



# Future Forests

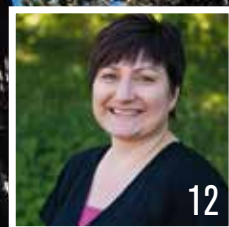
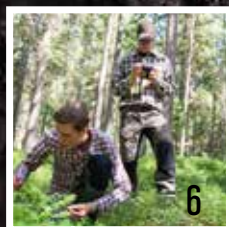
2013  
MAGAZINE

## A forest for all needs

Research shows the way

CONSERVATION SHAPES THE  
FORESTS OF TOMORROW p8

WARMER CLIMATE CALLS  
FOR ADAPTATION p11



- 3 Annika Nordin  
Program Director Future Forests

---

- 4 Everything is linked

---

- 5 Future Forests  
Forest research... and so much more

---

- 6 A leading environment  
for forest research

---

- 8 Is current conservation model  
sufficient to maintain diversity?

---

- 11 Warmer climate and changing  
world demand adaptation

---

- 13 International perspective  
on Swedish forest policy

---

- 14 Future Forests in brief

---

- 16 Comprehensive solutions vital  
if we are to fully realise forest potential

**Production:** SLU, Division of Communication,  
Box 7077, SE-750 07 Uppsala, Sweden

**Editorial staff:** Annika Mossing, (project leader and editor),  
Lars Klingström, Olof Bergvall (assistant editors)

**Illustrations editor:** Jenny Svennås-Gillner

**Cover photos:** Lars Klingström, Jenny Svennås-Gillner

**Illustrations** unless otherwise stated:

Fredrik Saarkoppel

**Photo** unless otherwise stated:

Jenny Svennås-Gillner

**Graphic design and layout:**

Michael Kvick

**Translation:** Leslie Walke

**Printed by:** Danagård

**Print run:** 1200

**Web:** www.futureforests.se

## The vision

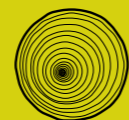
Future Forests will provide scientifically robust knowledge to enable sustainable and increased provision of ecosystem services from forests in a future characterized by climate change, energy transition and altered markets for forest goods and services

## Senior Management Group

Professor Annika Nordin is Program Director of Future Forests. Members of the Senior Management group are Johan Bergh (SLU, Associate Professor in Forest Management), Linda Gruffman (SLU, PhD in Forest Ecophysiology), Stig Larsson (SLU, Professor in Forest Entomology), Hjalmar Laudon (SLU, Professor in Forest Landscape Biogeochemistry), Tomas Lundmark (SLU, Professor in Forest Management), Annika Mossing (SLU, Communications Officer), Erland Mårald (Umeå University, Professor in History of Science and Ideas), Urban Nilsson (SLU, Professor in Silviculture), Camilla Sandström (Umeå University, Associate Professor in Political Science), Johan Sonesson (Skogforsk, Researcher Forest Management).

## Researchers

Petter Axelsson (SLU, PhD Biology), Karin Beland Lindahl (SLU, PhD Rural Development), Mats Berlin (Skogforsk, PhD Biology), Kevin Bishop (SLU, PhD Geography), Christer Björkman (SLU, PhD Forest Entomology), Johanna Boberg (SLU, PhD Biology), David Ellison (IWE, PhD Political Sciences), Gustaf Egnell (SLU, PhD Silviculture), Kristina Espmark (SLU, PhD History of Science and Ideas), Nils Fahlvik (SLU, PhD Forestry), Adam Felton (SLU, PhD Natural Resource Management), Martyn Futter (SLU, PhD Watershed Ecosystems), Peichen Gong (SLU, PhD Forest Economics), Anna Gunulf (SLU, PhD Forest Management), Carina Keskitalo (Umeå University, PhD International Relations), Maartje Klapwijk (SLU, PhD Community Ecology), Rolf Lidskog (Örebro University, PhD Sociology, PhD Ethics), Lars Lundqvist (SLU, PhD Silviculture), Tomas Lämås (SLU, PhD Forestry), Eva-Maria Nordström (SLU, PhD Forestry), Thomas Ranius (SLU, PhD Ecology), Eva Ring (Skogforsk, PhD Soil Science), Lucy Rist (SLU, PhD Forest Ecology and Management), Jean-Michel Roberge (SLU, PhD Ecology), Daniel Sjödin (Örebro University, PhD Sociology), Ryan Sponseller (Umeå University, PhD Life Sciences/Ecology), Anna Sténs (Umeå University, PhD History), Kristina Wallertz (SLU, PhD Forest Management), Camilla Widmark (SLU, PhD Economics), Anneli Ågren (SLU, PhD Physical Geography), Lars Östlund (SLU, PhD Ecology).



**Future Forests**

PHOTO: LARS KLINGSTRÖM



ANNIKA NORDIN | PROGRAM DIRECTOR, FUTURE FORESTS

# Join us in developing a forest for all needs

Welcome to Future Forests Magazine, our new publication aimed at international researchers. In this magazine, we provide a glimpse into the largest-ever research project on the theme of forest and sustainability in Sweden.

It is a privilege for me to lead the program, and a pleasure to note the great interest from politicians, forest companies, public agencies, individual forest owners, and the general public.

Future Forests is also attracting increasing international attention as an interesting example of how important sustainability issues may be tackled. It is primarily to satisfy this international interest that we are now looking to disseminate information about our work beyond Sweden's borders. Three years ago, we launched our own domestic magazine, *Skog & Framtid*. It is distributed to all Swedish forest owners, and contains popular science articles about the various subjects of our research.

