Forests in Change

Metla Monitors the Condition of Finland's Forests

METLA

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Päivi Merilä and Marjatta Joutsimäki (eds.)

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FUTMON
forest monitoring for the future

Contents

Monitoring reveals changes in forest condition

Päivi Merilä, Liisa Ukonmaanaho, Seppo Nevalainen and Pasi Rautio

Reliable information on forests is fundamental to sound forest and environmental policy, good decision-making and rational practical work. Time series created through monitoring are the only reliable method of detecting changes in forests. In Finland, the Finnish Forest Research Institute (Metla) is responsible for nationwide monitoring of forests.

Forest ecosystems are affected by both natural processes and anthropogenic activities, such as pollution, fragmentation and wear of forests, and climate change. These have already caused, or may cause, changes in species diversity, increased incidence of diseases and pests, and damage due to storms and snow. In addition, they lead to changes in the nutrient condition, growth and carbon sequestration of forests.

High-quality monitoring system

Metla implements forest monitoring on two levels. Based on systematic sampling, a nationwide extensive monitoring network produces information on regional and time-based variations in forest condition. It also produces information on various types of forest damage in Finland. Around 800 permanent sample plots of the National Forest Inventory (NFI) (Figure 1) are monitored

in this way. The monitoring network is also used for soil and vegetation inventories and heavy metal deposition surveys.

Intensive monitoring is also carried out via a network of observation plots distributed throughout the country (Figure 2). This involves diverse monitoring of forest condition and ecosystem functioning, with the aim of analysing the causes of any changes observed. Deposition of air pollutants, element fluxes, nutrient cycling, tree condition, and growth are among the features monitored. Meteorological measurements are conducted in cooperation with the Finnish Meteorological Institute.

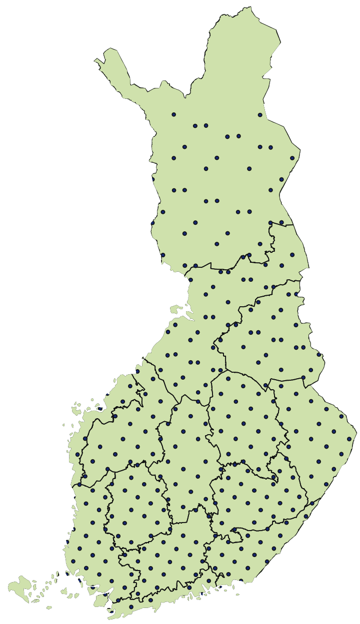


Figure 1. Forest condition is extensively monitored on certain permanent National Forest Inventory plots.

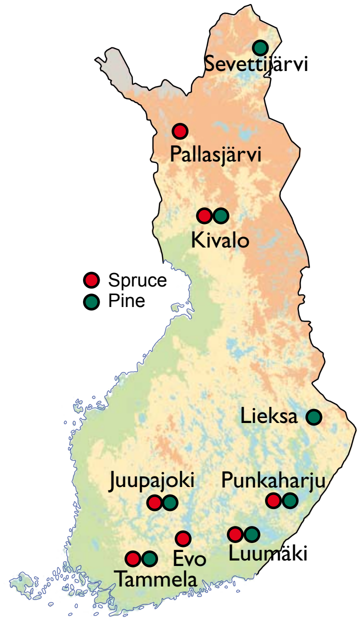


Figure 2. Intensive monitoring plots (14 in all) are located in spruce and pine forests in various parts of Finland. Most observation plots are located in stands under conventional forest management.

Long-term monitoring necessary

Changes in forests occur slowly. The benefits of long-term monitoring include:

Long-term observation
time series enable observation of trends and the preparation of forecasts

Representative samples
A representative monitoring network produces reliable information (large-scale monitoring)

Versatile, simultaneous observation activity at identical locations
Facilitates the study of causal connections (intensive monitoring)

Continuity and regularity
Enables the documentation of random, unprecedented phenomena such as radioactive deposition or storm damage, and the study of their impacts

Standardised methods and a quality assurance system
Enhance comparability of results

International conventions oblige us to monitor the environment

A number of international conventions oblige Finland to monitor the condition of the environment. The UN Framework Convention on Climate Change (UNFCCC) and the related Kyoto Protocol, as well as the UN Convention on Biological Diversity (CBD), can be regarded as legally binding. National decrees have been issued to implement the regulations laid down in these.

For instance, the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and Forest Europe (MCPFE, Ministerial Conference on the Protection of Forests in Europe) are not legally binding. The CLRTAP, functioning under the United Nations Economic Commission of Europe, obliges member states to report on the impacts of air pollution on forests. Such work is performed within the framework of the ICP Forests programme. Many indicators monitored under the ICP Forests programme are also included in the list of MCPFE indicators.

Abrupt changes in the condition of forests are caused by abiotic and biotic damage

Metla/Pekka Pietiläinen

Seppo Nevalainen, Martti Lindgren, Antti Pouttu and Jaakko Heinonen

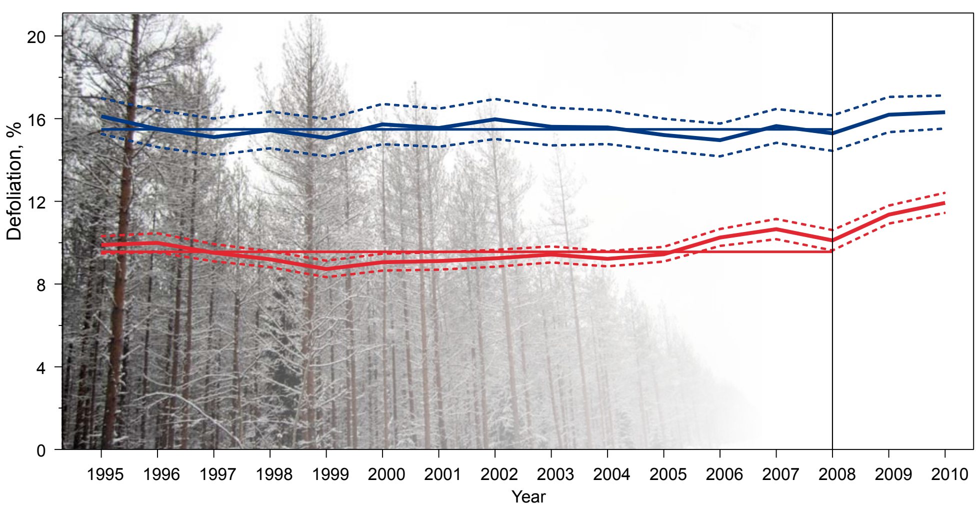
Fungal and insect damage are the greatest immediate threats to forest health. Storm and drought damage and the risks posed by new pests are expected to increase as the climate changes. Regular monitoring of forest health is important for the early detection of the changes. In fact, monitoring by Metla has revealed major abiotic or biotic epidemics.

