured by the game fencing. Regarding young plants, there is a significant difference between inside and outside fences, where browsing pressure is high.

Natural regeneration should primarily take place in the slowly phased-out spruce forests, in most cases without fences. By edges and in gaps of the thinned areas, we already see birch and rowan, but most of the forests ought to be thinned more in order to give enough light and water supply for new trees and bushes.

Game fencing

In order to protect new plants from browsing animals as moose, fallow deer, roe deer and hare, almost all plantations and sowings has been fenced. For environmental reasons, the fence posts have not been impregnated. The lower half of them was instead burned, to resist decay for a longer time than would untreated posts. The net is strong and resistant to corrosion and have smaller meshes nearer the ground to stop hares. It was folded by the ground to prevent animals to crawl or dig themselves in. The net was fixed to the posts with wooden beams, so it’s easier to dismount. At least two gates per fenced area were arranged in order to permit public access and ease future supervision, maintenance and work inside fences. Above the

Special constructed machinery that managed to work in rough terrain was used when fencing.
A fallow deer hesitates whether passing the open gate or not.

fence, a stripe was stretched to put off game from jumping over.

The storm in 2005 created many clear-felled areas that were too small to fence. In these areas we have built small net cages that can house one to three plants, which at least brings some trees to the spot.

In order to get as much benefit as possible for paid money, we have tried to get as much fenced area with shortest possible net length. Through putting the fence in straight lines, supervision and maintenance is facilitated. Consequently, some other forest land, wetlands and other areas outside action areas also has been fenced. In these areas, natural regeneration was favoured.

Fallow deer, roe deer and hare are effectively hindered by the fence, though hares have jumped in on a high covering of snow. A number of deers did also get into the fenced areas, but this mostly happened when fences were new and the game weren't used to them. The animals were preferably driven out but in rarer cases shot. Roe deer seems to be much easier to stress than fallow deer and should be treated more carefully. Because posts and net are often harmed when moose enters fenced areas, other animals can also find they way in. Badger has dug itself into most areas. Because of the strong smelling from the badger, it seems as hares don't use these narrow “gates”. If a wild boar wants to get in, it gets in. Boars have rather severely damaged the fence in many places. Roe deer seem to use these openings to get in. However, wild boars don't harm our plantations, but can instead contribute to variation and regeneration in the area. We therefore plan to build special designed gates for the boars.

Another problem is of course that trees fall over and damage the fence. Moreover, hikers sometimes leave gates open after passing through. The game soon find these openings and wild animals must not, according to Swedish law, be captured in fences even for a short time.

These experiences demonstrate the importance of regular supervision of the fenced are-
Since many of the mature trees are old, supervision of fences is necessary.


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as. Damages must be immediately repaired in order to prevent game from entering. Animals yet found inside fences must be driven out as soon as possible. Our goal is to control fences every third week.

**Monitoring**

Monitoring performed actions is necessary to follow-up if goals have been achieved. If not, monitoring should hopefully give the answers to why.

Within different actions areas, 12 lines have been placed out. Along these lines, circles of inventory were established, in which plant survival and height was examined as well as forest habitat regeneration. Planted trees that have been measured are oak, beech and hornbeam. Natural tree regeneration was also notified. Cooperating with scientists has been fruitful because, among other things, they currently shared their opinions on plantation management, which we then could change. The aim is that monitoring should continue until plants are established and have reached proper height.

All activities are of course documented in writing. We also carried out an over-all follow-up by photographing all areas before and after undertaken measures.

**Information and experience exchange**

In order to meet understanding and acceptance for project goals and actions in a nature conservation area like this, dissemination of knowledge and information to visitors and local public are important measures.

We have produced a brochure and mounted sign-posts about the project in the forest. We have also put up posters in the national park visitor’s centres. We have arranged public meetings and continuously informed me-

One of the most rewarding things has been to guide interested visitors in the project.
dia about our activities. Many different foreign and Swedish companies, schools, universities, organisations, authorities, projects and associations have paid us study visits, and we have given talks in other places.

