University of Copenhagen

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FACT SHEET 1
Biodiversity in managed Forests

Planning and prioritization

Planning and Prioritization

WHERE IN THE FOREST?

Throughout the forest

In forest where production takes high priority, biodiversity considerations primarily revolve around utilizing opportunities to maintain or create small habitats and stepping stones for demanding species without significantly affecting production. Open natural habitats and wetlands in the forest are under Danish law protected under Forestry Act §28, even if they are not registered and have a smaller area than the area limits that apply in the open landscape.

Obvious Measures:
- Promotion of dead wood in ongoing forest management (FS 3 - Measure 1)
- Regeneration and planting with a focus on promoting native tree species (FS 2 - Measures 2 and 3)
- Buffer zones around wetlands (FS 4 - Measure 2)

Management Zones

In many forests, you can find small light-open habitats or groups of veteran trees, which, due to their age and continuity, have great value for biodiversity but are threatened by overgrowth, inappropriate forest management, or lack of successors. Targeted nature conservation may be necessary here to secure the current values.

Obvious Measures:
- Maintenance of veteran trees and veteranization (FS 3 - Measures 2 and 4)
- Securing biodiversity in and around wetlands (FS 4, Measure 2-5)
- Management of open habitats (FS 5, measure 2 and 3)

Restoration Zones

If you have ambitions to increase natural values through the conversion of managed forests, active restoration can achieve faster results than can be achieved through passive management. Nature restoration makes the most sense in areas adjacent to existing valuable nature and in areas where there are already existing natural values to build upon.

Obvious Measures:
- Active creation of dead wood and veteranization (FS 3 - Measures 3 and 4)
- Planning for wetlands and light open natural areas and the establishment of new forest glades (FS 2 - Measure 1)
- Establishment of forest grazing and new meadows (FS 5 - Measure 1 and 4)
- Restoration of natural hydrology (FS 4 - Measure 1)

Minimum intervention zones

Areas with particularly high natural values, including swamp forests and old stands, are best protected through very extensive or complete cessation of management. The same applies in forest edges and buffer zones along wetlands, seacoasts, lake margins, and riverbanks, except for stands with high values associated with open conditions.

Obvious Measures:
- Bring out the hammock
- Learn about the fungi, plants, and animals in the forest

Five Fact Sheets (FS) have been published on biodiversity in forests. See titles on the back cover.

A fictitious forest map containing some of the most common elements in Danish forests. The designated zones represent areas in the forest where different measures are particularly suitable. Depending on the level of ambition, the effort can be narrowed down or expanded.

General considerations

To plan for higher biodiversity in the forest, a detailed mapping of natural values, threats, and potentials is a prerequisite. Based on this, you can prioritize spatially, set objectives, and choose relevant tools to maximize the biodiversity gain. The planning zones shown on the map provide a general idea of the overall natural conditions and potentials in different parts of the forests.