Our primary aim with Future Forests Magazine is to create an interface with the international forest research community. Researchers from other countries already participate in a number of our current research projects, and we have established successful collaboration with other research institutes in, mainly, Europe, including EFINORD\* and IIASA\*. Future Forests also plays an active role in international forest bodies, such as FAO Forestry and in research organisations such as IBFRA\* and IUFRO\*. At the major UN sustainability conference last year, Rio+20, Future Forests was one of Sweden's representatives.

These types of international contacts stimulate our research activities. In fact they are vital to a successful outcome. An international outlook is essential to make the results we attain here in Sweden more accessible, and thereby also applicable in other parts of the world. For viable and legitimate science-to-policy processes on the impending complex challenges relating to forest land use, successful international research collaboration is fundamental.

It is my hope that, with this magazine, we can attract interest in Future Forests, and so generate more valuable contacts in the international research community. ●

#### EFINORD:

North European Regional Office  
of the European Forest Institute

#### IIASA:

International Institute for  
Applied Systems Analysis

#### IUFRO:

International Union of  
Forest Research Organizations

#### IBFRA:

International Boreal Forest  
Research Association



# Everything is linked

None of the major issues we are facing can be solved in isolation. Everything is linked. A holistic approach and interdisciplinary research – the standard model for Future Forests – is a way of finding the solutions that we now need.

**Climate lies behind all future issues.** More forest products and bioenergy is one of the solutions.

**Oil is running out.** Global oil extraction is nearing its peak. Forests can provide alternative sources of energy.

**Forest resources.** All the signs indicate that forest resources will be in short supply in the future. They can – and must – be increased.

**Recreation and wellbeing.** Spending time in forests has positive effects on people's mental and physical health.

**New pests and diseases.** Warmer climate and global trade increases the risk of new forest pests and diseases.

**Biological diversity under threat.** Species impoverishment continues. We need to reverse the trend.

**Globalisation.** The world is shrinking. National boundaries are disappearing. The conditions for forests and forest resources are changing.

**Clean water.** Healthy forests provide clean water.

**Values.** The technocratic view of forests is changing, and humanistic values are becoming more important.

**Land.** The future sustainable society is based on what grows in the soil. Access to land is a key issue.

PHOTO: MICHAEL KVICK



Forests provide wood products and renewable energy, as well as many other functions.

Future Forests:

# Forest research ...and so much more



**Forests play an important role in global issues like climate change, energy supply, biological diversity, renewable resources, and human wellbeing.**

Future Forests research is based on a holistic and interdisciplinary approach. The objective is to identify scientifically-based strategies that can optimise benefits from the forest for the sustainable society of the future.

Forests and forestry have been the subject of research in Sweden for over a century. At the start of the 20th century, research focus was on restoration of overused forests. Since then, the growing forest stock has doubled. There is capacity and scope to increase wood production even further, while also developing other forest ecosystem values.

Most indications suggest that the need for raw materials from forests will increase. Bioenergy is experiencing something of a boom in parts of the world. New technology is being developed for building houses of wood

instead of concrete and steel. And just around the corner are completely new areas of application, involving biological raw materials and nanotechnology.

At the same time, the forest offers many other ecosystem services that are vital for both the integrity of the biosphere and for human wellbeing. Biological diversity, clean water, clean air, and recreation are just a few of them.

Consequently, sustainable forestry involves identifying silvicultural strategies that provide the greatest range of ecosystem services, and – where necessary – making complex trade-offs between them.

In the dynamic phase of forest-related knowledge development that is currently taking place globally, the Swedish research program Future Forests was set up in 2009. The guiding vision behind the program is to use an interdisciplinary approach to find sustainable strategies for land use in forests that can give society more of the ecosystems services demanded.

Another ambition of the program is to establish a collaborative hub between academia and society. It aims to serve as a catalyst for knowledge development and as an arena for dialogue between researchers and the many stakeholders on the subject of future forests.

Around 40 researchers – some of them from outside Sweden – are currently engaged in Future Forests. A large number of practitioners also participate, including forest owners and representatives of forestry companies, public agencies, and NGOs.

So far, the program has generated a large number of scientific articles and reports, and now occupies a clear role in public debate on Swedish forestry.



Forestry students measuring ground vegetation in a continuous cover forestry experiment.

# A leading environment for forest research

The Faculty of Forest Sciences at the Swedish University of Agricultural Sciences (SLU) occupies a unique position. No other Swedish university conducts research and offers educational courses in forestry at the same level. The faculty also holds a strong position internationally, with by far the largest number of publications within the field of forestry.\*

The Faculty of Forest Sciences was set up in 1978, but its roots go back to the beginning of the 19th century. It was then that the Forest Institute was set up, offering educational programmes for forest managers. Towards the end of the 19th century, the institute's task was broadened to also include field research.

Forests and forestry were already a controversial political issue at that time. After several centuries of exploitive forestry, Swedish forests were decimated and in certain areas in acute need of restoration. Forestry research got under way at the start of the 20th century, and, with its help, the area of productive forest doubled in Sweden. Research has led the way for Swedish forestry to become a global leader.

Today, SLU conducts research and provides educational programmes and courses at several locations in Sweden, from Ätnarova north of the Arctic Circle to Alnarp in the very south. The Faculty of Forest Sciences has ten departments and units, over 500 employees, approximately 700 students, and nearly 200 research students. 📖



Monitoring diurnal variations in stem diameter.



PHOTO: THE FORESTRY LIBRARY

## More than 100 years of data

SLU rests on a stable research base of field experiments. The first plot was set up in 1902, and still provides valuable information. Over 1 600 long-term field experiments provide data for research projects. More than a thousand scientific articles and nearly 100 doctoral theses are based on data from these experimental plots.

