Knowledge on Trees and Forests – Finnish Forest Research from the Nineteenth to the Twentieth Century

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SECTION 1

IDEAS AND THE HUMAN CONSTRUCTION OF THE ENVIRONMENT

Chapter 2

KNOWLEDGE OF TREES AND FORESTS – FINNISH FOREST RESEARCH FROM THE NINETEENTH TO THE TWENTIETH CENTURY

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Introduction

Forests are an essential part of Finnish culture and society in history and in the present and will be so in the future.

Research-based knowledge on forests has been and is integral both in societal discussion and the sustainable use of forests. This article explains how forest research over the past hundred years has gained and offered knowledge on trees and forests for state administration, societal stakeholders and private citizens. The article scrutinises the 'dialogue' between society and forests: what demands society has set on forests and, more importantly, what knowledge society has needed when living in coexistence with forests. The article sets forest research in the context of forest history and environmental history.

Finnish forests are mainly boreal forests with an abundance of coniferous trees. Around 79 per cent of the forests are dominated by Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*). The third dominating tree is the silver birch (*Betula pendula*). Forests cover around 75 per cent of the land area, which demonstrates forests to be the country's most important natural resource.[1] Traditionally, forests have been used in almost all aspects of everyday life: food, buildings, lighting and heating. Forests have offered raw materials for domestic use as well as for all forms of the forest industry.

1. Luke, Statistics database, Forest resources: https://statdb.luke.fi/PXWeb/pxweb/en/LUKE/.

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Up to the 1990s, forests were the basis of economic growth and prosperity. Until the mid-1950s, the forestry and wood and paper industry accounted on average for one fifth of GDP in Finland. Due to the diversification of the national production structure, the forestry sector's share of GDP has steadily decreased, and in the 2000s it has been below five per cent. Another important aspect is the forest industry's role in export revenues. Up to the 1950s, forest products generated an incredible eighty per cent of export revenues, declining below fifty per cent in the 1970s to around twenty per cent in the 2010s. In view of the above, the environmental history of forests is tightly embedded in Finnish economic and social history and needs to be contextualised accordingly.[2]

Because of the importance and multi-use of forests, through the centuries the main question has been how to balance sustainable and destructive uses of forests. In a society that has been and is economically, socially and culturally intertwined with trees and forests, knowledge of them has always been highly appreciated. Forest research has, from the late nineteenth century onwards, produced knowledge that societal actors have demanded, and even more important knowledge which they had not thought to ask for. In forest research, due to the slow growth of trees, the timespan of creating new knowledge is often counted in decades. Forest research stresses careful planning and foresight about the expected demands of knowledge.

This article includes four main sections, covering different periods: Know the Forests (late nineteenth century–1930s), Exploit the Forests (1940s–1960s), Define the Forests (1970s–1990s) and Discover Forests' Futures (2000s–). Each section consists of a short description of societal circumstances, clarifying the status of and demands placed on forests during that specific period, and paragraphs explaining the specific forest-related knowledge of the period.

Know the forests (late nineteenth century–1930s)

Through the nineteenth century and up to 1917, the Grand Duchy of Finland found herself under the rule of Russian tsars. However, the forest-related institutions and scarce legislation reflected mostly Swedish origins, despite Swedish rule having ended in 1809. The export of tar and sawn timber formed the major industrial use of forests. Forests played an elemental role in household consumption (housing, fuel, nutrition, etc.) and it was not until the beginning of the 1920s that industrial use of timber exceeded household consumption.[3]

2. Laine 2019.

3. Kunnas 1973, pp. 110–11.

The reform of forest legislation from the mid-nineteenth century onwards, and especially the 1857 repeal of production restrictions on steam-powered sawmills, enhanced the economic use of forests. When pulp and paper mills, mainly from the 1880s onwards, joined this development, the wooden path towards prosperity was mapped out.[4] The most far-reaching institutional changes took place after independence in 1917 and the civil war in 1918, when land reform, the so-called Crofter Liberation, transformed most former leaseholders into landowners. Widespread private forest ownership emerged, and forests were defined as part of farms.

Forests being the most valuable natural resource in Finland, the state demanded more information both about existing stock volume and its quality. This task was entrusted to German forester Edmund von Berg, who after travelling mainly in Southern and Central Finland, wrote his report in 1858. In this first evaluation of the Finnish forests, von Berg stated that the situation was alarming, especially around towns and major traffic routes, mainly due to cutting of fuel wood and traditional slash-and-burn cultivation.[5] The following decades, witnessing ever-growing forest industrial production, increased stakeholders' uncertainty about forest resources and the need for university-educated foresters and science-based forest research.

