News and Views

from Nordic Forest Research SNS

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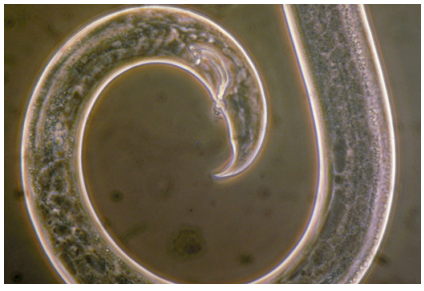
Threats and opportunities. Five new SNS-supported projects tackle an uncertain future. Photomontage: Mats Hannerz.

Pests, pathogens and wood properties in focus for five new cooperative ventures

Five new research projects have been initiated with financing from SNS. They all tackle the challenges of an uncertain future. Three projects will enhance the prospect of the forest withstanding pests and pathogens, with solutions such as early warning systems, decision support for species choice and genetic selection for tolerant trees. Two projects will improve the utilisation of wood, both for construction timber and for new products in the pharmaceutical and food industries.

All projects start in 2019 and continue for three years.

Find out more on: www.nordicforestresearch.org



The pinewood nematode, a pest we don't want to invade our Nordic forest.
Photo: L.D. Dwinell, CC BY-SA 3.0.

Project 1: Learning from history to forecast invasive pests

History is full of examples of non-native insects and other pests invading ecosystems and new tree species. The pinewood nematode in East Asia, emerald ash borer in North America and *Sirex* wood-wasp in South America, Africa and Australasia have all had devastating consequences for forest ecosystems. Pests that are introduced from other parts of the world can cause severe harm to the local trees since the host and pest are not adapted to each other. The same applies to new tree species being planted in a new environment.

The aim of the project "*Biogeographic analysis of historical forest insect invasions and host associations*" is to shed light on invasions and host associations worldwide. Biogeography is the scientific field that explores how species and ecosystems are distributed in space and through time. A greater geographical range of a tree species is also related to greater diversity of herbivore insects. The SNS-supported project will compile information about the range and patterns of

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New cooperation, cont.

invasions worldwide. Using this information, the researchers will test the hypothesis that numbers of native and non-native insects on a host tree are directly related to the geographical range and biological traits of that host. They also hypothesise that numbers of native insects are related to numbers of non-native ones, and that this can be due to traits such as chemical and physical defences of the tree.

It is known that more European insects have invaded North America than North American species have invaded Europe. Therefore, the researchers will study whether tree species range and traits differ on the two continents. Another topic in the project plan is studying whether specialist insects differ in their range compared with generalist herbivores.

The outcome of the project will be a better understanding of which tree species are more susceptible to invasive insects. This knowledge will be valuable to assess invasion risks and to guide the choice of non-native tree species to be introduced.

Project name: *Biogeographic analysis of historical forest insect invasions and host associations*

Cooperation between: *SLU (Sweden), Nibio (Norway), University of Helsinki (Finland) and USDA Forest Service (USA).*

Coordinator: *Maartje J Kapwijk, SLU. maartje.klapwijk@slu.se*

The wood wasp *Sirex noctilio* is native to Europe and northern Asia, where it lives in deep pine forests. It has been introduced to new continents as a result of the timber and firewood trade, and has caused devastating harm to planted pine forests in South America, South Africa, Australia and New Zealand. The wood wasp has also been introduced into North America. Photo: Michael Becker, CC BY-SA 3.0..

Project 2: Insights how to fight invasive pathogens

A new project will take a broad view of the problems with invasive pathogens. In recent decades, Europe has experienced an exponential increase in problems with introduced, invasive forest pathogens. The Nordic countries have seen the hardwoods elm and ash being decimated by pathogens. Scots pine, a keystone species in the Nordic forests, has been exposed to several new pathogens such as *Dothistroma septosporum*, *D. pini*, *Lecanosticta acicula*, *Diplodia sapinea*, and pitch canker caused by *Fusarium circinatum*. Other problems are related to *Phytophthora* species, which can infect a broad range of host tree species.

International trade in plants and soil is an important pathway for new pathogens, and the problems will probably increase with climate change. Drought periods may stress the host trees, and warmer and wetter winters may expand the range of introduced pathogens.

