

Forest



RESEARCH

METLA's customer publication

2b

July 2000

Will there be enough forests in the world of the future?

The article takes a look at the issues of the world having or not having enough forests in the future to meet the growing demand for timber for industrial purposes and how the environmental services of the forests might be guaranteed.

Even berries now on the map

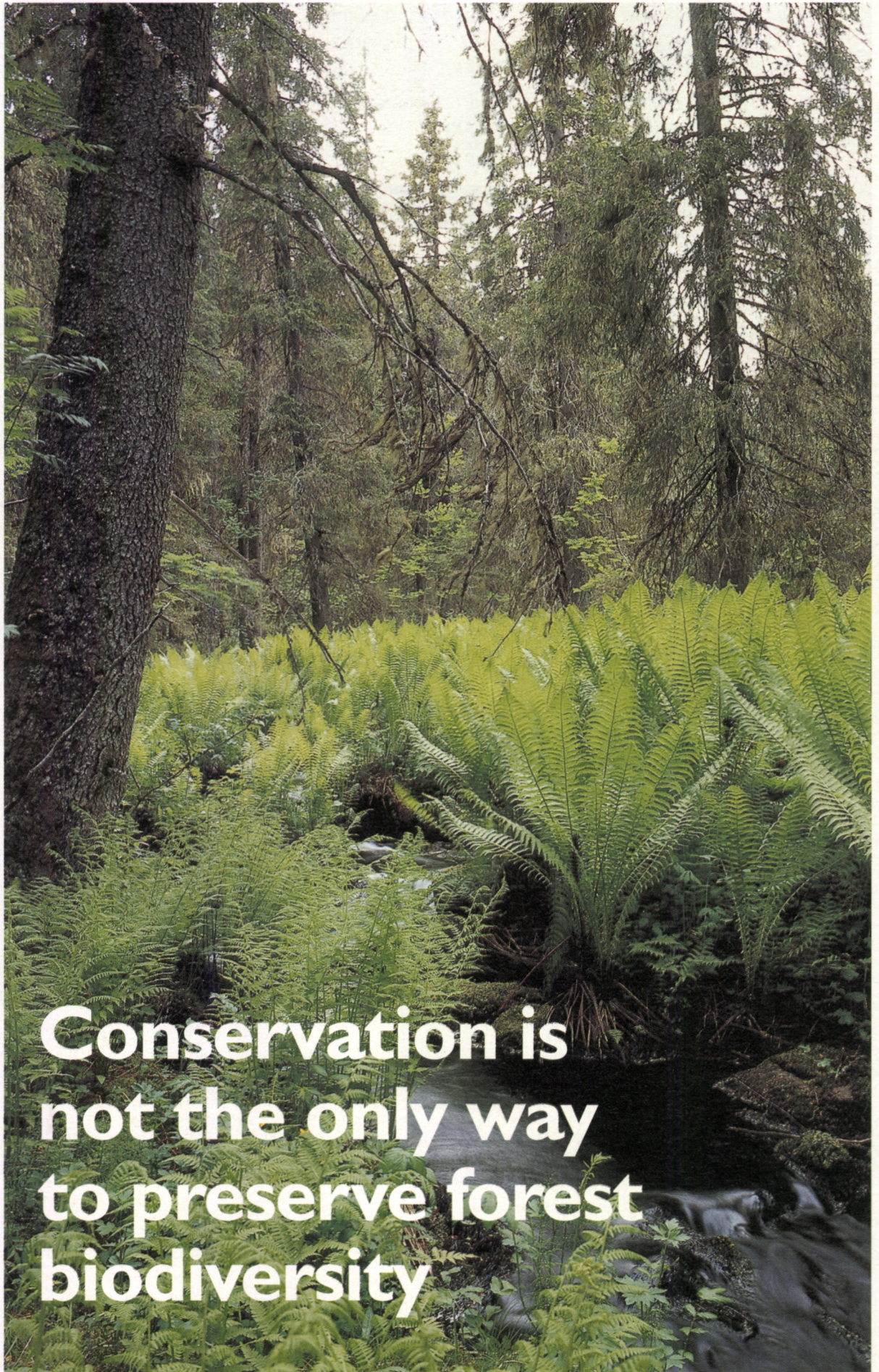
Finland continues to uphold its age-long tradition of people having public right of access to outdoor areas, e.g. to pick wild berries. The Finnish Forest Research Institute has started to produce thematic maps and media reports concerning berry yields.

Trees remember

Tree trunks embedded in mires and in the layers of sediments in lake bottoms can retain their "environmental data" for thousands of years.

Information technology and the use of paper

The demand for paper has grown steadily for centuries and so it is only natural that no significant changes are expected. However, it is now becoming increasingly evident that the development of digital information technology (IT) may have substantial impacts on the paper industry, and thereby also on the use of the world's forest resources.



Conservation is not the only way to preserve forest biodiversity

METLA

The world increasingly needs forests

LEADER

The articles in this newsletter are based on ongoing research and research results of the Finnish Forest Research Institute (Metla). The Institute carries out research in all the fields of forestry, from growth and regeneration of forests to forest products marketing, from forest inventory to multiple-use forestry.

For decades, forests have been a major source of well-being in Finland and will continue to be so in the future. The forest sector, along with the metal and electronic sectors is one of the three supporting legs on which the Finnish economy stands and on which the nation's welfare has been built. Finns look upon forests not only in the material sense, but also as a valuable ecological and cultural resource. In recent years, the Finnish forest sector has, however, received many challenges. The globalisation of the forest industry, Finland's membership in the European Union, the certification of forests and the emphasis on biodiversity and ecological sustainability, are trends which reflect the situation in Finland and increase the importance of international thinking.



Photo: Erkki Oksanen

From the global point of view, most countries of the world appear to be quite similar to each other. Forestry is being affected by strong external forces. For example, climate change, the environmental movement, international agreements, and globalisation, all have their impacts on forests and utilisation of

forest resources. Forests should not offer only wood-based livelihoods, but also environmental benefits. This means that the challenges for research in forestry are increasingly universal. There is a need to improve and enlarge knowledge of how to attain all the desired benefits from the forests so that the growing and diversifying needs of people and societies can be sustainably met.

I believe that we forest researchers, and all persons working in the forest sector, are perhaps privileged. We have no need to call in question the importance of our work. There exists a world-wide demand to improve forest-related know-how through a stronger innovation based on research, education and expanding internationalisation, and being a renewable resource forests will also offer a solid basis for sustainable development.

Raija-Riitta Enroth

Forest Research

METLA's customer publication
July 2000

ISSN 1455-0393

Publisher
Finnish Forest Research Institute
Head office:
Unioninkatu 40 A,
FIN- 00170 Helsinki, Finland
Tel. +358-9-857 051
Fax +358-9-625 308, 857 05 677
Email:
firstname.surname@metla.fi
<http://www.metla.fi/>

The publication comes out four times per year in Finnish.

Chief editor
Raija-Riitta Enroth
raija-riitta.enroth@metla.fi
Editorial secretary
Merja Lindroos
merja.lindroos@metla.fi

Editorial board
Jyrki Hytönen
Ritva Ihalainen
Leena Iisalo
Heli Mikkilä
Tiina Nieminen
Jarmo Saarikko
Marja Ruutu
Heidi Vanhanen

Cover photos:
The forest/Erkki Oksanen
Crested tit/Heikki Kokkonen

Layout
MBE Oy/Seppo Laakkonen

Compilation
Johanna Torkkel

Printed in
esa print
Esan Kirjapaino Oy, Lahti



Text: Jussi Uusivuori
Photo: Erkki Oksanen
.....

Will the world have enough forests in the future?

Although in many respects, the question in the title escapes scientific reasoning, it is well worth trying to answer. The effort is useful in that it forces one to highlight the growing controversial needs placed on forests in today's world both globally and locally.

There seems to be a lot of them but ...

About 3.5 billion hectares, or 27 percent of the total global land area are forests. Area-wise, there are about 2.5 times more forests than land under active agriculture. Furthermore, according to the FAO, so-called other wooded land makes up some 1.6 billion hectares of land.

A minority of the world's forests are so-called commercial forests managed for timber production. Only about five percent of all forests are classified as plantation forests: high-yield, fast-growing forests consisting of usually one single tree species. However, these forests account for about 27 percent of the total industrial timber production in the world.

The area of timber plantations is growing both in the tropical and the temperate zones. Simultaneously, especially in the tropics, the area of natural forests is diminishing. The FAO estimates that annually 12–13 million hectares of tropical forests are deforested. Studies show that some pantropical factors, related to population growth, income and ecological conditions, drive the deforestation process. Expanding agricultural production accounts for about two-thirds of the total annual loss of forests. Timber extraction for logging purposes accounts for only a small share of deforestation directly, although indirectly, through increasing accessibility to forests, industrial utilization of tropical forests is a

major factor behind deforestation.

Markets will direct industrial timber needs

Global demand for industrial timber is likely to grow 1-2 percent per year until 2020. Obviously, a large share of the increasing supply must come from timber plantations. This means that new plantation forests have to be established, and that the production in the existing ones needs to be intensified. However, there has to be intensification of timber production in the other commercially utilized forests as well. It can be expected that markets will equate demand for and supply of industrial timber at price levels above the current prices. More conservation-induced restrictions are placed on management in commercial forests in many industrialized countries, and timber production from plantation forests may imply higher marginal costs in the future (due to expansion of plantations to less favorable soils, and due to the need to account for the demands of improving the ecological record of timber plantations).

Since forest plantations have a high potential in timber production, and since the threats of tropical deforestation are becoming more evident, an obvious question is whether, to help abate deforestation, pressure could be taken away from natural forests



by expanding timber production from plantations. The answer would be a simple 'yes', if demand for industrial timber – instead of the demand for agricultural land – was the primary cause of deforestation. However, since this is not the case, plantation forests may only slow down deforestation marginally.

The real challenge

In so far as we believe in global market mechanisms, we can rest assured that the world will have enough forests in the future to meet the growing timber needs for industrial purposes. As there are fewer restrictions on international capital movements allowing the expansion of foreign direct investments, and as there are likely to be fewer restrictions on international trade in the future, more timber and timber products can be produced where production is most efficient, and be transported to where the production is consumed.

The real challenge to guaranteeing a sufficient level of forests in the world does not relate to

commercial timber production, but rather to environmental services of forests. Here, policymakers cannot put full confidence in market mechanisms, since there are no operational markets for these services. This has made some believe that governments should work to establish mechanisms that would allow markets to emerge around the environmental services of forests. Plans towards including forest investments in the system of tradable carbon emission permits is an example of this.

It should be emphasized that markets for tradable pollution permits are 'real' only to an extent. Governments can rely on them in determining 'correct' price levels, and finding efficient ways of reducing pollutants. However, they must be heavily controlled by policymakers; for example, the initial 'endowment' of permits has to be decided from outside the markets. In principle, markets could be

► from previous page

created to encompass the role of forests in carbon sequestration. The 'taxonomy' of carbon content in different types of wood material does not pose an insurmountable obstacle, and verifying the volume of timber investments should not be impossible either.