STEP 1

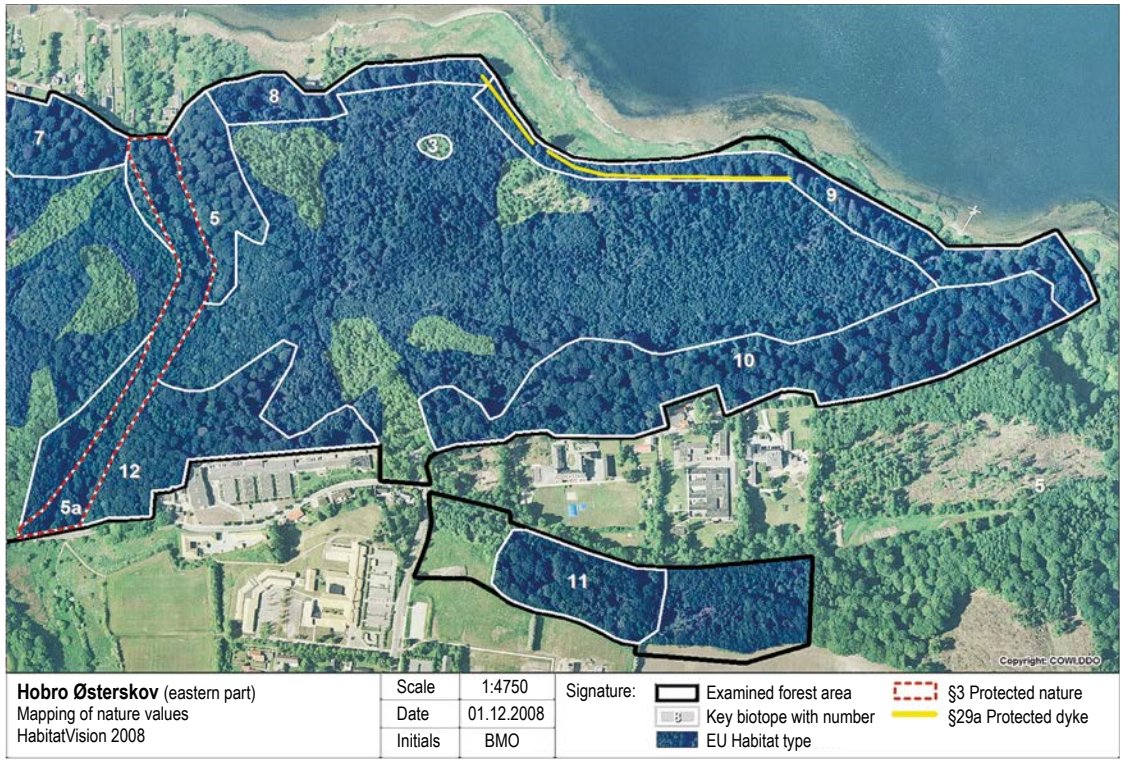
Mapping

What?

Mapping of natural values is an important basis for a good nature plan and a requirement for FSC- and PEFC-certification. Relevant knowledge includes data on forest history, habitats, biodiversity, and threats. Forest continuity and the presence of certain habitats, e.g., veteran trees, are easy to map for most people with a forestry background. Conversely, mapping species in a way that makes sense for management requires specialized expertise, and many skip this part. The same applies to mapping threats. The most obvious threats to forest biodiversity are the loss of valuable stands during logging, overgrowth of open habitats, and the loss of values associated with veteran trees due to the lack of successors and encroachment..

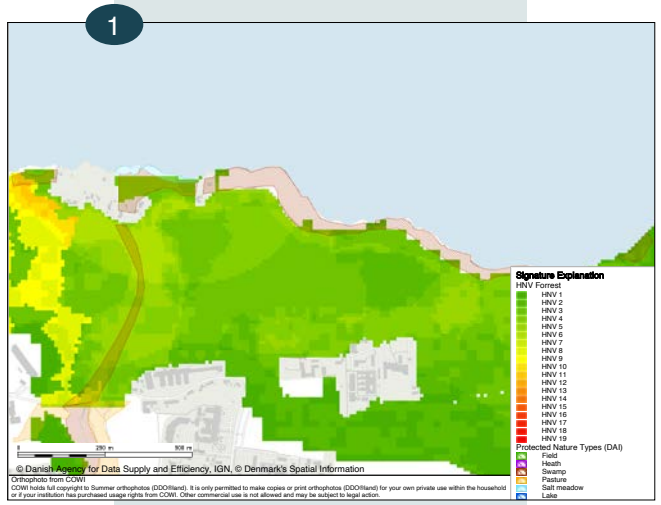
Where and when?

The first step in mapping natural values is to check existing data on the internet regarding protected habitat types, historical use, and known occurrences of valuable nature. The next step may be to involve local experts, including the municipality's nature managers, and translate the collected knowledge into physical or electronic maps. However, if you are planning for a nature-friendly forest, it is advisable to take one more step, and seek professional expert assistance for mapping key biotopes in the forest. Such mapping should not only illuminate the local natural values in the forest but also the landscape context and threats to the current natural values.



Mapping of nature values provides an optimal foundation for planning for increased biodiversity. Key biotopes with special nature values are numbered and delineated with white lines, while red and yellow markings indicate protected nature. The example is from Hobro Østerskov.