The European pine sawfly (*Neodiprion sertifer*) causes particularly clear, sudden regional changes. The worst areas of pine defoliation by this species can now be found in Ostrobothnia in western Finland. Damage caused by dieback and canker disease of pine (also known as Scleroderris canker, *Gremmeniella abietina*), was common in pine forests in western Finland in 1988–89, as well as discolouration and defoliation due to drought in 2006–07.

The crown condition and changes in it have been monitored nationwide for 25 years. The defoliation of pine has been slight on average, although it has increased since 2006. In a trend analysis of the 1995–2008 data, clearly more pine forests in southern Finland showed an increasing defoliation trend than the pine forests in the north. However, the variation between adjacent sample plots was large.

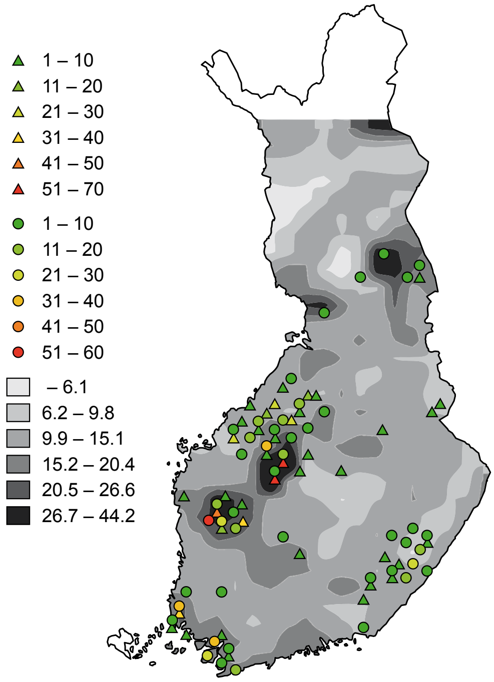
The early years of monitoring revealed a clear increase in the average defoliation of spruce. This was followed by a clear decrease and only minor variation thereafter. In 2010, the defoliation of spruce was highest in northern parts of the country and in the southernmost coastal areas. In spruce forests too, the number of sample plots showing an increasing defoliation trend was higher in the south than in the north. However, the difference between areas was smaller for spruce than for pine.

Changes in annual defoliation have been fairly minor nationwide. Approximately half of the differences in defoliation between tree stands are due to age variation between trees.



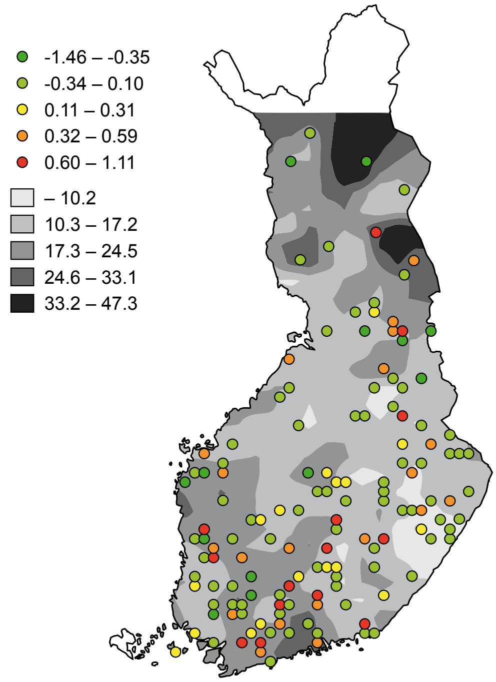
Average degree of defoliation, corrected for age, of spruce (blue) and pine (red), with a confidence interval, in 1995–2010. The figure also shows the grand mean of defoliation for 1995–2008. Due to differences in sampling, the latest results for 2009 and 2010 are not directly comparable with each other or results for previous years. Photo Metla/Pekka Pietiläinen.

Pine defoliation in 2010 and damage by pine sawflies in 2009–2010



In 2010, pine defoliation was highest in Ostrobothnia. The map also shows a shift in the occurrence of damage caused by the European pine sawfly between the years 2009 (circles) and 2010 (triangles). The colours indicate the number of damaged pine trees per assessment tract.

Spruce defoliation in 2010 and the trend in defoliation 1995–2008



Defoliation is highest in the northern parts of the country and the southernmost coastal areas. The number of spruce forests with a rising defoliation trend (red circles) is higher in the south than in the north.

On monitored sample plots, the mean annual tree mortality was 0.18%. Wind, snow and rot fungi, particularly the Annosus root rot (*Heterobasidion* sp.), are the most commonly identified causes of death. Storm damage causes the highest annual mortality rates.

At national level, no clear connection has been found between defoliation and sulphur or nitrogen deposition. On the other hand, defoliation has not decreased in areas where sulphur deposition has decreased the most.

Forest health also monitored as part of forest inventory

Kari T. Korhonen

Monitoring of the health and biodiversity of Finnish forests, and most recently, reporting on greenhouse gases, have become key tasks of the National Forest Inventory (NFI). Pan-European monitoring of forest health has been implemented as part of the National Forest Inventory since 2009.

NFI results show that the increment of growing stock has doubled from the 1920s to the present day, the current increment being approximately 100 million cubic metres per year. This increase is explained by high amount of growing stock in forests and the high share of well-growing young forests. In addition, young forests can even be excessively dense due to neglected thinnings of young pole stands.

Forest resources have increased by more than 50% compared with the early 1900s. In the early 1920s, the total volume of tree stands on what is currently Finnish territory totalled 1.4 billion cubic metres. Today, it totals 2.2 billion cubic metres. This volume is increasing because growth is higher than the drain due to fellings and natural mortality (Figure 1).

Increment of growing stock doubled from the 1920s to the present day

The increase in the growing stock volume and increment, which has primarily occurred since the early 1970s, can be explained by the concerted forest improvement activities that began in the 1960s. Selection felling had already ceased by the early 1950s. Forest drainage transformed treeless and sparsely wooded bogs into forest land and the area of sparsely wooded, underproductive forests contracted.

The clearest result of biodiversity monitoring is the increasing quantity of dead wood in forests. In southern Finland, the quantity of dead wood increased in the 2000s (Figure 2). In part, this change can probably be explained by the recommendation, included in forest management instructions since the late 1990s, to leave dead trees and retention trees in place during regeneration cutting. Another causes are excessive forest density, due to neglected thinnings of young pole stands and storm damage in 2000.

Finland’s forest resources under constant monitoring

Since the 1920s, Metla has monitored the condition of forests in Finland through the National Forest Inventory (NFI), based on statistical sampling. NFI was launched due to the suspicion that slash-and-burn agriculture, tar burning, selection felling and the emerging forest industry were eradicating forests. Since the first inventory the NFI has been repeated at ca. 10-year intervals. There is now a five-year inventory cycle and monitoring is continuous, i.e. measurements are conducted annually throughout the country.