Compared to carbon sequestration, many other environmental services of forests, such as biodiversity, are much more alien to the concept of being exchanged on the markets. But this might be overcome by creating and improving markets for forests and forest land. In fact, some international investors operating in industrialized countries have already purchased forests rich in biodiversity from de-

veloping countries. The motives for these transactions – even if not made public – seem to be, in some cases, related to the anticipation or possibility that these forests will in the future have a high monetary value. Of course, such examples are very few and there are strong reasons in today's developing countries as to why this type of forest investment might not become popular. Investing in ecologically rich forests is too risky and costly under prevailing unclear land-tenure and open-access practices, even if investors expected that these forests gain in monetary value because of growing scarcity.

There are also other ways that governments and policymakers can hope to influence markets to

take into account the environmental services of forests. Various certification schemes of sustainable forest management, such as those of FSC (Forest Stewardship Council) and PEFC (Pan-European Forest Certification), are primarily market-based initiatives to incorporate environmental values into the end-products of forest industries. Even if these schemes are market-based, they will concern policymakers closely at least when the questions of trade liberalization and non-tariff barriers to trade are discussed in the WTO process. At that point the governments decide their stance with respect to allowing or fighting forest and timber certification schemes.

mental services related to these forests will worsen in the future. This will translate into an increase in the unit value of these services. Governments need to agree on how to set a monetary value – with or without the assistance of markets – on these services.

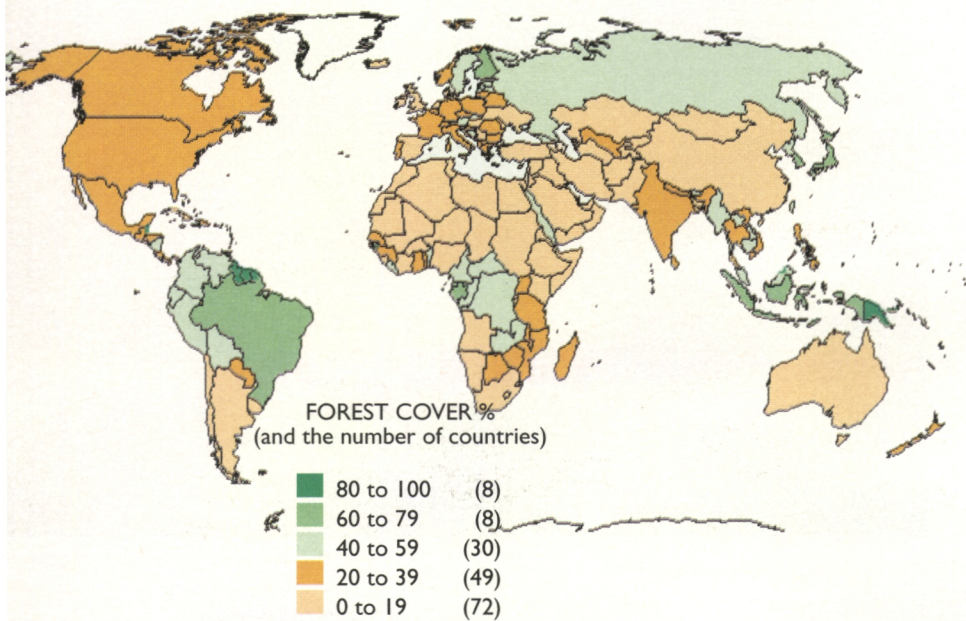
Intergovernmental political processes will play a central role in both valuing global and local environmental services of forests, and building compensatory schemes. It is a commonly accepted notion that the future of forests depends mostly on factors outside the realm of forest sector issues. This makes the international policies around forests even more complex; the controversies between national interests are complicated by widely varying national and local conditions. Partly because of this, the international forest policy processes have not been very successful. In fact, at times they must have produced more frustration than results. However, the deeper meaning of the function of the intergovernmental negotiations and processes is that governments and the general public are kept informed of the threats related to the growing scarcity of the many values of forests.

Beyond markets

Governments seem to have ways to utilize and support markets in order to meet the challenge of guaranteeing a sufficient amount of forests to future generations. However, at best, markets can only help policymakers in finding solutions to problems such as deforestation or degradation of biodiversity. Often, the external-to-market values of forests are so subtle and long-run – and even unknown – that it is inconceivable that markets would ever fully account for them. Yet, there seems to be growing evidence that ignoring these values may turn against societies. As certain forest types are getting scarce, the shortage of environ-

Literature used:

- World Forests, Society and Environment. Palo, M. and Uusivuori, J. (eds.). Kluwer Academic Publishers. Dordrecht, Netherlands. 1999.
- State of the World's Forests 1999. FAO.



Sources: WFSE, FAO

Monitoring nonindustrial private forestry in Finland

Text: Pekka Ripatti, Harri Hänninen and Heimo Karppinen

Photo: Erkki Oksanen

In Finland, nonindustrial private forests are divided into 300 000 forest holdings with at least 5 hectares of forest land. Private forests play an important role in Finnish forestry, supplying 70–80 percent of the domestic roundwood purchased by the forest industries. Until the 1960's, holdings were typically owned by farmers and they were mostly owners' permanent resi-

dences. During the last thirty years, Finnish society has changed considerably. The main changes have been occupational differentiation and the migration of the population. These changes have had a major impact on the structure of private forest ownership and on the objectives of forest owners. During the last decade, also forest policy and forest legislation were reformulated, while in roundwood markets, collective stumpage price agreements between forest industries

and forest owners were denied. As a whole, these developments emphasize the need to monitor private forestry.

Since the 1960's Finnish forestry research has produced information concerning holding and ownership characteristics, as well as timber sales and silvicultural practices on private forest holdings. Recently, these studies have also considered forest owners' values, attitudes and objectives. However, the data have been gathered at varying in-

tervals and with different sampling and data collection methods. The investigations have concentrated more on up-to-date issues in forest policy than on collecting information suitable for monitoring certain characteristics and behaviors.

In countries such as Finland, dominated by nonindustrial private forest ownership, one of the prerequisites for a successful forest policy is up-to-date information on the structure of private forest ownership, owners' objec-



National Forest Inventory of Finland (NFI)

- based on long traditions and newest technique

Text: Erkki Tomppo and Kari T. Korhonen
 Photo: Erkki Oksanen



tives and behavior. The number of forest owners is large and the structure of forest ownership is continuously changing. The most feasible procedure to collect information on private forestry is to conduct separate survey studies based on representative samples of private forest holdings. As the same type of information is collected periodically, the various data can be combined into a database providing a monitoring system for private forestry.

The Finnish monitoring system for private forestry so far consists of three country-wide cross-sectional data collected in 1975, 1990 and 1999. The data sets were collected in a similar manner in 1975 and 1990. The latest data were collected by a mail inquiry to 9000 forest owners throughout the country resulting in 4800 responses. The mail inquiry data was combined with National Forest Inventory data on forest resources and with infor-

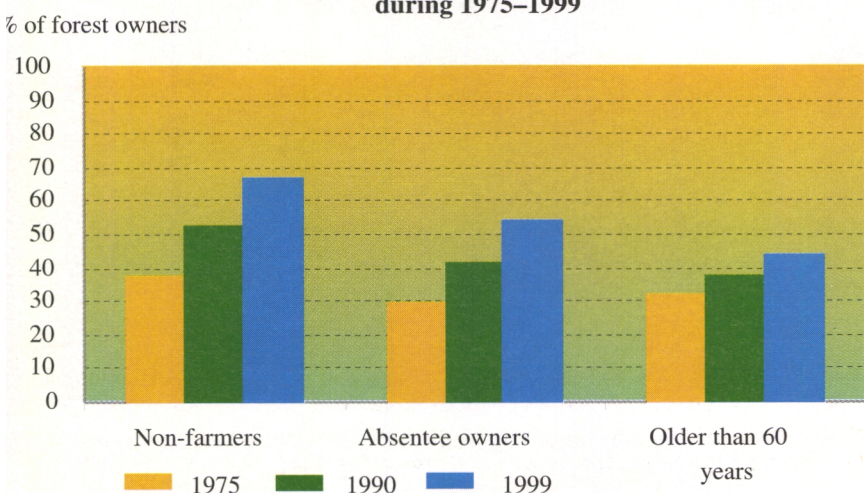
mation on owners and holdings from tax registers. External information on silvicultural measures on woodlots and corresponding subsidies were also linked to the basic data.

The system produces periodical information concerning holding and ownership characteristics, forest owners' values and objectives as well as timber sales and silvicultural practices. In addition, participation in forestry extension activities is monitored. The system also produces data for separate studies on up-to-date topics, in this case on reforestation motives of forest owners.

Further information:

Pekka Ripatti, Harri Hänninen and Heimo Karppinen
 Finnish Forest Research Institute,
 Helsinki Research Centre
 Unioninkatu 40 A, FIN-00170 Helsinki, Finland
 Fax: +358 9 8570 5717, Email: pekka.ripatti@metla.fi

The Finnish monitoring system for private forestry includes information concerning the structure of forest ownership. This graph shows the proportion of non-farmers absentee and aged owners during 1975–1999



Since the 1920's, the Finnish National Forest Inventories (NFI) have produced information at national and regional levels concerning

- forest resources – volume, growth and quality of the growing stock
- land use structure and forest ownership
- forest health
- biological diversity of forests.

The National Forest Inventories provide a unique database concerning forest resources and their development in Finland. The first inventory was carried out in the beginning of 1920's. Since then, the inventories have been conducted at 5–20 year intervals. The most recent, the 8th inventory (NFI8), was carried out in 1986–1994. The 9th inventory (NFI9) was begun in 1996.

The NFI methodology

Field measurements are the core of the National Forest Inventories. The workload of the 8th inventory was

- over 70,000 field plots on forestry land
- over 150 characteristics measured or assessed
- half a million tallied trees (tree species, diameter, timber assortment class and its precision as well as crown layer are measured)
- every 7th tree was measured in more detail, e.g. height, diameter and height increments and age, health and timber assortments.

Some of the field sample plots have been established permanently. Remeasurements of the permanent sample plots provide information about those changes in trees and forests which cannot be easily assessed by means of

temporary field plots.

The field data are used to estimate statistics on forest resources for large areas, such as Forestry Centres. The sampling intensity has been designed in such a way that estimates of forest area and volume of growing stock are reliable for areas larger than 200 000–300 000 hectares.

A multi-source inventory method has been developed to produce forest resource information for small areas, e.g. municipalities, as well as thematic maps. Satellite images and other geo-referenced data are employed, such as digital maps, in addition to the field data. Landsat TM or Spot -images are employed.

The NFI products

The results of the NFI are published in publications of the Finnish Forest Research Institute, in other scientific papers, in seminars and articles, etc. The results are widely used, both nationally and regionally, for

- decision making within forestry
- forest management planning
- assessing the investments of forest industries
- national forestry and nature conservation programmes.

Thematic maps of small regions have been used, for example, for timber procurement planning.

The most important advantage of the multi-source inventory method is the possibility to obtain results for



Field measurements of the NFI

smaller areas than is possible with field measurements only. The method has been applied since 1990. By 1997, the whole country had, for the first time, been inventoried by the new method, and results for all the c. 500 municipalities were made thus available. Results for other small-areas – for forest holdings, etc. – are made by order.