Apart from the many field experiments, SLU also operates experimental forests, production forests, and field stations. When the first experimental forests were set up in the 1920s, it was decided that the activities would have a broad focus. Extensive surveys were carried out of ground conditions, vegetation and forest status, and meteorological stations were set up.

Activities in the experimental forests comprise a very important base source of information about the forest and for testing new methods.

## Cutting-edge plant research

Umeå Plant Science Centre, UPSC, is a collaboration between the Faculty of Forest Sciences and researchers at Umeå University. The Centre is the leading environment in northern Europe for experimental plant research.

Researchers at UPSC and the SciLifeLab in Stockholm have recently successfully mapped the genome of spruce, a discovery causing ripples around the world. The spruce genome is complex, and no less than seven times larger than the human genome. The results were presented in spring 2013 in the renowned scientific journal, Nature.

Not only is this result scientifically important, it can also open the door to completely new opportunities.

"Throughout the world, intensive research is looking into biological alternatives to fossil-based products and energy sources," says Ove Nilsson, Professor at UPSC and SLU. "The spruce can now be customised to various purposes and can be made resistant to, for example, root rot and frost damage."

WWW.UPSC.SE

## Unique forest survey

Since 1923, Swedish forests have been regularly surveyed and data gathered through the work of the Swedish National Forest Inventory. The aim of the survey is to describe status and changes in Swedish forests. SLU carries out the survey on behalf of the Swedish Government.

A new research infrastructure is currently being built up. RINFI (Research Infrastructure National Forest Inventory) will make data about Swedish forests over 90 years more accessible for research and environmental analysis.

WWW.SLU.SE/NFI

## Heureka predicts outcomes

The forest has many roles, and measures taken in the forest often have effects over a very long time. Researchers at SLU have developed a tool that facilitates assessments of long-term outcomes – the Heureka planning system.

What is pioneering about Heureka is that it enables users to compare the long-term consequences of various types of forestry. For example, the programme can be used to create maps and diagrams that show the consequences for wood production and biological diversity after a transition to more intensive forestry.

The Heureka system is at the cutting-edge of international developments in this field, with its multi-level analyses and the ability to analyse various forest values at different geographical scales.

WWW.SLU.SE/SHA



500

scientific articles are based on data from Krycklan.



## Tiny stream provides invaluable data

How are forest streams affected by air pollution, forestry and climate change? What are natural variations and which variations are governed by human activities? These are the types of questions that SLU researchers are examining in the small stream, Krycklan, in northern Sweden.

This is a unique field experiment area for studying hydrology, biochemistry and ecology. The site comprises 6 800 hectares and enables research at both detail and landscape level.

WWW.SLU.SE/KRYCKLAN

# Is current conservation model sufficient to maintain diversity?

**Will environmental measures applied in forestry have the intended long-term effects on biodiversity? This has been debated since set-asides and tree retention became common practice in forestry in the mid-1990s.**

Swedish forestry applies a model in which conservation measures are integrated with wood production over most of the forest land base. In brief, this means that old, especially biologically valuable trees and all dead trees are retained during felling. In addition, between five and ten percent of the area is protected as set-asides for the benefit of species requiring natural forest for their survival.

Before the Swedish Forestry Act imposed more stringent conservation measures in 1994, and the big forestry companies joined various environmental certification schemes some years later, conservation practices in Swedish forestry were almost negligible.

“The problem is that the actual results of conservation measures applied in the past 20 years are barely visible yet. Forest ecosystems in the boreal zone are slow, and it will take many years, perhaps up to a century, before we can observe the full effects of these conservation measures.”

This is the explanation given by JEAN-MICHEL ROBERGE, Future Forests researcher, who is currently participating in a broad study of landscape strategies for efficient conservation.

“We want to quantify the future effects of today’s conservation measures – and to find out whether conservation is sufficient to attain the goals of the Swedish environmental policy. We also want to evaluate the potential of various alternatives to current conservation models.”

In the project, the researchers use simulations to study the effects of various scenarios at both landscape and stand level.

One of the assumptions is that the demand for wood is expected to increase in the future, because of climate mitigation work for example. This was the subject of an investigation of intensive forestry carried out a few years ago. The study considered, for example, increasing fertilisation of forest land and greater use of faster-growing tree species, such as the lodgepole pine.

“We’re designing a number of model landscapes and simulating the effects of various intensive forestry measures on future biodiversity,” says Jean-Michel Roberge.

Another area of study is the effects on biodiversity of dividing up the forest landscape into zones with different main functions. In recent years, there has been growing



## Retention forestry common practice around the world

**“Retention of trees in conjunction with logging is not just applied in Sweden, but also in many other countries. But whether the measures are sufficient to preserve species diversity in the long term is too early to say.” So says Lena Gustafsson, professor in conservation biology, who together with 15 international researchers has carried out a scientific study of retention forestry in the world.**

“Conservation in the form of retention is part of a forestry model that has spread rapidly in recent decades,” she says. “The ideas behind it are the same everywhere, but circumstances vary between countries, so there are differences in how it is practised.”

In the report, the researchers note that forests in some countries, including Sweden, have been in production for a very long time. In other countries, previously untouched natural forests are still being felled. In these, the proportion of retention is often higher than in countries with a long history of forestry. Another explanation is that, in countries with a large proportion of state-owned forest, it may be easier to impose a higher level of retention compared with countries where a large proportion of forest land is privately owned – as in Sweden, for example.

“Extensive research has confirmed that forest retention is beneficial. We also agree that the positive effect depends on the degree of retention.”

Even if the researchers express doubt about the benefit of the lowest levels of retention observed, they are still convinced that some form of retention is always better than none. In the long term, retention forestry helps to improve the biological qualities in production forests.