More information: www.metla.fi/ohjelma/vmi/info.htm

Monitoring of forest damage shows that the most severe form of damage, creating an immediate need for forest regeneration, can be observed on only 0.5 per cent of the total forest land area. Severe damage clearly affecting forest quality is found on nine per cent of the total forest land area, elk being the most significant cause of such damage.

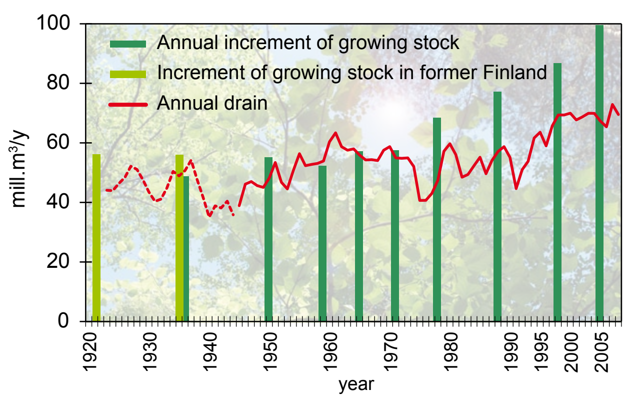


Figure 1. Increment of growing stock and drain since the 1920s. In recent years, fellings and natural mortality have accounted for some 70% of the increment.

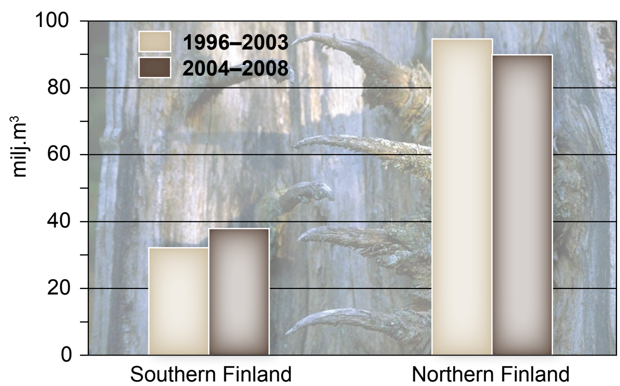


Figure 2. The amount of dead wood has increased in Southern Finland in the 2000s.

Climate change
increases carbon stocks of northern forested mineral soils?

Hannu Ilvesniemi, Pekka Tamminen, Jaakko Heikkinen, Tiina Tonteri and Leila Korpela

As the climate becomes warmer, carbon storage in Finnish forests will probably increase because, at present, the amount of carbon is higher in southern than in northern Finland, both in the soil and tree stands.

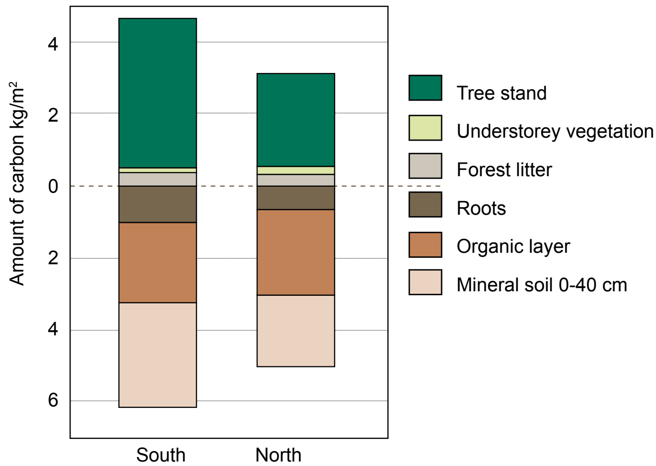
On average, one square metre of forest in southern Finland contains ten kilos of carbon, and some 20% less in northern Finland. In southern Finland, the amount of carbon sequestered in tree stands is slightly higher than in mineral soil (topmost 40 cm) and humus layers together. In northern Finland, forest soils play a greater role than tree stands as a carbon storage.

These results were produced by the BioSoil project, financed by the European Union and engaged in the development of soil monitoring and research methods suitable for use throughout Europe.

Why information on forest and forest soil carbon storage is important?

Forests form part of the national carbon balance. Aimed at preventing climate change, the current agreements in force oblige signatory nations to report all significant greenhouse gas emissions, and carbon sources and sinks within their territory.

In Finland, reporting on forests is based on stand measurements conducted for the National Forest Inventory (NFI), and changes in the size of forest soil carbon storage calculated on the basis of this data. As long as reporting is not based on direct measurements of soil, in order to determine initial values for calculation, reliable information on the size of soil carbon storage at different sites in various parts of the country is required.



The amount of carbon sequestered in vegetation and soil was specified for sample plots. Both the soil and tree stands contained more carbon in southern than in northern Finland. In southern Finland, the amount of carbon sequestered in tree stands was slightly higher than in a 40 cm thick layer of mineral soil and humus layers. In northern Finland, the case was the opposite i.e. the soil contained somewhat more carbon than tree stands.

Metla/Leila Korpela


Metla/Reijo Penttilä

Dead wood serves as an indicator of biodiversity

Juha Siitonen

Increasing the amount of dead wood – for instance, by sparing valuable habitats and by leaving retention trees – has been a central goal in biodiversity-oriented forest management.

As a structural feature of stands, dead and decaying wood is important to biodiversity. A total of 4,000–5,000 *species dependent on dead wood, termed saproxylic species*, are found in Finland. Consisting mainly of decay fungi and invertebrates, these make up no less than a fifth of all forest-dwelling species. The low average volume of dead wood in managed forests is the most important threat factor for forest species; it has been assessed as the primary cause of threat for 523 species.

The Forest Focus community scheme strove to develop tools for monitoring the state of European forest ecosystems. In a pilot study under the programme, an investigation was performed of the extent to which stand characteristics such as stand age, volume of living trees, tree species composition and dead wood can be used as indicators of species diversity. The volume and variability of dead wood generally explain a considerable proportion of the species richness of saproxylics in a stand.

In most cases the diversity, i.e. the qualitative variability, of dead wood, is a better predictor of species richness than the volume of dead wood (Figure 1). The correlation is easy to explain: the more different dead-wood qualities (different tree species, decay stages, diameters etc.) there are in a stand, the more species can find suitable host trees for their reproduction in the site.