The project will combine expertise from across the Nordic countries to improve methods of early and accurate detection of new pathogens. There are many methods for detecting pathogens, such as gaseous signals, DNA/RNA or spectral changes in infected plants. The project will also increase knowledge about pathways of spreading new diseases. For instance, *Rhododendron* plants have been implicated as a source of the spread of *Phytophthora* species.

Another outcome, besides new scientific information about invasive, introduced forest pathogens, will be a multicriteria decision analysis tool to improve biosecurity in relation to alien invasive forest pathogens.

Project name: *Preventing the spread of new pathogens in Nordic forests to secure sustainable forestry in growing bioeconomy*

Cooperation between: *SLU (Sweden), Luke (Finland), Nibio (Norway), University of Copenhagen (Denmark), Estonian University of Life Sciences (Estonia), Institute of Forestry (Lithuania), Nature Research Center (Lithuania), Friodlingens Riksorganisation (Sweden), Rhododendronsällskapet (Sweden) and UPM Joroisten taimitarha (nursery, Finland).*

Coordinator: *Johanna Witzell, SLU. johanna.witzell@slu.se*

Diplodia pinea is a pathogen common in southern Europe, which has spread north, possibly due to climate warming. It was discovered in Sweden in 2013, and has since attacked pine stands so severely that they had to be harvested prematurely. Photo: Steven Munson, USDA Forest Service. CC BY-SA 3.0.

Rhododendron plants have been suspected to be a source of the spread of *Phytophthora* species. Photo: Pixabay.

Project 3: Genetic selection will save the ash

Ash trees in Europe have experienced a dramatic decline in the last few decades due to ash dieback. The tree, having been a keystone species in fertile ecosystems, is now classified as "critically endangered" on the Swedish Red list. Nordic and Baltic foresters no longer rely on ash as a timber species since new regeneration has been prevented by the disease.

It has been shown that susceptibility to ash dieback is under strong genetic control, and tree breeders are therefore hopeful that they will find more tolerant ash trees with which to create future forests. This joint Nordic-Baltic project will combine efforts focused on genetic selection in the partner countries to start up a second-generation selection programme.

The healthy individuals already identified will continue to be used in the programme, as well as newly selected trees. The aim is to identify a large number of trees and establish trials to allow robust forward selection of trees. An initial screening will be conducted in a nursery, but the activities will continue for much longer. After about 5-8 years in the field, strong individuals can be selected.

***Project name**: Conservation of resistant ash (*Fraxinus excelsior*) genotypes in Nordic and Baltic regions to maintain the full range of ecosystem-services provided by this keystone species*.

***Cooperation between**: Skogforsk (Sweden), University of Copenhagen (Denmark), Nibio (Norway), SLU (Sweden), Lithuanian Research Centre for Agriculture and Forestry (Lithuania)*.

***Coordinator**: Mateusz Liziniewicz, Skogforsk*.
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Will the Nordic and Baltic ashes rise from the ash? Photo: Mats Hannerz.

Project 4: Chemical modification makes wood more durable

In some construction uses, such as when exposed to open air and moisture, wood must be durable and resistant to fungal degradation. This is sometimes a drawback for wood as an alternative to more climate-impacting materials. Historically, wood has been treated with preservatives such as creosote or copper compounds, but the use of such substances is now very restricted. But, there are environmentally friendly methods to improve the durability of the wood.

Chemical acetylation is one method that has proved successful in making wood more resistant to fungi. However, we don't know how acetylation improves the wood. It is known that the water in the cell walls is reduced, but water is present in many places and forms in wood. This is why the researchers are asking: "*Where is the water in acetylated wood?*", and this is also the title of a new SNS-funded project.

The project combines specific equipment and expertise from Sweden, Denmark and Norway to investigate the influence of acetylation on the amount, location and state of water in wood. The hypothesis is that acetylation not only affects the amount of water, but also the location and state of it. Wood from Norway spruce will undergo chemical treatment and then the amount of water will be measured (at Lund university) and the location and state of water determined (at University of Copenhagen). The amount of cell wall water and capillary water in the wood will also be measured at Nibio.

***Project name:** Where is the water in acetylated wood? Studies of amount, location and state of water in acetylated wood for development of more durable wood products*.

***Cooperation between:** Lund university (Sweden), University of Copenhagen (Denmark), Nibio (Norway)*.

***Coordinator:** Maria Fredriksson, Lund university*.
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Bridge in the Netherlands from acetylated pine wood. Photo: Gerhard Büttner, CC BY-SA 3.0.