Young botanist A.K. Cajander was persuaded to write a proposal for the organisation of forest research, which he did in 1906, after visiting several German and other European forest research organisations. Due to the second oppressive Russification period (1909–1917), the First World War (1914–1918) and the Finnish civil war (1918), the forest research organisation only began to operate at last in 1918. Forest research and education formed a tripartite structure, where the Finnish Forest Research Institute co-operated with the University of Helsinki, responsible for higher forest education, and the Society of Forest Science, which shared research results and information with the stakeholders in the forest sector.[6]

The first years of the Finnish Forest Research Institute were filled with ambitious expectations in extremely modest circumstances. The staff, consisting of three professors, represented the research fields of silviculture, forest mensuration and forest soil science. Later, four more disciplines entered the

4. Michelsen 1995.

5. Berg [1859] 1988.

6. Laine 2017, pp. 22–24.

research institute: in 1928 peatland forestry and in 1938 forest economics, technology and biology.[7]

Forest regeneration and management

According to research publications in the 1920s, the forests seemed to be in a rather poor condition. Due to unclear ownership institutions, high household consumption, active tar production and steadily growing industrial use of timber the destruction of forests was feared. Therefore, one major task for the newly founded research institute was to develop silvicultural practices, e.g., regeneration, thinnings and cuttings. They concentrated on forest regeneration, both natural and artificial. Natural regeneration in northern Finland was carefully scrutinised since the harsh northern climate limited seed production in these areas, where state-owned forests were largely situated. Researchers concentrated on different phases of natural regeneration, such as soil preparation with a horse-driven harrow. Even though natural regeneration covered nearly all forests, the first steps towards artificial regeneration, via nurseries, domestic and foreign seed provenances and forest tree breeding, were also taken.[8]

Towards the end of the 1930s, researchers focused on forest management practices. Traditional selective cutting, high-grading where mainly older and bigger trees were cut, was increasingly deemed unsatisfactory among forest professionals. Scientific research and public discussion anticipated the changes in forest management towards clear cutting and period cover forestry that were enacted after the Second World War.

National forest inventories

The questions set by societal stakeholders and state leaders were, how many trees, of what kinds, and where. Until the beginning of the 1920s, all information about forests was vague estimation lacking a scientific basis. The first national inventory of forests, conducted in 1921–1924, opened a long-lasting series of inventories of which the latest was the thirteenth in 2021.[9] The first and the three following inventories (1936–1938, 1951–1953 and 1960–1963) involved symbolic and heroic achievements. Skilful forest professionals walking through

7. Ibid., p. 24.

8. Heikinheimo 1939.

9. Forest resources, www.luke.fi.

the country measured and evaluated forests. For instance, during the second inventory, the total length of inventory lines was around 24,600 kilometres.[10]

Besides current information on standing stock, they also estimated the future need for forest management activities and the possible drain on standing stock. For the forest industry, the information was published according to geographical areas and watercourses, since industrial timber procurement was highly dependent on log floating.

Information gathering was not restricted merely to growing trees –other flora was also reported with exceptional accuracy. The main reason for this lies in the prevailing paradigm for Finnish forest management and increment, the forest type theory created by Professor A.K. Cajander. The most suitable and profitable tree species for the forest concerned are extrapolated based on the forest ground flora.[11] This paradigm still dominates Finnish forestry in the 2020s.

Timber consumption inventories

To ensure national prosperity, information on the amount of growing stock and forest productivity was not enough. Nearly as important was information on timber consumption. For what purposes was the cut timber used, and how did this contribute to economic development? Accordingly, the Forest Research Institute launched the first national timber consumption inventory in 1927. Information was gathered all over the country, from forest industries, municipalities, forest-related organisations and even from 1,400 private farms that reported all their timber consumption for a year.