Possible changes in dead wood – decreasing or increasing volume – will also eventually be reflected in species assemblages. However, the decrease or increase in species occurs with time delays. This can be seen in the richness of saproxylic species and, particularly, in the occurrence of threatened species, which vary considerably within the area of southern Finland. The lowest numbers of threatened species were found in the southwesternmost and southernmost parts of the country, where forest use has been intensive for longest, and the highest numbers in eastern Finland, which has a shorter land

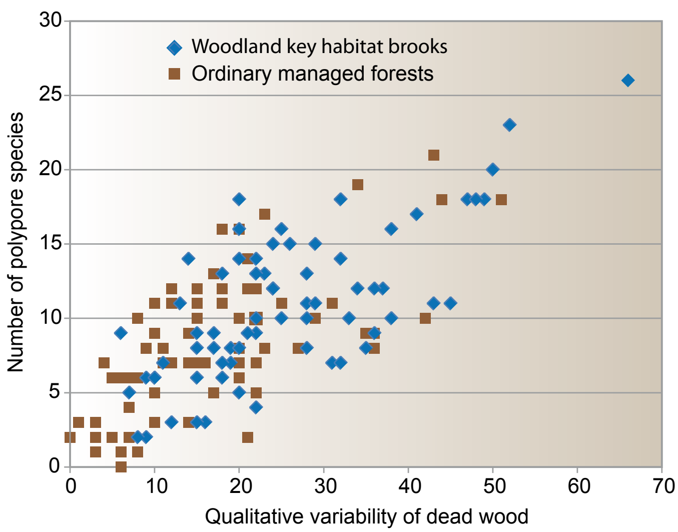


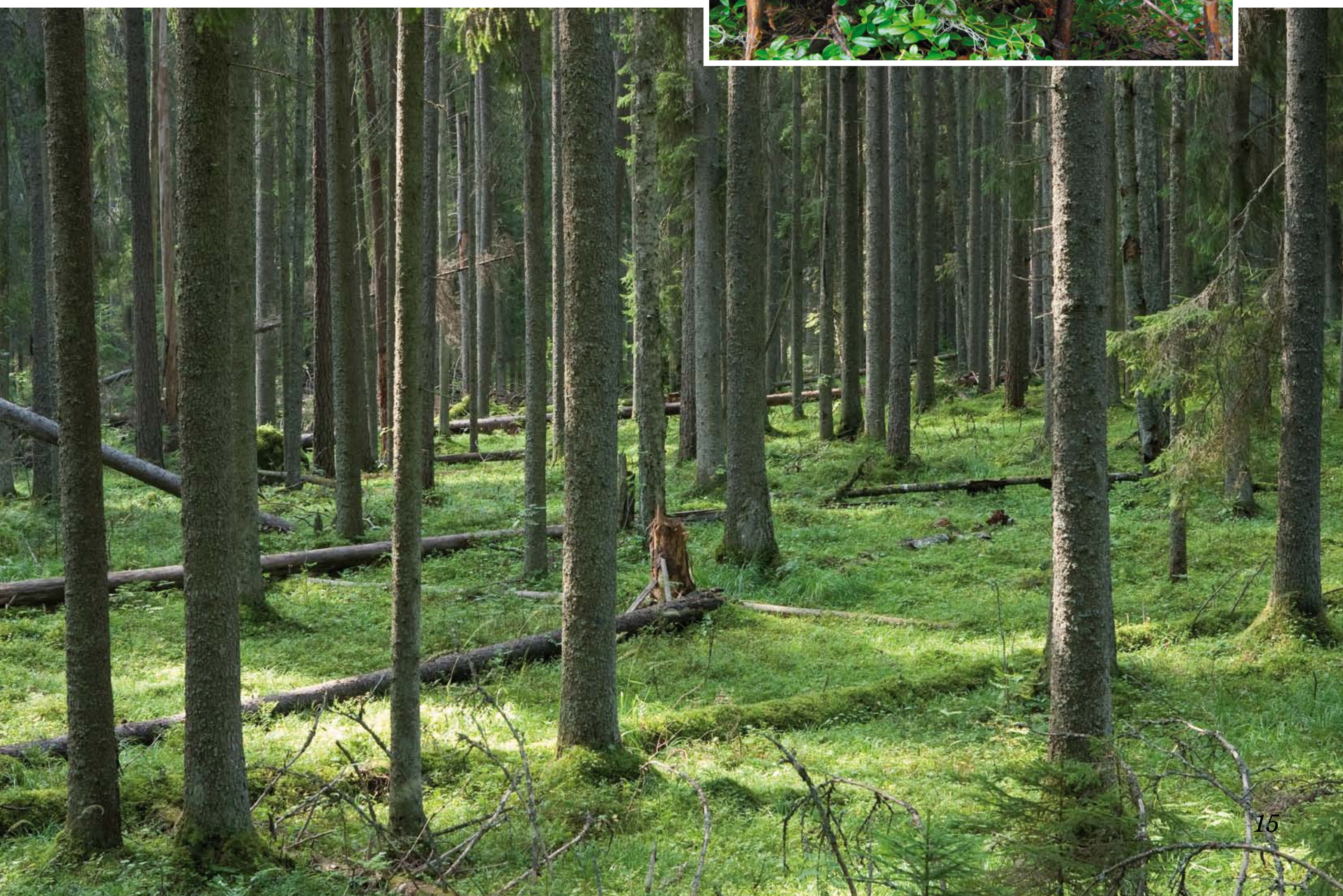
Figure 1.The number of polypore species was higher in woodland key habitats than in ordinary managed forests, due to the higher average volume and the higher qualitative variability of dead wood in key habitats..

use history. Depending on the region, species composition may thus differ in sites with similar stand characteristics.

Measurement of the volume and quality of dead wood was included into the National Forest Inventory (NFI), beginning in the year 1996. Monitoring of forest fauna and flora using the NFI's permanent sample plot network would also be feasible and effective. Implemented three times, surveys of understorey vegetation serve as an example.

The polypore flora has also been surveyed once on permanent sample plots in 1995. Repeating a similar inventory would produce valuable information on saproxylic species based on a large, systematic sample.

The polypore species Phellinus ferrugineofuscus grows on the undersides of relatively hard logs of Norway spruce. P. ferrugineofuscus is common in old natural forests, but can also occur in old managed forests, provided that the number of logs suitable for the species is sufficiently high. Photo: Metla/Reijo Penttilä.



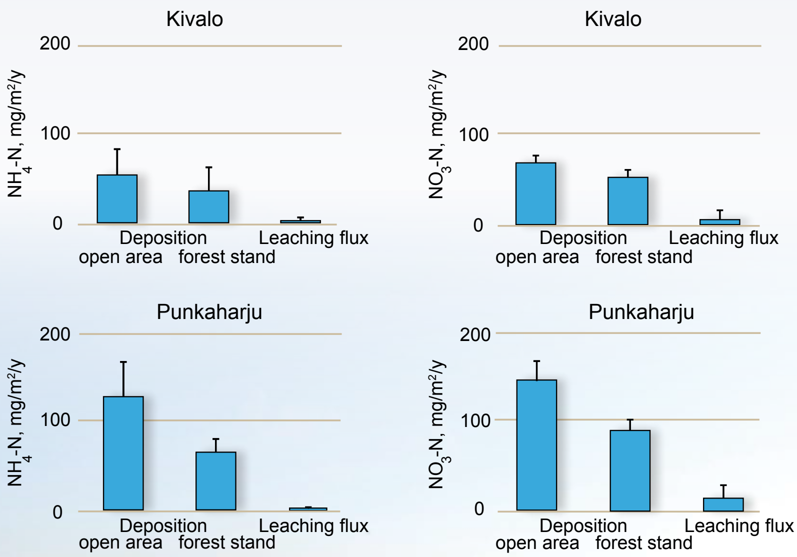
Forests play a key role in protecting groundwater

Antti-Jussi Lindroos, Kirsti Derome and Tiina M. Nieminen

Forests provide an ecosystem service vital to society, by decelerating and preventing nitrogen deposition from leaching into groundwater. Forests are an efficient filter, preventing nitrogen from affecting the groundwater quality.