Acetylation

Unlike pressure treatment, in which preservatives such as ammoniacal copper quaternary compounds are infused into wood, acetylation chemically modifies wood. In the process, acetic anhydride reacts with the hydroxyl groups on large molecules such as lignin and hemicellulose in the plant cell wall. The reaction replaces hydroxyl groups with acetyl groups and yields acetic acid as a by-product. (*Source Chemical and Engineering News*)

Project 5: Hemicellulose is an underutilised resource

Wood contains 20-30% hemicellulose, a polymer which is much smaller than the main component used in pulp production, cellulose. Hemicellulose is, to a large extent, a waste product in chemical pulp processes and is washed out along with lignin and other compounds to become fuel or other energy sources. However, hemicellulose has properties that could mean that it would be more efficiently utilised in various other applications. Purified hemicelluloses have been tested as films and gels, so far with limited success. But, it has been shown that hemicelluloses are suitable for use as emulsions and stabilisers. The properties have great potential for cosmetics, pharmaceuticals and chemicals.

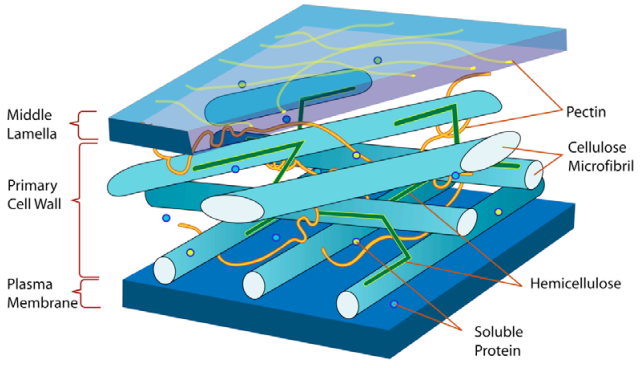
We still need to develop the methods to extract, purify and utilise hemicelluloses. Three existing projects involving wood hemicelluloses will be combined in the new SNS-supported project. One project in Finland is working on oxidised wood hemicelluloses as film additives, and another on stabilising emulsions. A project in Norway is examining wood prebiotics and will continue in the field of hemicellulose. A Swedish project is working on the oxidation of wood xylans (a type of hemicellulose common in hardwoods).

Being brought together, the existing projects will improve understanding of hemicellulose utilisation. In the long run, the results will help to change hemicellulose from a waste product to a valuable resource.

Project name: *Liberation and solution properties of wood hemicelluloses towards surface active molecules (HEMISURF)*

Cooperation between: *Chalmers University of Technology (Sweden), University of Helsinki (Finland), Norwegian University of Life Sciences (Norway) and CH-Bioforce (Finland).*

Coordinator: *Tiina Nypelö, Chalmers* *tiina.nypelo@chalmers.se*



The plant cell wall. Image by Ladyofhats, CC BY-SA 4.0.

Shortcuts

Sweden: Foundation strengthens research on forest production

The Knut and Alice Wallenberg foundation continues to support forest research. In a new effort, 100 million SEK is being allocated to forest production and silviculture at the Swedish University of Agricultural Sciences. Another 180 million SEK is targeting biotechnology and forest genetics at SLU, Umeå University, Uppsala University and the Science For Life Laboratory.

The funded projects will aim, inter alia, to identify new genes controlling tree growth and wood formation. They will also continue and deepen the genetic mapping of trees. In collaboration with Skogforsk, thousands of trees in the breeding programme will be mapped and used in genomic selection.

The silviculture part of the effort will deal with the utilisation of the new trees derived from the genetic projects.

Source: *www.slu.se*

Norway: Firewood ranking places holly and yew at the top

Common holly (*Ilex aquifolium*) has the best fuel value per volume unit for wood stoves. The next best is European yew (*Taxus baccata*), followed by beech, oak, ash and rowan. NIBIO has measured weight, volume and fuel value with a so-called bomb calorimeter. The fuel value is directly related to the weight (density) of the wood. Holly has a weight of over 650 kg per cubic meter, while spruce has less than 400 kg.

Source: *www.nibio.no*

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More info about SNS:

www.nordicforestresearch.org

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SNS Nordic Forest Research

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