The inventory revealed astonishing details about the wood-dependency of Finnish society in 1927. The statistics consisted of amounts of timber used in pulp mills, sawmills or transportation (e.g., steamships and trains) and export of roundwood. Industry used 49 per cent and export of roundwood accounted for eleven per cent of total wood consumption (40.14 million m^3). However, from the historical research point of view, the statistics about wood used for heating are also fascinating, e.g. heating of schools and hospitals, or how often Finns heated the sauna in summer compared with winter. The original questionnaires included information on the size of houses, the number of fireplaces, the number of inhabitants and livestock. Domestic use formed 32 per cent of all wood consumption and two-thirds of this was for heating.[12]

10. Laine 2017, pp. 33–35, 51–53.

11. Cajander 1949.

12. Saari et al. 1934.

In 1929, statistics stated that the average size of the 232,400 privately owned forests was 45 hectares and 75 per cent of all private forests were under fifty hectares.[13] This raised concern in the forest industry, since timber procurement relied mostly on private forests – around two thirds of the timber used in the forest industry originated from private forests.[14] Small forest areas, firstly, diminished forest owners' ability and willingness to sell timber and, secondly, raised costs the timber procurement.

The first decades of forest research stressed the need to know the forests. Researchers produced knowledge on forest resources and wood consumption, besides new silvicultural practices.

Exploit the forests (1940s–1960s)

The two decades after the Second World War are characterised by intensive development of forest institutions, management and practices. Forest research concentrated on the improvement of forest management and technology, the regeneration of low-yielding stands, the ditching of peatlands and gaining more information on forest work and workers.[15]

For Finland, the Second World War ended in a catastrophe. Finland was condemned to pay US$300 million (at 1938 prices) war reparations to the Soviet Union. Territorial concessions, amounting to ten per cent of land area, caused the loss of twelve per cent of forests and twenty per cent of industrial capacity, consisting mainly of the forest industry.[16] War reparations concentrated heavily on the products of the steel and engineering industry, which helped to diversify the structure of the national economy. However, both export revenues and citizens' income were still highly dependent on forests and the forest industry.

Although the war caused nearly 100,000 Finnish casualties, the civilian population mostly remained untouched. However, the people of ceded areas, around 420,000 evacuated citizens (circa eleven per cent of the total population), had to be resettled. Around half of them continued as farmers and forest owners through the resettlement process, and nearly 52,000 new farms reclaimed land mainly from municipalities, state and companies, but also from private citizens. Post-war resettlement slowed down the modernisation of Finnish society and,

13. Osara 1936.
14. Laine 2006, pp. 93–96.
15. Uusitalo 1978.
16. Eloranta et al. 2006.

at the beginning of the 1950s, nearly half the workforce was still occupied in agriculture and forestry.[17]

The post-war years stressed efficiency and productivity. The administrative grip over private forest owners tightened. New and more specific regulations on silviculture and timber felling in private forests also included compulsory membership of local Forestry Management Associations. State administrative District Forestry Boards enforced the Private Forest Act and, if the law was not respected, private forest owners were subject to fines, the forest was taken under supervision and owners' rights to decide forest management were restricted for years. Forests and economic-based forestry became a symbol of national consensus, as demonstrated in June 1950 by the Forest March. Over six summer days, around half a million Finns, eighteen per cent of the population over fifteen years of age, participated in silvicultural activities.[18]

After World War Two, the state research organisations developed extensively. Forest research received its share of resources and established a nationwide network of research stations. The most radical change, however, occurred within international research co-operation and the language used. Forest science, as well as other sciences, had been in many aspects connected to the German forest tradition. Suddenly, after the war, forest science and researchers turned to North America. It was a confusing situation. Highly respected forest scientists had published their research in German, and most barely spoke English. This transition offered opportunities for younger scholars and, until the late 1960s, new professors stepped forward.[19]

After somewhat reckless wartime cuttings, silviculture and forest management needed to be reorganised. The selective felling of large trees, quite common before the war, was banned and private forest owners were forced to adopt period cover forestry with clear cutting and artificial regeneration. Despite more efficient timber procurement, the lack of timber seemed to restrict the forest industry's capacity to grow. To alleviate the timber shortage, massive forest improvement activities were launched.

