

A photograph of a forest landscape. In the foreground, a large, weathered log lies horizontally across the bottom of the frame. Behind it, a field of green grass and small plants is visible. In the background, a dense forest of tall, thin evergreen trees stretches towards the horizon under a clear blue sky. A single, taller, more slender tree stands prominently in the center of the image, slightly to the left of the log.

Roadmap for the wood processing industry

More biodiverse forests

Biodiverse nature is the foundation of the forest bioeconomy

The significance of biodiversity is emphasised more strongly and extensively than ever before. The importance of viable and biodiverse nature as a safeguard for every person, society and the economy is well understood.

Native tree species form the basis for viable forest ecosystems. Wood from forests is used as a raw material for renewable and globally valued products. At the same time, forests sequester carbon, provide habitats for the majority of our native species and produce various ecosystem services. Finnish forests are also open for the public to enjoy the nature.

The current state of forests is the result of the combined effect of the climate after the last ice age and the use of forests. The most recent factors that have affected the use of forests have included slash-and-burn agriculture, the intensification of forest management and the transition that has been underway since the 1990s that has highlighted the importance of different values of forests.

This roadmap is a strong expression of the will of the wood processing industry to take care of Finnish forest nature, to strive for nature positivity in its operations and to contribute to the achievement of international and national biodiversity goals. The roadmap is also an invitation to forest owners, various sectors, policymakers and NGOs to engage in dialogue as well as an initiative for increased cooperation with research organisations.

The roadmap is based on an extensive research project that surveyed the current state and future development of forest biodiversity as well as key ways to promote biodiversity as part of the forest management. In addition, the survey assessed opportunities provided by technology in monitoring biodiversity. The research served as a foundation for analysing the effectiveness and direction of the work carried out in managed forests.

By many indicators, forest biodiversity has seen positive development in recent decades. Future scenarios show that the actions we are already familiar with will promote this positive trend. This is an important and encouraging finding that prompts the continuation and further improvement of the work carried out by Finnish forest owners and the entire forest sector for the benefit of biodiversity.

Information is the basis for safeguarding forest nature

Forest biodiversity can be promoted in various ways at different stages of forest development. Valuable habitats are safeguarded, and forests treated in such a way that they provide habitats for an increasing number of species. Actions for biodiversity have been carried out in our managed forests on a large scale since the 1990s when the national Forest Act and the Nature Conservation Act were reformed, forest management recommendations were updated, and global forest certification schemes landed in Finland. At the same time, area of protected forest has multiplied.

The activities are supported by nationwide inventories. The over 100-year-old National Forest Inventory has been developed since the 1980s to increasingly describe the changes taking place in structural features important for forest biodiversity. Extensive vegetation inventories, thus far carried out four times for forest species, provide information on changes in vegetation. The development and regular implementation of national monitoring and inventories will also be important in the future when verifying the effectiveness of actions for biodiversity.

Roughly half of the native species in Finland are forest species. So far, there have been three assessments of threatened native species in Finland. Threatened species are an important indicator in describing the state of forest nature.

In addition to national inventories, forest operators collect information about forests in different ways in connection with forest planning, fellings and monitoring their own activities. A strong knowledge base is needed both for understanding the effects of the operation and for its further development.



Many ways to increase biodiversity

Valuable habitats

Valuable habitats are areas that are usually quite small in scale, serving as a habitat for a set of species that differs from the rest of the forest. The prevailing conditions in valuable habitats are different, especially in terms of water conditions and nutrition. These habitats include the surroundings of springs and streams as well as some herb-rich patches. Safeguarding valuable habitats maintain species whose presence is limited to or clearly focused on these sites.

Retention trees and dead wood

Retention trees are trees that are permanently spared in the forest in regeneration and intermediate fellings. They die and decay at their own pace. The impact of retention trees can be seen at stand level in the species dependent on different tree species, in the species living in old trees and in the species dependent on dead wood. In Finland, there are thousands of dead wood dependent species. In addition to living retention trees, existing dead wood is spared at different stages of forest growth. Over time, dead wood can be produced at an accelerated pace with the use of high biodiversity stumps, in other words stumps that are 2–5 metres tall. A significant number of dead wood dependent species also live and multiply in sawn stumps and crown wood left behind after felling.

Protective thickets

Protective thickets are dense, small-scale groups of brush and trees of varying sizes, left untouched in forest management. Thickets provide shelter and food for example for forest birds and mammals. Protective thickets are good to place close to groups of retention trees.

Riparian buffer zones

Riparian buffer zones are spared along the edges of water bodies of different types to promote water conservation, forest and aquatic biodiversity and scenic values. Buffer zones often host different species than the surrounding forest, and over time, they also produce large-diameter trees and dead wood.

Tree species diversity and mixed forests

Compared to tree stands with single species, mixed forests increase the biodiversity of forest nature. Native tree species together with all the species that depend on them form the basis of our forest ecosystems. By diversifying the tree species composition, we can promote the health of forests and their adaptation to climate change as well as their resilience against forest damages.