1



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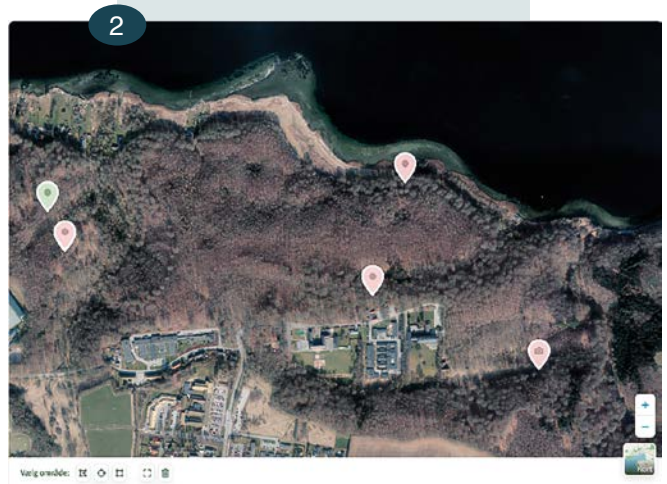

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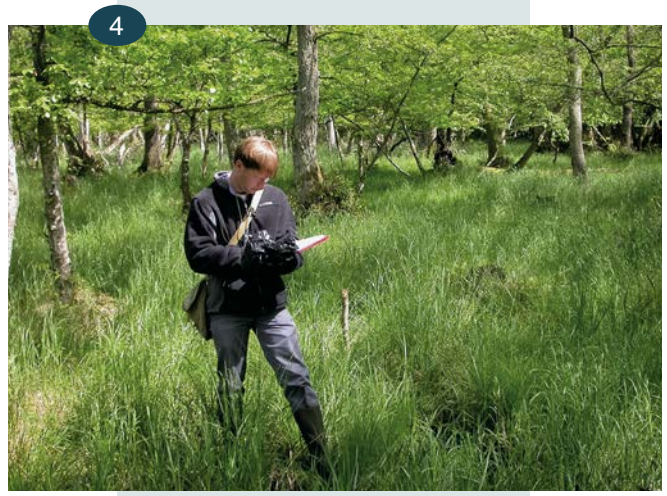


1. Data on protected nature and nature qualities can be found online (see sources on the back) and can provide insights into current nature values and their historical background. The map shows High Nature Value (HNV) forest and protected nature types from Hobro Østerskov. As shown, the HNV map captures only to a limited extend the key biotopes, which were mapped in the field based on forest structure and indicator species (see the map on p. 4).

2. Species registrations based on professional monitoring and mapping as well as the efforts of volunteers can be found on www.arter.dk. Setting the right filters, you can create a map showing local registrations of, for example, red-listed species, as shown here for Hobro Østerskov. Registration activity is unevenly distributed across the country, and the lack of registrations cannot be translated into the absence of nature values.

3. Involving local experts is appropriate for anchoring your nature efforts in the local community. A logical first step is to contact the municipality to clarify how your ideas align with local nature planning. You can also involve local naturalists with expert knowledge of specific groups of species, but do not expect these individuals to possess professional knowledge of nature management.

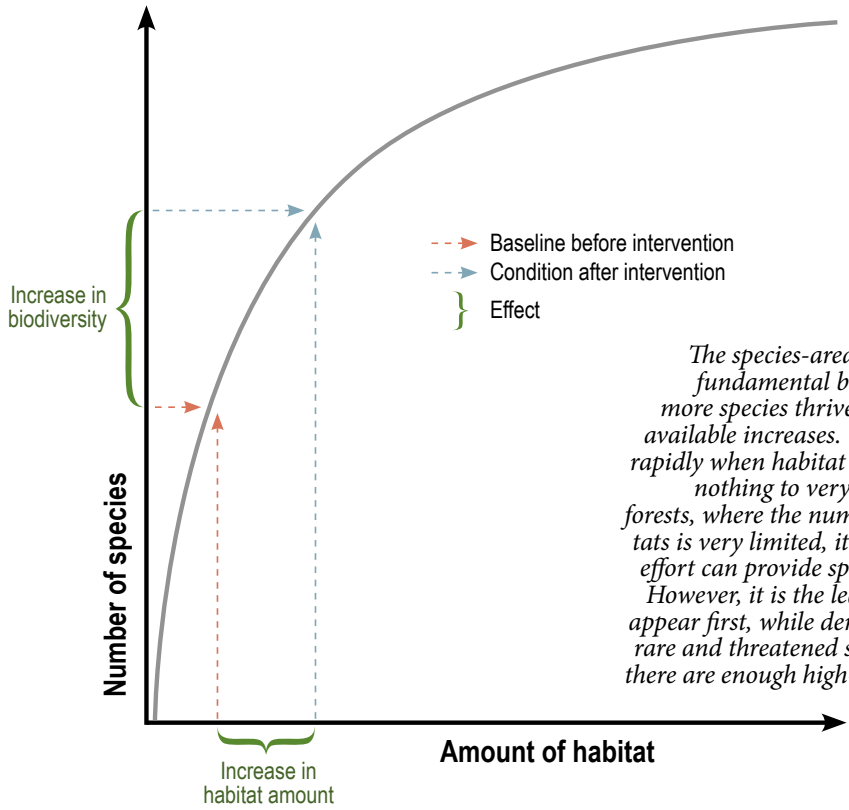
4. Professional assistance for mapping nature values, such as mapping key biotopes, is essential if you want to ensure the best starting point for protecting or promoting biodiversity. Here, nature values are mapped directly in the forest, based on factors like forest structure, the presence of specific habitats, and indicator species that can provide insights into soil conditions and forest history.