Research and development – cornerstones of the NFI

The NFI is continuously developed in order to better meet the increasing information needs of the forestry sector and other information end-users. Both increasing timber production demands and ecological and environmental need for forest information necessitates the further development of the multi-source inventory method.

The current research topics in-

clude, for example,

- use of remote sensing data in large area inventories; airborne imaging spectrometer AISA
- assessment methods for the biological diversity of the forests
- estimation of changes in forests with remote sensing data.

Technical progress in satellite and air-borne imaging will bring radiometrically and spatially improved sensors and imaging systems which are not sensitive to imaging conditions, such as the amount of light, atmosphere humidity or clouds. Active remote sensing is based on the idea of sending a signal and receiving its scattered reflection. Microwaves penetrate through clouds without changing and imaging is, in principle, possible under any condition. Research has shown, however, that the backscattering depends very much on the canopy and soil moisture conditions. Interferometry and multi-temporal images may provide a solution for applying the microwave technique.

Air-borne imaging spectrometers are currently under active research and have also been

tested by the Finnish NFI group. The smallest ground element is typically 1 m x 1 m, and almost 300 spectral bands can be employed. Digital measurements can also be applied in the field. A study to utilise digital camera images in tree stem measurements has been recently completed.

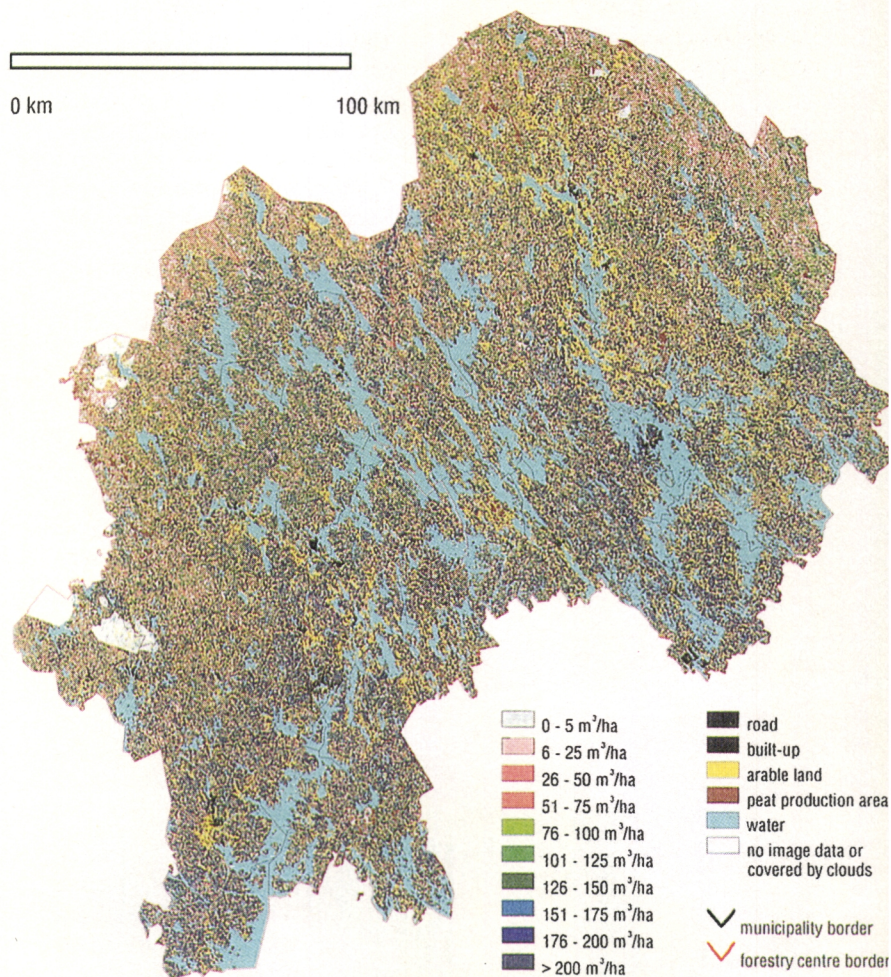
The increasing demand for new and diverse information, e.g. ecological needs, necessitates the further development of the estimation methods. Remote sensing data is particularly suitable for the analysis of the landscape diversity of forests and forest fragmentation analysis, but its use presumes methodological development as well.

The key methodological development is related to improving the reliability of small area estimates and the use of remote sensing data in updating multi-source inventory based forest resource estimates. In developing the method, the first goal was to obtain results for the municipality level, i.e. for areas of approximately 10 000 hectares, but it was then noticed that the results were also applicable at forest holding level, i.e. at the level of 100 ha. Operative forest management planning needs information at the forest stand level, i.e. for

areas of about one hectare. To achieve this goal, objects on images should be analysed instead of single picture elements. This procedure is also under investigation.

Finland's forest resources have been investigated through the National Forest Inventories for almost 80 years. The information has provided a firm foundation for planning Finland's forest industry and the utilisation and management of forests. The future global forest inventories can possibly be based on the co-use of digital field measurements, airborne instruments, such as imaging spectrometers, scatterometers and satellite images in the optical and microwave frequencies. The roles of different input information sources vary depending on the application and information need. Sampling at different resolutions can be applied. This kind of system will have very wide possibilities for international applications.

Further information: <http://www.metla.fi/tutkimus/vmi/nfi.html>



The mean volume of growing stock (m³/ha) in Keski-Suomi and Pohjois-Savo forestry centres according to the 9th inventory (multi-source method).

Annual forecast system and inventory of wild berry and edible mushroom yields

Text and photo: Kauko Salo
 Drawings: Seija Sulonen



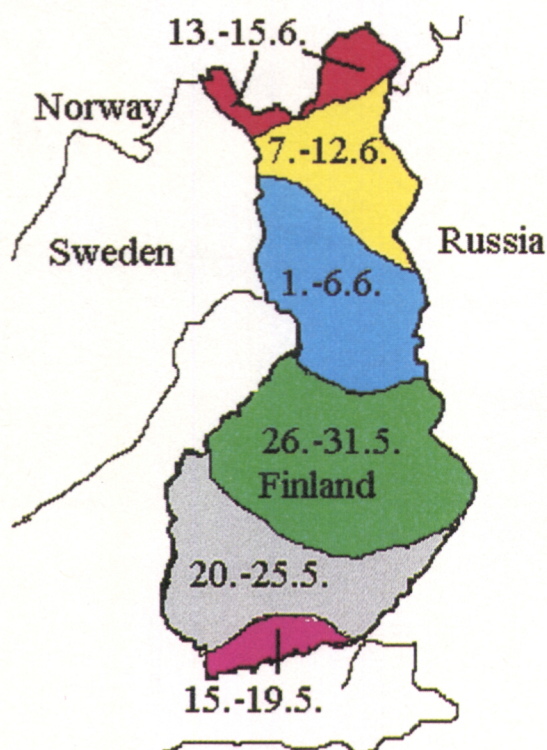
200 bilberries picked at one permanent sample plot (1 sq. m) in a coffee cup. If there are 150 berries or more from five permanent sample plots on the average on the *Myrtillus* site type, the berry yield is abundant.

The citizens of Finland have the right of free access to outdoor areas, where they can pick wild berries, edible mushrooms, wild herbs and flowers. Picking berries and mushrooms is a very popular hobby in Finland, but picking also provides supplementary income for some people in rural areas. Income earned from the sales of wild berries, herbs and mushrooms is tax-free.

In 1997, the Joensuu Research Station of the Finnish Forest Research Institute began a nationwide research project concerning the yields of the economically most significant and most popular wild berry species which grow mainly in forests, the cowberry (*Vaccinium vitis-idaea*), the bilberry (*V. myrtillus*), and also cloudberry (*Rubus chamaemorus*) which grows on mires, bogs and fens.

In a good crop year, the biological yield of all wild berries in Finland is about 1000 mill. kg and in a poor crop year the yield

of berries is probably about 500 mill. kg. Only a minute fraction of this yield is harvested. The value of wild berries picked on



Timetable of bilberry (*Vaccinium myrtillus*) flowering in 2000

mineral forests and peatlands was 445.3 FIM mill. (100 USD mill.) in the good berry year 1988.

Nowadays, a system of observers give written information to the Metla concerning edible mushroom species and how plentiful they are in the forest. Maps of the distribution of edible mushrooms are produced on the basis of forecasts. There are many plant species in Finland which can be used for human consumption and they are also to be included in the forecast system.

The most common and most popular edible mushrooms have commercial value. These include ceps (*Boletus*, *Suillus* and *Leccinum* species), milk caps (edible *Lactarius* species), mild *Russula* species and *Cantharellus cibarius*, *Rozites caperatus* and *Craterellus cornucopioides*.

In a good crop year, biological yield of macrofungi in Finland is about 2000 mill. kg, but in a poor year about 400 mill. kg. Again, only a small fraction of this crop is harvested. The value of edible mushrooms picked in the good mushroom year 1988 was 118.6 FIM mill. (26.4 USD mill.). In recent years Finns have picked about 10 percent of the total biological yield of bilberries, cowberries and cloudberry but only 2-3 percent of the biological commercial mushrooms.

National observation network

Between 1998 and 2000 observers in selected research areas around the country have provided information for research into the annual berry and fungi crop. The annual forecast system and inventory of wild berry and commercial mushroom yields is based on this national observation network of 400 forests and peatlands (2200 permanent experimental plots) in different parts of Finland.

Observers will normally choose forest and peatland compartments close to his/her home or working place. These forest sites are *Myrtillus* forest site type (MT) and *Vaccinium* forest site type (VT), where bilberry and cowberry have been observed to produce good crops of berries. Peatland sites with cloudberry include different peatland site types. Five marked permanent experimental plots of 1 sq.m. are located at each forest and peatland site. In each plot, the flowers, unripe and ripe berries are counted three times during the growing season.

Written reports must be filled out for every bilberry and cowberry forest site and cloudberry peatland site. The forest observation form

► from previous page

consists of names of the municipality and village, coordinates where the forest site is situated and general knowledge of forest site type. The yield report form consists of the dates of the three visits in the area and the counts of the number of flowers, unripe and ripe berries, as well as factors affecting the yield.

