



Close-to-nature forestry in Denmark

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Table 1. Different management approaches and their respective fulfilment of different specific management goals. The scale from 1 to 5 plusses, and '+' = low goal fulfilment, whereas '+++++' = high goal fulfilment.

Management approach	Plantation (production) approach	Nature-based (integrative) approach	Nature protection (conservation) approach
Specific management goals	Focus on timber production and direct economic outcome	Flexible wood production, nature protection and recreation	Strict forest reserves following natural structures and processes
Production of timber	+++++	++++	+
Economic outcome, long term	+++	+++++	+
Economic outcome, short term	+++++	+++	+
Production of quality timber	++++	++++	+
Biodiversity protection	+	+++	+++++
Protection of wetlands	+	+++	+++++
Ecosystem integrity	+	++++	+++++
Aesthetic qualities	+	+++++	+++++
Landscape integration	++	++++	+++++
Historical and cultural values	+	++++	+++
Space for public recreation	++	++++	++
Place of quietness/meditation	+	+++	+++++
Hunting qualities	+++	++++	+
Robust and resilient forests	+	++++	+++++
Flexibility to changing goals	+	+++++	+

Silviculture tool /Anticipated stand structure	Traditional plantation (production) approach	Modified Sustainable plantation approach	Nature-based Economic Production approach	Nature-based Nature Conservation approach
Clear cutting at rotation age Single tree/group harvesting	+++++ +	++++ ++	++ +++++	+ +++++
Planting or sowing Natural regeneration	+++++ +	++++ ++	++ ++++	+ +++++
Use of soil preparation No soil preparation	+++++ +	++++ ++	++ ++++	+ +++++
Use of pesticides Ban of pesticides	+++++ +	++ ++++	+ +++++	+ +++++
Use of exotic species Use of native species	+++++ +	++++ ++	+++ +++	+ +++++
Stand management Single tree management	+++++ +	++++ ++	++ ++++	+ +++++
Harvest when economic ripe Preserving old trees	+++++ +	++++ ++	++++ ++	+ +++++
Wood salvage Leaving dead wood	+++++ +	++++ ++	++++ ++	+ +++++
Draining for production Maintain wet habitats	+++++ +	++++ ++	+++ +++	+ +++++
Monoculture Species mixtures	+++++ +	++++ ++	++ ++++	+ +++++
Even-aged stands Uneven-aged stands	+++++ +	++++ ++	++ ++++	+ +++++

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Developing National Guidelines for Sustainable Forest Management (2001)

- **Nature based forestry (10 guidelines)**
- **Measures to additional support natural, social and economic values (3 guidelines)**

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Guidelines for functional integration = nature-based management

- **Ensuring production as basis for forest management**
- **Establishment of a broad supply of various products**
- **Use of locally-adapted species and provenances**
- **Promotion of species mixtures**
- **Promotion of natural regeneration etc.**
- **Improvement of forest structure**
- **Organic and biological plant protection**
- **Ecosystem-adapted wildlife management**
- **Ecosystem-adapted forest management techniques**
- **Registration, planning, information and training**



Guidelines for functional separation = nature-based management

- **Special measures to promote and ensure biological diversity**
- **Special measures to develop and protect recreational, social and cultural values**
- **Special measures to promote and ensure the economic "pillar" in sustainability (intensive production systems)**



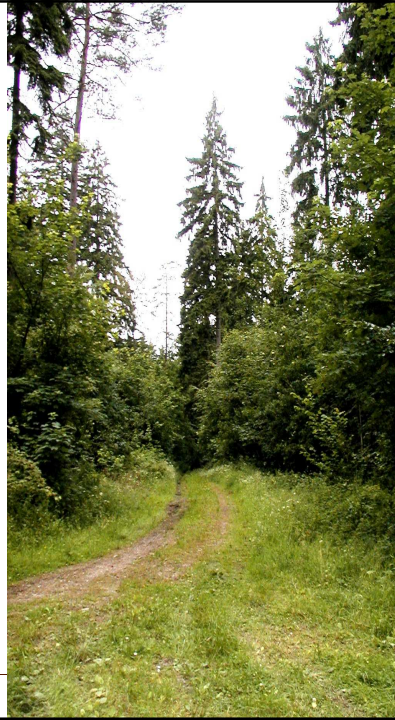


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Implementing the National Guidelines for Sustainable Forest Management – 2004

- The goals - where are we going?
- The ways - how are we getting there?