STEP 2

Objectives

What?
Defining concrete objectives for nature is necessary if ambitions are to be translated into measurable results, and it is a requirement for certification according to FSC and PEFC standards. The certification schemes' objectives focus on biodiversity areas, forest edges, high stumps, old trees, and dead wood, but these are formulated in very general terms. It is advisable for forest owners or managers (certified or not) to define more precise objectives for biodiversity in time and space. To balance production and nature objectives, it is often advantageous to be very specific about which stands should meet which goals, rather than focusing on general goals for the entire property.

Where and when?
The formulation of objectives should be based on mapped nature values, as described in Step 1. This way, you can prioritize the existing nature values in the forest and handle threats to them. Objectives can be formulated in various ways depending on targeted habitats and species groups, and depending on the overall approach to management. In general, it makes sense to differntiate 1) quantitative objectives, which focus on area sizes, the number of habitats (e.g., old trees), or quantities (e.g., dead wood volume), and 2) quality objectives, which focus on the extent to which the prioritized habitats in reality increase biodiversity.



The species-area curve describes one of the fundamental biological laws, namely that more species thrive as the number of habitats available increases. The increase happens most rapidly when habitat amount shifts from almost nothing to very little. Applied to managed forests, where the number of many natural habitats is very limited, it means that even a modest effort can provide space for many more species. However, it is the least demanding species that appear first, while demanding species (including rare and threatened species) only move in when there are enough high-quality habitats available.

1. Area goals are suitable for wetlands, open natural types, and unmanaged forests, and are part of both FSC- and PEFC-certification. Area objectives can also be used to set limits for intensive production areas with exotic tree species.

2. Countable goals are suitable for habitats that can be counted, such as old trees.

3. Quantitative goals are suitable for habitats that can be quantified, such as volume of dead wood.

4. Qualitative goals are important if you want to promote more demanding species. However, they are often more abstract and can be demanding to quantify. The best quality goals are based on selected demanding species or species groups that provide insights into habitat quality. For example, the presence of the rare and critically endangered lion's mane (Hericium erinaceum) reflects significant natural qualities.

STEP 3

Spatial prioritization

What?

Spatial prioritization translates the overarching nature objectives into a concrete and area-differentiated effort in the forest. Prioritizing biodiversity typically involves a greater or lesser loss of production, a so-called trade-off. In practice, these trade-offs mean that biodiversity efforts typically take place where the production potential is low, e.g. wetland forests, benefiting the selection of species thriving in such areas. If the ambition is to increase biodiversity more substantially, it's necessary to also intervene where biodiversity values are highest, even if this may result in more significant production losses. Prioritization should, as previously mentioned, start with a mapping of the natural values in each forest. However, as described on the facing page, a set of rules of thumb can be followed in the absence of such mapping.

Where and when?