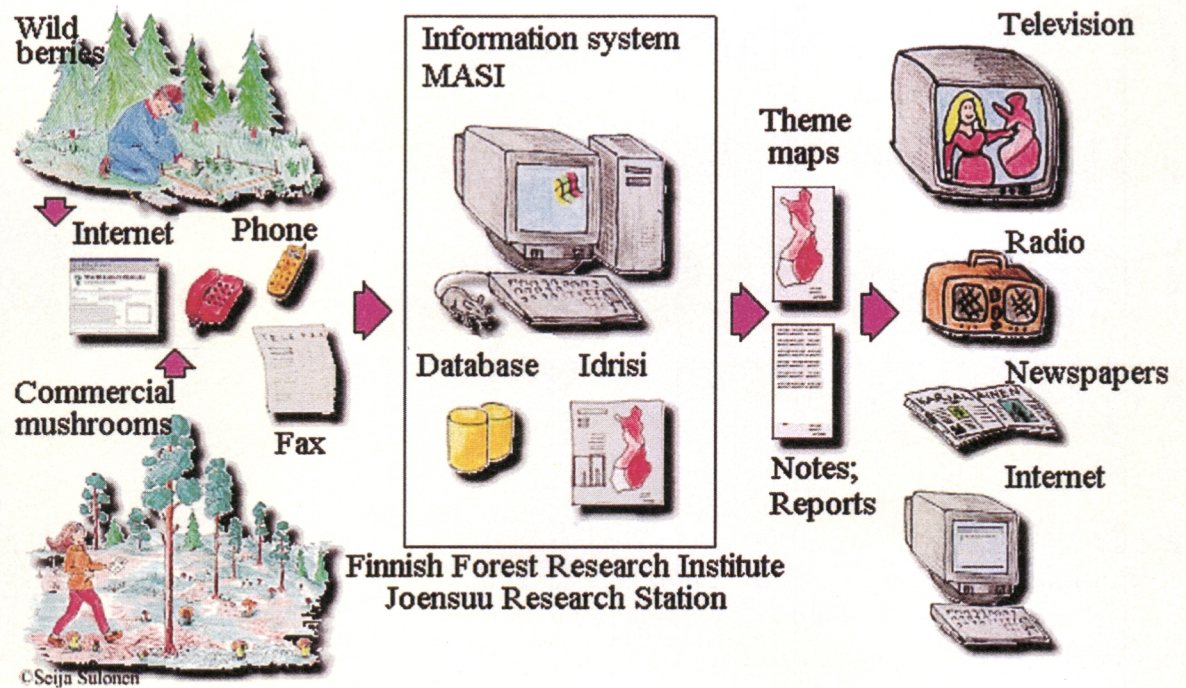
The information concerning wild berries and commercial mushrooms is sent via Internet, phone or fax to the Joensuu Research Station, where the data is processed with the MASI programme. The Finnish name MASI means berry and mushroom information system and it consists of databases and a GIS.

Theme maps and reports

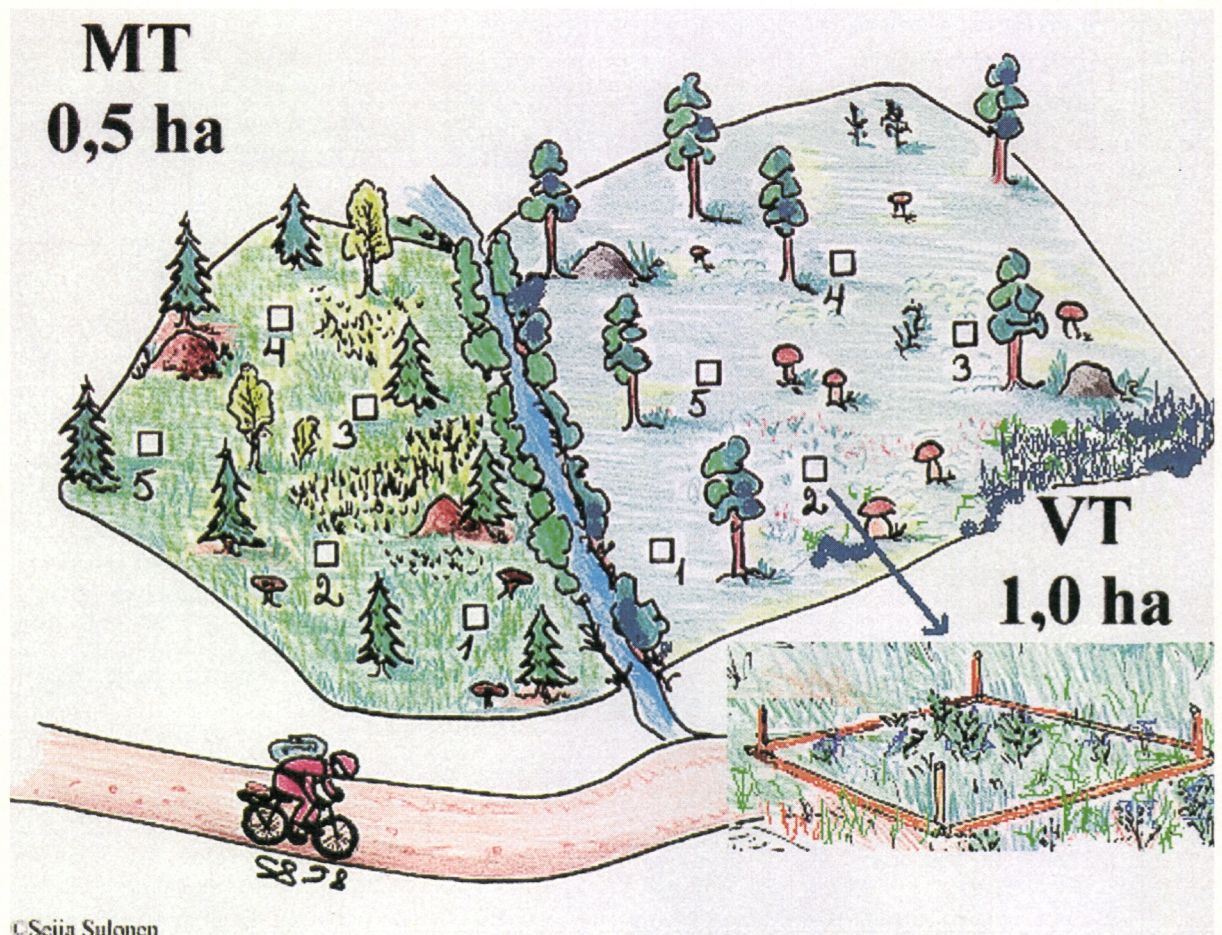
During the growing season, three or four reports are written for the local radio stations and for newspapers and many theme maps are drawn for reports or television. In Finland two million people pick wild berries and edible mushrooms every year. So there is a considerable demand for the forecasts and theme maps.

Via theme maps and media reports Finns can obtain information concerning the timetables of wild berry flowering, development of unripe and ripe berries throughout the country, as well as factors affecting the yields (frosts in spring and summer, pollination, drought) to ascertain on what kind of sites the main yields will occur. Theme maps show the level of berry yield (very abundant, abundant, average, fairly poor and poor). The yield levels are based on the numbers of flowers, unripe and ripe berries on an average of five permanent experimental plots.

There has been general satisfaction with the theme maps and reports which have been given to media, because people can now plan when to go to the forest to pick berries and mushrooms and enterprises know how much to buy and keep in stock. With the information from theme maps and reports, an increase in picking activities can be expected. The amounts of bilberries, cowberries and cloudberries thus harvested can easily be increased to 5–10 percent of the total biological yield, and perhaps 5 percent for the commercial mushrooms in the near future.



The data of wild berries and commercial mushrooms was sent in electronic form to the Joensuu Research Station, where the data was processed with MASI and disseminated further on sent by the means of reports and theme maps to the media.



Five marked permanent sample plots of 1 sq.m situated in Myrtillus forest site type (MT) and Vaccinium forest site type (VT). The flowers, unripe and ripe berries were counted.

Further information:
 Kauko Salo
 Finnish Forest Research Institute,
 Joensuu Research Station
 Yliopistokatu 7
 FIN-80100 Joensuu, Finland
 Fax: +358-13-251 4111
 Email: kauko.salo@metla.fi



Cycle of the year

Plant phenological observation network in Finland

Text: Jarmo Poikolainen, Eero Kubin and Jouni Karhu

Phenology is the study of cyclic events of nature in response to seasonal and climatic changes to the environment. Finland is an ideal country for phenological observations because there are four distinct seasons and the country extends from the hemiboreal zone almost to the Arctic zone. The main part of the country belongs to boreal coniferous forest zone. For example, the coming into leaf of deciduous trees proceeds every spring as "green wave" through the country from the south to the north. The plant phenological studies have long traditions in Finland.

The oldest observations are from the middle of the 18th Century.

In 1995 the Finnish Forest Research Institute founded a plant phenological observation network for observing of plant phenological events in forest trees and plants. The observation sites are situated in the research forests of the Finnish Forest Research Institute and in the field research stations of other research institutes and universities. Observations are made of the following phenomena: the flowering of *Prunus padus* and *Sorbus aucuparia*; the coming into leaf, the yellowing and the shedding of leaves of *Betula pubescens*, *Betula pendula* and *Populus tremula*; the increasing and flowering of *Pinus sylvestris*, *Picea*

abies and *Juniperus communis*; and the flowering and ripening of berries of blueberry (*Vaccinium myrtillus*) and cowberry (*Vaccinium vitis-idaea*). Observations are converted into maps and animations. The Finnish Forest Research Institute has the phenology-service on the Internet, where the information about phenological phenomena updates once a day (<http://www.metla.fi/metinfo/fenologia>).

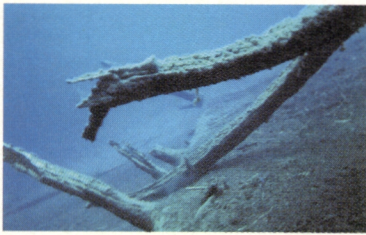
The long term phenological observations provide information about, among other things, the effects of the global climatic changes on the forest ecosystem. Monitoring will also provide accurate information concerning the forest trees height increment developments in the different

parts of country and this information can be useful in the modelling of tree growth. The observations of flowering are useful when making forest tree seed crop forecasts as well as pollen forecasts. One important target of phenological observations is to provide more information to the public concerning different natural phenomena.

The picture shows an example of observations concerning the leaf formation of downy birch (*Betula pubescens*) in Finland in the years 1998–2000. The leaves of the downy birch become full-size, on the average, at the end of May in southern Finland and a little less than a month later in northernmost Finland.



Text: Kari Mielikäinen and Mauri Timonen
 Photos: Mauri Timonen and Erkki Pesonen



The debate that began about twenty years ago over the impact of man's actions on the forests has made the variation in tree growth interesting in a new way. Airborne pollutants, the weather and the treatment of forests all leave their marks in the growth rings and shoots of trees. Tree trunks embedded in mires and in the layers of sediments in lake bottoms can store the environmental information to the accuracy of individual cell layers for thousands of years.

Trees have

long memories



The authors, professor Kari Mielikäinen (R) and researcher Mauri Timonen, with their "catch", an ancient tree trunk fished out from the bottom sediments of Lake Koierinjärvi in the Finnish Forest Research Institute's (Metla) Laanila Research Area. The trunk had lain in its watery grave for over 2,000 years.

The Finnish Forest Research Institute's (Metla's) research project looking into growth variation addressed the issue of what growth rings can tell us about the environment. Variation in tree growth was examined over time spans varying from a few hours to a few millennia. This involved using a girth band developed at Metla for recording short-term growth while long-term monitoring of growth was done using conventional growth-ring analysis and the dendrochronological approach. The subject matter led to the co-operation with several international research groups. Dendrochronology enabled researchers to cope with long time perspectives, which is a prerequisite for success in many environmental studies. Exchange visits by the researchers involved in the project to centres of excellence in this field of research served also to promote the updating and internationalism of growth-ring research at Metla.