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MILJØMINISTERIET
Miljø og Natur

Danish National strategy - close to nature management

Handlingsplan
for naturnær skovdrift
i statsskovene

2005

- Basic principles for CNFM
- Forest Development Types
- Conversion
- Site classification
- Safeguarding production
- Biodiversity
- Natural hydrology
- Groundwater protection
- Natural vegetation
- Genetic resources
- Climate change
- CO₂-sequestering
- Landscape values
- Recreational values
- Historic and cultural values
- Ungulates
- Forest techniques
- Economical considerations

Close-to-Nature Forestry in Danish State Forests

What, How and When

2005

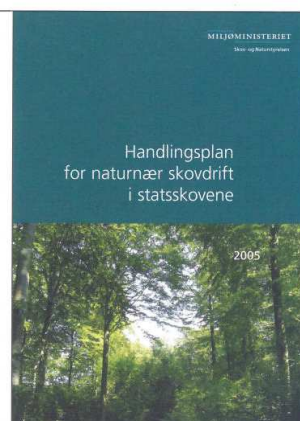
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An action plan for close-to-nature forestry

In 2002, it was decided to manage the Danish state forests, which cover an area of 110.000 ha, according to the principles of close to nature forestry. Close-to-nature forestry takes major consideration for animals and plants, opens opportunities for more recreational activities in the state forests, ensures continued production of quality timber, and it is hoped that it may also help improve the economy of forest management. Moreover, close-to-nature forests will be better than today's forests at withstanding storms and changes in the climate of the future.

In 2005, the Ministry of the Environment published an action plan for how the transition to close-to-nature forestry in the state forests is to be carried out (Action Plan for Close-to-Nature Forestry in Danish State Forests). This pamphlet briefly describes the contents of the Action Plan and the changes you will see in the Danish state forests. If you would like to read more about this, you can find the entire Action Plan on the website of the Danish Forest and Nature Agency. www.skovognatur.dk.

Minister for the Environment, Connie Hedegaard



The Action Plan for Close-to-Nature Forestry in Danish State Forests contains a description of close-to-nature forestry and a plan for the conversion of Danish state forests to this type of management.

What is close-to-nature forestry

The most important principles of close-to-nature forestry are:

- That the forest regenerates on its own, i.e. that seeds from trees are allowed to sprout and grow into fully-grown trees.
- That trees are felled individually or in small groups and not in large areas all at once.
- That predominantly indigenous tree species are used, which are adapted to the specific site.
- That different tree species are used and mixed.
- That pesticides are not used.
- That machinery is used in such a way that it does not damage the forest.

Close-to-nature forests will have:

- Better conditions for animals and plants.
- Good opportunities for outdoor recreation and protection of historical monuments and other heritage sites.
- Better resistance to storms and climate change.
- Better resistance to attacks by pests.
- Production of timber and better forest economy.



Close-to-nature forestry

– the forest regenerates on its own

Close-to-nature forestry uses many of the trees which sprout and grow naturally on their own. In comparison with current methods, this saves costs of planting or seeding new stands.

In order to encourage seeds to sprout and plants to grow, it is important to have a protected forest climate, and the new plants should not have to compete with grass. Therefore, in close-to-nature cultivation it is important to ensure that the forest is managed so that there are good opportunities for natural regeneration to occur and survive.



Close-to-nature forestry exploits the ability of the forest to regenerate naturally. In stands where the aim is to introduce specific species, these will still be planted.

Close-to-nature forestry

– trees are felled individually or in small groups

Instead of felling all the trees in large areas at once, trees will be felled individually or in small groups, once they have reached the most profitable size. Felling trees in this way avoids loss of forest climate and invasion by grass and weeds.

Regularly felling trees means small saplings are able to grow in the gaps so that stands come to comprise trees of different ages and size. This is beneficial for animal and plant species which depend on a continuous forest cover. Moreover, such stands will not be entirely destroyed by storms as only trees over a certain height are blown over. Therefore, there will always be small trees on an area which will be able to take over the space vacated by larger trees when they fall.



The ash is very quick to exploit the light resulting from a fallen tree. Its seeds spread easily and sprout rapidly, and under the right conditions the young saplings can grow by more than 1 metre per year.



Felling large trees opens the forest floor for light, and small saplings can grow up. As time goes by the new trees will completely “close the gap” left by the large tree.

Close-to-nature forestry

– indigenous and locally adapted tree species

Tree species such as beech, birch and ash will be more widespread in close-to-nature forests, as indigenous tree species are used more than they are today. Indigenous tree species are those which have migrated to Denmark since the last Ice Age. These tree species are particularly valuable for animals and plants, because they have many more dependent animal and plant species than the tree species we have introduced over the past couple of centuries, such as most of the conifer species.

Even though it is expected that the native tree species will be resistant to future climate change, the state forests will not concentrate on these species alone. This is because many introduced tree species thrive under Danish conditions. Also, introduced conifers are important for timber and other wood products. Therefore, conifers with great adaptation abilities towards climate change, for example the Douglas fir, will continue to be used. However, conifers will only be used in mixed stands together with deciduous trees. There will be much less Norway spruce in forests because Norway spruce cannot withstand the warm winters and strong winds expected.