Spatial prioritization should take place in parallel with the definition of objectives (see Step 2) and can advantageously follow the "fireman's law." According to this, the first step is to secure areas containing significant natural values. Next is to protect and enhance areas with high natural potential, while natural restoration of less valuable areas and the creation of new nature come in third place. Spatial prioritization should consider local values as well as a landscape perspective, prioritizing natural qualities typical for the landscape where the current forest is located. For example, it is logical to support open habitats in a conifer plantation in Jutland rather than planting deciduous tree species that haven't grown in these landscapes for generations.

Design principles	Size	Number	Proximity	Connectivity	Form
Better	Larger	Single	Concentrated	Connected	Circular
Worse	Smaller	Multiple	Widely dispersed	Isolated	Linear

All else being equal, it is advantageous for designated biodiversity zones to be as large, well-connected, and circular as possible. This provides most coherence between various ecological functions in the zones and minimizes adverse edge effects. Based on Diamond (1975).

1. Outer forest edges are generally narrow and nutrient-rich due to nutrient input from agriculture. This limits their natural value and potential. The greatest natural values are typically associated with old sunlit veteran trees and standing dead wood, the presence of insect-pollinated shrubs, and in some cases, a rich, light-demanding flora.

2. Inner forest edges and transitions to open or wetland areas are less affected by nutrients compared to the outer forest edges. Moreover, they typically have a more humid microclimate and better opportunities for dynamic development since they are not squeezed between production forests and agricultural land. They have significant natural potential and should be a high priority in biodiversity planning.

3. Wetlands in the forest often have high natural value while having limited production potential. This results in a relatively low trade-off and makes them suitable for prioritization in a biodiversity plan. Many wetlands have historically functioned as open areas for grazing or haymaking and can potentially be restored as open habitats if a valuable flora still exists, surpassing the forest-associated values in the area.

4. Minimum intervention and restoration zones should be placed in areas where high natural values already exist. This could be particularly old stands with dead wood, forests on heavy clay or calcareous soils, slopes, or hilltops with well-developed mor soils as well as stands facing wetlands.

5. Steppingstones in the form of small groups of veteran trees, scattered tree ruins, or small areas with wet or open nature can help species spread between larger core areas with high natural quality. Steppingstones should be prioritized to connect core areas rather than being randomly placed in the forest.

STEP 4

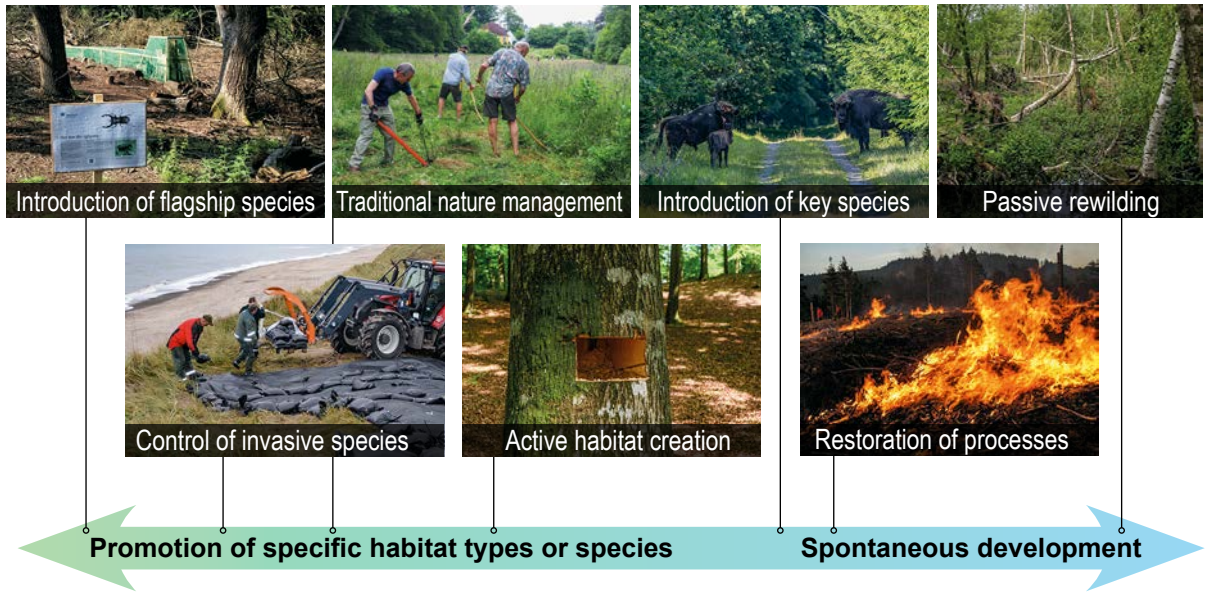
Selection of measures

What?