Decades of work pays off

Measures to strengthen the state of nature in connection with forest management have been carried out for about 30 years. At the same time, the area of protected forest has multiplied. The effects of these measures and restrictions are often not visible until after a long time. Therefore, structural and species-related changes are only partially visible in our forest nature today.

The desire of the wood processing industry to invest in Finland has long encouraged forest owners to take care of the vitality of forests and increase forest resources. The volume of growing stock on forest land (forests available for wood supply and protected forests) has increased by 50 per cent over the past 40 years. The positive trend is visible in various tree species. The volume of broad-leaved trees has almost doubled in southern Finland (Figure 1). Aspen, which is important for biodiversity, has doubled its volume. The volume of birch and several rare broad-leaved tree species has also increased. The risk for future forests is that the young forests in southern Finland have become dominated by spruce.

The extensive introduction of forest certification in Finland has made retention trees part of forest management. Mainly for this reason, the volume of living trees spared on clear felling sites has almost tripled in our managed forests over the past 30 years (Figure 2). The total volume of large-diameter trees has increased, almost doubling in southern Finland, since the 1980s (Figure 3).

The volume of standing and lying dead wood has increased in southern Finland (Figure 4). Nowadays removal of dead wood is avoided in felling, and retention trees are left on felling sites, leading to increased amount of dead wood in forest in the long term. The amount of dead wood in northern Finland has decreased in both forests available for wood supply and protected forests as there has been no large-scale storm damages for decades in the north. However, the latest inventories show that the downward trend has come to a halt.

In addition to actions for biodiversity, various forest management methods affect the state and development of forest species. The changes in soil scarification with methods that disturb the soil less has improved the growth and spread of subshrub plants. The coverage of bilberries, lingonberries and crowberries have taken a positive turn from the 1990s to the present day. The coverage of glittering wood-moss and red-stemmed feathermoss has also increased.

At the same time, the decline of wetland species has continued as the bogs drained in the last century have dried up resulting in a vegetation similar to that on mineral soils. For example, several sphagnum moss species as well as bog bilberry and cloudberry have decreased in coverage.



DEVELOPMENT OF STRUCTURAL FEATURES

■ southern Finland ■ northern Finland

Figure 1 BROAD-LEAVED TREES

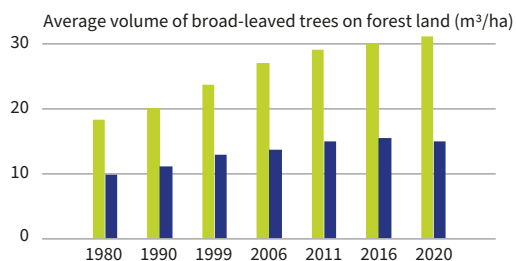


Figure 2 TREES ON CLEAR FELLING SITES

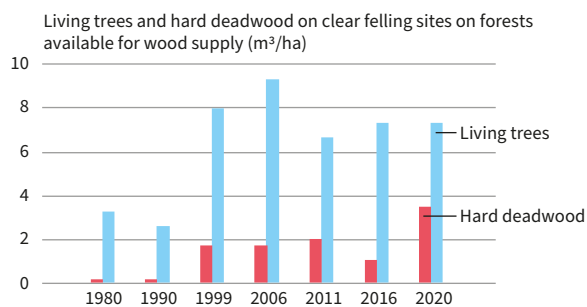


Figure 3 LARGE-DIAMETER TREES

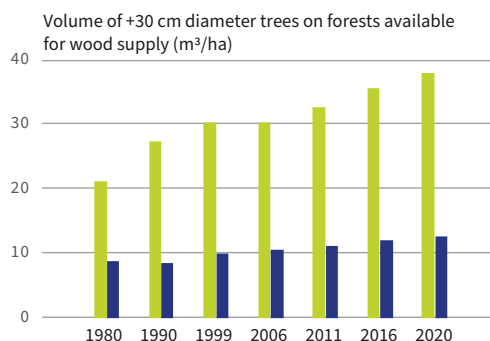


Figure 4 DEADWOOD

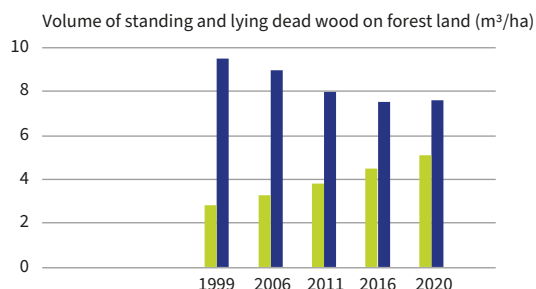


Image by: Vastavalo, Hannu Rämä

Bilberry, a well-known species living in herb-rich and mesic heath forests as well as spruce bogs, has become more abundant in recent years. Bilberries can also be found in sub-xeric and fjell forests. It is the primary subshrub of coniferous forests in Finland.

Bilberry is not only a tasty food plant for humans; it also has a great impact on a variety of plants and animals. For example, the larvae of at least 140 species of butterflies feed on bilberries.