Growth – ring calendar at the service of science

The tree trunks found in Finnish lakes located north of the present timberline are indications that the climate was considerably warmer there some millennia ago. It would appear that these ancient trees were subject to the same kinds of fungal diseases as are trees nowadays. Repeated wildfires have left their marks in the woody tissue as indelible scars. Such tree trunks also retain for posterity the greetings inscribed by ancient reindeer hunters with their primitive axes; an example of these marks is provided on a pine trunk recovered from Lake Pätikkä, dating back some 2,800 years.

The pines of Lapland demonstrate that summers can be very unlike: in cold summers the growth rings produced by trees are narrower than normal and in warm summers they are wider. These so-called "climate signals" can be similar over wide areas

and this feature is made use of when determining the origin of a sample of woody tissue.

Growth rings are diverse and relatively precise indicators of environmental impacts. However, reading the indicator is often difficult because of the complexity of growth as a physiological event. Fortunately, this problem can be approached via dendrochronology, a discipline dedicated to the study of growth rings. Its foremost tool is cross-dating; the skilful application of exceptional years enables the overlapping of trees which have partly grown in different times to form a continuous growth-ring calendar. All precisely timed living and dead trees, stumps, log buildings and subfossilised tree trunks are suitable "building blocks" for such a calendar. Metla's project dealing with variation in tree growth included the formulation of a growth-ring calendar for pine in Lapland spanning 1911 years. The EU-financed ADVANCE-10K project seeks to achieve a calendar of

over 7,500 years in length for Fennoscandian pine.

The weather regulates – Trees remember

In the north of Finland, tree growth is restricted by the temperature of the growing period while more to the south of the country the limiting factor is drought. Through having access to weather and growth data covering more than a hundred years, we have been able to model the dependence between growth and weather conditions. With this done, the models drawn up can be used to "read" weather conditions from times preceding the inventing of the thermometer by examining the growth rings from ancient times. Alternatively, they can be used to predict tree growth in drought changing climatic conditions.

Recent studies have revealed that a rainy early summer has greater impact on the growth of spruce in southern Finland than

was previously thought to be the case. It would appear that spruce trees remember the lack of water in several past summers. The needle loss, decline in growth and sudden death of spruces observed in the early 1990s in Finland are all in good agreement with the weather statistics. Between 1985 and 1993 the rain-falls for May-June were reduced by half in southern Finland. This eight-year period also included the two coldest winters of the century (1985 and 1987) as well as the three warmest winters (1989, 1990 and 1992).

A strong negative correlation prevails in southern Finland between the temperature in July-August and the following summer's tree growth. A warm late summer has usually been followed by a sudden growth reduction of spruce. In the light of the data provided by the monitoring of seed crops spanning a few decades, the reason for this fall in growth lies in the abundant flowering which weakens the trees' growth vigour. The seed years of spruce can be retrospectively pinpointed by viewing growth rings formed in times preceding systematic cone assessments.

Variation in tree growth in southern and central Europe also correlates with rainy and dry periods. The most significant periods of drought manifested in tree growth taxed forests in the early 1920s, in the late 1940s and in the mid 1970s. The latest of these recessions in growth, combined with needle shed, launched a Europe-wide debate on impacts of air pollutants. Subsequent growth studies have shown that predictions of the rapid destructions of the forests of Europe were premature.

Europe's rising growth trend

According to the results of a comprehensive research project completed in the autumn of 1996, tree growth in Central Europe had picked up in speed throughout the 1990s in a manner which cannot be explained by the influence of forest management or changes in stand structures. However, the growth of trees in those parts of Finland, Norway, central and northern Sweden, and Russian Karelia, which have been beyond the reach of human management actions, has not increased. In other words, the 40 percent increase in the total increment of Finland's forests from the 1950s onwards is based on their management and changes in

A diving researcher has found a submerged tree trunk. These subfossilised tree trunks are of fairly recent origin, generally having lain in the water for less than 500 years.

the age structure of forests.

The non-existence of this trend in the north of Finland would indicate that one reason for this increase in tree growth would lie in the nitrogen released by agriculture and traffic. An annual dose of 25-40 kg/ha in Central Europe as nitrogen deposition corresponds to the amounts applied in the forestry practice when adding fertilizer. However, the news of the increase in forest growth in Central Europe is not simply good news. The uncertainty as to the continuation of the trend is a cause for concern. The extra nitrogen may at some stage cause problems in the nutrient balance of forest soils. An even more serious matter is the risk of groundwaters becoming polluted by leached nitrate.

Some cases of forest death and decreased tree growth have been recorded in the vicinity of major emission sources on the Kola Peninsula (in NW Russia) and in the mountainous regions of Central Europe. Total destruction of forest is at its maximum on the Kola Peninsula, where it extends outwards to a radius of 5-7 kilometres from the nickel foundries. Defoliation and distinct decline in growth are observed at distances of between 30 and 50 kilometres.

Part explanations for the sudden occurrences of forest decline in the mountainous regions of Central Europe lie in the dramatic weather variations combined with the long tradition of large-scale planting of spruce beyond its natural range of distribution.

The trees able to tell the difference between night and day

Growth bands registering the girth of trees at intervals of one hour have revealed that the circumference of trees fluctuates during the growing period and even during a period of 24 hours. In addition to growing, trees have been found to shrink during sunny days and then to swell at night as the relative moisture level rises. The rains following dry periods show up as abrupt peaks in the recordings. Long cold periods during the growing



An electronic girth band developed as a joint collaboration by staff from Metla and the University of Oulu doing its job measuring diameter growth variation on a pine tree.

period cause growth to cease.

The automatic girth bands mounted in stands of pine and spruce across Finland in 1997 register the beginning of the growing period, the forming of new tissue and the advent of autumn. The aim is to set up a monitoring network enabling researchers to determine the total growth of Finland's forests at the end of each growing period in the autumn. The network will also enable the progress of the growing period to be monitored.

Also the possible strengthening of the greenhouse effect is studied using the growth bands. Provenance trials involving pine and spruce established by professor Olli Heikinheimo in the 1920s using provenances brought from different parts of Europe were laid out across Finland at locations ranging over 1000 kilo-

metres from the south coast to the Arctic Circle. The growth rhythm of trees originating from Lapland subject to southern Finland's 4-5 degrees warmer climate is now yielding valuable information about the ability of trees to withstand higher temperatures. The comparison of the growth of trees of different provenances planted alongside each other will add to our knowledge about the possibilities of transferring tree provenances in the changing climate.

Birch genes can be preserved at a super-low temperature

Text: Leena Ryyänen

Photos: Jouko Lehto



*Conservation of the biodiversity of forest trees has a tradition of long standing at the Finnish Forest Research Institute's Punkaharju Research Area; the conservation of the stunningly beautiful landscape in the area was for the first time called for some two hundred years ago. At the present moment, in addition to having a large nature conservation area, the research area has a research arboretum, several clonal archives of various tree species, and Finland's first gene reserve forest, which was established in 1992. The latest technique employed at Punkaharju Research Station to preserve species biodiversity is cryopreservation. Dr. Leena Ryyänen, employed at the Station, has developed cryopreservation methods for preserving the winter buds and tissue-cultured material of silver birch (*Betula pendula*).*

Rapid progress in biotechnology, together with micro-propagation of species, has made it possible to develop new techniques for the conservation of biodiversity, the latest of these being cryopreservation. In the sense of maintaining the clonal integrity of tree species, the cryopreservation technique has several advantages over conventional conservation methods. During cryopreservation, environmental effects such as climate change, natural selection, and the effects of different kinds of stress, which are threatening to material conserved under conventional methods, are avoided. The practical advantages of cryopreservation are in its minimum demand for space and maintenance.

Germplasm immersed in super-cold liquid

Cryopreservation means storing material at a very low temperature, usually in liquid nitrogen at -196°C . Cryopreservation is a new approach to

the task of conservation of plant material, which means that empirical results covering decades or even longer spans of time involving cryopreservation experiments are lacking. Nevertheless, the metabolic activity of biological material is restricted and ultimately halted at the temperature of liquid nitrogen. One could postulate, based on the super-low temperature, that material could be stored indefinitely in such a state.

The results of the study show that cryopreservation of the winter buds and tissue-cultured material of silver birch with concomitant regeneration of the plants is possible. The prerequisites for successful cryopreservation of both types of material are 1) the meristematic nature of the explant, 2) cold-hardening, 3) slow-cooling, and 4) fast-slowing.

Regeneration of cryopreserved winter buds is excellent throughout the year

Vegetative buds cold-hardened in nature are used as explants for the cryopreservation protocol for

winter buds of silver birch. The buds, collected in March or April, are frozen slowly to a temperature of about -40°C before being immersed in liquid nitrogen. After the cryostorage, the material is thawed fast in a water bath, and the buds are cultured according to standard tissue-culture protocol. The winter buds of silver birch can be cryopreserved successfully. When this protocol is used, there is no significant decrease in the regeneration of buds even after a five-year cryostorage compared to unfrozen buds. As a method of germplasm conservation, the cryopreservation of winter buds is most suitable for use together with conventional conservation methods. In addition to its use in germplasm conservation, the cryopreservation of winter buds can also be used as an aid when organizing the time schedule for the micropropagation of birch using buds as the explants. Although the initiation of micropropagation from silver birch buds is possible throughout the year, even the short-term cryopreservation of buds collected in March or April for later use is worth doing due to their more successful initiation ability.

Differences in cryopreservability of tissue-cultured shoot tips

Tissue-cultured shoots of silver birch are cold-hardened for a month under artificial climate conditions on a medium containing modified growth regulators and nitrogen constituents. During cold-hardening, the artificial climate conditions resemble the photoperiod and temperature circumstances of real-life late summer and autumn. After cold-hardening, the shoots are decapitated. The dissected shoot tips are briefly precultured and treated with a cryoprotectant mixture and then immersed in liquid nitrogen following slow cooling. After cryostorage, the material is thawed rapidly, the shoot tips are washed carefully, and tissue culture is performed. The recovery of cryo-damaged tissues can be improved by employing decreased light intensity and by using a modified medium during the first three days of the post-thaw culture.

The cryopreservability of shoot tips differs according to the genotype of the donor tree from which the buds are initially col-



Recovery of shoot tips of silver birch after cryostorage



Conservation is not the only way to preserve forest biodiversity

Text: Erkki Annala
 Photos: Reijo Penttilä and Juha Siitonen

Old trees, decaying wood and special habitats are the main features of natural boreal forests affected by forest management. These characteristics can be reinstated in commercially-used forests without any significant economic expense.

Conservation has been the traditional way of thinking in forest preservation. It is also a relatively easy way because there is no need then to think about the precise requirements of the species to be preserved. This is also a rather expensive way because large areas are placed entirely beyond commercial timber utilization. This is an approach which can also lead to an attitude according to which nothing is to be

done for the good of nature protection in managed areas.

In recent years, it has been more and more accepted that nature protection is needed also in all managed environments. This principle was internationally agreed upon at the 1992 Earth Summit held in Rio de Janeiro.

In 1995, the Finnish Forest Research Institute (Metla) established a special research programme titled "Forest

next page ►



Collecting of winter buds of silver birch

lected. The recovery of tissue-cultured shoot tips of some genotypes is over 90% while that of others can be less than 20%. Cryopreservation, however, maintains the juvenility of genotypes already growing in tissue culture. This cryopreservation protocol may be applied for purposes such as research or as a storage means during progeny testing.