“Here in Sweden we see, for example, that the retention that was introduced in forests 20 years ago has increased the proportions of old and dead trees in the young forests,” says Lena Gustafsson. “This is positive, because many species depend on old trees and dead wood for their survival. However, it is still too early to draw any certain conclusions about whether the measures are sufficient to preserve species diversity in the long term.”

A summary of the report *Retention Forestry to Maintain Multifunctional Forests: a World Perspective* is available for download from the website of the scientific journal, *BioScience*: [www.aibs.org/bioscience/](http://www.aibs.org/bioscience/)

*“The need for raw materials from the forest is expected to increase – and the economic frames for producing them will be tight”*

JEAN-MICHEL ROBERGE

interest in ‘triad’ forestry. According to this system, the forest is intensively managed in certain areas while, in other areas, conservation measures are applied roughly according to today’s model; in a third type of area, biodiversity conservation is prioritised.

“So far, doubts have been expressed about the potential of triad forestry in Sweden. We’re not taking a stand on the issue, but aim to fill in current gaps in knowledge.”

Another aspect that will be considered in this Future Forests study is the economic consequences of various management strategies.

“The need for raw materials from the forest is expected to increase – and the economic frames for producing them will be tight,” observes Jean-Michel Roberge. “Consequently, it is crucial to design conservation measures which are effective both in ecological and economic terms.”

## Forest conflicts – a growing field of research

**Forest conflicts** occur all over the world, leading to everything from heated political debates to violence. The transition to a global 'green' economy is increasing pressure on forest resources, leading to extended and probably also new conflicts. This creates new research needs, and new ways must be found for managing forest conflicts.

"Because forest is a common resource with many possible areas of application, conflicts arise, such as land rights, preservation and degradation of forest, and about who is to have access to forest resources," says Associate Professor CAMILLA SANDSTRÖM who, together with Professor KATARINA ECKERBERG, has edited a special edition of the journal *Forest Policy and Economics* on the theme forest conflicts.

The new situation with competition for forest resources is not always covered by applicable forest policies, which is a major cause of conflicts.

"This lack of precision in policies and regulations can exacerbate conflicts and, in the worst-case scenario, make them irresolvable", says Camilla Sandström. "It should therefore be a priority for politicians, practitioners and researchers to develop management models that can help to manage and resolve conflicts relating to forests."



PHOTO: OVE KJÄLLSTRÖM/SYNIC

## North European collaboration on climate

**A warmer climate** can result in trees growing faster, but also increases the risk of storm damage and outbreaks of diseases and pathogenic insects. Since the UN climate panel, IPCC, presented new, increasingly gloomy, climate scenarios, a scientific assessment is needed of the effects the new scenarios will have on boreal forests.

"Primarily, we want to study the effects on practical forestry," says JOHAN BERGH, who is coordinating the project. "It applies to the forestry methods that are most common today but also other, alternative methods."

Because all the forests in northern Europe are likely to be affected in the same way, a collaboration project has been initiated on the subject of the new climate scenarios. Researchers from Future Forests will be collaborating with colleagues from Metla and EFI-NORD.



PHOTO: MOSTPHOTOS

## Water Footprint – not applicable everywhere

**'Footprint' is an important** concept that enables us to measure and, above all, to communicate how human lifestyles affect the earth and its finite resources.

Carbon Footprint, which indicates effect on climate, is today an established concept that has had widespread impact. The objective of Water Footprint is to promote sustainable use of water by communicating the effects of human activities on freshwater resources.

"It's a very important and commendable concept – but it's mostly relevant in areas of the earth where there's a shortage of water," says MARTYN FUTTER, hydrology researcher in Future Forests. "In Sweden and other north European countries, water is rarely or never a problem. Unfortunately, the current design of the Water Footprint system can lead to incorrect conclusions about the environmental effects of wood-based products from Nordic forests."

The Water Footprint concept overlooks the fact that trees only 'borrow' water and then breathe it out as water vapour in the air. Consequently, trees recirculate water to the atmosphere rather than, as Water Footprint currently suggests, consume water.

## Stakeholders' visions identified

**How we envisage** the forest's future depends on what we see as it's most important value. A key pillar in Future Forests research is to investigate what various stakeholders see as a desirable future for the forest, and how to reach that future.

"Identifying the desirable forest future of various stakeholders will show both dividing lines and similarities. This will provide valuable understanding for policy makers, for example if Sweden decides to prepare and adopt a national forest programme," says ANNIKA NORDIN, program director of Future Forests.

The method that will be used is called backcasting, and it involves gathering relatively homogeneous stakeholder groups in a series of workshops. The aim is to produce a description of the desirable future of each stakeholder group, and also the measures that are needed to reach this future. The subsequent phase will comprise a scientific analysis of the various futures.



## Clearfelling or continuous cover?

**One of the major issues** of debate in Swedish forestry today is the question of whether continuous cover forestry is a viable and beneficial alternative to clearfelling.

"The issue has been discussed for more than a century, but we have never reached a satisfactory conclusion," says TOMAS LUNDMARK, who is leading the new Future Forests study addressing this issue. "We're using an interdisciplinary approach. It's not just about wood production but also about examining what the two methods mean for social values and for forest biodiversity."

"We need to determine how alternative approaches to continuous cover are likely to affect biodiversity, specifically in relation to which taxonomic groups are likely to benefit, and how such changes are likely to play out at the stand and landscape scales," says ADAM FELTON, who is one of the forest ecologists involved in the Future Forests project.