Renewed forest management

During the 1940s, a fundamental paradigm shift took place in Finnish forestry. The signs of change already existed in the late 1930s, but the real starting point

17. Ilvessalo 1963.

18. SVT 6:C 102,8, Väestötilastoa Population Census 1950, p. 18.

19. Laine 2017, pp. 58–63.

was the Declaration against selection felling in 1948. With this declaration, six distinguished foresters rejected selection felling and proclaimed the benefits of silvicultural fellings, i.e., clear cuttings and artificial regeneration with saplings. Forest professionals, supported by the state administration, implemented this change in practice and legislation.[20]

Forest researchers faced the challenge of providing coherent information to guide thinning, clear-cutting and regeneration. They created specific tables for different geographical areas, forest types and tree species. Based on these tables, forest professionals decided the timing of thinning and other cuttings. When implementing the tables, the volume of thinning was based on the defined basal area (with a specific gauge) and estimation of the average height of trees. This method systematised and standardised silviculture all over the country and aimed to secure timber for industrial use.[21]

The forest industry's demand for timber grew inexorably and finally threatened foresters' main principle – that yearly cuttings should not exceed the yearly increment. However, large clear cuttings with evolving harvesting technology had caused a situation where the volume of growing stock seemed to decrease. Something needed to be changed. The solution was to improve the increment of the growing stock by launching massive forest improvement campaigns.[22]

Forest improvement

From the 1960s onwards, the state launched several national forestry improvement programmes, funded by the Bank of Finland and partly by the World Bank. These programmes estimated the connection between total timber consumption, growing stock and increment, maximum removals and, especially, how and with what measures to increase timber volume. The major funded activities were forest tree breeding, artificial regeneration, afforestation of low yielding forests and abandoned fields, drainage and fertilisation. In addition, the state funded building of forest roads and development of forest work technologies. Since, according to the fifth national forest inventory (1964–1970), private citizens owned 58 per cent of forestry land and 71 per cent of growing stock, funding was especially awarded to the privately owned forests. Private forest

20. Laine 2017, pp. 54–55.

21. Nyyssönen 1954.

22. Uusitalo 1976, pp. 105–35.

owners commonly paid half of the forest improvement costs themselves and the state contribution was 21 per cent loan and 29 per cent subsidy.[23]

Finland is a swampy country. One-third of the land area (9.2 million hectares), classified as various swamps, bogs or peatlands, was evaluated as a solution to the looming timber shortage. National planning supported by specific funding and administration officers worked efficiently. At the beginning of the 1950s, drainage covered around eighteen per cent of the swamps in southern Finland and four per cent in northern Finland. In the next decade, the shares were 47 per cent and 21 per cent, an incredible achievement given the modest technology available and hard conditions.[24] Unfortunately, overly effective and motivated work resulted in errors, which have since been widely criticised. Draining also affected around 0.45 million hectares of nutrient-deficient swamps and bogs, which lacked timber production capacity. In the twenty-first century, these areas have mainly been left outside active forestry or are under restoration back to swamps. Thus, peatland forests, representing around 23 per cent of growing stock and twenty per cent of increment and removals, have a growing importance in Finnish forestry.[25]

One highly respected but criticised measure of forest improvement was forest tree breeding. When entering plantation forestry, large clear cutting areas and low yielding forests were regenerated with saplings, and the need for inherited high-quality seeds was urgent. Northern Finland, where a good seed year might occur every tenth year, particularly suffered from lack of seed. Tree breeding is based on reproducing genetically inherited properties such as healthy trees with straight stems and better increment. Finnish Forest Tree Breeding and Forest Research Institute created a nationwide system of so-called plus trees whose seeds were collected and used in tree nurseries. Later, specific seed orchards fulfilled the need for seed and, in the twenty-first century, three-quarters of all saplings originate from seed orchards.[26] Despite good results, forest stakeholders have criticised tree breeding as an extremely expensive and slow way of increasing productivity.

23. Laine 2017, pp. 68–71.
24. Ibid., p. 56.
25. Luke, Suometsät: https://www.luke.fi/tietoa-luonnonvaroista/metsa/suometsat/.
26. Rusanen et al. 2021; Laine 2017, pp. 76–80; Luke, Tree breeding: https://www.luke.fi/en/natural-resources/forest/tree-breeding/.

Forest work

Forest work – timber felling, hauling and floating – was regarded as a basic skill for rural men. In 1950, nearly seventy per cent of rural men worked in the forest at least a few days a year. This common knowledge faded as Finnish society slowly recovered from the war and industrial employment lured rural young men away from the forest. A shortage of skilled forest workers was threatening timber supply and forest industry production.[27]

Rising societal prosperity contrasted to forest workers' hard conditions and modest income. Their work and life became a political question, which culminated in President Kekkonen's rhetorical claims that forest workers' poor living conditions were a national disgrace. Men whose hard work enabled Finnish society to gain prosperity lived in misery.