All actions were filmed during the whole project period. The result is the film “From needles to leaves – a LIFE-Nature project in Söderåsen national park”, which can be watched in the visitor’s centres and from our and the EC websites, but also be ordered on DVD.

Experience exchanges with other people working within the same sector enhance our competence and disseminate knowledge about our results and experiences. We have arranged one network conference for all LIFE-projects in Sweden and Denmark, and one final project conference. We have visited other projects and research areas as well as participated in conferences and seminars, in Sweden and abroad.

The project had a reference group with members from the municipalities of Klippan and Svalöv, Mycological association of Skåne, Swedish University of Agricultural sciences, Swedish Species Information Centre, and the Swedish Society for Nature Conservation in Skåne. The group has been informed of project achievements at several occasions, and given us constructive feedback and advice.

We have spent much more time than predicted on dissemination of results and information about the project. The great interest has been very interesting and given us a good deal of positive and constructive response. The project was also highlighted in press and radio several times. In many study tours, the whole project group has been involved, because each member regards things from different point of views, which has positively developed our project. Our opinion is that experience exchange should be a very important part in all projects, to carry the work forward, add and spread knowledge and to develop the project group.

We have learned a lot through our exchange with scientists and practicians working with forest restoration; for example, we visited the Ravine WoodLIFE project in the United Kingdom.
Facts about the project

The LIFE-Nature project “Restoration of deciduous forest in Söderåsen National Park” (LIFE02NAT/S/8483) started the 1st of June 2002 and ended the 31st December 2006.

Original conditions:

The project area was 1070 hectares within the national park total area of 1625 hectares. When the project started, the project area consisted of:

- 126 hectares young and middle aged spruce forests,
- 142 hectares clearcut areas (former spruce forests),
- 57 hectares young birch forests,
- 700 hectares deciduous forest, wetlands and ravines with spruce undergrowth, and
- 45 hectares other foreign tree-species.

Performed actions by the end of the project: (areas partly overlap)

- 81 hectares spruce stands were thinned and will be successively phased-out in the future by thinning, leaving shelterwood and cutting of edges, gaps and corridors. (77 hectares remains after the storm 2005).
- 45 hectares of young spruce stands with a large proportion of deciduous trees were felled.
- In 700 hectares of deciduous forest, wetlands and ravines, spruce undergrowth was felled.
- In more than 45 hectares, foreign tree-species as sycamore maple, northern red oak, thuja, Nordman and Douglas fir, and larch were cut or controlled in some other way.
- 14 hectares were soil scarified by old-breed pigs.
- 66 hectares were soil scarified with a small eight-wheeled tool carrier.
- 229 hectares were planted with about 512 000 plants of oak, beech, hornbeam, maple, ash, lime and cherry.
- Experiments with sowing were executed with 385 kilos of beechnuts (about 1 500 000 pcs.) in 14 hectares.
- 71 hectares of the spruce forest were planted and 55 hectares will be naturally regenerated.
- 113 hectares of clearcut areas were planted and 29 hectares will be naturally regenerated.
- 44 hectares of birch forests were planted and 13 hectares will be naturally regenerated.
- More than 51 000 meters of game fence have been put up surrounding 258 hectares distributed on 56 areas, to protect against moose, fallow deer, roe deer and hare.
- Supervision and maintenance of all fences has been carried out every third week all year round.
- Clearing of grass and herbs around plants has been performed when needed in most fenced areas. Thinning of birch was carried out in 90 hectares.
- Monitoring on plant survival and growth and habitat recovery has been executed by scientists from Southern Swedish Forest Research Centre at the Swedish University of Agricultural Sciences in Alnarp, Sweden.
- About 1500 people have visited the project or been informed through lectures.
- We have visited other projects and participated in seminars and conferences in Sweden, Denmark, United Kingdom, Germany, Poland and Estonia
- We contributed to the implementation of the LIFE-Nature programme in Lithuania.
- We have produced a film about the project.
Budget

The total budget of the project was 1 761 086 Euro distributed on following actions: (16378100 SEK with changing rate 1 € = 9.30 SEK)

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<th>Action</th>
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<td>Soil scarification</td>
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<td>Norway spruce phase-out</td>
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<td>Cutting of spruce undergrowth</td>
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<td>Clearing around planted trees</td>
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The project was financed by the European Commission with 43%, the Swedish Environmental Protection Agency with 42% and the County Administrative Board of Skåne with 3%. The rest was financed through selling spruce timber.