Positive development of biodiversity continues towards 2050

The adequacy and interrelationships of actions for biodiversity were reviewed and assessed using scenario calculations. Scenarios describe a possible future vision based on predetermined assumptions. The results show that targeted measures as part of forest management can significantly increase the structural features important for forest biodiversity.

Forest certification is an integral part of Finnish forestry, covering more than 90 per cent of our managed forest area. The updated national FSC and PEFC forest management standards that came into force in 2023 will have an impact on the state of biodiversity in Finland. The standards encourage, for example, the addition of broad-leaved trees at different stages of forest management, which will be visible in the future as an increase in the volume of broad-leaved trees (Figure 1) and the diversification of the tree species.

The number of retention trees may increase by tens of millions of trees (Figure 2). In 2055, our forests may contain up to twice the number of retention trees compared to the current state. This is partly reflected in the number of large-diameter trees (Figure 3).

The same positive trend can be seen in the volume of standing and lying dead wood (Figure 4). It may even double. Currently, there is an average of 6,6 m³ of dead wood per hectare on forest land (forests available for wood supply and protected forests, National Forest Inventory 13). Measures in managed forests play an important role in achieving the goal of the

National Forest Strategy 2035 by increasing the total amount of dead wood towards 10 m³ per hectare.

The diversity of dead wood is examined in terms of tree species, size categories of the stems and rates of decay. Based on this, dead wood is expected to diversify in terms of quality significantly, which will improve the conditions for species dependent on dead wood in future forests.

Renewed forest certification practices produce great results in the development of structural features important to biodiversity. Even more positive results can be achieved by intensifying the selected actions. Higher targets for increasing the number of broad-leaved trees and the quality and quantity of retention trees will develop the structural features in a positive direction.

The diverse needs and expectations targeted at forests require not only the promotion of biodiversity, but also the strong growth of forests. The key conclusion of the scenario reviews is that the goals of wood production, forest-related climate goals and goals related to the state of nature can be reconciled when the investments in forest growth are also stronger than at present. In the studied structural features, the conflict of objectives is only reflected in the decrease in the amount of dead wood with a small diameter in managed forests, which is not the most significant factor from the biodiversity point of view.

FUTURE SCENARIOS OF THE DEVELOPMENT OF STRUCTURAL FEATURES

SC1 SC2 SC3 SC4

Figure 1

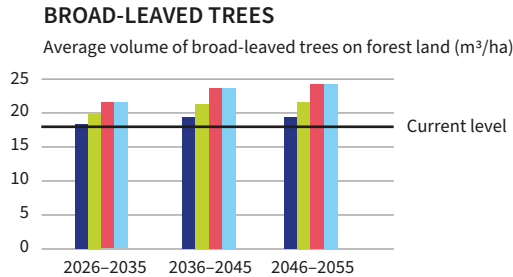


Figure 2

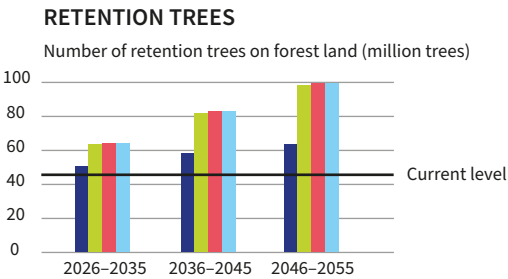


Figure 3

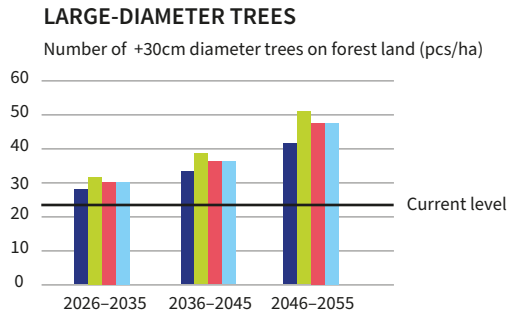


Figure 4

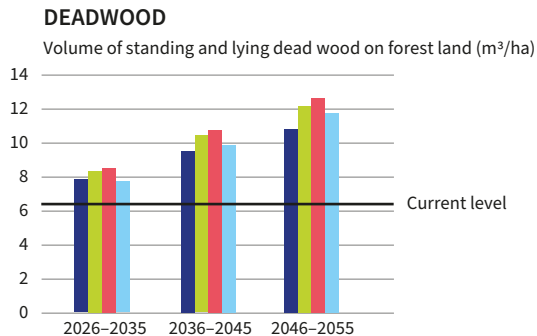


Image by: UPM

Predetermined assumptions for the scenarios

Scenario 1 (SC1): FSC and PEFC forest management standards in force until 2023

Scenario 2 (SC2): FSC and PEFC forest management standards in force since 2023

Scenario 3 (SC3): Enhanced actions, over SC2 in terms of broad-leaved trees (20%), number of retention trees and buffer zones.

Scenario 4 (SC4): SC3 and the additional measures concerning forest growth and management restrictions in the Finnish forest industry’s climate road map¹.