At first, forest research improved practices and tools for forest work and aided stakeholders, employers and trade unions in defining piece wages. Later, research was impacted by the social sciences and the focus was laid on forest workers' professionalism, societal position and living and health issues. Results and especially popularised publications raised a mix of embarrassment and guilt which also benefited forest workers.[28] At the beginning of the 1970s, they became qualified professionals with a new modern title and a better labour market position.[29]

Define the forests (1970s–1990s)

Finnish society finally became modern. Up to the 1950s, the majority of Finns were occupied in agriculture and forestry. During the 1960s, Finland pretty much jumped straight from being a primary sector society to a tertiary sector society. That is, Finland skipped the phase where citizens occupy themselves mainly with industrial tasks.[30] Exceptionally quick and somewhat violent changes in social structure caused severe problems: rural citizens moved to crowded cities struggling with the housing shortages whereas rural areas were deserted and small farms collapsed with diminishing agriculture. The turn of the 1960s and 1970s witnessed Finnish mass emigration to Sweden in search of a better life.[31]

27. Laine 2019.
28. Heikinheimo 1972.
29. Laine 2012.
30. Eloranta et al. 2006.
31. Koivukangas 2003.

Knowledge of Trees and Forests

Like other Western countries, Finland encountered two significant global phenomena in the 1970s. Firstly, the golden years of economic growth ended abruptly in oil crises, causing economic recession and unemployment. This economic shock was smoothed by the bilateral trade with the Soviet Union whereby imported oil was paid for by the export of Finnish products to the Soviet Union.[32] Secondly, the environmental movement also arrived in Finland, starting several decades of harsh disputes and conflicts about forests.

Forest research reacted quite actively to the oil crises, which increased interest in fuel wood. The forest industry had no intention of giving any timber for heating purposes; all timber was badly needed for industrial use. Therefore, research concentrated on substitutes, such as growing willow as the source of energy.

The image of forestry and the forest industry turned to that of a sunset business when, in the 1990s, Nokia and other electronics industries began their triumphal success. Towards the end of the 1990s, the forest sector and research had to justify the societal importance of their activities.

Environmental conflicts and criticism against forest management in the 1970s were hardly acknowledged in forest research, which was committed to economic-based forest management. However, urbanised citizens, enjoying forests more for recreational purposes, embraced environmental and conservation values. Little by little, forest research broke away from economy- and ecology-based research and new, multidisciplinary research with more societal themes arose. Forest research came to acknowledge the recreational and conservational importance of forests.[33]

Acid rain

Concern for the future of forests also shook Finns. News and photos of Central European forests dying because of air pollution and acid rain alarmed the forest sector and society. Could this be possible also in Finland? In the face of growing unrest, forest research discovered conifers suffering from needle loss, especially in northern Finland. Since these northern areas almost totally lack domestic industrial activities, the source of acid rain had to be outside the country's borders, especially in the Russian Kola Peninsula. Acid rain, the threat of dying trees and needle loss created strong debate both among the public and forest researchers. The official results of forest research declared that Finnish nature

32. Eloranta et al. 2006.

33. Laine 2017, pp. 101–13, 137–41.

did not significantly suffer from acid rain. The damage to conifers was caused mainly by natural phenomena, such as abundant rainfall and early autumn frost. However, public discussion and a suspicious attitude towards the forest sector and research had gained more room, normalising the questioning of the forest sector's authority and paving the way for continuous forest conflicts.[34]

The acid rain discussion had some positive aspects in terms of developing multidisciplinary research. In the mid-1980s, the state funded one of the first multidisciplinary research programmes to study the consequences of air pollution and acid rain. Altogether eight state research organisations, seven universities and around 200 researchers scrutinised, over five years, the amount of acidification and its impact on nature and forests. Next, another five-year research programme concentrated on how air pollution affected forests. All in all, the 1980s opened the period of multidisciplinary research and directed it towards taking into account not just forests but also other environmental and societal issues.[35]

Important economy

Forests are the source of national prosperity and enable the forest industry. Thus, effective technologies, procedures and institutions are the prerequisites for a prospering forest sector; economics has been an integral part of Finnish forest research from the late 1930s onwards.