Measures and practical initiatives translate the overarching objectives into reality in the forest. In general, you can distinguish between interventions focusing on i) restoring natural qualities through a targeted, often short-term effort, ii) ongoing active management to maintain and improve natural qualities typically associated with light open conditions, iii) adjusting ongoing forest management to create more space for biodiversity, and iv) cessation of drainage or active forest management with a focus on allowing more wild nature in selected areas.

Where and when?

The choice of measures should reflect a combination of biodiversity ambitions, identified values/threats, and the forest manager's approach to management, e.g. related to the use of mechanical interventions. Active management and restoration is particularly relevant where threats to existing natural values are identified, such as overgrowth or the lack of new veteran trees. Adjusting forest management practices or discontinuing drainage or active management is, on the other hand, a suitable option if the general goal is to enhance biodiversity more broadly.



In nature management, a wide range of measures can be employed, some of which may focus on supporting natural processes, while others may have a narrower goal of promoting (or combating) specific species or habitat types. The latter often lead to disappointment and can be costly because they typically involve countering natural processes.

1. Passive interventions, where you simply let vegetation grow without intervention, reduce long-term revenue but involve very few operating costs and are, all else being equal, the cheapest means of promoting biodiversity. This intervention is particularly suitable in wetlands, forest edges, and older deciduous and mixed forests without obvious values associated with light open areas.

2. Adjusting forest management to create more space for biodiversity can include reduced clean-up after storm damage, reduced thinning, reduced maintenance of drainage ditches, or active creation of high stumps and leaving trees and tops during harvesting.

3. Restoration focus on restoring natural habitats and processes that are completely or partially lost. In practice, this can involve restoring natural hydrology, natural grazing impacts, or promoting the formation of veteran trees through active interventions.

4. Active management is particularly relevant where valuable open areas in the forest would become overgrown without targeted mowing, burning, or grazing. In populated areas, one can collaborate with grazing or mowing associations, which can take on part of the maintenance and supervision task.

STEP 5

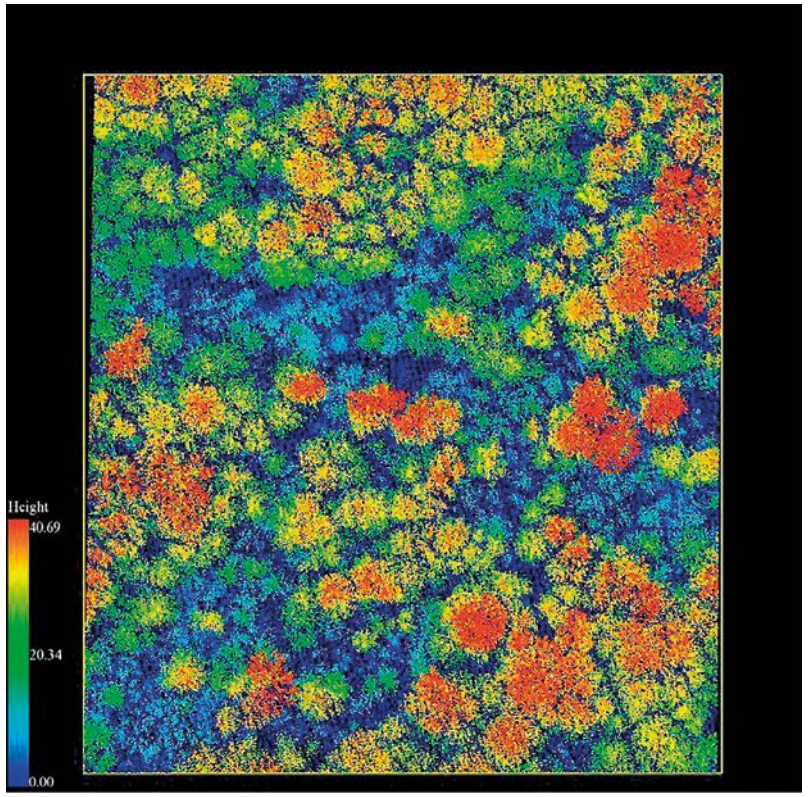
Monitoring and follow-up

What?

