SLU Department of Forest Resource Management

Annual Report 2015

SP Certified ISO 14001

Johan Fransson
Head of Department

Contents

Cover photo: Tomas Lämås, SLU. Picture from Granö, Sweden.
Publisher: Johan Fransson, SLU.
Editor and Layout: Sofia Hansson, SLU and Ylva Melin, SLU.

Dear Reader,

Dear Reader,

For eight consecutive year the achievements of the Department of Forest Resource Management are published in an Annual Report. Here we proudly present the Annual Report 2015.

The report is divided into the main fields of activities of the Department: Undergraduate, Master's and Doctoral studies, and research within six subject areas, as well as three major environmental monitoring programs. Also included in this report are the schematic view of the Department's organization, Department photos, press clippings, facts and figures, major activities of the Forest Sustainability Analysis program and the Department's environmental management system followed by a compilation of publications, names of the field staff, a page with special events that happened during the year and last but not least a visualization of the Department co-publication and usage by research community.

To mention some of the high-lights of 2015 I will first start with an activity within the research area that seldom gets its full credits. Successful applications to research funding foundations and agencies are the back-bone of the research at the Department. In total, 60% (26.6 million SEK) of the research at the Department 2015 was externally financed. I do highly appreciate the great work that is done by the Department staff with producing successful applications. This is well illustrated by the impressing list (on page 7) of the major donors and how many projects they are financing where Department staff was applicants or co-applicants, for example, Formas – 12 projects, the Swedish National Space Board – 8 projects and the Swedish Environmental Protection Agency that financed 4 projects. Furthermore, also EU, NFS, SNS, the Åforsk Foundation, the Swedish Forest Society, the Önnesjö Foundation, Anna och Nils Håkansson's Foundation, Hildur and Sven Wingquist's Foundation are funding research at the Department. In this context, we should not forget the effort put into great applications that are not granted! But in the scientific world, highly exposed to competition, we must keep the annual number of applications at a very high level to reach the funding's needed, and therefore un-successful ones will unfortunately be a part of a researchers everyday life.

Within the area of Undergraduate and Master's studies, a lot of efforts have been put into the work with the new frame schedule for the years 2016/2017. The staff at the Division of Forest Remote Sensing and the Division of Forest Resource Analysis has this year prepared a brand new course that will be launched in January 2016.

I also would like to mention some environmental monitoring and assessment high-lights of 2015. In September the new TaxWebb version was launched. This is an interactive tool that gives everyone possibilities to produce customized estimates based on National Forest Inventory (NFI) data. In November SKA 15 was presented for the public in Stockholm in front of among others the Minister of Rural Affairs Sven-Olof Bucht. The projections for SKA 15 was performed by Department staff and for the first time, in this kind of national projections, using the Heureka RegWise package, a very successful SLU/Department product. Finally, I would like to pay attention to the continuous success of the Swedish Forest Agency tool "Skogliga grunddata". In this project the Division of Forest Remote Sensing produced the pixel-wise estimates combining airborne laser scanning data with NFI data. In many ways this application has revolutionized the forest planning work, both in private and in enterprise forestry management. Finally, I would like to once again congratulate our carbon reporting team to two well-attended side-events at COP 21 in Paris.

All of the achievements of the Department are, of course, based on a combination of individual and team efforts, contributions that all definitely deserve to be mentioned. This is unfortunately an impossible task. Nevertheless, I would like to highlight a few important events with respect to the staff during 2015:

- Göran Ståhl was elected as the new Dean of the Faculty of Forest Sciences
- Three new doctoral students started; Xin Zhao, Camilla Thellbro and Nils Lindgren
- Three doctoral dissertations took place; Per Sandström, Sebastian Schnell and Thomas Kronholm
- The Department got full marks in the external audit of our environmental management system and also at the national archives audit
- Ulf Söderberg retired from the Department after serving SLU for more than 30 years
- Gun Lidestav, Björn Nilsson and Göran Ståhl were honored in a special celebration for employees that have served the government for 30 years

I hope you will enjoy reading this annual report and do not hesitate to contact us if you would like to find out more about the activities touched upon here. We would be more than pleased to share our knowledge and experiences with you!

Yours sincerely,

Johan Fransson

Organization

Schematic View of the Department

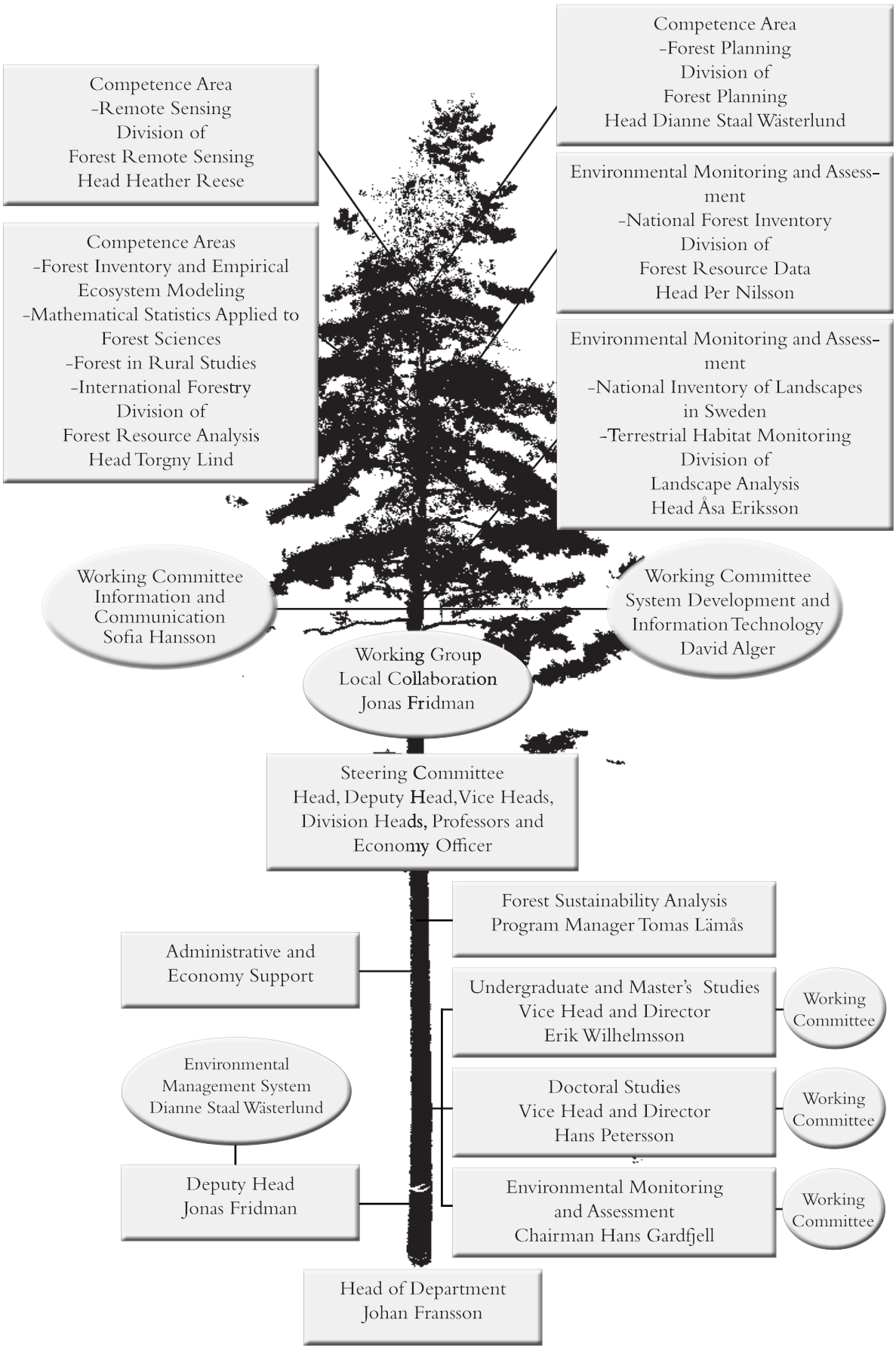


Figure:
Kenneth Olofsson, SLU and Emma Sandström, SLU.