Nitrogen cycling is highly efficient in Finland's forest ecosystems. In southern Finland, the annual nitrogen deposition on the forests is ca. 3–4 kg per hectare, but less than 0.5 kg per hectare is leached into groundwater on forested mineral soils. In northern Finland, the deposition is 1–2 kg per hectare and, as in southern Finland, the leaching flux is very small.

The situation is very different in the loaded forest soils of Central Europe, where considerable leaching of nitrogen into groundwater can occur. In Central Europe, nitrogen deposition can be over tenfold that of southern Finland. In areas with a high deposition and in forest soils saturated with nitrogen, leaching flux has been



NH_4-N = ammonium nitrogen
NO_3-N = nitrate nitrogen

measured at up to dozens of kilos of nitrogen per hectare. Clear reductions in nitrogen emissions have been proposed to remedy the situation.

In recent decades, air pollution control measures have succeeded in efficiently reducing the sulphur deposition load on forest soils. The deposition in southern Finland is now only one third of peak levels in

Nitrogen deposition must be monitored

the 1980s. Nitrogen deposition has not reduced correspondingly and this is not to be expected within the next few years.

At European level, future monitoring of nitrogen leaching fluxes will be extremely important in various deposition load areas. This will ensure the preservation of the protective role of forests, based on effective nitrogen retention, in areas such as Finland. On the other hand, it will facilitate risk assessment and mitigation actions related to groundwater quality in loaded areas.

Heavy metal deposition has decreased in Finland

Jarmo Poikolainen

Today, Finland's heavy metal deposition is among the lowest in Europe, excluding Northwest Lapland and the environs of a few large industrial facilities. At five-year intervals, Metla has been surveying heavy metal deposition on the basis of moss concentrations. This has been done since 1985, on the permanent sample plots of the 8th National Forest Inventory (NFI).

Lead, cadmium and *vanadium* spread easily over large areas. Their concentrations in mosses have decreased most among the metals analysed in the monitoring period, with concentrations clearly reducing the further north we go. This is great news since lead, cadmium and mercury are the heavy metals most toxic to wildlife. Accumulation in the food chain makes them even more toxic.

The transfer to unleaded gasoline in the 1990s has been a major factor in decreasing lead deposition. Whereas, in 1985, the average concentration of lead in mosses was around 15 mg/kg in Finland, with the highest concentrations close to 50 mg/kg, in 2005 the average concentration was only around 3 mg/kg, with maximum concentrations around 10 mg/kg (Figure 1).

Major sources of *cadmium* emissions are the metal industry and waste burning plants, whereas the metal industry and oil refineries are accountable for vanadium. During the monitoring period, the average concentration of cadmium in mosses fell from around 0.40 mg to 0.10 mg per kilo. That of vanadium fell from ca. 5 mg to 1.5 mg per kilo.

Mercury differs from other heavy metals – it primarily appears in gaseous form in the atmosphere and can be transported up to thousands of kilometres from actual sources of emission. Concentrations of mercury in mosses are generally low in Finland, averaging 0.050 mg/kg. Concentrations fell slightly during the monitoring period.

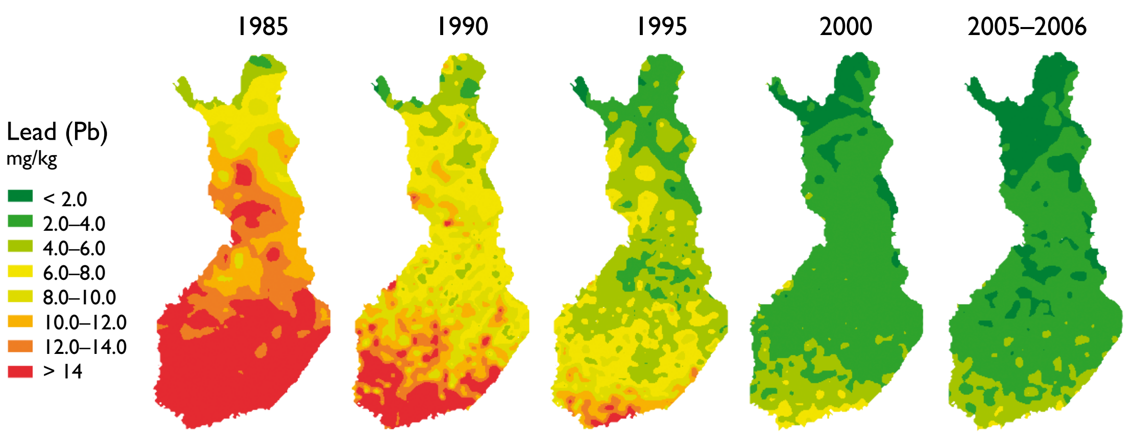


Figure 1. The lead concentrations in mosses decreased clearly in Finland in 1985-2006.

Copper, nickel and *chromium* concentrations in mosses were low in background areas throughout the monitoring period. In the vicinity of a few major emission sources, however, concentrations have risen to relatively high levels. In northeastern Lapland, copper and nickel concentrations have varied greatly, depending on the wind direction and quantities emitted by smelters located on the Kola Peninsula. In the vicinity of Harjavalta, concentrations have declined and the impact area of emissions has clearly decreased. Emissions from the Tornio refined steel plant have been evident in mosses, in the form of clearly higher chromium concentrations in northwestern Lapland. Concentrations have fallen due to cuts in emissions at the steel plant.

Research by Metla is now part of Europe-wide charting. More information: http://www.metla.fi/metinfo/metsienterveys/raskasmetalli/index.htm

In minor quantities, *iron* and *zinc* are essential to live organisms. Both are emitted into the air by sources such as the metal industry. However, habitat also influences their concentrations in mosses. Above-average concentrations, caused by emissions from industry, were detected at sites in southern and central Finland. Even in industrial areas, concentrations of both iron and zinc have decreased.

Stricter legislation and new emissions reduction technology due to legislation have helped reduce the deposition of heavy metals. Other parts of Europe have seen similar developments, which has decreased the long-range transport of air pollutants to Finland.