In its simplest form, monitoring involves measuring selected indicators that can illuminate whether the management meets the set objectives. It can involve measuring whether the amount of dead wood or the number of high stumps matches the planned targets. Or determining the extent of light open areas or water levels in restored wetlands. If you are more ambitious or curious, it is relevant to gain insight into the effects of the chosen measures. Do they actually benefit local biodiversity? It is obvious to involve selected species and species groups in monitoring to shed light on whether biodiversity has responded to the implemented measures.

Where and when?

The main purpose of monitoring is often to check if defined objectives have been fulfilled, but monitoring is also a very suitable means to learn more. It can satisfy curiosity and, most importantly, provide input for adjusting management if it turns out that the chosen measures have not yielded the expected results. Ideally, a baseline should be established before initiating changed management, so that the initial state of nature can be documented. Depending on the measures used, the development can then be monitored annually or at longer intervals. Forests are generally slow ecosystems, and unless there is a targeted conservation or restoration plan, monitoring every 10 years is often sufficient.



LIDAR is a laser-based approach to measuring physical structures, which is increasingly being used for documenting forest structure. It is currently mainly used in national monitoring, but in the near future, it may also become an important tool in local monitoring. The colour codes indicate tree heights in a section of an unmanaged forest in Suserup Skov.

1. Habitat goals can be easy to set, such as area, quantity, or quantity goals, as discussed in Step 2. Quantity goals are generally preferred as they provide a better insight into the quantity of habitats. It is more precise to measure the quantity of standing and fallen dead wood than to count the number of ancient trees or calculate the area of unmanaged areas.

2. Species often have specific habitat requirements and are good at indicating whether nature conservation efforts are bearing fruit. In open habitat types, vascular plants and butterflies are obvious indicators of habitat quality, while beetles and insects associated with dead wood and veteran trees reveal the quality of habitat.

3. Own monitoring of simple habitat measures, such as the amount of dead wood, the number of veteran trees, plant diversity, or the degree of overgrowth, can be performed by anyone with a forestry background with a little training.

4. Involving volunteer naturalists cannot replace professional monitoring but can provide important insights into habitat quality and development, especially if you want to anchor your management in the local natural history community.

5. Expert assistance is essential if you want to conduct professional biodiversity monitoring that provides a deeper insight into whether the implemented measures have been effective. Species groups for monitoring should be selected carefully based on the measures to be evaluated.

BACKGROUND

Significance for forest biodiversity

Forest management requires overview, long-term planning, and flexibility in dealing with the opportunities and challenges that arise due to insect attacks, changes in the timber market, and other unforeseen events. The same applies to the management of forest biodiversity. Here too, it is important to have an overview of the property's values and an overall, long-term plan and direction in management while being open to the opportunities that arise unexpectedly, due to storm damage, fungal attacks, or changes in biodiversity support schemes.