Department Photos

Department Steering Committee

In the photo:
Dianne Staal Wästerlund
Ola Eriksson
Jonas Fridman
Per Nilsson
Hans Petersson
Arne Pommerening
Heather Reese
Thomas Kronholm
Åsa Eriksson
Pär Andersson
Johan Fransson

Missing:
Torgny Lind
Håkan Olsson
Göran Ståhl
Erik Wilhelmsson

The duties of the Department Steering Committee are to identify key issues and define the Department's position on strategic and comprehensive questions. The responsibilities also include supporting the management of the Department. The committee convened on a weekly basis and also had 6 indepth meetings during 2015.

Administrative and Economy Support

In the photo:
Nanna Hjertkvist,
Administrator
Ylva Jonsson,
Economy Administrator
Pär Andersson,
Economy Officer
Anne-Maj Jonsson,
Economy Officer

Missing:
Linda Ågren,
Economist
Sofia Hansson,
Information Officer
Carina Westerlund,
Administrator

The administrative staff are involved in most of the activities within the Department including bookkeeping, employment issues, field administration, student course registration, information issues and layout of reports.

Employees at the Department 2015

On 24 November the staff gathered for a Department day at Väven, Umeå. The theme for the day was working environment and Strategy. The day started with coffee and then a lecture by Lena Lundqvist, Shift education, about stress and how to handle it. After lunch Maria Blechingberg and Åsa Ögren from Esam AB held a workshop focusing on future visions and strategies for the Department, in a realation to the UN global sustainability goals. The day ended with a social activity and then dinner at Bishop Arms.

Text: Johan Fransson, SLU.
Photos: Ylva Melin, SLU.

Press Clippings

Heureka, better loan conditions

An analysis by Heureka is extremely valuable as a complement to our own calculations when a forest owner is in need of a, relatively, high mortage on a large possession. Johan Freij, Section manager for Forestry and Farming at Danske Bank.

Published Skogsvärden 1-2015

Drones for every budget

There is a huge range of drones and unmanned aircraft. A simple helicopter drone can cost just a few thousand Swedish crowns whereas an advanced military drone can cost 100 million Swedish crowns.

Published 20 March 2015
ATL

Modern technology reaching new heights

In the wake of the many storms over the last decades and the forest fire in Västmanland, new methods for documenting forest damage and utilizing wind-thrown trees are being developed. Researcher at SLU in Umeå have, together with SCA, even used drones to rapidly acquire full coverage image-mosaics covering damaged forest areas. With the help of these images forest-harvester drivers, who were previously forced to drive around searching for wind-thrown trees, can now get almost daily information regarding the current status directly on the screens in their harvester.

Published December 2015
Skogseko no. 4

Record year for lingonberries in Götaland

This year's lingonberries harvest looks to be a record in Götaland. The forecast from the Swedish University of Agricultural Sciences (SLU) shows good abundance in all parts of the country except in Northern Norrland. The forecast is based as always on data from the Swedish National Forest Inventory and SLU's forest research parks.

Published 13 August 2015
Skogsaktuellt

Grant for remote sensing of forests

The Foundation, established by the late Anna and Nils Håkansson, has awarded the following grant: 100 000 SEK to Mattias Nyström (PhD) and Jonas Bohlin (Msc Forest Science), Swedish University of Agricultural Sciences, Umeå, for "Development of the training laboratory for remote sensing of forests using modern technology".

Published 5 May 2015
Västerbottens-Kuriren

A sustainable use of forests is climate-smart

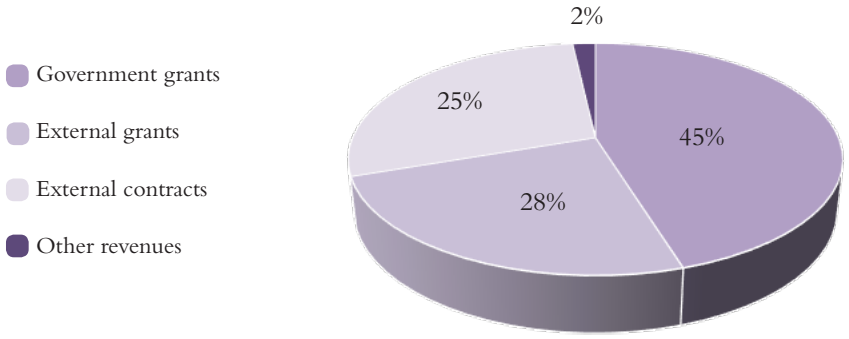
Sweden's reporting of greenhouse gas emissions under the Climate Convention and the Kyoto Protocol is conducted by the Swedish University of Agricultural Sciences. This reporting is based primarily on data from the National Forest Inventory and National Soil Inventory and constitutes objective measurements of carbon pool changes in forest and other land uses.

Published 22 June 2015
Västerbottens-Kuriren

Facts and Figures

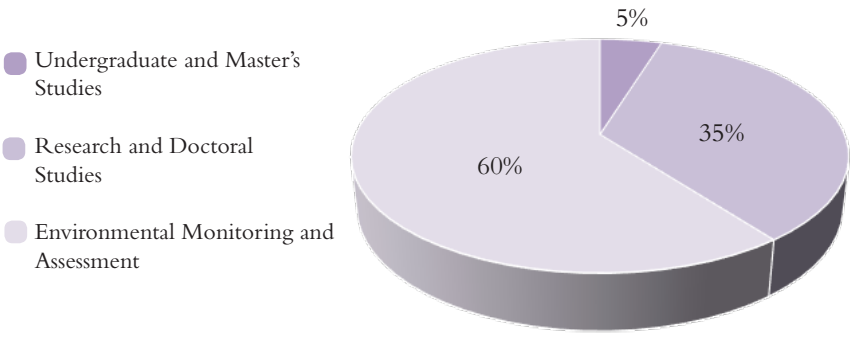
Revenues

Revenues (1000 SEK)	Undergraduate and Master's Studies	Research and Doctoral Studies	Environmental Monitoring and Assessment	Support Function	Total
Government grants	4 996	16 888	36 015	0	57 899
External contracts	634	1 490	28 931	344	31 399
External grants	433	25 136	10 719	223	36 511
Other revenues	27	1 128	1 127	0	2 282
Total	**6 090**	**44 642**	**76 792**	**567**	**128 091**