The scenarios include the current areas of protection and areas with limited wood supply, as well as additional protection objectives in accordance with the national voluntary METSO and Helmi programmes (90,000 ha).

The scenarios are derived from the maximum sustainable yield of commercial timber and energy wood (Natural Resources Institute Finland)

¹ <https://bit.ly/46CpbOL>

Diverse forests improve the status of many threatened species

Forest species benefit from introducing structural features typical of natural forests to managed forests. Safeguarding valuable habitats and increasing the proportion of old trees, dead wood and broad-leaved trees produce habitats for both the common and threatened species.

In the most recent assessment of threatened species in Finland (2019), 833 forest species (9%) were assessed as threatened. Almost half of all threatened forest species live in herb-rich forests. However, herb-rich forests account for less than two per cent of the total forest area. In addition to herb-rich forests, a large number, about 13 per cent, of threatened forest species live in sun-lit forests – in other words sunny and dry habitats – even though their total area is very small. Actions targeting these habitats can improve the status of threatened species significantly. Effective prevention of forest fires has reduced fire habitats and the species dependent on them. These species benefit from controlled burning after felling and the burning of retention tree groups.

Species have different temporal reactions to measures targeting structural features. Some of the actions affect the species almost immediately after implementation, while the positive effects of other measures will be visible only after years or decades. For example, safeguarding a valuable habitat benefits its species immediately. Valuable habitats change over time, and the species living in them also change.

Species dependent on dead wood can be maintained by sparing existing dead wood in forest management, by preparing high biodiversity stumps and by ensuring the future dead wood with the help of retention trees. For example, the decaying fungus, *Trametes trogii* thrives on aspen retention trees in their early stages of decay. On the other hand, increasing the habitats required by certain species dependent on dead standing pine trees requires a lot of time, as the decay of pine as a dead standing tree and then downed wood can take hundreds of years.

It is estimated that at least half of the threatened and near-threatened species in boreal heath forests can survive in forests of different ages as long as there are enough old living trees and dead wood, which are important structural features for them. Some species only thrive if they are surrounded by old-growth forests.

The effectiveness of actions to promote biodiversity can be increased by improving their quality. Actions are important to be taken in places that yield the greatest benefits. For example, leaving retention trees in groups provides better shelter for several species, compared to individual retention trees. This effect is increased by placing retention trees and protective thickets close together. In areas close to water bodies, the retention trees can be placed in the riparian buffers zones, thus promoting the habitat of species dependent on moist conditions.