It is important that tree species are used in the right places in the forests so that they can develop and regenerate in the close-to-nature forest. Knowledge of the content of water and nutrients in the soil is therefore very important. As a result, soil conditions in the state forests will be studied.



The oak migrated to Denmark more than 8,000 years ago. It is thought that more than 1,000 species of plant and animal use the oak as their habitat. For example, insects live on the oak's leaves, and birds eat acorns.

Close-to-nature forestry

– different tree species in stands

Instead of only having one tree species in the various stands in the forest, the close-to-nature stands will contain different tree species. This will provide a better regeneration climate and the forest will become more stable towards climate change and pests because one has “covered one’s bets” in the same stand. Using several different tree species also means several different wood products.

Tree species are not mixed at random. Stands are established with tree species which can grow together and not out-compete each other. Some stands will consist of tree species which can grow and flourish in shade, for example beech and silver fir, while other stands will be dominated by species which need a lot of light, for example oak, Scotch pine and larch.

Close-to-nature forestry will also ensure that there is more room for the tree and bush species which perhaps cannot supply wood products, but which are important for the forest climate as well as animals and plants.

Today, variation is very meagre in many Danish forests. Often, there are only few tree species and all the trees are equal in age. Such forests provide few habitats for animals and plants.



Open forest types contain tree species such as oak, Scotch pine and larch in mixed stands. Under the large trees, bushes thrive, because the open forest allows a lot of light to reach through to the forest floor.

Close-to-nature forestry

– no pesticides and environmentally friendly use of machinery

Pesticides have been used in forests to eliminate weeds and combat pests in order to give trees the best chance of surviving and growing. Use of pesticides harms many animals and plants, which it is actually not intended to harm, e.g. the wood anemone. In order to protect the groundwater as well as animals and plants, pesticides are therefore not used in close-to-nature forestry.

In fact there will be no need for pesticides in close-to-nature forestry. A better forest climate will mean that the previous problems with weeds on the forest floor no longer arise. Use of mixed tree species will also mean that pests will not have as great an impact as they will only attack one tree species in the stand.

If heavy machinery is driven around in the stand, it will impede possibilities for the forest to regenerate itself, because the machinery will destroy the forest floor and damage small trees and saplings. Using machinery is important for the economy of forest management and the working environment of forest workers, but in future machinery will operate on fixed tracks in the stands in order to avoid damage to the forest floor.



Wood anemones are very sensitive to pesticides. It will take many years for wood anemones to return after spraying in just one year.

Close-to-nature forestry

– greater consideration for animals and plants

One of the goals of close-to-nature forestry is to make sure that the decline in the number of animal and plant species in forests is reversed and that conditions are improved so that species which are rare today will again become more common. A large number of animal and plant species have disappeared or are endangered because traditional forestry has destroyed their habitats.

- Drainage has meant that water holes and bogs have disappeared and thus important habitats for many species depending on these wetlands have been lost.
- Several species depend on open nature areas in the forest but there are not many such areas in forests today.
- In traditional forestry no old trees are allowed to remain standing until they fall of old age. Such dead trees are important for many insects, fungi and birds.
- Most forest organisms depend on the special climate under the tree canopy and cannot withstand its sudden disappearance. When forests are managed by felling all the trees in a stand at once, many animal and plant species are lost.



In close-to-nature forestry, many of the forests' wetlands are restored and open nature areas are established, e.g. woodland meadows. Furthermore, more indigenous tree species are used and more old trees are allowed to remain unfelled in stands. When large trees are felled, new trees will grow in

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Close-to-nature forests

– outdoor recreation and protection of cultural heritage

Close-to-nature forests will be interesting and exciting places to visit, and there will still be good access by roads and paths and opportunities to experience the forest. There will be contrast between light and open stands, and darker forest types, and all forests will also contain completely open areas suitable for resting and picnicking.

Restoration of lakes and bogs and retaining the old trees will also make the forest more attractive.

The state forests contain a large number of heritage monuments such as burial mounds, high-ridged selions, and other cultural remains. Close-to-nature forestry allows better opportunity for protecting these ancient monuments. This is partly because machinery must keep to fixed tracks. Efforts will also be made to make heritage sites more visible, for example by clearing and by using open forest types in areas rich in cultural heritage.



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Close-to-nature forests

– better at withstanding storms and climate changes

One of the goals of close-to-nature forestry is to establish forests which are not destroyed by storms and which can withstand the climate change we expect to make an impact over the next 100 years.