Costs

Costs (1000 SEK)	Undergraduate and Master's Studies	Research and Doctoral Studies	Environmental Monitoring and Assessment	Support Function	Total
Staff	2 702	25 183	47 215	7 436	82 536
Premises	786	2 646	2 452	483	6 367
Other operative expenses	342	7 912	13 792	2 160	24 206
Depreciation	96	145	171	14	426
Overheads	2 283	9 350	14 666	-10 197	16 102
Total	**6 209**	**45 236**	**78 296**	**-104**	**129 637**



External Contracts and Grants

Financier	Incomings (million SEK)
EU	17.4
Swedish Environmental Protection Agency	10.5
Swedish Research Council	4.9
Formas	4.6
Swedish Board of Agriculture	4.4
Swedish Forest Agency	3.6
Swedish National Space Board	2.9
The Swedish Forest Society	2.2
Swedish Energy Agency	1.3
Kempe Foundations	1.2
Vinnova	1.0
IVL Swedish Environmental Research Institute	0.8
Hildur and Sven Wingquist's Foundation	0.7
Umeå kommun	0.5
Sveaskog	0.4
The Åforsk Foundation	0.3
Ljungbergs Foundation	0.3
Nils and Dorthi Troëdsson's Foundation	0.3
County Administrative Boards	0.2
Forestry Research Institute of Sweden	0.2
Swedish Forest-Owner Plans AB	0.2
SCA	0.2
Bergvik Skog	0.2
Norwegian Institute of Bioeconomy Research	0.2
Önnesjö Foundation	0.2
Norrskog	0.2
Fonden för skogsvetenskaplig forskning	0.1
NASA	0.1
Holmen	0.1
The National Property Board of Sweden	0.1
Anna and Nils Håkansson's Foundation	0.1
Norra Skogsägarna	0.1
SSR (Svenska Samernas Riksförbund)	0.1
Swedish National Land Survey	0.1
The Church of Sweden	0.1
Others	8.2
Total	**67.9**

Personnel Categories

Personnel Categories	Number of Work-Years*
Professors	3.2
Associate professors/University lecturers	9.8
Researchers	23.2
Postdoctoral researchers	1.8
Doctoral students	8.2
Other teachers	1.9
Administrative staff	7.9
Technical staff	29.5
Technical staff (field)	38.5
Total staff	**124.0**

*These figures show the number of work-years at the Deparment. It's not a true reflection of the number of employees.

Tables: Pär Andersson, SLU and Anne-Maj Jonsson, SLU.
Figures: Sofia Hansson, SLU.

Undergraduate and Master's Studies

Erik Wilhelmsson
Vice Head and Director
Undergraduate and
Master's Studies

The Department is a major contributor to SLU's Master of Forestry Program (Jägmästarutbildningen). Our course selection amounts to 40 ECTS credits at Bachelor's level and 45 ECTS credits at Master's level. The courses are given in five subject areas: Mathematical Statistics, Remote Sensing and Geographic Information Technology (GIT), Forest Inventory, Forest Planning, and Organization and Leadership.

Curriculum development is handled by subject co-ordinators Anders Muszta (Mathematical Statistics), Heather Reese (Remote Sensing and GIT), Torgny Lind (Forest Inventory), Erik Wilhelmsson (Forest Planning) and Dianne Staal Wästerlund (Organization and Leadership).

The individual courses for each subject are shown in the table on page 9, divided into Bachelor's and Master's studies. Courses at Bachelor's level have 60 to 80 students per course. Courses at Master's level have 10 to 60 students per course.

High-lights for 2015

Together with other departments, we made a detailed description per week of the content in the subject "Forest management" as an input to the work and decisions on restructuring and harmonization of all programs at the university. We also contributed to a corresponding revision of subject content and scope for "Economics", "Management of tropical forests" and "Conservation biology".

We supervised students during their thesis work, 14 at the Bachelor's level, and also 14 at the Master's level.

The total volume of teaching performed at the Department corresponds to 71 full-year students entering our courses and 70 passed. Approximately 7.5 full time equivalents and 6.0 performance equivalents of the total volume comes from Master's theses. This means 10 completed, of which 3 in Remote Sensing, 3 in Forest Inventoty and 4 in Forest Planning.

"Basal area at breast height" is a common variable for stand density, and can be measured with a relascope or calculated after calipering. This measure cannot be seen directly, as the area is on the inner side of the stems. To help students understand and learn this variable, and with a twinkle in the eye, an installation was made in the forest near the campus. All trees on a circular plot were cut at breast height so that the basal area becomes visible. The felled stems are left and will be a demonstration of the decay process. The high stumps are beautifully topped with snow hats during the winter (see pictures). During the summer they can be used as tables for drinking coffee. There might also be other options.

Text and photos:
Erik Wilhelmsson, SLU.

Master's Theses and Courses

Remote Sensing

Blombäck, Johanna, 2015. Update of forest management plans from Södra using stereo matching of aerial images, the national terrain model and data from the National Forest Inventory. (Supervisor: Jörgen Wallerman)

Singhania Sousa, Monica, 2015. Forest estimates derived from airborne laser scanning data in southern Sweden: A comparison of regional and local model calibration. (Supervisor: Mats Nilsson)

Söderberg, Jon, 2015. A method for using harvester data in airborne laser prediction of forest variables in mature coniferous stands. (Supervisor: Jörgen Wallerman)

Forest Inventory

Linck, Lisa, 2015. Social values in the Dalasjö forest in northern Sweden. (Supervisor: Gun Lidestav)

Lundin, Marika, 2015. The need for forest owner´s web – a market survey within AB Karl Hedin Råvara. (Supervisor: Gun Lidestav)

Nilsson, Robert, 2015. Long term effects of forest restoration with Heureka PlanWise: Analysis of restoration actions for nature values in Sveaskogs Ecopark Käringberget. (Supervisor: Torgny Lind)

Forest Planning

Elldegren, Linus, 2015. Zoned forestry on estate level – effects on economy and ecology. (Supervisor: Tomas Lämås)

Jönsson, Michael, 2015. The extent of nature conservation areas during the final felling on Älvdalens Besparingsskog. (Supervisor: Tomas Lämås)

Ullen, Moa, 2015. The impact of forest management on forage availability for ungulates. (Supervisor: Karin Öhman)

Vestin, Sandra, 2015. Gone with the wind -Forest owners´ experience of the providing cutting services after the storm Ivar. (Supervisor: Dianne Staal Wästerlund)

Courses given at the Department in 2015

Subject Area	Undergraduate Level (years 1-3) 60-80 students per course	Master's Level (years 4-5) 10-60 students per course
Mathematical Statistics	Mathematical Statistics (yr 1), 7 ECTS Forest Inventory and Statistics (yr 2), 3 of 9 ECTS	
Remote Sensing and GIT	Basic GIT (yr 1), 1 of 7 ECTS	Advanced GIT (yr 3, 4 or 5) 7.5 ECTS Remote Sensing and Forest Inventory (first time in spring 2016, yr 4 or 5), 7.5 of 15 ECTS
Forest Inventory	Basic Tree and Stand Measurement, (yr 1), 1.5 ECTS (in Forest Management and Product Processing) Forest Inventory and Statistics (yr 2), 6 of 9 ECTS Silviculture and Forest Management Planning (yr 3), 2 of 15 ECTS	Remote Sensing and Forest Inventory (first time in spring 2016, yr 4 or 5), 7.5 of 15 ECTS
Forest Planning	Forest Planning and Silviculture (yr 2), 3 of 15 ECTS PlanWise as Decision Support in Forestry Planning (yr 3), 7.5 ECTS	Forestry Sustainability Analysis (yr 4), 7.5 ECTS
Organization and Leadership	Individual and Group Leadership (yr 1), 1 day	The Forestry from Organizational Theory Related Perspective (yr 5), 15 ECTS

More information: Master's Theses can be found in SLU's digital archive Epsilon, pub.epsilon.slu.se/

Text: Ylva Jonsson, SLU.
Table: Erik Wilhelmsson, SLU.