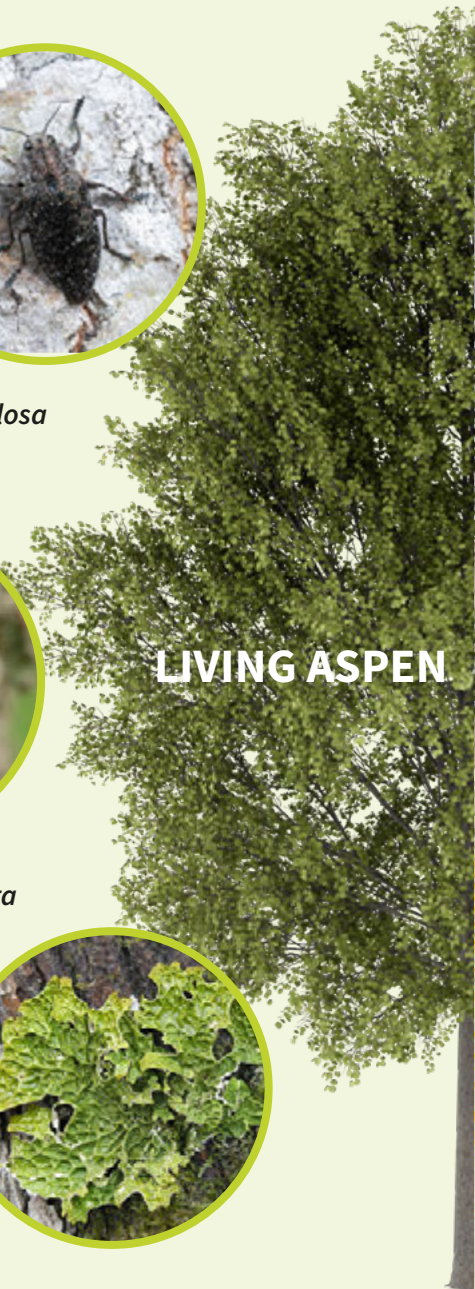
Poecilonota variolosa



Protaetia marmorata



Lobaria pulmonaria



LIVING ASPEN



White-backed woodpecker



Saperda perforata



Antrodia mellita



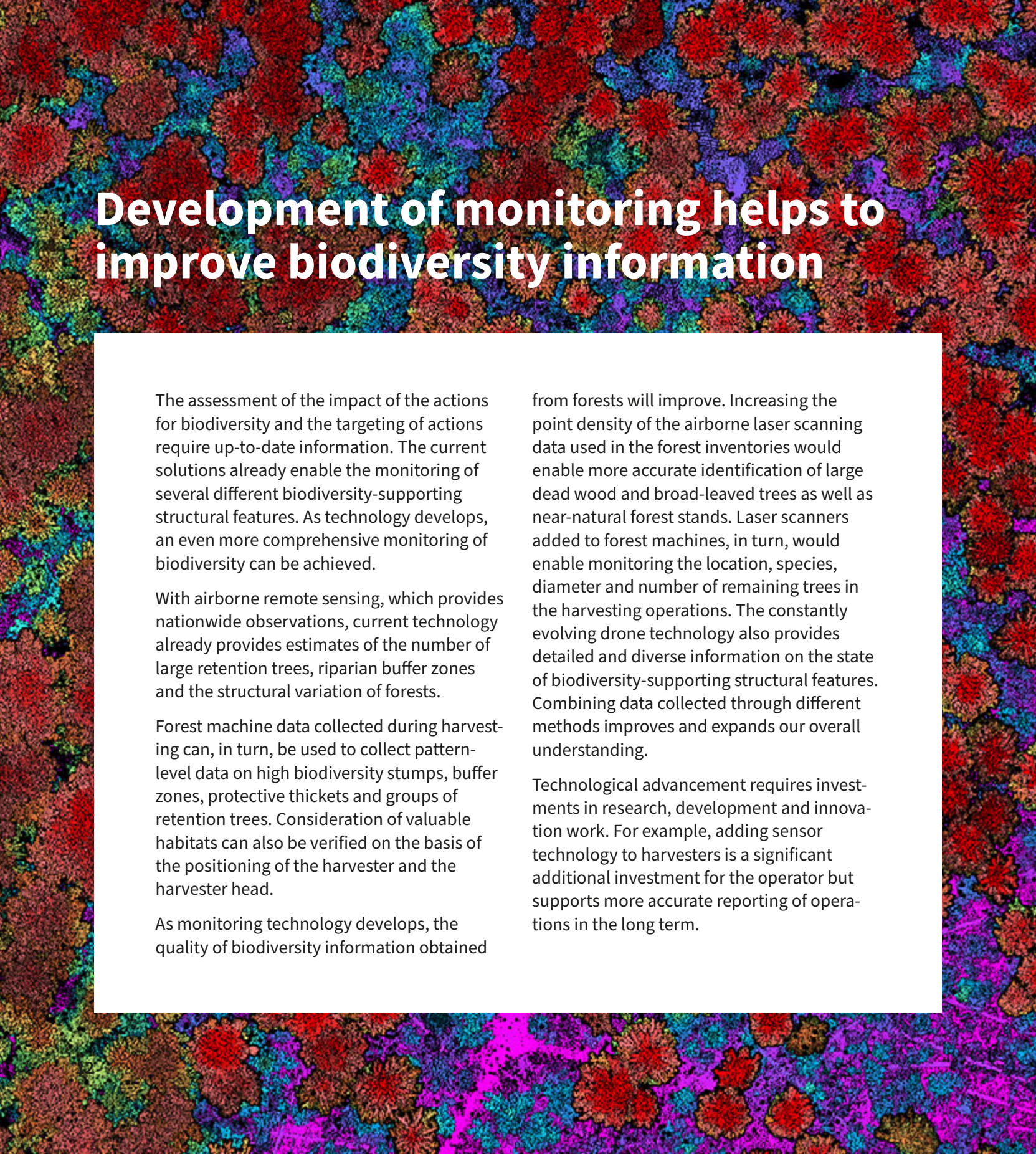
Funalia trogii



DEAD ASPEN

Aspen is an important tree species in terms of biodiversity. There are hundreds of species that depend on living and dead aspen.

Images: Natural Resources Institute Finland; Juha Siitonen, Shutterstock; Henri Lehtola, Henrik Larsson, Vastavalo; Esa Ervasti, Esa Borén and Henri Koskinen.

An aerial photograph of a forest canopy, where different colors represent various tree species or structural features. The colors include red, blue, green, and purple, creating a mosaic-like pattern. The text is overlaid on the upper left portion of this image.

Development of monitoring helps to improve biodiversity information

The assessment of the impact of the actions for biodiversity and the targeting of actions require up-to-date information. The current solutions already enable the monitoring of several different biodiversity-supporting structural features. As technology develops, an even more comprehensive monitoring of biodiversity can be achieved.