Through the project, 3.5 new employments have been generated in 55 months.
Key figures for different actions (changing rate 1 € = 9.30 SEK)

**Game fencing**
fence and posts 3.02 €/m (28.09 SEK/m)
mounting 3.68 €/m (34.19 SEK/m)
gates (in average) 64.05 €/gate (596 SEK/gate) (218 pcs.)
Totally 6.97 €/m (64.82 SEK/m)

**Planting** average prices for 1, 2 or 3 year old plants.
Plants 0.388 €/plant (3.59 SEK/plant) incl. seed harvesting, stratification, nursing, storing and delivery
Planting 0.315 €/plant (2.92 SEK/plant)
Totally 0.702 €/plant (6.51 SEK/plant)

**Soil scarification with carrier**
322.6 €/hectare (3000 SEK/ha)

**Cutting spruce with carrier** (m³ = cubic metre solid volume excl. bark)
Motor-manual felling 2.7 €/m³ (25 SEK/m³)
Cross-cutting and limbing with carrier 6.4 €/m³ (60 SEK/m³)
Totally 9.1 €/m³ (85 SEK/m³)

**Motor-manual clearing of young birch forest**
235.5 €/ha (2190 SEK/ha)

Map showing the fenced areas and the remaining spruce forest in Söderåsen National Park.
What is NATURA 2000?

Natura 2000 is an ecological network of valuable nature areas that are of special conservation interest. Natura 2000 was created by member states within the European Union to prevent animals and plants from becoming extinct and to prevent the destruction of their habitats. The forming of Natura 2000 is one of the most important measures in order to conserve the European flora and fauna for future generations. This is the contribution of the European Union to realize the intentions stated in for example the Bern Convention and the convention on biodiversity. Natura 2000 requires all EC member states to take steps to ensure that natural habitats and species in the network receive "favourable conservation status". In Sweden, the county administrations are responsible for creating conservation plans to ensure the long-term protection and management of Natura 2000 areas. Söderåsen national park is such an area.

More information about NATURA 2000 can be found at the County Administrative Board of Skåne: http://www.m.lst.se/natura2000 and the website of the European Commission: http://ec.europa.eu/environment/nature/home.htm

What is LIFE?

LIFE, the Financial Instrument for the Environment, is the EC environmental fund that co-finances environmental initiatives. LIFE consists of three parts: LIFE-environment, LIFE-Nature and LIFE-Third countries. LIFE-Nature was set out specifically to contribute to the implementation of the Birds and Habitats Directives, in particular the Natura 2000 network. The last projects funded by LIFE started in 2006. LIFE will be followed by LIFE+, which will provide specific support for developing and implementing Community environmental policy and legislation, in particular the objectives of the sixth Community environmental action programme (EAP).

Read more about LIFE+ at the European Commission website: http://ec.europa.eu/environment/life/home.htm
Literature


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Restoration of deciduous forest in Söderåsen National Park

Establishing new broadleaved forest in Söderåsen National Park!

In order to enhance the natural prerequisites of a more diverse flora and fauna in the national park, we have since year 2002 started to phase-out Norway spruce and treat clearcut areas.

In more than 1000 hectares, we have been cutting spruce and other foreign tree-species, scarified clearcut areas, fenced against game and created future forests by planting oak, beech, hornbeam, maple, ash, lime and cherry, and by sowing beechnuts. The overall objective is that deciduous forests, mainly broad-leaved forest, should be established in all these areas in 20 years.

To create new broadleaved forests is a long-term commitment.

The initial phase consisted of a LIFE-project that was co-financed by EC environmental fund LIFE, Swedish Environmental Protection Agency and County Administrative Board of Skåne.

This book presents the LIFE-project in Söderåsen National Park.

Read more at www.nationalpark-soderasen.lst.se/life