To address these issues, clearfelling and continuous cover forestry will be compared using structured dialogue approaches, which were developed within the Future Forests program. This means that researchers from other disciplines will engage with forest owners and representatives of NGOs. One important task is to define exactly what continuous cover forestry is, since different stakeholders have different perceptions of this forest management option.

"We've also started to collaborate with our Finnish research colleagues," says Tomas Lundmark. "Public interest in a more varied use of forests is the same in both countries. By gathering together the best researchers in the field, we hope to be able to develop the decision support that is currently lacking."



PHOTO: LARS KLINGSTRÖM

# Warmer climate and changing world demand adaptation

**Conditions in the boreal forests will change. A warmer climate poses threats, yet affords opportunities. Forests will grow faster, but may be at greater risk of damage. Changes in land use and fluctuations in the global economy, closely interlinked with prices and global markets, are also strong drivers. One important research task is to analyse effects and alternative courses of action that will ensure correct decisions in relation to new conditions.**

"A warmer climate doesn't just affect forest trees – all other organisms in the forest are affected." These are the words of JOHAN BERGH, Associate Professor at the Swedish University of Agricultural Sciences, SLU, who is leading the research program Climate Change Mitigation and Adaptation within Future Forests.

The research assignment also considers the situation in reverse – the effect of forest on climate.

"Forests have a positive effect on climate because the trees absorb carbon dioxide, thereby mitigating the effects of increasing quantities of carbon dioxide in the atmosphere."

Some of these different aspects of climate change conflict, so trade-offs are needed to find the optimal solutions for forestry.

"For a forest-dominated country like Sweden, the necessary strategy choices and adaptations of forestry will affect the role of the forest as a source of raw materials. They also affect the ways in which we can use the forest as a carbon dioxide store and use forest raw materials instead of fossil fuels and other materials that are detrimental to climate, such as steel and concrete."

Adaptation of forest management and new strategies in society in response to climate change will of course influence production, business economics, and possibilities to export forest goods. Forested countries with low population density like Sweden and Finland export wood products to Europe and other

parts of the world, and actions taken in northern Europe could affect the use of wood products, the market, and prices abroad.

Naturally, forestry is also affected by external factors, such as the price of oil. Future Forests has therefore started to collaborate with IIASA (*International Institute for Applied Systems Analysis*), based in Vienna.

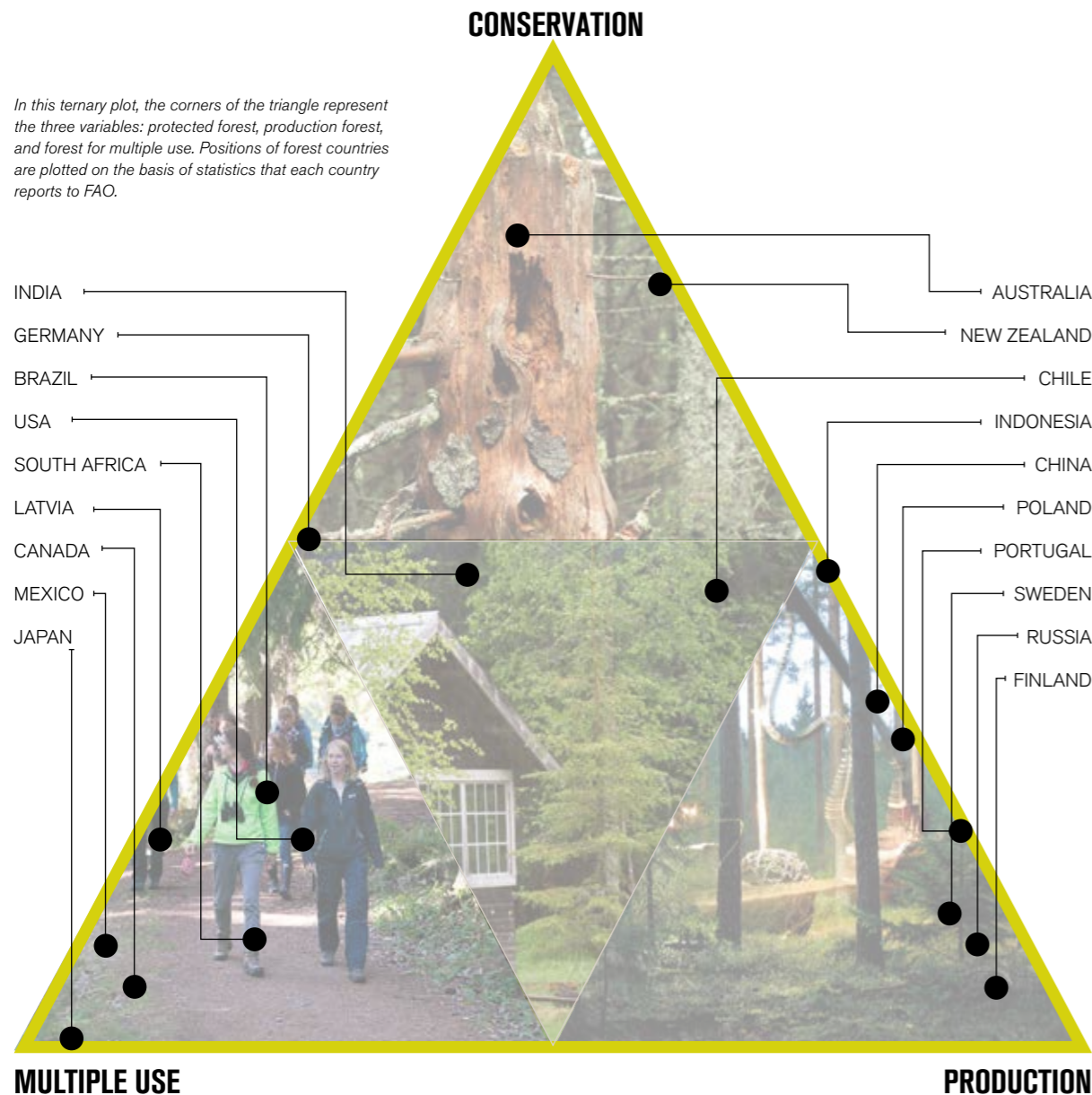
"IIASA is the leading research institute for global issues, so we're very pleased that we could start collaborating with them," says Johan Bergh.