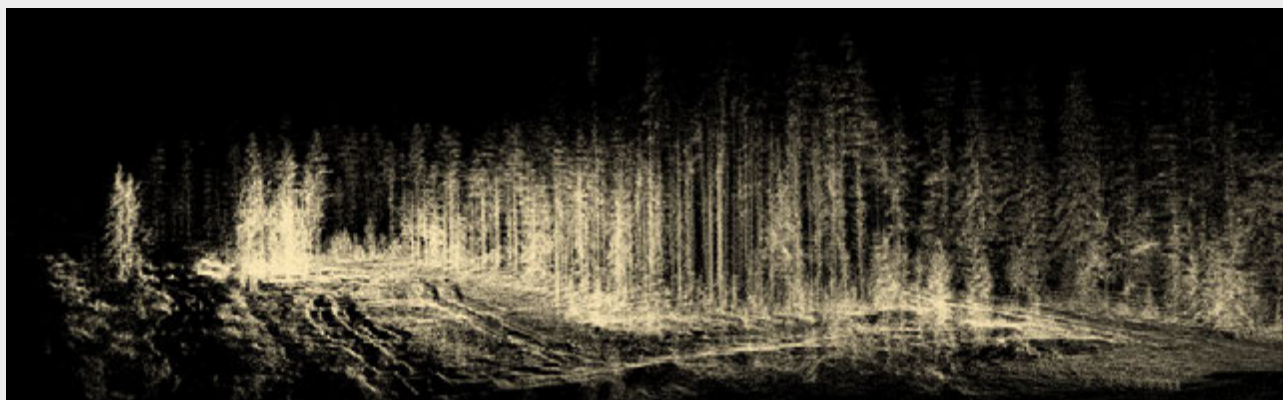
With airborne remote sensing, which provides nationwide observations, current technology already provides estimates of the number of large retention trees, riparian buffer zones and the structural variation of forests.

Forest machine data collected during harvesting can, in turn, be used to collect pattern-level data on high biodiversity stumps, buffer zones, protective thickets and groups of retention trees. Consideration of valuable habitats can also be verified on the basis of the positioning of the harvester and the harvester head.

As monitoring technology develops, the quality of biodiversity information obtained

from forests will improve. Increasing the point density of the airborne laser scanning data used in the forest inventories would enable more accurate identification of large dead wood and broad-leaved trees as well as near-natural forest stands. Laser scanners added to forest machines, in turn, would enable monitoring the location, species, diameter and number of remaining trees in the harvesting operations. The constantly evolving drone technology also provides detailed and diverse information on the state of biodiversity-supporting structural features. Combining data collected through different methods improves and expands our overall understanding.

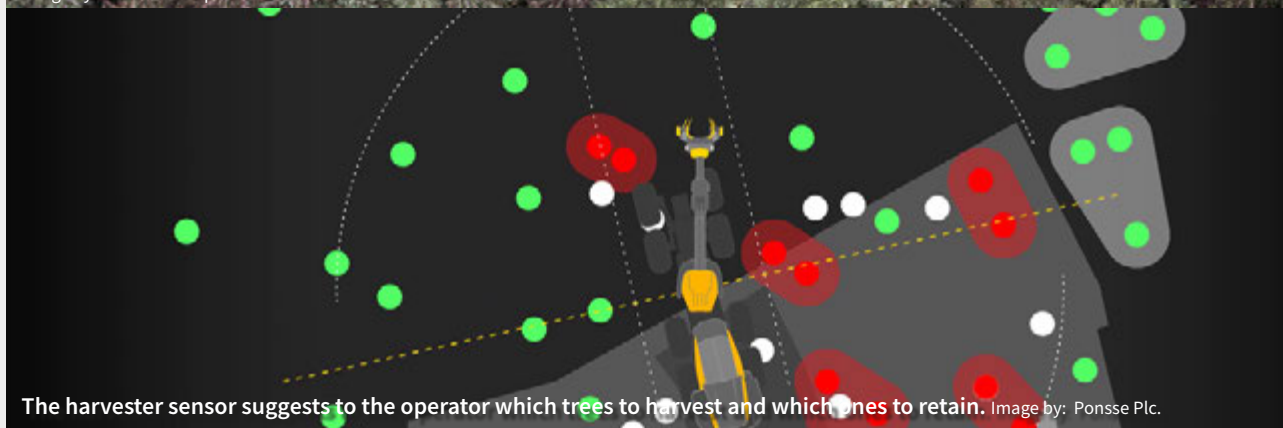
Technological advancement requires investments in research, development and innovation work. For example, adding sensor technology to harvesters is a significant additional investment for the operator but supports more accurate reporting of operations in the long term.



The point cloud, laser scanned from the harvester, describes the structure of the tree stand. Image by: Ponsse Plc.



The multispectral camera depicts the proportion of tree species and the health of the tree stand.
Image by: Finnish Geospatial Research Institute.



The harvester sensor suggests to the operator which trees to harvest and which ones to retain. Image by: Ponsse Plc.

Roadmap of the wood processing industry shows the way

Everyday choices in managed forests play a key role in promoting biodiversity. Both by developing measures and improving quality, it is possible to increase the positive effects on nature. Five main practical themes have been selected for this roadmap, all of which have been studied to have a significant impact on biodiversity. We present both everyday forest management measures and factors that contribute to practical implementation. In addition, we highlight development needs for the forest sector, researchers and policymakers.

1

Tree species diversity

Diversifying the proportion of tree species by increasing the share of broad-leaved trees and a number of rarer tree species.

2

Quantity and quality of dead wood

Ensuring sufficient dead wood resources for forest species. Increasing the amount and diversity of standing and lying dead wood.