Doctoral Studies

Hans Petersson
Vice Head and Director
Doctoral Studies

The PhD program aims to provide a high-quality university education, where PhD students gain both broad knowledge and expert skills in the competence area of their choice.

In 2015, a total of 18 active students were enrolled including 10 men and 8 women. Three PhD students completed their studies, resulting in three doctoral degrees and two new students were recruited. A total of 4, 3, 7 and 3 students passed 25, 50, 75 and 100% of their examinations, respectively.

The PhD students made great progress, and their research resulted in co-authorships of several scientific publications. In addition, the PhDs who completed their doctorates the previous year published several manuscripts from their theses. PhD students also presented their results at several national and international conferences, meetings and workshops.

The majority of the PhD students actively participated in seminars. Doctoral students have taken part in the Working Committee of Doctoral Studies at the Department level and the self-organized Council of Doctoral Students at the Faculty level. Currently, 10 different senior researchers act as supervisors, and the PhD students are supported by about 45 assistant supervisors. The gender balance within the group is uneven with only two female supervisors and twelve female assistant supervisors.

The Department undertakes an annual review of the individual study plans of all PhD students, and the Department's director of PhD studies reports the outcome of this review to the Faculty. The director of PhD studies of the Faculty organizes annual meetings for the department directors to provide information about new regulations and to facilitate harmonization of the various PhD studies.

During 2015, the Department gave the following scheduled courses at PhD level: An Introduction to Applied Experimental Design and ANOVA, Basic Sampling with Extensions, Regression Analyses, Statistics with Mathematics, and Qualitative and Mixed Research Models.

Courses given at the Department in 2015

	Credits (ECTS)	Participants
An Introduction to Applied Experimental Design and ANOVA	3.0	18
Basic Sampling with Extensions	3.0	8
Regression Analyses	4.0	10
Statistics with Mathematics	4.0	7
Qualitative and Mixed Research Models	7.5	16

Text and Table:
Hans Petersson, SLU.
Photo: Julio Gonzalez, SLU.

Doctoral Theses

Doctorate - Forest Planning

Thomas Kronholm
Forest owners' associations in a changing society

Dissertation: November
Supervisor: Ola Eriksson
Assistant supervisor: Dianne Staal Wästerlund

Doctorate - Forest in Rural Studies

Per Sandström
A toolbox for co-production of knowledge and improved land use dialogues - the perspective of reindeer husbandry

Dissertation: February
Supervisor: Gun Lidestav
Assistant supervisors: Johan Svensson and Mahesh Poudyal

Doctorate - Forest Inventory and Empirical Ecosystem Modeling

Sebastian Schnell
Integrating trees outside forests into national forest inventories

Dissertation: April
Supervisor: Göran Ståhl
Assistant supervisors: Arne Pommerening and Thomas Nord-Larsen

Text: Ylva Jonsson, SLU.
Photos: Sofia Hansson, SLU.

Remote Sensing

Nationwide forest database made from airborne laser scanning

Håkan Olsson
Subject Area Manager

Staff
Peder Axensten
Inka Bohlin
Mikael Egberth
Johan Fransson
Johan Holmgren
Mats Högström
Jonas Jonzén
Mats Nilsson
Mattias Nyström
Karin Nordkvist
Kenneth Olofsson
Henrik Persson
Heather Reese
Emma Sandström
Sebastian Schnell
Jon Söderberg
Jörgen Wallerman

Doctoral Students
Jonas Bohlin
Mona Forsman
Ann-Helen Granholm
Nils Lindgren

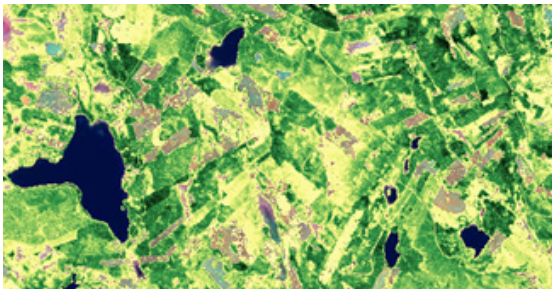
Postdoctoral Researchers
Eva Lindberg

A nationwide raster database with forest varaiables based on airborne laser scanner data has been produced by the Division of Forest Remote Sensing at SLU and the Swedish Forest Agency. The project was an assignment from the government to be carried out from 2013 to 2015.

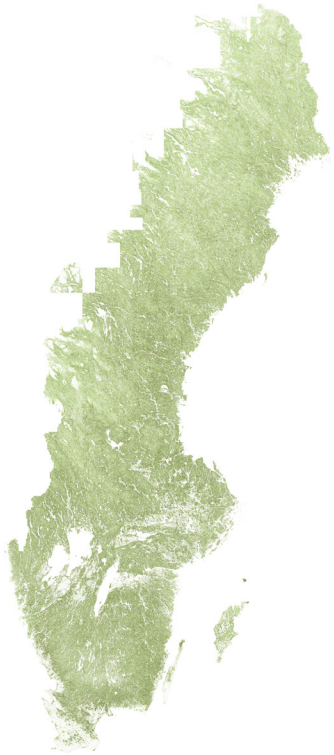
The laser scanner data used until now were obtained by "Lantmäteriet" (the Swedish Mapping, Cadastral and Land Registration Authority) from 2009 to 2015, originally for the purpose of creating a new national elevation model. The national scanning was done in blocks of 25 km x 50 km.

The prediction of forest variables was done for 12.5 m x 12.5 m grid cells. Features from the laser returns in the tree canopy were computed for each grid cell, for example, the proportion of returns from the trees compared to all laser returns from that grid cell, or the height above ground for the 90th percentile of the laser returns from the tree canopy. These features were used as independent variables in regression models, where forest data from the Swedish National Forest Inventory (NFI) carried out by SLU were used as dependent variables. Once the regression coefficients were estamated for a forest variable as a function of laser data features, the forest variable could be predicted for all raster cells in the laser scanned block. The predicted forest variables were stem volume, basal area, mean stem diameter, mean tree height (basal-area weighted), and above-ground tree biomass.

The result is a nationwide raster database. The accuracies when aggregated at stand level are as good as, or better, than the accuracies of variables estimated in traditional forest management planning. For example, the accuracy for the most important variable, namely stem volume, is generally better than 20% at stand level. In stands dominated by broadleaf species, the accuracy may, however, be worse, especially if the scanning was done during leaf-on season. It was very important that the new forest database had an accuracy equal to or better than what the users were used to, in order to gain acceptance of the product. Even better accuracy could be achieved in the future, for example, if lower scanning angles are used, and if field plots from the same year as the scanning are available. In the present production, field data from the NFI had to be forecasted, or backcasted, to the year that each respective laser block was scanned.