During the past century, and in Denmark as recently as 2005, forests have been hit by storms which lay waste to vast areas. Storm damage has often been extensive because forests are composed of stands with just one tree species and trees of equal age and height. Therefore the entire stand is at risk when the trees reach a height where the wind can uproot them. Storms have been especially destructive for coniferous stands because conifers have 'leaves' in the winter, when storms usually occur. Deciduous trees, on the other hand, have no leaves in the winter and also larger and deeper roots.

Within the next 100 years, it is estimated that climate change will lead to higher temperatures and more storms. It is likely that there will also be changes in precipitation. In current forest management only one or two tree species are used in an individual stand, and in some regions only a handful of tree species are used in the forests. If the climate changes to the detriment of these tree species, there may be catastrophic consequences for the forests.

Close-to-nature forests will be better at withstanding storms and climate change. This will be done by mixing different tree species as well as young and old trees in the stands and by using more deciduous trees.



Storms can cause enormous damage to stands of just one tree species. At worst the entire stand or forest can be destroyed by a single storm.

Close-to-nature forests

– good at withstanding attacks from pests

One of the goals of close-to-nature forestry is to establish forests with a natural balance between the forest and its pests.

Just as with storms, a number of different insects, fungi and other organisms can destroy large areas of forest. Specific pests are usually linked to a single tree species, and are a natural part of plant and animal life. But when, as in the past, we only plant one tree species across a large area, damage can be extensive.

Close-to-nature forestry mixes different tree species within the same stand. Using tree species which are adapted to the specific site also ensures that the trees are healthy, and this will help make them more resistant to pests.



Today, the large pine weevil is a great problem for young conifers when re-establishing coniferous forests. The weevil gnaws at the young trees' bark, which weakens, or at worst kills the tree. There are many examples where weevils have killed almost all the saplings across even large areas.

Close-to-nature forestry

– timber production and better forest economy

Close-to-nature forestry will continue to produce high quality wood.

Profitability of producing wood has gradually weakened. For example, more timber is entering the Danish market from Eastern Europe, and this has pushed prices down.

The destructive storms have also put pressure on timber prices. Although we cannot control the wind and weather, much of the damage is due to the way in which we manage the forest. Furthermore, there are large costs involved in producing the wood. When we replant forests, we prepare the ground before planting and saplings are planted by hand or machine. Moreover, the saplings often require care for several years if they are to survive their fight against, e.g. weeds. If we are only getting a low price for the wood and if we are spending a lot of resources on planting and caring for the stands, the economy is at risk.

Establishing a more stable forest, which is not as vulnerable to storms, will ensure better profitability for close-to-nature management. Moreover, natural regeneration is also applied so that costs of planting are avoided. One of the goals of close-to-nature forestry is therefore to secure a better balance between costs and revenues.

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What will the forests look like?

Close-to-nature forests will have:

- Many more deciduous trees than today
- Young and old trees mixed together
- Permanent forest cover
- More dead wood
- More wetlands
- Far more variation

When clear-cutting is no longer practiced, but single trees are felled instead, small gaps will arise from where new trees will grow. Forests will quickly become more wild in appearance, where stands are composed of both old and young trees. When ditches are no longer cleared out, more wet areas will appear in the forest. Many old trees will be allowed to remain standing and this will provide more dead wood for the insects, fungi and birds. Overall there will be greater diversity in the forest and it will become a more interesting and exciting place to visit.

Today, coniferous forest makes up 63 per cent of the state forests total forest area. In future, many of these coniferous forests will be converted to deciduous woodlands or to a mixture of coniferous and deciduous species.

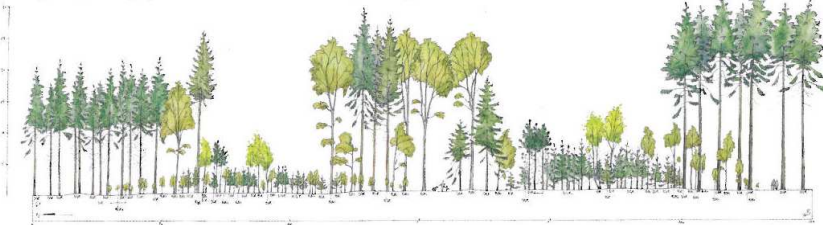
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Forest development types

Before changing management of a forest, it is important to consider which tree species will in the long run be best adapted and thrive in the area. Therefore different objectives have been set for how the close-to-nature forest can be configured. These objectives are called forest development types.

A catalogue describing 19 different forest development types has been prepared. The catalogue is available at www.skovognatur.dk. In future years forest development types will be designated for all forested areas in state forests. The choice of forest development type will depend on the site and the soil as well as the objective of forest management in the individual area. The individual forest will comprise several different forest development types.

Douglas fir, Norway spruce and beech / Forest development type 61



Examples of different forest development types. The choice of forest development type will depend on the soil and climate and the objective of management of the specific area. (Illustrations, Anders Busse Nielsen)

How will conversion be carried out?