1

Competence

2

Cooperation

3

Technology

4

Information and research

5

SHARED MOTIVATION AS THE BASIS FOR ACTION

3

Valuable habitats

Safeguarding valuable habitats in forest management and promoting voluntary conservation.

4

Herb-rich forests and sun-lit habitats

Identifying herb-rich forests and sun-lit habitats in commercial forests and increasing their biodiversity values with management.

5

Fire habitats

Increasing fire habitats by implementing controlled burning and nature management-related burning.

Actions for biodiversity and enablers

Promoting biodiversity requires the integration of environmental objectives into everyday activities. The entire value chain of forestry and wood processing must share the common goal of more biodiverse forest nature. Engagement starts from top management and runs through the entire organisation. Cooperation, evolving know-how and a better knowledge base inspire everyday activities where research and technology provide invaluable help.

1. DIVERSIFYING TREE SPECIES COMPOSITION

- Increasing the share of broad-leaved trees and mixed tree stands in regeneration, tending of seedling stands and intermediate harvestings, as well as in the retention tree stands
- Sparing broad-leaved trees that are fewer in numbers, such as aspen and goat willow, as retention trees in forests of all ages
- Aiming for a natural tree species composition in riparian buffers zones and valuable habitats

Development needs

- Ensuring the availability of high-quality reproductive material for birch cultivation and breeding resources for other broad-leaved trees as well
- Increasing research on optimal tree species composition for climate resilience and biodiversity
- Drawing up guidelines on the ecological quality and allocation of the retention trees

2. INCREASING DEAD WOOD AND IMPROVING QUALITY

- Sparing naturally generated dead wood, both standing and lying, and leaving part of the forest residues behind
- Increasing the effectiveness of retention trees by placing them in groups and allocating them to the sites with most potential
- Increasing the number of high biodiversity stumps in places where there is not enough dead wood

Development needs

- Better preserving dead wood, ascertaining the causes of destruction and finding ways to improve the situation
- Investigating the long-term effects of retention trees and high biodiversity stumps
- Developing practical retention tree guidelines to improve quality and allocation

3. SAFEGUARDING VALUABLE HABITATS

- Safeguarding valuable habitats as referred to in the Forest Act and forest certification and monitoring implementation
- Focusing actions for biodiversity in connection with valuable habitats
- Contributing to the protection of most valuable sites through the METSO programme

Development needs

- Clarifying the classification of nature sites, as well as the delimitation and handling instructions
- Developing and regularising the collection of biodiversity information and the implementation of monitoring
- Promoting the establishment of a national nature information centre to ensure the uncomplicated sharing of nature information

4. IDENTIFYING HERB-RICH FORESTS AND SUN-LIT HABITATS AND INCREASING THEIR BIODIVERSITY

- Implementing a management action plan for herb-rich forests to help



identify and manage different types of conserved herb-rich forests and those in commercial use

- Diversifying the tree species, especially in southern Finland, by reducing the number of spruce trees
- Implementing a management action plan for sun-lit habitats to help identify and manage these habitats
- Increasing the amount of dead wood in both herb-rich forests and sun-lit habitats

Development needs

- Drawing up a national programme for herb-rich forests to survey the location of them and to develop management measures for different herb-rich forests
- Drawing up a national programme for sun-lit habitats to survey their location and to develop the necessary actions

5. INCREASING FIRE HABITATS

- Increasing controlled burning related to forest and nature management.
- Maintaining a fire continuum by concentrating burning on areas where the forest has recently burned or where forest sites have been recently burnt
- Controlled burning of sun-lit habitats

Development needs

- Promoting the analysis of bottlenecks in controlled burning and their dismantling
- Communicating the biodiversity benefits of using controlled fire

1. INCREASING COMPETENCE

- Promoting the expertise of personnel and cooperation with forest owners, contractors, entrepreneurs and employees in the sector, the logistics chain and customers to strengthen biodiversity competence
- Ensuring up-to-date practical guidelines for putting research data and emerging methods into practice

Development needs

- Making the goals of forest owners visible from planning to implementation, identifying bottlenecks in data transfer and ensuring the availability of personal guidance
- Ensuring the availability of up-to-date nature information from the authorities

2. INCREASING COOPERATION

- Enhancing the cooperation with forest owners and various operators in the forest sector to mainstream actions for biodiversity
- Deepening the cooperation with NGOs and expanding cooperation across industry boundaries
- Promoting the functioning of the Forest Biodiversity Round Table by encouraging cooperation across the sector

Development needs

- Creating a constructive and inviting culture of discussion to ensure a balanced dialogue

3. INVESTING IN TECHNOLOGY

- Developing the verification of impacts and practical operations with the help of monitoring technology
- Promoting the diversification of nature information collected by remote sensing, forest machines and other new technologies

Development needs

- Collecting nature information sourced from different sources in one place

4. EMPHASISING KNOWLEDGE AND INTERDISCIPLINARY RESEARCH

- Contributing to the development of economically and socially sustainable biodiversity solutions through multidisciplinary research
- Utilising research data in practical measures, for example by updating guidelines and operating instructions

Development needs

- Reconciling and developing national follow-up studies

5. REINFORCING MOTIVATION

- Raising awareness of the importance of biodiversity
- Highlighting the importance of the health and adaptability of forests in ensuring timber production capacity, the development of wood products and the profitability of forestry

Development needs

- Better identifying different sources of motivation

We are on the right track

– we can all make a difference

The biodiversity roadmap of the wood processing industry helps to better understand the impacts of forest management and the actions for biodiversity on the forest environment. The roadmap shows that we are on the right track. By many indicators, forest biodiversity has seen positive development in recent decades. Future scenarios show that the measures already in place and the measures to be further intensified will reinforce this trend. Extensive implementation and better targeting of actions will improve the results.