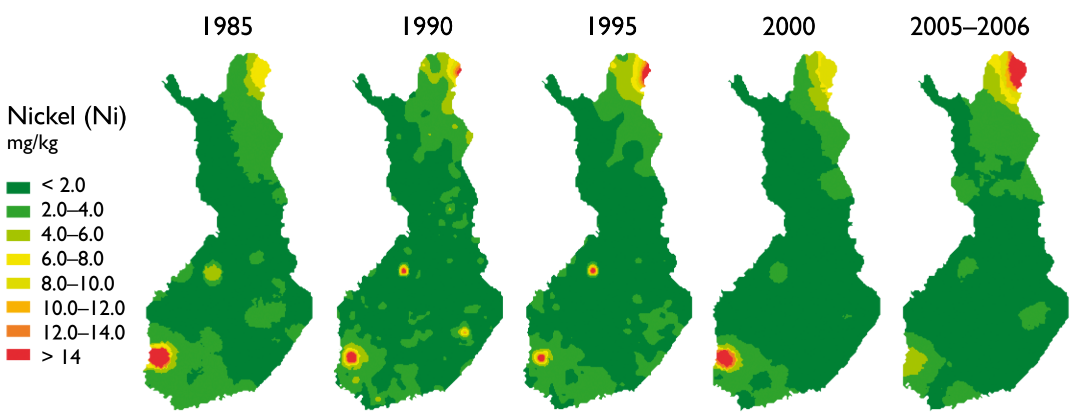


Figure 2. Clearly elevated copper and nickel concentrations in mosses where found in northeast Lapland and in the Harjavalta area in western Finland.

Monitoring annual rhythm of trees using girth bands and phenological observations

Pentti Niemistö and Egbert Beuker

Tree phenological observations, such as the annual growth, budburst, flowering and yellowing of leaves, are used in studying the impacts of weather variations and climate change on forest ecosystems. The results provide evidence of long-term climate changes and may also predict the adaptation and growth potential of different tree species in changing conditions.

Temperature is the main determinant of the start of the growing season in the spring, whereas the end of the season is regulated by longer nights in late summer. Height growth ceases first, followed by stem radial increment. Roots continue to grow late into the autumn.

In 2009 and 2010, silver birch began to flower as early as around the 1st of May in southern Finland. Leaf buds began to open soon after. It has been observed that birch stem radial increment begins as soon as the leaves have clearly grown past the budding stage.

In 2010, spruce radial increment began as early as 15th to 17th May in southern Finland, probably due to the extremely warm spell between 14th and 22nd May. In Lapland, spruce radial increment ended as early as the 9th of July in 2009, but in 2010, almost a month later. Birch and spruce radial increment usually ceases at the end of July or in early August.

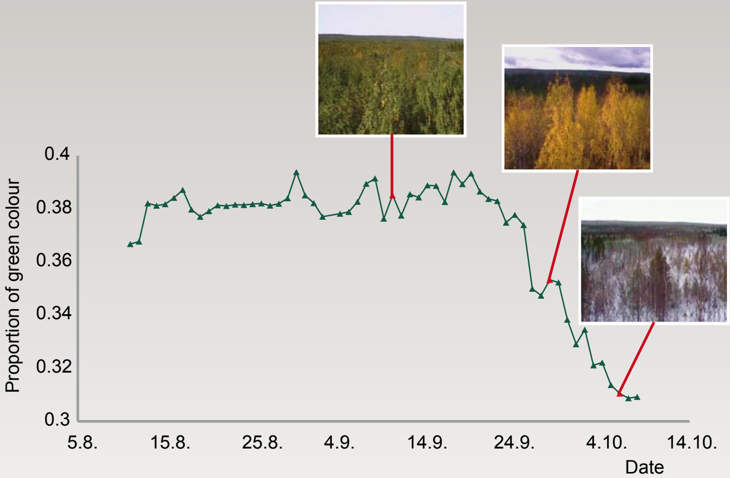
Girth bands are a good but insufficient method of accurately monitoring tree growth. Alongside other phenological observations, continuous weather monitoring and analysis of cell-level growth samples, girth bands provide reliable results, when all essential parameters affecting measurements and tree diameter are known.

Girth bands automatically measuring changes in tree stem diameter record tree circumference growth at one-hour intervals. The time that growth begins and ceases can be determined on the basis of the recorded data. Radial increment is also monitored using manually read girth bands.

Phenological observations and monitoring of radial increment of birch and spruce in four locations in Finland, 2009 and 2010.

	Year	Flowering began	Buds burst	Radial increment began	Temperature sum	Radial increment ceased	Leaves fell
Silver birch, Punkaharju	2009	4.5.	4.5.-11.5.	25.5.*		5.8.	24.8.-14.10.
	2010	29.4.	3.5.-12.5.	15.5.	61 dd	25.7.	25.8.-20.10.
Spruce, Punkaharju	2009		25.5.-1.6.	20.5.	105 dd	5.8.	
	2010	21.5.	19.5.-26.5.	17.5.	90 dd	25.7.	
Spruce, Tammela	2009			19.5.	104 dd	3.8.	
	2010			16.5.	64 dd	25.7.	
Spruce, Juupajoki	2009			30.5.*		1.8.	
	2010			16.5.	67 dd	11.8.	
Spruce, Kivalo	2009			3.6.	105 dd	9.7.	
	2010			4.6.	164 dd	6.8.	

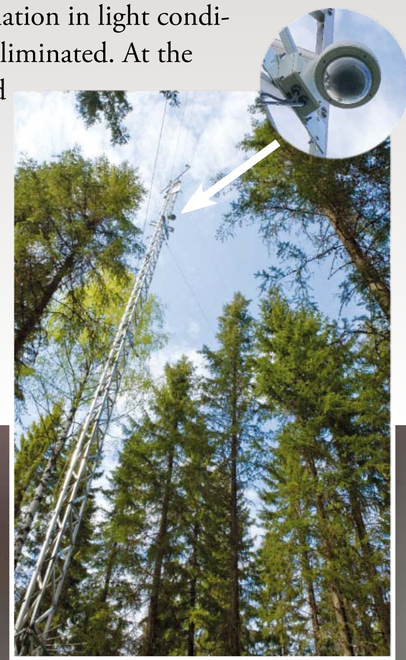
** Growth had already begun when girth bands were installed in spring 2009.*



Daily photos of the Kivalo birch forest stand in the autumn of 2009 allow easy determination of the period when leaves begin to turn yellow and fall.

Phenological monitoring with digital cameras

Automatic digital cameras have been installed on six intensive monitoring plots, to enable daily monitoring of foliage development during the growth period. This method is based on the amount of green colour in the pictures or picture areas. By using the relative amount of green, variation in light conditions is more or less eliminated. At the moment, this method functions well with deciduous trees (birch). There are also plans to adapt it to conifers.



Digital camera attached to a meteorological observing station (weather tower).

Nowadays, in the spring silver birch leaf buds open an average of eight days earlier than a century ago.

Phenology is the study of the annual rhythm of biological phenomena – such as bursting of buds – and how these are influenced by various factors.