Status

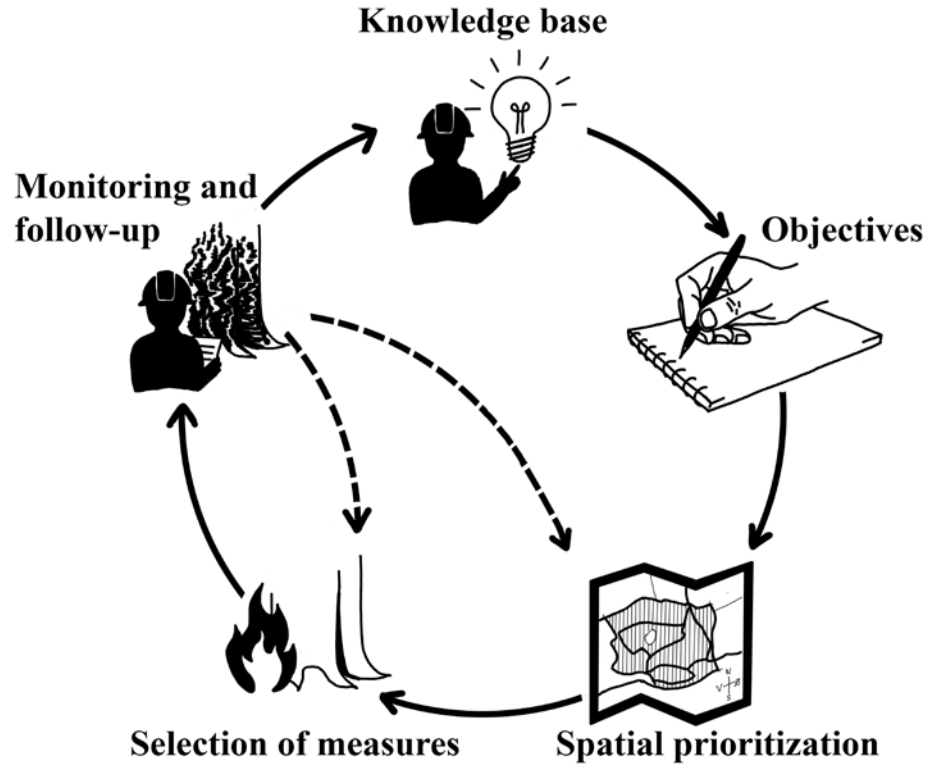
While planning for the forest's productive functions is a classic discipline, planning for biodiversity is relatively new. The task is complex, and the results of the effort cannot be quantified in monetary terms but must be measured in terms of species and habitats. Forests are complex ecosystems, and there are no simple and reliable methods to measure biodiversity comprehensively. Therefore, it is challenging to plan how best to promote biodiversity and subsequently document the effects. Typically, it will be necessary to work with various goals and indicators tailored to the level of ambition, natural qualities, and potential in each forest.

Photo: Karina Tybjerg

Restoring hydrology is one of the most effective and quickly acting measures if you want more light, water, and dead wood in the forest for the benefit of biodiversity. Other measures, such as ensuring valuable open habitats in the forest, require careful planning and the choice of the right tools.

Overall prioritization

The first step in biodiversity planning is to determine the approximate level of ambition for the effort. Should biodiversity be a primary purpose of management, or is the goal to ensure that forest management does not harm nature more than absolutely necessary? For most forest managers, the level of ambition lies between these extremes. The specific tools described in this fact sheet provide suggestions on how to plan your effort depending on the level of ambition and resources and are intended as a broader foundation for the other fact sheets in this series. The tools are presented in steps that reflect the most obvious sequence in the decision-making process.



Ideally, nature management should be based on a well-planned procedure where a series of logical steps ensure that you achieve the maximum biodiversity for your efforts and that you can adjust management as you become more knowledgeable.

CENTER FOR MACROECOLOGY,
EVOLUTION AND CLIMATE
UNIVERSITY OF COPENHAGEN

FACT SHEET 1
Biodiversity in managed forests

Planning and prioritization

1: Planning is key for a serious effort to enhance biodiversity in the forest.

2: Start by mapping existing natural values and threats to them.

3: Translate the acquired knowledge into spatial plans and objectives.

4: Then choose concrete measures that can implement the objectives.

5: Make a monitoring plan if you want to follow up on objectives and adjust management.

MAKE A DIFFERENCE for forest biodiversity

Five fact sheets focus on specific measures that can promote forest biodiversity.

1. Planning and prioritization
2. Afforestation and regeneration
3. Dead wood and veteran trees
4. Wetlands
5. Glades, forest meadows, and transitions zones

Front cover photo: Casper Tybjerg.
Uncredited photos are by Jacob Heilmann-Clausen.
Graphic design: TTF ApS / Karina Tybjerg

Read more

Villard, M. A., & Jonsson, B. G. (eds.)(2009). Setting conservation targets for managed forest landscapes. Cambridge University Press.

Online resources:

Species: https://arter.dk/ (access to nearly 50 million species observations, with tools to search for local records of red-listed species, etc.)

The Digital Nature Maps 2021, including the Biodiversity Map (protected nature, HNV, and biodiversity map, a large catalogue of aerial photos)

Danmarks areainformation: https://arealinformation.miljoeportal.dk/ (some overlap with the above, but with more advanced background maps and planning layers)