The wood processing industry wants to increase the biodiversity of Finnish forests. Our native tree species will continue to serve as the foundation of forest biodiversity. Achieving nature positivity is possible when the entire forest sector shares a common goal and undertakes to carry out the necessary actions. In this way, we can also contribute to the achievement of international and national biodiversity goals. At the same time, it is important to be able to verify and compare the impact of different sectors and activities internationally.

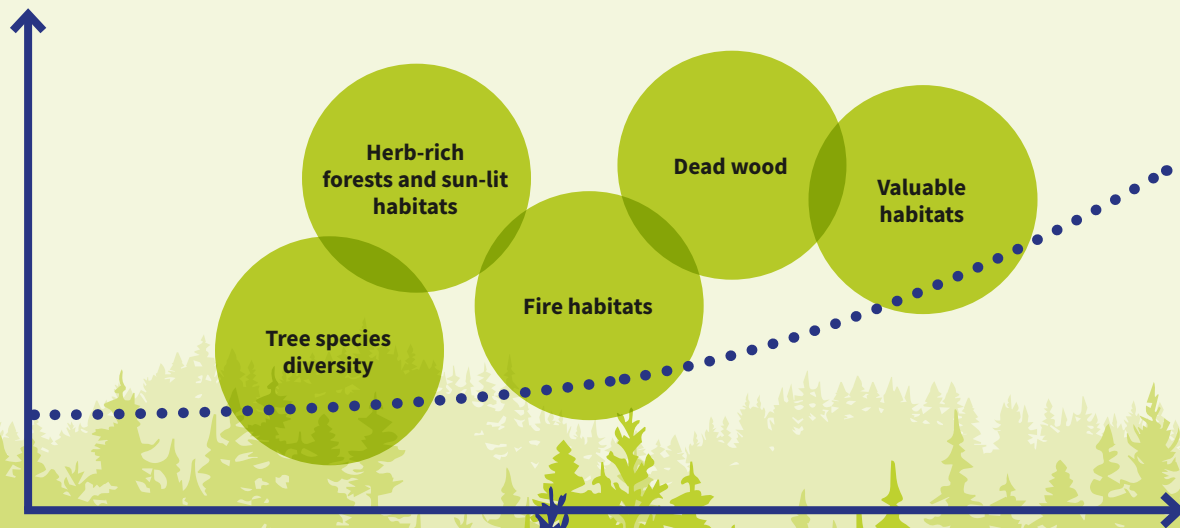
Understanding the state of forest nature requires comprehensive analysis. The use of peatland forests and the impact of forest management on water bodies and soil are the next topics that call for attention. Adapting to climate change is one of the greatest challenges. Solutions to these questions must be sought together with researchers, decision makers and the entire forest sector.

The wood processing industry produces numerous products that are part of people's everyday lives for the global market. Wooden buildings, wood-based packaging, hygiene products, pharmaceuticals, fuels, textiles, energy and various chemical compounds derived from wood all serve a purpose as building blocks of a fossil-free society. It is important that securing the availability of the raw material to be processed goes hand in hand with safeguarding biodiversity.

Forests are an important source of income for forest owners, forest workers, the transport sector, those working in mills and the state in the form of tax revenue. The means of safeguarding biodiversity must, therefore, be fair not only to nature but also to those who utilise it in different ways. Financially sound and practical, understandable means are attractive and easily justifiable. In the future, it will be essential to examine and develop the link between strengthening the biodiversity and the economy.

When setting targets for promoting the state of nature, it is important to identify the time window of the activities. Even in the short term, many changes can be made to the state of forest nature, but most of the changes will be realised even after decades. The retention tree spared today may not turn into decaying wood until 50 years from now. Measured data is necessary to understand the effects of operations and changes in the nature. This understanding, foresight of development and measures derived from research will guide the wood processing industry towards a nature-positive future.

Growth of forest resources, use of forests and biodiversity can be reconciled



Model for cooperation in forest value chain

The interpretations made by the Finnish Forest Industries Federation and the Finnish Sawmills Association in the biodiversity roadmap are based on the following surveys:

CURRENT STATE OF FOREST BIODIVERSITY

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The biodiversity road map and the materials of the research projects can be found from the web pages
www.metsateollisuus.fi/en/biodiversity
<https://sahateollisuus.com/en/forest-biodiversity/>



Finnish Forest Industries



finnish sawmills