The key theme of the economic research has been roundwood trade, its practices and especially its prices. From the 1960s onwards, the Central Union of Agricultural Producers, representing private forest owners, and the Central Association of Finnish Forest Industries agreed on the price of roundwood. These agreements set the prices for different timber assortments (logs and pulpwood of various tree species). At the beginning of the 1990s, due to EU regulation and the forest industry's motivation to withdraw from the cartel, the co-operation over price setting stopped. However, despite anti-trust legislation, forest industry companies still secretly agreed on the roundwood prices. This illegal cartel ended in 2004.[36]

Research on roundwood trade and published forecasts evaluating price trends often caused conflicts between forest researchers and the forest industry. Industry representatives even occasionally declared that forest researchers

34. Ibid., pp. 144–47.

35. Ibid., p. 145; Tikkanen and Niemelä 1995.

36. Kuuluvainen et al. 2021.

should do what they are capable of and leave important business (i.e. timber trade) issues in the hands of the forest industry. The Forest industry's cautious attitude was due to its dependence on private forests but also to the possibility that forecasts might have an unwanted impact on roundwood trade.[37]

Up to the 1980s, studies concentrated on private forests' importance for agriculture and forest owners' incomes. Recently, research on forest owners' values and attitudes and their willingness to cut trees have become more common. This research has remained important mainly due to the private forests' irreplaceable role in the forest industry's timber procurement. In the 2010s, the forest industry used around 55 million cubic metres of domestic roundwood, of which 75 per cent originated from privately owned forests. The latest research on private forest owners was published in the spring of 2020.[38]

Discover forests' futures (2000s–)

Economic recessions and recoveries have characterised Finnish society since the 1990s. It has searched for direction and solutions to achieve a balance between economic growth and environmental issues. The forest sector and industry, deemed outdated sunset businesses, have encountered new appreciation in the course of globally increased demand for, e.g., tissue paper. Both new technologies and wood-based products and a strengthening understanding of forests' role in mitigating climate change have altered the societal position of forest-based activities.

Societal changes and attitudes set challenges to forest management and knowledge. Especially on social media, environmental and forest sector stakeholders react fast – and sometimes even furiously – when they think that 'the others' threaten their forest-related values and aims. Far too often, reactions and responses cause disputes and even escalate conflicts. Future forests require active reconciliation of different societal and global objectives.

Especially in the face of climate change, forests have increasingly gained global significance alongside national ones. In addition to national objectives and institutions, Finnish forests are subject to the European Union and other international obligations. Forest research aims to effectively develop co-operation and understand the complex future of forests.

Recognising the new possibilities in forests and the forest sector, society demanded fundamental changes in forest research. This needed the creation of

37. Laine 2017, pp. 193–94.

38. Karppinen et al. 2020.

a more multidisciplinary approach to forest research, particularly in the social and natural sciences. In addition to economic values, other approaches to sustainability (ecological, societal and cultural) had to be embedded in the research projects. Two main research themes, climate change and the bioeconomy with new products, have influenced almost all research.

Although international co-operation between forest research organisations has been taking place within IUFRO for a hundred years, the nature of the co-operation is expanding and becoming more multidisciplinary. Solving major global problems requires strengthening scientific co-operation within the European Union and other international organisations.

New research trends exist in forestry research. Firstly, almost all studies notice climate change in one way or another and seek to find out how ongoing research could mitigate climate change. Secondly, researchers are working to develop new forest-based products and promote bioeconomy. Thirdly, we find the somewhat revolutionary ideology of post-humanism, which aims to understand the forest as an entity where values are not defined only from a human perspective.

Recreation and wellbeing

In Finnish legislation everyman's right, or freedom, to roam lays all forests open to citizens despite their ownership. Everyone has the right to enter the forest and enjoy its benefits. Simultaneously, as the wellbeing of civil society has developed, citizens' everyday life has become detached from the forest. Many citizens no longer value the forest as a place of work or source of income. Forests are more valued for their recreational purposes and other than economic values.[39]

Research on forests' recreational importance has developed from being undervalued towards being an essential part of forest research's societal impact. The national outdoor recreation inventory, the first enacted in the late 1990s and the third by the end of 2021, has offered knowledge on citizens' attitudes toward nature, environmental changes and recreational values. According to the second inventory (2009–2010), around 96 per cent of citizens engage in outdoor activities two or three times a week. Besides recreation, the health impact of forests and nature-based tourism have opened new business opportunities for rural areas.[40] In 2020–2022, due to COVID-19, national parks experienced an exceptional rush. The surveys, conducted in co-operation with the Finnish

39. Simkin et al. 2021.

40. Sievänen et al. 2011.

state forest organisation and other Nordic countries, have explained both the number of visitors in national parks and their values and intentions. In 2011, researchers counted more than two million visits to Finnish national parks, in 2015 there were around 2.6 million visits, and finally 2020 saw around four million visits.[41] For a population of 5.5 million, these numbers are significant. The pandemic pushed Finns back to nature and forests, which will presumably have an impact on forest-related values. An impression based on public discussion sees ecological values outweighing economic ones.