Careful analysis of regenerated material is a necessity

With both cryopreservation applications of silver birch, the regenerated plants are juvenile and it takes a number of years before mature, seed-producing trees become available. Before cryopreserved plants can be used for breeding or practical silviculture, genetical stability analysis

and large-scale field tests will have to be carried out.

Publication:
 Ryynänen, L. 1999. Cryopreservation of buds and *in vitro* shoot tips of *Betula pendula*. Thesis. The Finnish Forest Research Institute, Research Papers 728. 116 p.

Further information:
 Leena Ryynänen
 The Finnish Forest Research Institute,
 Punkaharju Research Station
 Finlandiantie 18, FIN-58450
 Punkaharju, Finland
 Email: leena.ryynanen@metla.fi



A beetle, *Pytho kolwensis*, (a larva in the picture) is adapted to living in decaying logs in moist spruce forests. This kind of habitat is protected by the Finnish Forest Act.

▶ from previous page



Biodiversity". The main objective of the five-year programme has been to study the effects of forest management on biodiversity and how diversity can be better maintained in efficiently-managed forests without causing excessive impairment of wood production and the social values of the forests. Researchers are seeking to pinpoint the alternatives to strict conservation of large areas. The more we can promote nature preservation in managed forest the less we need conservation areas.

Changes in species diversity has been considered as one of the main criteria indicating how well biodiversity has been retained. The main goal of the research programme is to look into the reasons for why the numbers of some species have decreased and become threatened in commercial

forests, and how such changes can be prevented from happening or at least slowed down. It is also important to study the value of biodiversity itself and what it means for forest

owners.

Special habitats should be preserved

A forest habitat which differs from ordinary forest land and possesses special characteristics for a rare or threatened species is usually referred to as being a *key biotope*. The conditions in these habitats are generally quite stable and not even wildfires have changed them very much. Over half of Finland's total number of species threatened by



Inventory of mosses on decaying wood



Piptoporus pseudobetulinus, a threatened species living on the trunks of old aspen, and a lichen species *Lobaria pulmonaria* (above)

forestry are dependent on these key biotopes. The proportion of area taken up by key biotopes is just a few percents of the total area of forest land. The share of the various key biotopes differs from one locality to the next. This being so, the conservation value of a given key biotope should be evaluated at the regional level.

Clear cutting of forest or drainage for forestry of areas including key biotopes are the two most frequent reasons why some species have become rare or have disappeared from managed forests. Some species cannot tolerate abrupt or powerful changes in their environment. Many rare or threatened species can be preserved in managed forests by leaving these special habitats untouched.

Decaying wood

About one third of Finland's species of fauna and flora threatened by forestry live in decaying wood or in hollow tree trunks. Because of repeated thinning operations and the removal of weakened and dead trees before

final cutting, the amount of dead and decaying wood is very low in commercial forests. In pristine boreal forests, the amount of dead wood is typically 50-100 cubic metres per hectare whereas the figure for intensively-managed forests is just 1-5 cubic metres. Several studies have indicated that 20-30 cubic metres per hectare is sufficient for most species inhabiting decaying wood. By changing silvicultural and logging practices so that part of the suppressed and dead trees are retained on the site following thinning, it is possible gradually to have more decaying wood in commercial forests. This should be a consideration included throughout the rotation in managed forest. Generally, dead and decaying wood originates from solitary trees damaged or killed by wind, snow, insects, diseases or other agents. Economically, these trees are of minor relevance.

Old trees

Typically, final cutting in commercial forestry in Finland takes place when the trees reach

the age of about 100 year. However, there are many species of organisms such as lichens, mosses, fungi and insects which occur on trees only when they have passed the 100 year mark. Old trees are often hollow inside and provide nesting places for birds and small mammals. Populations of many species requiring old, large trees have declined in managed forests. The most important tree species in this sense is the aspen.

When key biotopes are left unmanaged it is possible to have old trees also in commercial forests. However, as the proportion of the key biotopes is so small when compared to the total forest area, it has been found necessary to retain old trees also on sites lacking key biotopes. Already now, there are signs in common forestry practice in Finland of the occasional large tree being left standing as solitary trees or as small groups on sites otherwise treated by clear-cutting. Recent studies have shown that several rare or threatened species can benefit from these retained trees.

How many species can we save?

About one third of the species threatened by forestry were previously more numerous in Finnish forests. The populations of these species can be made to rise again once their habitat requirements are taken into account. Another third of the species have been very rare for as long as records have been kept. The last third of the species are poorly known and so nothing can be said about their population changes.

Maintaining biodiversity in managed forests has certain advantages compared to conservation areas. It is possible to create a sufficiently dense network of suitable environments in managed forests and to prevent the fragmentation of populations into subpopulations while conservation areas used to be more or less isolated from each other. However, forest conservation areas are needed for species, which require large forest areas in the natural state; this applies especially to birds.

Information technology and the future of printing papers

Text: Lauri Hetemäki

In terms of economic significance, printing (communication) papers are the single most important forest product category. It is becoming increasingly evident, that the development of information technology may have substantial effects on this industry sector in the future. However, the timing and the precise nature of these impacts are unclear – partly because of the lack of research on the

Paper or bites?

Paper is to words and pictures as a bottle is to wine – the technology that allows the content to be delivered to and stored by consumers. For most people, paper or a bottle is not an end itself, which is rather the information or wine! Now that the development of digital information technology (IT) increasingly allows words and pictures to be transferred and stored in digital form, will this change the trend in paper consumption?

IT has already made obsolete some paper products, such as carbon- and punch card papers. But these are exceptions, and generally the development of IT has so far increased the demand for communication papers, rather than replaced them. For example,

since the early 1980s, when microcomputers started to spread to markets, the world consumption of printing and writing papers has more than doubled. But is tomorrow just another yesterday?

The case of the USA newsprint

The USA is the world's largest newsprint consumption region, its share being about one-third of the total world consumption. Recently, the United Nations Food and Agriculture Organization presented an outlook for global forest products consumption, including the USA demand for newsprint. According to FAO, newsprint demand in the USA is forecasted to grow by 1.8 percent per annum between 1994 and

2010 (see the *Graph*). The projection is essentially based on the assumptions that the demand for newsprint reacts to changes in economic growth, population growth, and prices of forest products, as they have in the past.

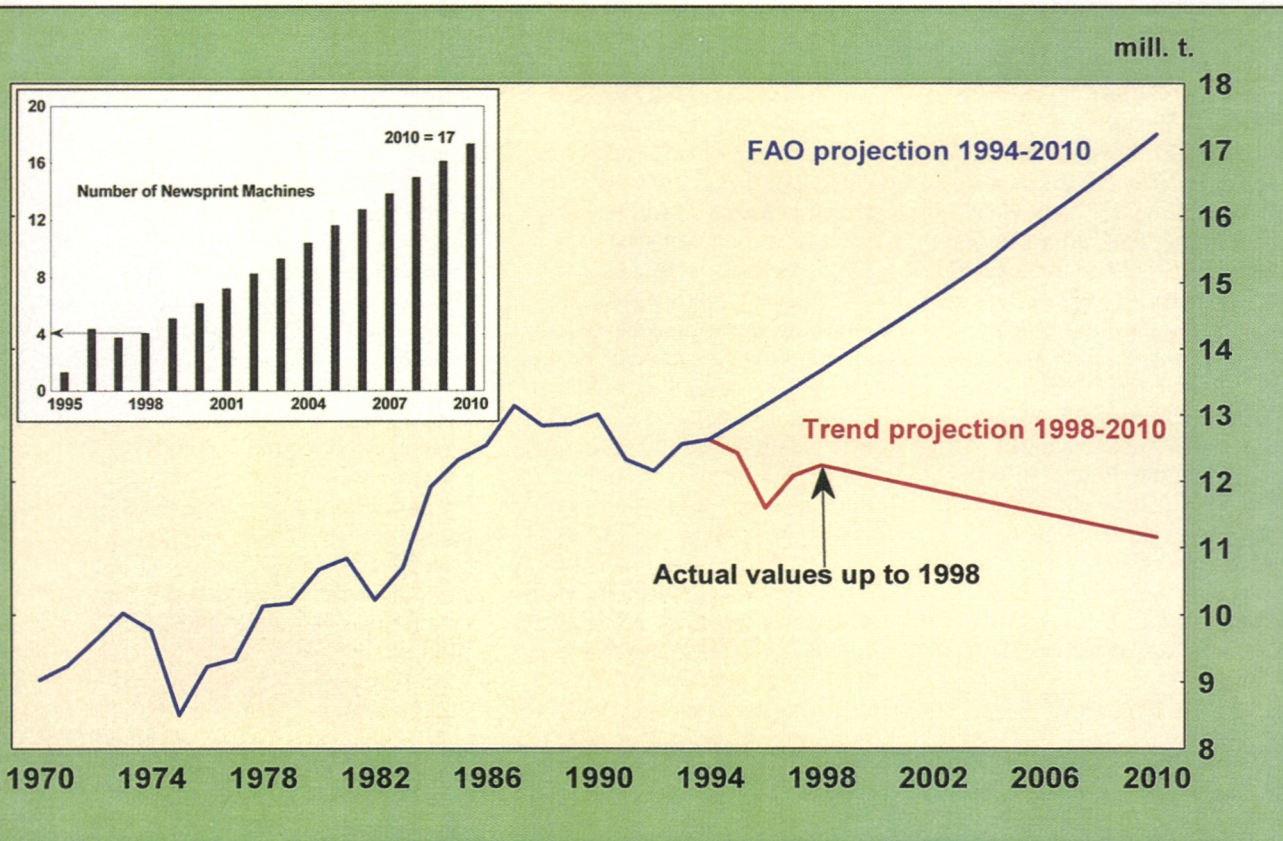
Although the FAO approach provides one of the most systematic and detailed forest products outlook studies, it is very sensitive to structural changes in demand patterns (as are most of the other projections). For example, the graph shows that there has been a structural change in the consumption in 1987, after which the trend has started to decline. Thus, computing the annual growth rate on the basis of the last 10 years of the data

next page ►

► from previous page

The USA Newsprint Consumption

The Forecast Difference Expressed as the Production of Newsprint Machines



(1988-98), gives a value of -0.5 instead of the growth rate of $+1.8$ as used by FAO. Extrapolating the -0.5 growth rate from 1998 to 2010 gives the *trend projection* shown in the graph. The difference between the FAO and the trend projection is 6.1 million tons in 2010. This is roughly equivalent to the total annual newsprint production of the USA (6.5 mill.tons in 1998), or, the annual production of 17 big newsprint machines. The evidence so far indicates, that the trend projection is more likely to be realized than the FAO projection.

One major reason behind the structural change appears to be a declining readership and circulation. For example, the average proportion of the population reading daily newspapers has declined from 64.8 in 1987 to 56.9 in 1999. This, in turn, seems to be partly the result of increasing usage of electronic media, particularly TV and the Internet. Although one should be careful and not to draw far reaching conclusions on basis of one example, the same driving forces that affect USA newsprint consumption appear to be working in many other OECD countries as well. Moreover, there are reasons to expect these tendencies to have ever increasing impacts in the fu-

ture. Let us turn to analyze these factors in a more general setting.