Subset of the stem volume layer in "Skogliga grunddata". All of Sweden is covered with 12.5 m x 12.5 m raster data cells that show key forest variables for each cell.



The status at the end of 2015 of the nationwide forest database made by combining laser scanner data and NFI field plots. No predictions have been made in the mountain areas, and laser scanner data were not yet available for a few areas due to cloud cover.

The data are freely available from the homepage of the Swedish Forest Agency under the name "Skogliga grunddata". There is already a large number of users, for example, forest owners, professional forest staff, banks, insurance companies, authorities and researchers.

Text: Håkan Olsson, SLU.
Figures: Jonas Jonzén, SLU.

Forest Inventory and Empirical Ecosystem Modeling

The future of LULUCF and REDD+ in the Post-Kyoto framework

Can forests play a more meaningful role in the general international climate policy framework? This question is currently being asked at multiple levels: at the EU level, in the United Nations Framework Convention on Climate Change, the Kyoto and Post-Kyoto framework, including with respect to the development of REDD+ (Reduced Emissions from Deforestation and Forest Degradation) approaches that attempt to reduce the rate of deforestation and forest degradation in the developing world. In the context of movement toward a more unified Post-Kyoto climate policy framework, the project focuses on the future potential integration of LULUCF (Land Use, Land-Use Change and Forestry) and REDD+ in the national, EU and international climate policy frameworks. The focus requires paying close attention to the development of an efficient and effective Measurement Reporting and Verification (MRV) monitoring framework. The project began in 2013, and is expected to be finalized in the beginning of 2016.

Giacomo Grassi, JRC-EU, discusses Intended Nationally Determined Contributions (INDC) and forestry at the side event "LULUCF and REDD+ Forest Potential in the Climate Policy Framework".

LULUCF, REDD+ and the Climate Policy Framework: what will a future UNFCCC-based Post-Kyoto LULUCF regime that merges the interests and goals of Annex I and non-Annex I member states look like? In what ways will the international carbon-trading framework adapt to incorporate a combined LULUCF and REDD+ framework? Will carbon trading in all LULUCF and REDD+ forest-based net removals be permitted?
A manuscript has been prepared addressing the general policy framework of LULUCF and REDD+ and assesses the potential for their integration in a common and cohesive framework.
A second manuscript will provide a detailed account of the evolution of the international carbon trading framework across the EU, New Zealand, California, Australia, British Columbia, and the UNFCCC/Kyoto framework. The analysis will focus, in particular, on the degree of integration of LULUCF/REDD+ and the potential for trading in forest-based carbon credits.

The potential/incentives for reforming the UNFCCC/Kyoto/EU and other frameworks have been discussed in several workshops organized.

- LULUCF and REDD+ Forest Potential on the Ground: Country-Level Dynamics (2015) Paris.
- LULUCF and REDD+ Forest Potential in the Climate Policy Framework (2015) Paris.
- Re-Imaging LULUCF and REDD+: Forest Potential, Low Carbon Roadmaps and the Climate Policy Framework (2015) Uppsala.
- Forest Potential for Climate Change Mitigation in the Post-Kyoto Climate Policy Framework (2014) Lima.
- LULUCF & REDD+: Convergence and the International Climate Policy Framework (2013) Warsaw.

MRV: Given the quite broad variation in current carbon accounting practice, capacity, and the intrusion of measurement uncertainties, how will MRV strategies develop in the coming years?
The situation for an Annex I country and a non-Annex I country is simulated by establishing a sample-based monitoring system for reporting carbon stock changes at different scales. A central question is how to balance the resources needed for field sampling, remote sensing and deriving empirical tree functions, since uncertainty will derive from trade-offs between sampling and model error. Three manuscripts have been prepared: "Use of models for improved estimation in sample-based large-area forest surveys: A review", "A two-stage ratio estimator for poststratified, model-assisted biomass estimation", and "Assessing uncertainty – sample size trade-offs in the development and application of models for estimating national carbon stocks".
Soil carbon stock changes from REDD+ activities will be estimated using process-oriented models (Yasso, Q-model). The role/importance of forest type, management, climate, and soil type will be tested. These methods will be used to estimate soil carbon in conjunction with estimates of stock change in woody biomass. These estimates will be used to create a tool for measuring the ecosystem net flux of carbon from REDD+ activities.
Two manuscripts will be written based on data collected in Ethiopia. The manuscripts have the preliminary titles: "Estimating past and potential land use trends in the context of socio-economic and climate change in Ethiopian watershed" and "Carbon stock developments in response to land use change, historical and climate change scenarios".

Göran Ståhl
Subject Area Manager

Staff
Anna-Lena Axelsson
Adam Dahlén
Henrik Feychting
Anton Grafström
Torgny Lind
Ylva Melin
Martin Nylander
Hans Petersson

Doctoral Students
Sarah Ehlers
Cornelia Roberge
Sebastian Schnell

Guest researcher
Svetlana Saarela

Text: Hans Petersson, SLU.
Photo: Mattias Lundblad, SLU.

Forest Planning

Forest Owners' Associations in a changing society

Ola Eriksson
Subject Area Manager

Staff
Hampus Holmström
Tomas Lämås
Eva-Maria Nordström
Maria Nyberg
Dianne Staal Wästerlund
Erik Wilhelmsson
Karin Öhman

Postdoctoral Researcher
Johanna Lundström

Doctoral Students
Julia Carlsson
Jeannette Eggers
Thomas Kronholm
Rami Saad

Guest Researchers
Sattar Ezzati
Alexandra Langner
Rachel St John

About 1/3 of the Swedish private forest owners are today members of a Forest Owner Association (FOA). The associations were established in the early part of the 20th century by forest farmers to improve their bargaining power vis-a-vis timber buyers. Today the associations have merged into four major co-operatives that have a substantial share in the Swedish timber market and their own industries. They are still owned and governed by their members according to co-operative principles, and their prime purpose continues to be to support their members' business activities. Yet, the proportion of forest owners that owns forest primarily for economic reasons is declining. In addition, relationships between people and organizations are changing in general. Society is becoming more individualistic, making people less willing to involve themselves in the work of an association. As a result, associations have often reduced their dependency on active members. This has for many associations resulted in reduced contacts with their members, while members regard themselves to be customers of the association.

A PhD project was started in 2011 to examine the processes shaping the future membership of FOAs and to identify critical elements that are likely to affect their relationships with members and (hence) the co-operative nature of their business. This project was conducted by Thomas Kronholm, who successfully defended his PhD thesis in November 2015. During his time as a PhD student, he was supervised by Dianne Staal Wästerlund and Ola Eriksson, and the project was financially supported by the FOA Norra Skogsägarna.