"We're focusing on issues that concern economics and trade, but we're also working in areas such as pricing and carbon balances."

IIASA has developed sophisticated macroeconomic models that are used to create various future scenarios. The IIASA systems are now being linked together, using the SLU planning and analysis tool, Heureka.

"This will give us access to a very powerful tool," says Johan Bergh. "It enables us to answer questions about how the Swedish forest industry is affected on the international market by various strategy choices."

Seven researchers from SLU and IIASA are working on this Future Forests project. Activities at IIASA are led by FLORIAN KRAXNER, leader of the IIASA programme for Ecosystem Services and Management. ■



# International perspective on Swedish forest policy

What is usually called the Swedish Forestry Model is based on the revised Swedish Forestry Act of 1993, in which wood production and preservation of diversity were made equal goals. This model is now the subject of intensive debate. In a broad study, Future Forests will be examining the Swedish Forestry Model in an international perspective.



Camilla Sandström, Associate Professor in Political Science

Opinions about forestry in Sweden fall into two camps. Some people feel that Swedish forestry operates according to a successful model, while others are questioning it, arguing that national environmental targets are not being attained and that protection of biological diversity is far too weak.

“Many people therefore feel that the current forest policy should be changed,” says political scientist CAMILLA SANDSTRÖM, Umeå University, who is leading the study. “But if we want to improve the policy, we need to find out more about which parts are not working. We will also be examining policies in other forest countries to see how they solve similar problems.”

The basis of the study is how the various countries submit data about their forests to the UN organisation, FAO.

“When we plot the proportions of *protected forest, production forest, and multiple use* on a ternary diagram, a clear – and for many people undoubtedly surprising – picture emerges of how the different countries view forestry.”

Camilla Sandström says that this accentuates how difficult it is to compare the forestry practised in different countries.

“It’s probably because different countries put different interpretations on the concepts. This means it’s not possible to compare forestry in different countries as long as each country makes its own, subjective assessment.”

The research group will examine what causes these differences and how the trade-offs work in each country. Forest policies in the various countries will also be studied to establish how they differ. Some countries have a more production-oriented forest policy while others focus more on protection.

“Their choice of orientation depends, for example, on history,” explains Camilla Sandström. “Where there are, or have been, problems with deforestation, the country is naturally more inclined to prioritise protection.”

Historical aspects, but also the ownership structure, shape the respective forest policies. The main focus of the study will be how trade-offs between the various stakeholders have developed in the policies.

Future Forests researchers have now invited researchers and experts on forest policy from several countries to participate in the study. The first meeting will be held in January 2014.

“We hope this will make it easier than is currently the case to make comparisons between forest countries, and also to provide factual information for the ongoing debate on forests and forestry.”

## Practical model for adaptive forest management

“The growing interest in a more varied type of forestry has increased the need to test new and untried methods,” says Professor TOMAS LUNDMARK, who is leading the Future Forests project to develop a practical model for adaptive forest management. “The difficulty is that Nordic forests grow slowly, and so it takes a long time to develop new methods.”

The new model is one way to overcome this problem. It is being developed together with the Swedish Forest Agency, and builds upon the theories of adaptive management.

The model has two parts: a structured decision-making process and a learning component. In the decision-making part, the new method that is to be tested is explored, drawing on both current knowledge and the identification of remaining uncertainties. Risks and opportunities are discussed together with stakeholders from the entire forest sector to draw upon a greater knowledge base.

“Forestry affects so many people, so it’s important to gather experience from all stakeholders,” says Tomas Lundmark. “We start by

reviewing all the existing knowledge about the new method. We then draw up a plan for learning before the new method can be applied in practice.”

Key indicators are continually monitored so that management itself is a learning process and, where necessary, supplementary research will support the process. This process allows for continual reflection about the state of knowledge of a novel method and builds up a bank of knowledge for the next stage – evaluation and decisions about whether to continue or abandon the method.

“The barriers to implementing adaptive management are well documented, and consideration of these will help us to avoid some of the pitfalls that arise when trying to use this approach in practice,” says researcher LUCY RIST, who has specialized in natural resource management and will support the project from a theoretical perspective.

She continues: “Our aim is to draw on experience and knowledge from around the world and therefore take a critical view of the specifics of the Swedish context as we move forward in exploring this approach.”

“Forestry affects so many people, so it’s important to gather experience from all stakeholders.”