The popularity of the berry crop forecasts is explained by the universal right to pick berries and mushrooms despite forest ownership. Every second Finn picks berries or mushrooms. The most important wild berries are bilberry and lingonberry, and cloudberry in the North. It is estimated that the yearly amount picked of wild berries is 40–45 million kilos, around ten per cent of the total crop.[42] Mushrooms are the other most often used product of forests and the amount of mushrooms picked varies yearly between three and sixteen million kilos. Researchers prepare separate mushroom yield forecasts for enthusiastic mushroom pickers.[43]

Climate change

Climate change has altered the way we look at our forests. For centuries, forests have provided us with game, berries, mushrooms and wood. Traditionally, forests have also protected against enemies, in the Finnish case neighbours or soldiers of the Swedish king or the Russian tsar. Our everyday life is based on forests and our culture has drawn its inspiration from it. Forests, important for carbon sequestration, have gained new value as carbon sinks and storage. Most standards and activities within forest management need revaluation.

Forests and forest management are facing several new difficulties. A warming climate is encouraging the emergence of new pests such as bark beetles, which can cause the widespread deaths of spruce trees. Increased rainfall and storms will have a negative impact on soil and trees. Preparing for climate change requires altering forest management practices, perhaps new tree species being used in regeneration and ensuring that forests after felling can withstand increased winds and storms. An effort is made on peatland forests, as drainage

41. Laine 2017, p. 231; Metsähallitus, Käyntimäärät maastossa: https://www.metsa.fi/vapaa-aika-luonnossa/kayntimaarat/kayntimaarat-maastossa/.

42. Roininen and Mokkila 2017, p. 12.

43. Luke, Mushroom yield: https://www.luke.fi/en/natural-resources/forest-berries-and-mushrooms/mushroom-yield/.

turns these areas into a source of carbon dioxide. Therefore, logging peatland forests demands special consideration.[44]

Bioeconomy and novel products

The raw materials from forests are seen as an increasingly diverse resource, allowing forest industry production to evolve towards the bioeconomy and even the circular economy. One highly fascinating research field focuses on bioactive compounds extracted from forest-derived materials. Current research produces new discoveries and verifies old traditional knowledge, for instance, the anti-inflammatory effect of resin. The new compounds are used not only in the pharmaceutical industry but also in the nutrition and cosmetics industries.[45]

Forests as entity

Alienation from the economic use of forests and forest work, as well as urbanisation, have changed the values attached to forests. Increasing numbers of people appreciate the non-economic importance of forests and see the forest as an entity, not just as a timber resource. Forests valued as recreational sites should remain intact, preferably with old-growth trees, rich biodiversity and efficient carbon sink and storage. Occasionally, economic-oriented forest owners and forestry professionals have difficulty in understanding non-economic aims, not to mention post-humanistic attitudes.

Conclusion

The knowledge needed and gathered from the forest has varied through the decades. The beginning of the twentieth century witnessed an ever-growing need for knowledge on the volume and quality of growing stock. The post-war era concentrated on forest improvement and searched for practices to increase timber growth and develop forest management and timber procurement. Due to the environmental movement, the focus widened to the non-economic aspects of forests, such as recreational and health issues. Finally, in the twenty-first century, some sectors of forest research scrutinise forests as an entity without assessing only economic significance. Forests, with their different living organisms and non-living elements, are valuable.

44. Venäläinen et al. 2020.

45. Högbom et al. 2022.

The main currents of forest research include, firstly, forest management-related knowledge and activities; secondly, research discovering the relationship between society and forests; thirdly, research on rich biodiversity; and finally, understanding the forest as an ecological entity in its own right.

Throughout the century, forest research has responded to the information needs of Finnish society, either by providing forward-looking accounts or by assessing developments that have already taken place. Either way, knowledge has shaped societal decision-making and strengthened forests' impact on the development of society.

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