The PhD project consisted of four studies concerning:

- The renewal processes of the member organization in FOAs
- The strategies developed by the FOA to meet the above mentioned changes
- The commitment and loyalty of forest owners to their timber procuring organisations
- Young adults' relationships with forest and forest ownership

The results showed that the present district council members leading the membership work at a grass-root level were traditional forest owners who regarded economic issues in forest management as highly important. The turnover among district council members was very low, and they were not actively seeking contacts with members, so there was doubt as to how much information on internal affairs actually reach the grass-roots members. The senior managers and board members of FOAs had identified the need for more services as a primary strategy to meet the societal changes as, in their view, new members tend to be less familiar with forestry. Several associations have introduced new types of economic and advisory types of services as well as educational activities, also with the hope of selling more managerial services and as such securing the members' timber deliveries to their industries. The content of the services was, therefore, clearly characterized by the associations' values, which concern forest management for economic purposes.

Customer relationship marketing research has revealed that a satisfied customer may develop commitment to an organization either in the form of affection (liking the firm) and/or in the form of calculation (this is the best deal), before they become loyal customers, and that affective commitment is a stronger mediator to loyalty than calculative commitment. This was also found to be the case for forest owners. Members of FOAs were found to express higher levels of loyalty than non-members; yet they were not more willing to advocate their business partner to other forest owners. Young people mainly spend time in the forest in their early childhood during recreational activities. In later life they hardly have any contact with the forest. Especially urban young people had very little faith in the ability of forest owners to manage the forest responsibly. In conclusion, it was shown that the main challenges facing the FOAs concern their democratic governance processes, which the FOAs need to reconsider. Communication strategies with their members on core values rather than calculative values of membership were also seen as a critical element.

Young people out on a forest walk.

Text and photo: Dianne Staal Wästerlund, SLU.

Mathematical Statistics Applied to Forest Sciences

This year has again been a very productive year for the subject area Mathematical Statistics Applied to Forest Sciences. Two new projects, human tree selection behaviour and crown plasticity, have commenced in February 2015.
As part of the first project, Xin Zhao is studying human tree selection behaviour. This includes a wide range of applications such as, for example, the selection of trees for thinnings, the selection of habitat trees and Christmas trees. Xin has started to review general statistical theories and models relating to this subject. Carlos Pallarés Ramos, an international Master's student, joined this project in September 2015 for his master thesis.
Jaime Uría-Díez is comparing stem centre and crown centre coordinates of trees in order to discriminate between trees shifting their crown locations for environmental reasons (e.g. wind, topography) from those that shifted their crowns to avoid competition. He is using methods from point process statistics to quantify and model these effects.
Kenneth Nyström joined Mathematical Statistics in 2014/15 and contributed to the field of plant growth analysis and modeling to our subject area. This decision was made, because it was felt that these two areas are a natural match. Kenneth's research involves growth and yield, and empirical ecosystem modeling in a forest planning context. It is complemented by Arne Pommerening's theoretical work in this field.
As particular high-lights, we have published a number of seminal papers in peer-reviewed, international journals. Grafström and Matei (2015) published a paper on the coordination of conditional Poisson samples in the Journal of Official Statistics. Sample coordination, by maximizing the overlap between samples, is important for estimating change in populations that evolve over time. Karlsson et al. (2015) reported the development of Scots pine stands after first biomass thinning and their paper was published in SJFR. Nguyen et al. (accepted 2015) investigated the spatial distribution and association patterns of trees in the tropical forests of Vietnam in the Journal of Vegetation Science. Pommerening and Muszta (2015) published a paper on the concept of relative growth rate in Forest Ecosystems. The paper has been high-lighted as a "highly accessed" paper from March 2015 until January 2016. Pommerening et al. (2015) also published a research note (Fakta Skog, no. 9) entitled "Towards understanding human tree selection behaviour".
A number of the staff in the subject area was involved in a data assimilation project. In Nyström et al. (2015), data assimilation techniques were, for example, used to estimate forest stand attributes by sequentially combining remote sensing data with predictions from growth models.
Arne started a forest biometrics blog in May 2015 at http://blogg.slu.se/forest-biometrics/. This blog aims at facilitating an exchange on current issues in forest biometrics and is also used for research dissemination.
There has again been great demand for statistical consultation this year. Anders Muszta, who runs this unit within Mathematical Statistics, reported 48, 16 and 8 hours for the departments of Forest Ecology and Management, Wildlife, Fish, and Environmental Studies and Forest Resource Management, respectively. Four hours were assigned to plant science, remote sensing and soil chemistry. Anders spent a total of 120 hours helping students in the Master of Forestry Program with their thesis work.
A proposal submitted in September 2015 to the Faculty Board secured funding to further extend the successful research school in Applied Forest Statistics and Scientific Computing by three new modules including Bayesian statistics and MCMC methods, empirical tree and forest modeling, and scientific programming and simulation. This research school is one of the Department's educational flagships and is jointly run by Mathematical Statistics Applied to Forest Sciences and Forest Inventory and Empirical Ecosystem Modeling.
In October/November 2015 Arne was invited to work with a research group in forest biometrics led by Harold Burkhart at Blacksburg, Virginia (USA) and carried out research on size-dependent relative growth rates during this time (see Figure 1).
Arne and Anton Grafström were invited to give papers at a number of international conferences in 2015.

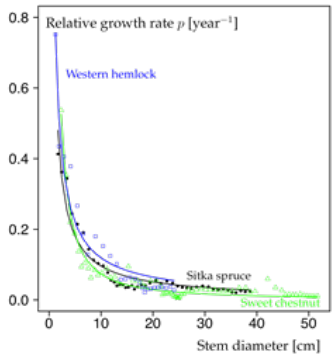


Figure 1. Size-dependent relative growth rates – one of the topics Arne Pommerening addressed at Blacksburg (Virginia). Interestingly, the trend lines of different species on different sites are quite similar.

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Subject Area Manager

Staff
Anton Grafström
Anders Muszta
Kenneth Nyström
Xin Zhao

Postdoctoral Researcher
Jaime Uría-Díez

Text and Figure:
Arne Pommerening, SLU,
Anders Muszta, SLU and
Anton Grafström, SLU.

Forest in Rural Studies

Gender equality as a joint strategy for the forestry sector

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Per Sandström
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Camilla Thellbro
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Carina Keskitalo

In the National strategy for gender equality in the forestry sector, Competitiveness requires gender equality, the gender imbalance is recognized as a major obstacle to the development of the sector and its organizations. Throughout the entire process - from initiation to implementation and evaluation - Forest in Rural Studies has been involved in the development. To benefit from the experiences gained and support further implementation, the project "Gender equality as a joint strategy for the forestry sector" has been carried out - involving both students, researcher and the sector.

The purpose of the project was, with point of departure in the National strategy for gender equality to critically analyse the joint gender equality work within the sector, but, also through these integrated analyses, to contribute to the development of the same practices and routines. This was done with a combination of critical policy analysis and an interactive research process that incorporate the participating organizations in knowledge development.

The project, funded by Vinnova, was started in November 2013 and ended in August 2015. Elias Andersson and Gun Lidestav have carried out the research, with the help of organization-specific studies and interactive workshops on the strategic gender equality actions. The ambition was to develop an experience-based platform for gender equality innovation in the Swedish forestry sector. The interactive research approach of the project has formed new, both practical and theoretical, knowledge on the practice and implementation of gender equality in forestry. The complementary relations of the projects have developed not only the separate projects, but also the research field of forest-related gender studies and male-dominated industries - strengthening the knowledge-based gender equality measures in the forestry sector.