TOMAS LUNDMARK

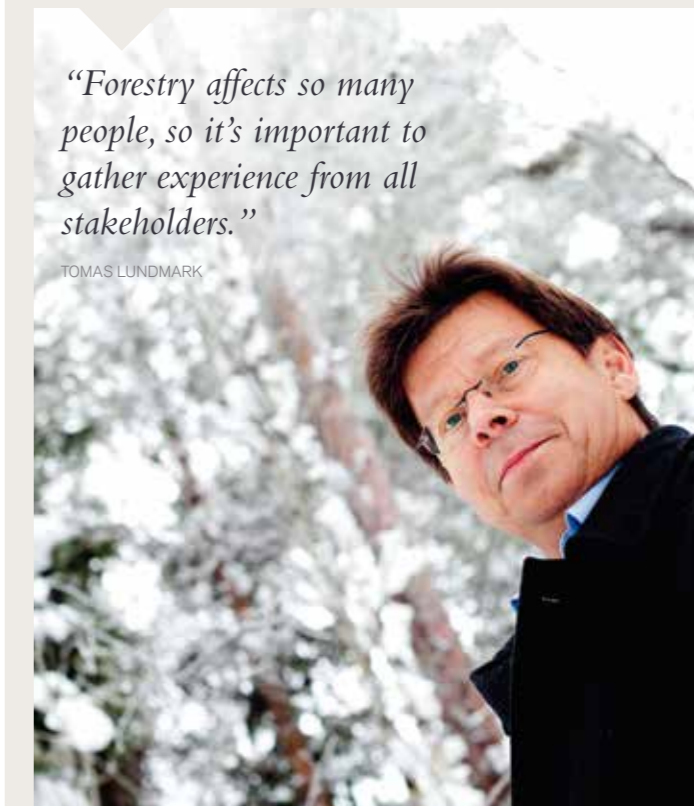


PHOTO: JULIO GONZALEZ



# Future Forests in brief

**The vision of Future Forests is that the program will provide scientifically robust knowledge to enable greater, and sustainable, provision of ecosystem services from forests in a future characterized by climate change, energy transition and altered markets for forest goods and services.**

**F**uture Forests is an interdisciplinary research program for the period 2009–2016, involving the Swedish University of Agricultural Sciences (SLU) Umeå University, and the Forestry Research Institute of Sweden (Skogforsk). Future Forests is funded by Mistra (the Swedish Foundation for Strategic Environmental Research), SLU, Umeå University, Skogforsk, and the Swedish forest industry.

The research is organized in four synthesis projects, four interdisciplinary components for original research, and a book project arching over the entire range of program activities. All Future Forests research addresses complex problems relating to forest use, primarily using review, synthesis, meta-analyses and modeling as methods. Stakeholder involvement is key to the success of the research, so communication is a central activity in the program.

Future Forests also hosts *ad hoc* thematic working groups on urgent topics involving both researchers and practitioners. The aim is to synthesize existing knowledge, identify knowledge gaps, and suggest research to fill such knowledge gaps.

## The four synthesis projects

**Desirable forest futures** analyses stakeholders' desirable forest futures using the backcasting technique.

Contact: Professor Annika Nordin, SLU, Annika.Nordin@slu.se

**Economic consequences of alternative forest land use strategies** are analyzed using the IIASA modeling cluster.

The project is a collaboration between Future Forests and the International Institute for Applied Systems Analysis (IIASA).  
Contact: Associate Professor Johan Bergh, SLU, Johan.Bergh@slu.se

**Strategies promoting biodiversity in managed forest landscapes** simulates and analyzes long-term effects of different landscape-level strategies for biodiversity conservation in managed forest landscapes.

Contact: Professor Annika Nordin, SLU, Annika.Nordin@slu.se

**Ecosystem-based forest management and adaptive forests management** advances studies of the theoretical framework of adaptive management to make it practically applicable in a Swedish context.

Contact: Professor Tomas Lundmark, SLU, Tomas.Lundmark@slu.se

## The four interdisciplinary components

**Future silviculture** focuses on the development of novel silvicultural practices for combining biomass yield regulation with biodiversity conservation, recreational values, water protection, and climate change mitigation.

Contact: Professor Urban Nilsson, SLU, Urban.Nilsson@slu.se

**Forest soils and waters** investigates the effects of different silvicultural practices on forest landscape nutrient cycling and water quality.

Contact: Professor Hjalmar Laudon, SLU, Hjalmar.Laudon@slu.se

**Climate change mitigation and adaptation** studies forest management adaptation strategies in relation to climate-induced changes in pests and diseases and catastrophic weather events. Climate change mitigation strategies are also studied, from both forestry and governance perspectives.

Contact: Associate Professor Johan Bergh, SLU, Johan.Bergh@slu.se

**Governing conflicting demands** studies forest policy and management options from ecological, economic, and social aspects, identifies synergies, trade-offs and conflicts, and assesses governance tools designed to manage multiple objectives in forested landscapes.

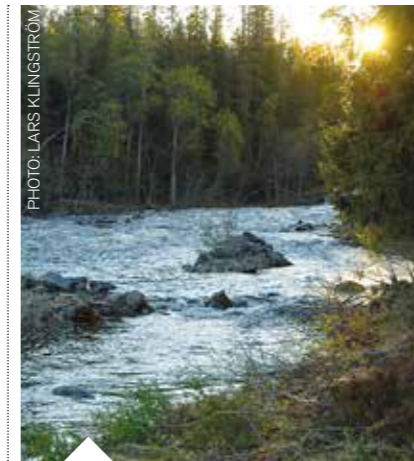
Contact: Associate Professor Camilla Sandström, Umeå University, Camilla.Sandstrom@umu.se

## Improving data on weathering

**Weathering** builds up the store of nutrients in the soil, and protects streams in the boreal forest from acidification. Research at Future Forests has shown that the models used to calculate weathering give different results, making it difficult to assess the long-term sustainability of forestry with any degree of certainty.

"We're working hard to close the knowledge gaps about weathering," says Professor KEVIN BISHOP. In conjunction with Future Forests, he is leading the Qwartz research programme, which aims to determine the rate of weathering much more precisely than is currently possible.

The researchers are tackling the problem at various spatial scales, from biological processes at microscale to the effects of weathering at landscape level.