Eeva Pudas

Imagine Finnish forests without bilberry

Maija Salemaa, Tiina Tonteri, Pasi Rautio, Leila Korpela, Markku Tamminen and Hannu Ilvesniemi

Finland's coniferous forests have only a few indigenous tree species. However, a species-rich understorey vegetation is formed by dwarf shrubs, herbs and grasses and the ground layer's mosses and lichens. Forest landscapes would appear very monotonous without the anemones that bloom in spring, the hummocks of berries, or the lichens that peek out of lush green moss cover. Understorey vegetation is a good indicator of a forest site's fertility and productivity. By protecting and feeding a large number of animals, it provides a basis for forest biodiversity.

Understorey vegetation accelerates nutrient cycling, regulates the water budget and influences the renewal of forest stands. The organic layer of forest soil is formed by dead understorey vegetation – mosses and dwarf shrubs in particular – and needle and leaf litter from trees. Bilberry (*Vaccinium myrtillus*) sheds its leaves every autumn; these decomposing leaves rapidly release nutrients into the ecosystem's nutrient cycle. In northern forests, understorey vegetation also binds a large amount of carbon. In particular, the extensive belowground rhizome networks of woody dwarf shrubs serve as long-term carbon reserves. As an example, almost 80% of bilberry biomass can be below ground (Figure 1).

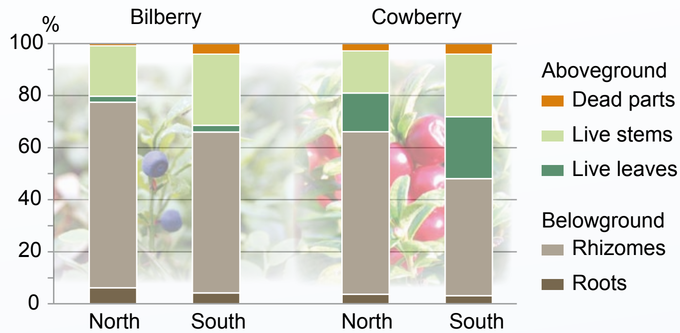


Figure 1. The distribution (%) of the biomass of bilberry (Vaccinium myrtillus) and cowberry (V. vitis-idaea) into above- and belowground parts. Data from six plots in both northern and southern Finland.

Due to vegetation surveys carried out for National Forest Inventories, an exceptional amount is known about the composition of Finland's forest vegetation. A network of permanent monitoring plots provides information on changes in vegetation, and on the causes of these changes. This information helps to predict the impacts of climate change on tree stands and forest vegetation.

Forestry the primary cause of change in vegetation

More than any other factor, intensive silviculture has affected the change in the composition of understorey vegetation. Since the 1950s, the age structure and ratios of tree species in Finnish forests have been transformed so much that only half of the original cover of our

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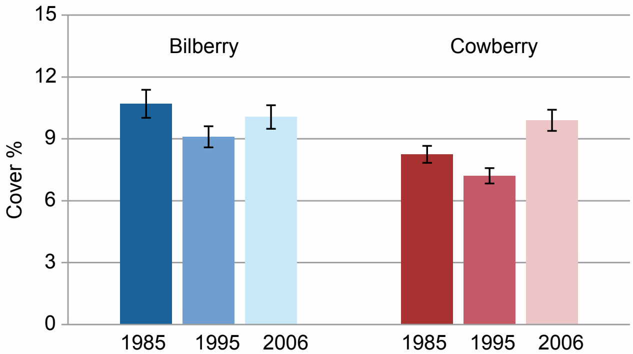


Figure 2. The mean cover % of bilberry and cowberry on 443 forested mineral soil sites in Finland during 1985–2006. All plant species were identified and their cover % estimated on four sampling quadrats (4 x 2 m^2) in each plot. The data includes both unmanaged and managed stands.

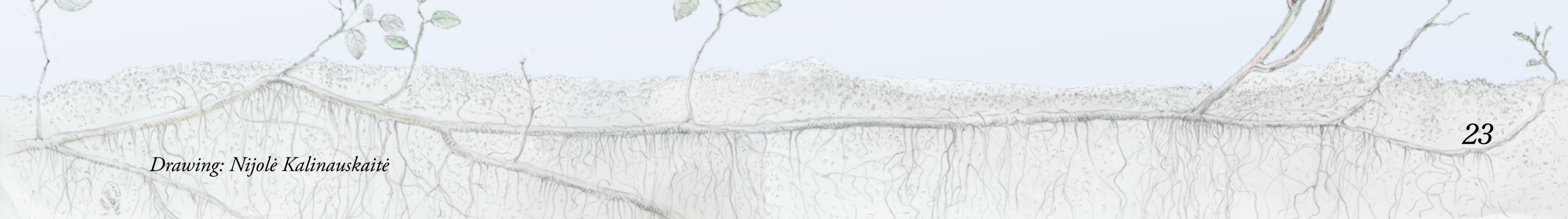
predominant dwarf shrubs, bilberry and cowberry (*Vaccinium vitis-idaea*) remains in some areas. However, in recent decades (1985–2006) the mean cover of bilberry in forested mineral soil sites has remained fairly stable, averaging 10% (Figure 2). In fact, the cover of cowberry has now begun to rise slightly, from 8 to 10%. These mean values have been calculated from a network of permanent sample plots, including uncut, thinned and clear-cut stands.

Minor changes in understorey vegetation in uncut forests

Dwarf shrubs show the widest cover in undisturbed mature forests. The cover of bilberry has remained fairly stable at close to 20% in mesic and 10% in dry, uncut mature forests during 1985–2006 (Figure 3). The cover of cowberry has declined slightly on mesic sites, but increased on dry sites. The reduction of cowberry in uncut mesic forests can be readily understood: these forests primarily comprise spruce, which provides increasing shade as trees age. However, in dry pine forests with plenty of light, cowberry often becomes more abundant as succession proceeds. In uncut forests, most changes in the dwarf shrub cover can be explained by weather-related factors, growth of tree stands or natural succession. Nevertheless, raised temperatures during the period 2001–2006 may have affected the success of dwarf shrubs indirectly, via the growth of tree stands and soil microbial processes.

Cowberry recovers faster than bilberry after regeneration cutting

Regeneration of forests through clear cutting, followed by soil ploughing, leads to a complete transformation of dwarf shrub habitats. In most cases, the harvesting of energy wood includes the uprooting of tree stumps and removal of logging residue. This affects understorey vegetation even more than traditional regeneration cutting.



Drawing: Nijolė Kalinauskaitė

Bilberry suffers from regeneration cutting more than cowberry (Figure 3). In mesic spruce forests, the cover of bilberry is only 5% after 20 years of clear cutting, while in mature forests, it totals 20%. However, the cover of cowberry returns to pre-cutting levels within a corresponding period of time. Adapted to shady forests, the thin-leaved bilberry suffers from drought and direct sunlight in clear-cut areas. On the other hand, cowberry, whose leaves are covered by a thick wax-layer, is more resistant to the increased amount of light and higher temperatures. In both bilberry and cowberry, soil ploughing destroys rhizomes. It therefore takes decades for their below-ground biomass to reach the levels of that in an old forest.