The organization specific studies involves analysis of the strategic policy documents of organizations in the sector, the forest preparatory year, student-, employee- and management-aimed educational measures, forest in the school, forest camp for girls, introductory course in forestry for girls, knowledge-driven gender equality work, and a web-based centre for information and exchange of knowledge based on experience. The three workshops that were held to further deepen the results of these separate studies, were structured based on three themes: to lead and guide with greater gender equality, to educate and recruit with greater gender equality, and to learn and do with greater gender equality.

The results of the project emphasise the challenges of contemporary gender equality measures and conceptualisation within the forestry sector. The separate studies of the project underline the limitations of the neoliberal discourse on gender equality. Their result reveals how the organizational measures are shaped by technologies and rationalities, i.e. through existing managerial frameworks and the present organisation structures, social relations and culture. The dominant framing of gender equality through economic and competitive incentives is shown, to restrict the development of gender equality and pose specific challenges and risks to the organizations. In the sector's drive to recruit women, the studies emphasise the essential implication of gender relations and division of labour of the present direction and measures. The project pushes the organizational need to learn from various forms of resistance and to engage in a transformative approach to gender equality at work, e.g. by challenging the fundamental structure and meanings of the forestry organizations.

The project has contributed to the joint perspective of the forestry sector on practical gender equality work. Together with other researchers within the field of gender studies in forest, the project published the popular scientific book *Den öppna skogen* (The open forest), based on the results and experiences of the present research. Since little is published in Swedish within this area, the book has met a good response both from the industry and the sector as whole.
Read more about the project: www.slu.se/jamstalldhetiskogsbrukssektorn

Text and figure: Elias Andersson, SLU.

International Forestry

Building an international student and teacher exchange in forest resource management

Background
Forestry is becoming increasingly multidisciplinary and globalized. The international debate on climate change, deforestation and the sustainable use, management and distribution of land and energy resources emphasizes the need for global perspectives within forestry and related sectors among students and staff.
To address that need, a teacher and student exchange program has been initiated by the Department. The collaboration partner is the Forest Research Institute (FRI), Deemed University, Dehradun, India. The engagement of FRI as a partner was based on the fact that it is the leading forestry university in one of the world's biggest and most rapidly developing nations with a long tradition in the management of forests and the environment. The long-term objectives of the co-operation are to strengthen the international dimension of forestry education in the activities of students and lecturers.
The program is funded through annual travel grants applied from the Swedish government and the Linnaeus Palme Foundation, while other costs and efforts are covered by the two partners. Following three years' preparations, the cooperation started in 2015/16 with a teacher exchange to be supplemented with a combined students and teachers exchange in the coming years. A continuous exchange over 5–9 years is foreseen.

Main administrative building at FRI campus.

Challenges of the co-operation
One aim of the program is to develop opportunities for students to study 3–6 months in regular courses of interest at the partner university within the frames of their graduate program at the home university. It requires that exchange courses are streamlined and acceptable to the home university and take place at a time of the year when, with regard to other courses, students have an opportunity to travel.
Exchange lecturers are expected to go for shorter visits of at least three weeks to teach at the partner university. Although this is an opportunity for teachers to gain new experience, it is also a challenge matching the time of the input with other commitments and identifying topics where the exchange teachers can contribute most.
The uncertainty of the success of annual applications is a challenge for planning by staff and students.
The co-operation is developed along with a framework set for the Linnaeus Palme educational exchange program. Therefore, scholarships are limited to department-to-department co-operation, although it also requires some involvement of the Faculty and other departments.

Current status
A package of regular courses identified as being of particular relevance, and the syllabuses for those courses have been adapted to suit the collaboration. The intention is that SLU forestry students will be invited to take two courses in India jointly with FRI students over a period of 3-6 months in the coming years. The course titles are People, Forest and Climate Change and Environmental Impact Assessment or optionally Natural Resource Management corresponding to a total of 15 ECTS. In addition, Master's students from FRI will attend the courses Remote Sensing and Forest Inventory and Sustainability Analysis at SLU, Umeå. The FRI students will stay for 15 weeks and be on their final semester also including thesis work. SLU and FRI teachers will be invited to contribute to some parts of those courses, giving lectures seminars and supervising students in their exercises and thesis work.

Field exercises involve interaction with local communities

Final remarks
There is mutual interest on the part of the partners to broaden collaboration also to involve research. Although research activities need to be developed separately from the educational exchange, the contact network established through the exchange program could provide a platform.

Mats Sandewall
Subject Area Manager

Staff
Ulf Söderberg

Text: Mats Sandewall, SLU.
Photos: Mats Sandewall, SLU. Esbjörn Andersson, SLU.

Environmental Monitoring and Assessment

Hans Gardfjell
Chairman
Environmental Monitoring and Assessment

SLU is unique among Swedish universities with its strong focus on environmental monitoring and assessment (Foma). The main objective of Foma is to provide accurate information on the condition of the environment to the Swedish government, national and regional government authorities, businesses, as well as NGO's and the public. Foma data are commonly also used in international reporting.

The Department has a long tradition of work in environmental analysis. The Swedish National Forest Inventory (NFI) started already in 1923 and the knowledge that has been developed during 90 years has given the Department a strong foundation in field methodology and survey sampling theory and a wide international network. Today the Department runs a wide array of Foma programs, and environmental monitoring and assessment is currently the largest activity at the Department.

The environmental monitoring and assessment at the Department consists of four main programs and several other projects. The programs are the Swedish National Forest Inventory (NFI), National Inventory of Landscapes in Sweden (NILS), Terrestrial Habitat Monitoring (THUF), and Forest Sustainability Analysis (SHa). These programs are all presented separataley in this report. Other projects include climate reporting, quality assessments of semi-natural grasslands and reindeer management planning.

One of the Department's strengths is the combination of research and environmental monitoring activities, leading to important synergistic effects. As an example, methods and models developed in research can be used in environmental monitoring and assessment activities. At the same time, data collected by Foma programs provide a unique and valuable source of information for different research projects. Even the connection between Foma and the Undergraduate and Master's studies is important, as it spreads knowledge about Foma activities and the basis of information used to make decisions about the sustainable use of the country's natural resources.

The Foma activities include data capture, analysis, reporting and communication with the responsible agencies and customers both within and outside of SLU. An important part of the environmental monitoring and assessment is a continual improvement of the methods and models used in order to improve the quality of the collected data, and to assure the quality of the whole process from data collection to finished product. Increased internationalization makes it even more important to follow and actively take part in international development by participating in conferences and national and international networks and projects.

The environmental monitoring and assessment at the Department consists of four main programs and several other projects. The programs are the Swedish National Forest Inventory (NFI), National Inventory of Landscapes in Sweden (NILS), Terrestrial Habitat Monitoring (THUF), and Forest Sustainability Analysis (SHa).