## Riparian zone determines water quality

**A forest stream** reflects the surrounding landscape, but research at Future Forests has shown that it is the zone closest to the stream that has greatest significance for the biochemistry of the water. The concentrations of humus (DOC), methyl mercury, lead and dissolved organic nitrogen (DON) are governed almost completely by the characteristics and function of the riparian zone. Humus particles play an important role as transporters of heavy metals and in the quality of the surface water as drinking water.

The riparian zone is important as a buffer zone because it can moderate the effects of forestry activities on the water. It is therefore important to understand how this zone governs water chemistry.

"What we want to study now is what effects a changed climate, for example lack of frozen periods, can have on the water in forest areas," says HJALMAR LAUDON, Professor in Forest Landscape Biogeochemistry.

"We also want to find out how far downstream the effects of a forestry activity on the water are felt.



Johanna Boberg, researcher

## Preparing for new pathogens

**Increased global trading** of plants is also increasing the number of uninvited insects and diseases. In the past hundred years, the number of forest pathogens, i.e. species that cause damage to growing forests, has doubled in Europe.

Researchers in Future Forests are not only working to find out more about the distribution and ecology of pathogens and insect pests, but are also trying to find ways to manage the risk associated with them.

"Preventing and limiting the damage that can arise when new species spread is a major challenge. One particular difficulty is to anticipate which pathogens can cause really extensive damage," says JOHANNA BOBERG, researcher at the Department of Mycology and Plant Pathology at SLU.

The Future Forests research group is collaborating with European colleagues to develop models for monitoring, detection and risk assessment.

## Gaps in knowledge cause problems in decision making

**In an increasingly** interwoven and global world, it is usually very difficult to create a solid factual base for decision-making. Consequently, organisations are often forced to make decisions based on incomplete and uncertain knowledge. They often develop strategies to manage uncertainty and to make reasonable assessments, but problems can still arise when large economic values are at stake, and when rapid and clear decisions are demanded.

ROLF LIDSKOG, Professor in Sociology at Örebro University is leading a project in Future Forests that is examining how forest decision-makers at different levels manage this uncertainty.

"Experts at public agencies and organisations are faced with conflicting requirements when rapid decisions are expected, and the decisions must also be relevant, credible and scientifically based," says Rolf Lidskog. "In our project, we're studying how decisions are made in this situation and the advice given."



Rolf Lidskog, Professor in Sociology

## New focus on aesthetic values

**The debate** about forest usually concerns yields and biodiversity, subjects that can be measured in terms of money, cubic metres, jobs or number of species. The aesthetic and social values of the forest have a much lower profile in the debate, and also in forest research.

Historian ANNA STÉNS has started a historical comparison of how philosophy and policy regarding the aesthetic values of forest have developed in Sweden and Canada since 1950.

"By investigating how 'forest aesthetics' issues have been treated earlier, I hope to be able to present a clearer picture of what aesthetic measures can be taken in boreal forests today, and to find arguments for why they should be taken," says Anna Sténs, who plans to present the first results in spring 2014.



# 40

researchers are currently engaged in Future Forests.

## The Book Project

In the period 2013–2016, an interdisciplinary team of researchers is analyzing the Swedish Forestry Model and framing it in an international context, with the aim of producing a book.

Contact: Stig.Larsson@slu.se.

## Future Forests communication

The program's communication includes researcher-stakeholder dialogues in collaborative learning processes as well as dissemination of popularized scientific results to a broader public.

Contact: Annika.Mossing@slu.se



EDUARDO ROJAS-BRIALES, HEAD OF FORESTRY DEPARTMENT, FAO:

# Comprehensive solutions vital if we are to fully realise forest potential

FOTO: MATTIAS EDMAN/AZOTTE

**“The time is definitely past when the economy and the environment could be managed as separate entities – today, we know better, and know that everything is interrelated. It must be managed as a whole if we are to attain the sustainability that is vital for the world’s development,” says Eduardo Rojas-Briales, Head of Forestry in the UN organisation, FAO.**

Eduardo observes that the world’s forests are a significant source of economic added value – but that their role is actually much greater. Forests can help to mitigate climate change and help to create clear, fresh water. Not least, they contain a biological diversity that is invaluable to all living things.

“In the report on forests that FAO published in conjunction with the Rio+20 Conference last year, we stated that more sustainable use of forest resources is one way of tackling many of the challenges facing the world. And not just climate, but also poverty, malnutrition and future energy supply”.

The Head of Forestry at FAO is well aware that logging and forest degradation in some areas have given wood-based products a poor reputation.

“Consequently, FAO has an important task to improve this situation, by developing programmes and policies aimed at

producing a more sustainable and green economy. We are also working to eliminate incentives that lead to deforestation.

“Not least, we’re also arguing against the forces promoting increased use of non-renewable materials like steel, concrete, plastic and fossil fuels. Here, it is positive to note how the world’s forest industries, as an effect of digital technology, have now seriously started to develop completely new biological products.”

EDUARDO ROJAS-BRIALES emphasises the importance of forest production based on sustainable and biologically-adapted methods.

“It’s interesting to see how you in Sweden are tackling these issues. There is now more research that considers the whole instead of the individual parts. This is completely in line with the FAO intentions – and is actually crucial if we are to attain the necessary sustainability.” 🌲



**Eduardo Rojas-Briales** is a professor in forestry, and has previously worked in his homeland Spain and in Germany. Since 2010 he has led the work of the FAO Forestry Department. In the spring he visited Sweden to participate in the major congress, *World Forests Summit* in Stockholm.

**FAO** is the Food and Agriculture Organization of the United Nations. It leads the work of the UN and the international community to reduce poverty and starvation, and the work to attain the objective of a world without hunger. The head office is in Rome.