IT driving forces

Because there has been very little research on the impact of IT on paper products, it is difficult or impossible to make any definite conclusions on the topic. However, despite the lack of knowledge, one may try to approach the topic by identifying the different channels through which the development of IT is likely to affect paper products. We can make enlightened assumptions about these channels, e.g. by identifying underlying driving forces, using economic reasoning, and drawing on empirical information on conceptually similar changes in history.

Technological changes have historically followed certain patterns which one can also expect to characterize the future development of IT. Typically, technological change substitutes inexpensive and abundant resources for scarce and expensive resources, it substitutes knowledge for resources, and it releases the constraints on growth imposed by inelastic resources supplies. Within this general classification, specific factors can be identified which are likely to characterize IT development and the demand for paper products. They are: (i) economic factors; (ii)

scarcity of time; (iii) consumer preferences; and (iv) environmental concerns.

The economics of IT

The rapid spread of new IT is partly a result of the economies of information: new IT reduces production and consumer costs. For example, the advantages of Internet over newspapers and magazines include lower costs of production and distribution. It has been estimated that paper, printing and distribution costs account roughly for 30 to 40% of the cost of newspaper and magazine publishing. With the Internet, the marginal costs of distributing information are very low and the cost difference between distributing it to one or 1 000 households is minimal.

The costs of computers have fallen drastically over past decades, and there appears to be no end to this development. Also, the speed of information transmission in Internet or mobile telephones is increasing rapidly, and with it, the cost of transmitting and receiving information decreases. The lower costs of producing and retrieving information exponentially increases the amount of information available for consumers. A lot of this information will also be printed and copied on paper. Therefore, it is likely that the consumption of

high quality printing and copying paper will increase in the near future.

However, the economic incentives and market advantages will work towards increasing the share of electronic publishing relative to printed publishing. The contents of many of the *intangible goods*, whose value does not rely on a *physical form* (e.g. newspaper and magazine articles, airline tickets, bank transfers, letters), are increasingly transferred in digital form over the Internet and mobile telephones.

The time factor

The total amount of time (and capacity) consumers can spend on information or entertainment is finite – 24 hours/day. As Nobel laureate economist Herbert A. Simon puts it: *‘What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.’*

The growth of a new information medium, such as the Internet and the wireless communication (e.g. UMTS mobile telephones), will consequently and inevitably result in choices between different information sources and ways to receive information. Printed media will increasingly compete with other media for users’ time, as well as for their money. Media studies show that Internet and TV decreases time spent on reading newspapers and magazines. This tendency is likely to increase in the future because of, among other things, changing consumer preferences.

Changing consumer preferences

History shows that major technological innovations are rarely instantly adapted by consumers. New technologies first appear in a crude embryonic state with only a few specific uses. Improvements and diffusion then occur simultaneously as the technology is made more efficient and adapted for use over an increasingly wide range of applications through series of complementary innovations. For example, the two important disadvantages of digital IT so far have been that it is very tiresome to read things on the screen, and that computers are not as portable as printed material.

However, new display technologies and portable e-books are

becoming ever more user-friendly. Simultaneously, the development of a reusable paper substrate that can be rewritten multiple times, is advancing rapidly. Moreover, there are also reasons to believe that the cultural adaptation to the new IT is changing. Indeed, the Internet adaptation rate has been much faster than was experienced with the phone, TV or radio. An important cause behind this tendency is the *generation factor*. Media studies indicate, that younger generations are using increasingly TV and computers as their primary source of information and entertainment, rather than books, newspapers and magazines. As time goes by, these new habits start to replace the older ones with ever increasing force.

Environmental impacts

The essential question concerning the use of paper from the environmental perspective is: *How can the services provided by paper be delivered to consumers with minimal resource use and pollution?* For example, the few existing studies that have assessed the life cycle impacts of newspapers and magazines, indicate how complex and large spread the impacts are. They include e.g. impacts from forestry, from energy usage and the processes in pulp and paper factories, as well as impacts from transportation in every stage of the life cycle.

By printing newspapers, magazines, and other documents when needed, and only the contents required, and at sites geographically close to the point of distribution, the environmental side effects of paper products can be reduced significantly. However, a major change could be achieved by transferring from the printed to the digital media. Although, computers and the networks required for IT also create environmental side effects, these are likely to be small compared to the life cycle effects of printed papers. Moreover, paper making also involves computers at many different stages. Finally, because consumers use computers for various purposes, they would exist independently of whether they are used for reading newspapers and magazines. Consequently, it may very well be the case that e.g. environmental pressure groups and authorities will, in the future, increase the pressures to substitute IT for paper products.

New opportunities

Besides causing new challenges, the development of IT will also create new opportunities for communication papers. The increasing usage of IT in the paper industry will enhance production efficiency and reduce costs. In particular, IT may be helpful in the business-to-business (b-2-b) and marketing stages. For example, online market places for raw materials and paper products are likely to play increasingly important roles in the future. Thus, IT will also help to maintain the competitiveness of the paper making in the future. Moreover, the development of IT is likely to increase the demand for new paper types suitable for high quality digital color printing.

More research needed

Summarizing, the likely impacts of IT will differ between different types of paper. For example, newsprint, archival paper, and letter paper will face competition from IT sooner than high quality office papers. Indeed, the demand for the latter type of papers is likely to increase in the near future. Nevertheless, because IT increasingly provides an alternative means of receiving information, it increases competition in "information markets", which in turn tends to push the real price of communication papers down. But, the timing and extent of these impacts is difficult to project.

So far, it has appeared that researchers, and the forest sector in general, have considered the impact of digital IT to be a theoretical possibility in the long-term, with not much impact on paper use and forests in the next decade or so. Because paper has served mankind for so long, and its demand has continued to grow steadily for centuries, it is only natural that no significant changes are expected. However, considering the potentially dramatic effect that IT could have on the paper industry, and therefore also on the use of world forests, the lack of research on the topic must give cause for concern.



IUFRO prize award to Jyrki Kangas

Interview: Raija-Riitta Enroth
Photo: Erkki Oksanen

In conjunction with its World Congress in Malaysia, IUFRO (International Union of Forestry Research Organizations) will be presenting Dr. Jyrki Kangas a prize in recognition of his pioneering work developing multiple-use forest planning methods. When interviewed in July, Jyrki Kangas told us, among other things, how he has found his research topics.

"I am a farmer's son, and our farm included forests, too. My basic interest in forests, forest nature and forest management comes from there. The other alternative for me when considering what to study was mathematics. However, I chose forestry because of its diversity and good employment opportunities. And

I feel I made the right choice", says Jyrki Kangas.

Jyrki Kangas recalls that research interested him already as a student, but he started his career in "practical"

next page ►

► from previous page

forestry. However, two years later the Finnish Forest Research Institute (Metla) offered him a position and he accepted it. Family matters also influenced the decision to take the job. He reckoned that as a researcher he would have more time for his family. Kangas admits that he is ambitious and he wasn't satisfied with the basic degree – especially as his wife begun her doctoral studies.

Demand for planning methods has increased

“The idea to study forest planning came to me when I noticed that so many forest owners in Finland were not satisfied with the existing planning systems,” tells Jyrki Kangas. “They felt that the planning systems were too commanding and their own changes of influencing the management of their own forests pour. This was especially felt to apply to forest regeneration. The reason for this lay in the lack of planning methods. Consequently, there was a need for research addressing the issue of forest owners’ objectives and preferences being taken into consideration. I noticed that most forest owners had many objectives regarding their forestry. They attached value not only to timber production, but recreation and biodiversity as well. The objective of forest planning was to find treatment schedule for the forest holding which would take into consideration the various concurrent objectives when comparing the alternatives. Since my doctoral thesis, my field of research has expanded. I have, for example, studied public participation in tactical forest planning. Participatory planning can be useful in conflict management and in developing compromises between competing interests.” Jyrki Kangas says: “At first, my research was looked upon almost as if it were rubbish. Nowadays, there is a lot of demand for this research and my planning expertise”.

Close co-operation with the “practical” foresters useful

“I feel that co-operation with the users of research results is very important. It enables the researcher to study

issues that are relevant, and it also makes it easier to have the research results applied in practise. For me, this co-operation has also provided excellent opportunities for discussions with people other than researchers. It is also nice to learn that research and researchers are highly appreciated – even when the research is unable to provide instructions for direct applications,” says Jyrki Kangas.

Jyrki Kangas has been the head of one of Metla’s regional research stations for several years. This has meant that he has not been able to fully concentrate on research. “Recently I noticed that the normal work day isn’t long enough for all the work that has to be done and I have considered the option of leaving this position. I have far more research ideas and desire for doing research than I have time for”, admits Jyrki Kangas. As was mentioned earlier, one of the reasons he chose the career of a researcher was the thought that it would give more time to spend with the family. “Perhaps I was mistaken in this respect, but somehow I have managed to merge my work and my private life. I can, for instance, partake of scientific discussions with my wife – these take place mostly in the sauna at home or at our summer cottage. At other times, I have also succeeded in focusing my research on topics close to my hobbies. For instance, I have done research on the environments of game birds and how to choose the best fishing place”, tells Jyrki Kangas.

Jyrki Kangas

Age: 38 years

Education: Doctor of Forestry

Job: Head of the Kannus Forest Research Station at the Finnish Forest Research Institute

Family: wife Annika Kangas (Doctor of Forestry), two sons (Tuomas, 12 years and Joonas, 10 years) and two pointing bird dogs

PUBLICATIONS BY METLA

Metla publishes research articles and reviews in several series.

Scientific journals

Published jointly by the Finnish Society of Forest Science and the Finnish Forest Research Institute

Silva Fennica

- A quarterly journal of forest science (in English)

Acta Forestalia Fennica

- An international monograph series (in English)

Metsätieteen aikakauskirja – Folia Forestalia

- A quarterly journal (articles in Finnish and Swedish)

Research paper series

Finnish Forest Research Institute, Research Papers gives the current research results for the practical forest sector.

More information on publications by Metla can be obtained <http://www.metla.fi/publish/>

NEW FACTS AND INFORMATION

Finnish Forest Sector Economic Outlook 1999–2000

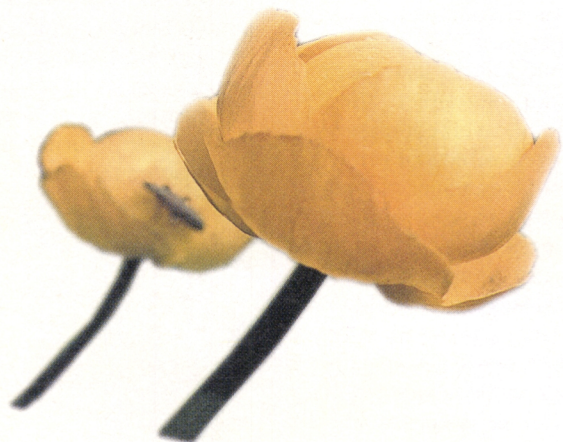
- is a detailed analytical information package on the Finnish forest sector and its export markets published by the Finnish Forest Research Institute. It summarizes the events of the current year and forecasts the expected development for the following year within the Finnish forest industry. Price 30 USD.