Shall we go bilberry-picking?

There is little point in looking for bilberries on clear-cutting sites. Bilberries produce a much sparser crop, sometimes being reduced by nine-tenths, in regenerated areas than before cutting. However, clear-cut areas may still offer suitably humid microhabitats in which bilberry produces an abundance of berries. Unlike bilberry, the cowberry crop recovers from cutting in only a few years. In thinned forests, berry crop volumes grow as the light increases.

Finland's stunning variety of moss and lichen species in forests

Dominated by conifers, Finland's sample plots lack the abundance of vascular plant species (particularly herbs and grasses) found in Europe's more temperate zones. On the other hand, Finland has far more forest bryophyte and lichen species than some southern countries. For instance, the pine sample plot in Utsjoki in Lapland hosted only nine species of vascular plants on a 400 m^2 area. However, the number of liverworts, mosses, cup lichens and other lichen species totalled 54.

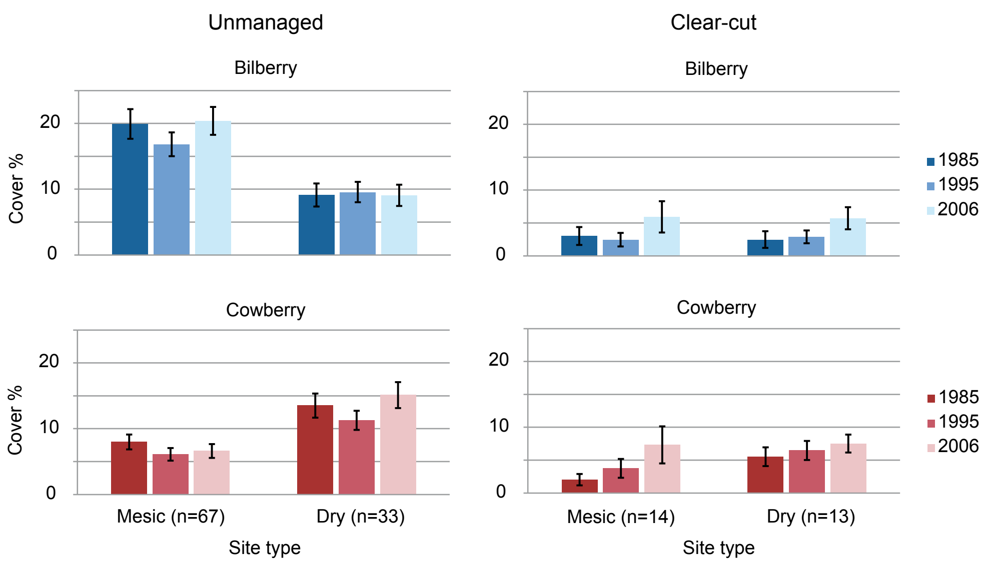
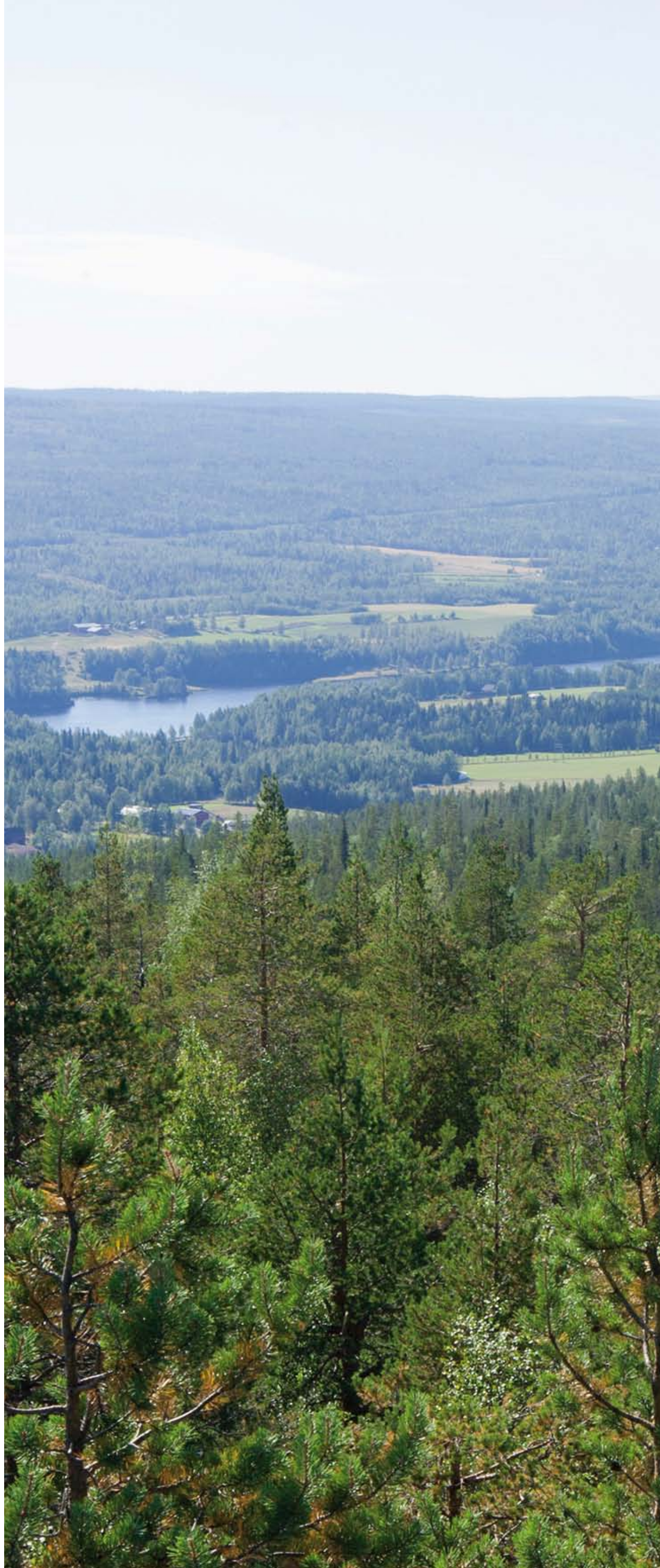


Figure 3. The mean cover % of bilberry and cowberry in unmanaged over 60-year-old stands (no cuttings 1975–2006) and in clear-cut stands (regeneration cut 1975–1985). Site types: mesic = herb-rich and mesic heath forests, dry = sub-xeric and xeric heath forests. n = number of sample plots.

FORESTS IN CHANGE is a concise review of the condition of Finnish forests. The monitoring of forest condition is needed by politicians and operational decision-makers to help make informed decisions concerning the sustainable utilization of forests, how to adapt to the impacts of climate change and how to conserve biodiversity.

The forest monitoring acitivities carried out by Metla provide reliable information on the changes observed in Finnish forests. It concerns us all.

More information:
www.metla.fi/ohjelma/myt/index-en.htm



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