Finnish Statistical Yearbook of Forestry 1999

- represents a central source of information for those interested in obtaining a thorough statistical view of forestry and the forest industry in Finland. The Yearbook, compiled annually since 1969 by the Finnish Forest Research Institute, constitutes part of the Official Statistics of Finland. Price 31 USD.

You can order the Outlook and/or the Yearbook from:

Pirjoriitta Lind, Finnish Forest Research Institute, Unioninkatu 40 A, FIN-00170 Helsinki, Finland
Fax: +358-9-8570 5741, Email: pirjoriitta.lind@metla.fi



Text: Susanna Laaksonen-Craig and Riitta Hänninen
 Photo: Seppo Nousiainen

Market review



Riitta Hänninen and Susanna Laaksonen-Craig (R)

Forest product markets are booming

The robust European economies have increased the demand for forest products causing also the prices to increase. The increased demand has led to about 12 per cent higher production of paper and sawnwood in Finland during the first quarter of this year compared to the last year.

The economies in the Euroland are growing just over 3 per cent annually which is still less than the almost 5 per cent growth in the United States. This has caused the euro to devalue against the US dollar about 23 per cent. From January to the early May the euro has also devaluated 19 per cent against the Pound Sterling and 11 per cent against the Swedish crown.

The European Central Bank has been raising interest rates already several times during this year to fight off the emerging inflation. The interest rate level is, however, still considerably lower than in the United States. The weakening of the euro can be expected to cease only when the economic growth and interest rates are closer to each other in the Euroland and in the United States. The weak euro against the US dollar and the Pound Sterling has benefitted the Finnish forest product exporters, since about half of the Finnish paper and sawnwood exports go outside the euro area.

Sawmills facing improving markets and prices

The sluggish economic development in Europe in the beginning of last year caused the Finnish exporters to turn to the markets outside Europe. The exports to Europe decreased slightly whereas the exports to other areas increased by 16 per cent. In Japan, which is an important balancing country for the European sawnwood markets, the recovery of the construction sector continues. In 1999, the sawnwood exports to Japan increased by about 60 per cent, partially due to the yen's strengthening against the euro.

Since the end of 1999, the

prospects have been brighter in Europe and the demand is expected to increase. For example, the construction activity in Germany, the biggest constructor in Europe and the largest buyer of Finnish sawnwood, is forecast to grow after last year's zero growth. In France, the growth of housing construction has in February reached a 12 per cent annual level. The private construction is picking up in the United Kingdom, but the weak pound causes uncertainty and hinders exports.

The sawnwood prices in the European markets have benefitted from the strong demand for sawn whitewood in the United States and Japan, which together with the devaluating euro have decreased the supply from the North America. The weakening euro has also decreased Sweden's competitiveness compared to the producers in the euro area. The increasing sawnwood demand will support the price development if the market balance stays good. The positive price development could, however, be threatened by the uncertainty in Japanese economy and the increased sawnwood supply in European market due to the storms last spring. So far the added roundwood supply has affected mainly the chip prices in the storm affected areas. Additionally, the price increase in the United Kingdom is not likely if the pound continues to strengthen against the euro.

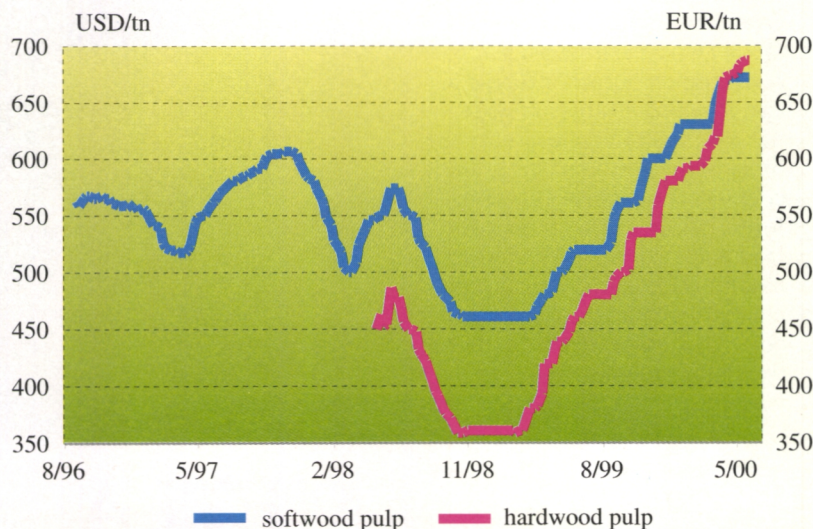
Pulp prices keep raising

The booming economies keep the demand very strong also for pulp and papers. This has led to almost a 12 per cent increase in paper production and nearly a 8 per cent increase in paperboard production in the first quarter of 2000 compared to the same period in 1999. The capacity utilization rate in paper industry has increased to 97 per cent compared to 90 per cent a year ago.

The pulp market has been extremely tight causing pulp prices to soar during the past year. From January to the beginning of June this year softwood pulp price increased by 8 per cent to over 670 US dollars and the hardwood pulp price over 18 per cent to almost 690 euros. Due to the weak euro this means that the 1995 record Finnish mark prices have been now reached. The price increase has, in fact, been so brisk, that Finnish and Swedish producers have already called for caution in price hikes to avoid a possible sudden price crash.

The paper market is also tight, in some grades, such as coated woodfree, as tight as the pulp market. This has caused also the paper prices to rise, e.g., newsprint price rose during the past year over 6 per cent, magazine paper nearly 5 per cent and fine paper over 16 per cent. Even though the raises in fine paper prices are considerable, the producers have not been able to transfer the increased costs caused by lofty pulp prices to their own product prices, which will show in papermills' profitability. In general, it can be expected that the rest of the year will be as profitable as the first quarter of 2000, during which the largest companies StoraEnso, UPM-Kymmene and Metsä-Serla over doubled their combined profits. A serious uncertainty factor in the industry are the soaring prices. They have caused worry among the producers that the customers will react to the raises by restricting their demand or at least substituting their current grades with cheaper ones.

Pulp Prices



Do you know...

Finnish forestry in brief

Finland the country

Total area: 338 000 sq.km.
Population: 5 million
Capital: Helsinki
Languages: Finnish, Swedish (6 %)

• Finland has firmly committed itself to sustainable forestry in broad sense, including the biodiversity and social and cultural values of the forests. The recently reformed forest and nature-conservation legislation, as well as Finland's National Forest Programme 2010, provide a framework for achieving these ends.

National economy, forestry and the forest industries

• In order to achieve economic growth in post-war Finland, investments in pulp and paper industries doubled the production between 1955 and 1965. This trend has continued, and not only in the forest industries, but also in the metal industries and more recently in the high-tech electronic industry.

• In 1960, roundwood and forest-industries' products represented 75% of the value of the total exports of goods; their share was 30% in 1998. The same diversification of production is, of course, to be seen in the structure of the gross domestic product. In 1960, the share of forestry of the GDP was 8.6%, and that of basic forest industries, 6.4%. The corresponding figures for the year 1998 were 2.5% and 5.4%. In employment, forestry accounted for 6.6% and forest industries for 5.2% in 1960. In 1998, the corresponding figures were 1.1% and 3.2% respectively.

• Flourishing engineering and service industries have developed around Finnish forestry and forest industries. Strong mutual connections have contributed to the success of the whole. Finnish companies are in a strong position globally, e.g. in the manufacturing of timber harvesters, paper machines and in providing consultant services.

Forest industries: production and exports

• Finland is among the major suppliers of forest-related products to the world markets, particularly in printing and writing paper, and one of the biggest importers of roundwood. In 1998, the total value of forest-industries' products exports amounted to FIM 68 000 million (about USD 13 000 million). Germany, the United Kingdom and France are the foremost importers of Finnish forest-industries' products, together accounting for 42% of the total.

Forest resources

• Information on Finland's forest resources is based on surveys carried out by the Finnish Forest Research Institute. Traditionally, systematic ground sampling has been used. Since 1990, satellite imagery and digital map data have been employed in order to produce results also for small areas.

• During the past 70 years, the structure of Finnish forests has changed significantly. They now have a more even age structure. Scots pine's share of the growing stock is 46% and that of Norway spruce 36%, leaving 18% for the broadleaved species, mostly birch. This distribution has been a stable one. However, Scots pine is the dominant species on 65% of the forest land area.

• The area of productive forest land (i.e. land capability to yield at least 1 m³/ha/yr) is 20.1 million hectares and that of other wooded land 2.9 million hectares. Thus, the total wood-growing area is 23.0 million hectares. Of this, 1.16 million hectares (5.1%) have been set aside for conservation purposes. These areas, in which all forestry activities are prohibited, lie almost entirely in the northern part of the country. The Finnish concepts of forest land and other wooded land both enter into the new, internationally defined forest-land concept, which sets a canopy cover of 10% as the threshold between forest lands and other lands.

Forest ownership in Finland, 1986-98

Ownership category	Forest land mill. ha	Forestry land mill. ha	%
Non-indust., private	12.4	14.3	54.3
Industrial, private	1.8	2.0	7.8
State	4.9	8.7	33.2
Other public	1.0	1.3	4.8
Total	20.1	26.3	100.0

Finnish Forest Research Institute

• Metla (Finnish Forest Research Institute) is an impartial state research institute, founded in 1917.

Research

• Research work has been organised into over 100 projects. A number of projects have been combined to multi-disciplinary research programs. Primary research problems are:

- Biodiversity of Forest Ecosystems
- National Forest Inventory
- Forest Health
- Environmental Impact of Forestry
- Growth and Regeneration of Forests
- Forest Tree Breeding and Forest Genetics

Staff and research units

• Metla has a staff of more than 800 people, about 250 of these being researchers. More than 90 of the researchers have a Ph.D. or similar degree. About half of the staff is based at the two centres within the capital area, and the other half at the eight regional research stations.

• Metla participates in several international research projects, for example World Forests, Society and Environment –project with European Forest Institute (EFI) and UN-university, (UNU/IAS). Metla also takes part in several EU-projects, for example the intensive monitoring of forest ecosystems in Europe.

Research forests

• Metla's own research forests enable a versatile, long-term execution of field trials. Metla has 150 000 hectares of research forests, of which 69 000 hectares are conservation areas. 5000 hectares are used by forestry schools for instruction. Metla has a stewardship over three national parks and five nature reserves, which are also used for public recreation.

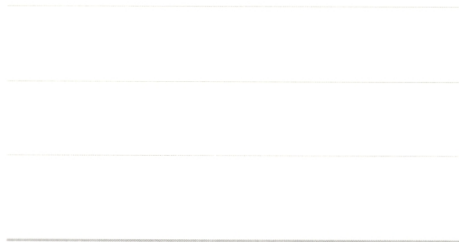


Photo: Erkki Oksanen



Lingonberry *Vaccinium vitis-idaea*
– Picking berries in the forests is a very
popular outdoor activity in Finland.

The Finnish Forest Research Institute
www.metla.fi



Koli National Park
– nature, culture and recreation

The Finnish Forest Research Institute
www.metla.fi