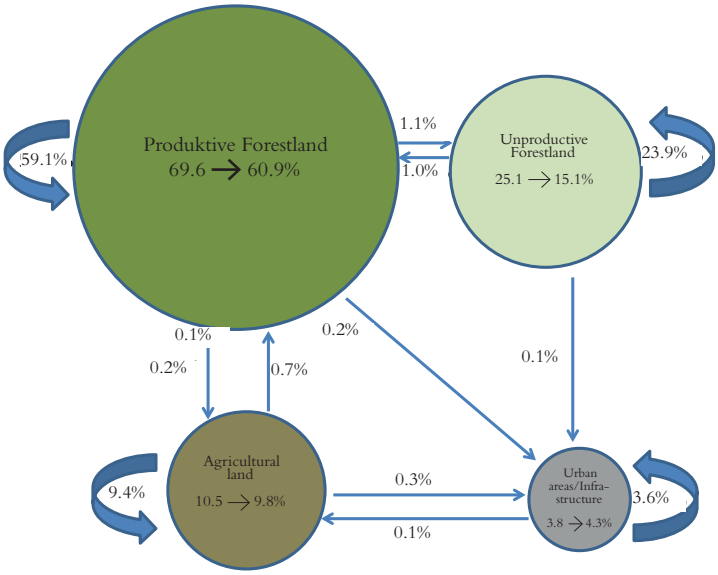
Text: Hans Gardfjell, SLU.
Photo: NILS field staff, SLU.

National Forest Inventory

Since the middle of the 1920s we have been able to follow the development of Sweden's forests through statistics from the Swedish National Forest Inventory (NFI). Since 1983 a combination of temporary and permanent sample plots has been used. The permanent sample plots have been resampled with a 5–10 year interval. Permanent sample plots (P-plots) improve the accuracy and broadens the applications of the Swedish NFI's data.

By using the information from P-plots when estimating change, the coefficient of variation is reduced by 50% and for estimates of status by approximately 20%. If P-plot data are combined with the stump data, the coefficient of variation for estimates of felled volume can be reduced by 25%. NFI's P-plots can also be used for analyzing the flow of areas between two points in time.

Registering data in a handheld computer on one of the Swedish NFI's permanent sample plots.



Landuse classes proportion of the total land area (circles) and the flow between this classes (arrows) during the period 1985-2010. Land areas excluding national parks, nature reserves and nature protection areas that are protected from forestry as of 2013. Total of all flows is 100%, only flows greater than 0.06% (22 000 ha) are shown in the figure.

Key points during 2015 at the Swedish NFI

- The Swedish Society for Nature Conservation is now represented on the NFI advisory board
- Pilot testing of expansion of the NFI to include mountain areas
- Official statistics published in May, four months earlier than previous years
- The new interactive analysis tool TaxWebb was launched in September
- Data from the NFI vital in two projects from the Swedish Forest Agency; "Skogliga grunddata" and "SKA 15"
- Moss sampling for the Swedish Museum of Natural History
- Extensive testing of new high-precision GPS receivers
- Leadership training for field team leaders
- Psychosocial survey of the field crews showed a high level of satisfaction, but there is potential for improvement in the area of equal opportunities
- Anton Grafström and Hans Petersson replaced Sören Holm and Göran Ståhl on the NFI board
- Patrik Norman was appointed unit leader of the NFI's IT Unit

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Program Manager

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Mikaela Asplund
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Jonas Dahlgren
Joakim Eriksson
Karl-Erik Grundberg
Mikael Holmlund
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Anders Lundström
Per Nilsson
Patrik Norman
Gunnar Odell
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Sören Wulff
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Text and figure: Neil Cory, SLU.
Photo: Ola Borin, SLU, Neil Cory, SLU.

National Inventory of Landscapes in Sweden

Multi-temporal inventory of landscape history using infrared aerial photos

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The program also uses other employees within the Department's subject areas and environmental monitoring and assessment programs.

Text and Figure:
Pernilla Christensen, SLU.

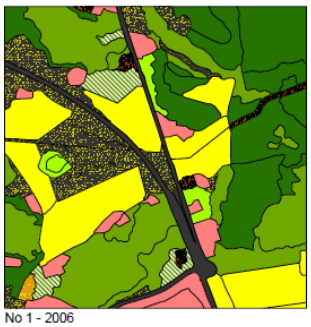
National Inventory of Landscapes in Sweden (NILS) is an environmental monitoring and assessment program that began in 2003 and covers the entire country by collecting landscape and environmental data related to natural changes and the impact of land use on biodiversity and natural and cultural values. NILS uses both aerial-photo interpretation and field surveys to collect data.

During the summer of 2015, NILS surveyed 122 squares in the field. Both sample plots and line intersects were monitored. In the aerial-photo inventory, NILS went all the way back to the 1980s. By using older aerial photos in colour infrared, the detailed square of 1 km x 1 km was inventoried. The focus was put on the agricultural landscape, including farmed fields, meadows and pastures for grazing; both actively managed and abandoned pastures and fields in successive stages of regrowth towards forest. Focus was also put on other areas that have been altered by human management, such as roads, railroads and different types of the built environment. The major part of Sweden including the mountain region was inventoried. With the inventory of the 1980s, the time series is now extended back in time, which enables us to compare the 1980s with data collected 2003–2007. Paralel to the detailed inventory of the inner square we have been developing ideas on data collection of the landscape square (5 km x 5 km). In 2015, this work has consisted of taking part in a project at Metria (in Stockholm) financed by European Space Agency, called CadasterENV, aiming at creating a map layer of land cover, using satellite data and several ancillary data sources, such as the national laser scanning data and reference data from NILS and the Swedish National Forest Inventory. The NILS program is also an active partner in a project entitled the Biotope Map, using a refinement of CadasterENV. The Biotope Map project is managed through collaboration between SLU, Stockholm University and the County Administrative Board of Stockholm and several municipalities (i.e. Umeå and a number of municipalities within the county of Stockholm).

The collected data are imported into a database (NILSbas). In 2015, work has been done on importing field data from 2014 and 2015 and then testing and correcting the data. Database views make analysing easier and provide a good platform for further analyses. The goal for the analysis part of NILS is to develop indicators that can be used to follow up the national environmental objectives set by the Swedish Environmental Protection Agency (EPA) and to compile it in a report that will be published in 2016.

Some results during this year based on data from NILS:

- Semi-natural grasslands show a decline when comparing aerial photos from the1980s with 2003–2007
- As a measure of regrowth of open agricultural landscape to forest, every third stone wall today lies inside the forest, compared with being found at the border between forest and open land or out in open areas earlier
- Pastureland for horse grazing has increased, and land used for the grazing of cows has decreased
- As a measure of Green infrastructure, coherent areas with tree cover over 30% with and without mechanized forestry have been estimated. Patch sizes of forest with large-scale mechanized forestry, increase in size from south to north in Sweden. Patch sizes of forest without large-scale mechanized forestry measures are between 0.5 – 1.5 ha, except in the mountainous region where sizes are at 7.1 ha
- Vehicle tracks from motorbikes, four-wheelers (quads) and snowmobiles have increased over a 5-year period



To enhance the dialogue between stakeholders and other environmental monitoring programs a Stakeholder group was established. Two meetings were held in 2015 (March and September), attended by the Board of Agriculture, the Swedish EPA, the county administrative boards, "Regional miljöövervakning i landskapsrutor", NILS, Terrestrial habitat monitoring and "Kvalitetsuppföljningen av ängs- och betesmarker".

Terrestrial Habitat Monitoring

The EU Habitats Directive can be seen as the foundation of the European Union's nature conservation policy. The aim of the directive is to protect habitats and species of European community interest, and it states that every member state shall undertake surveillance of the conservation status of habitats and species. As a response, the program Terrestrial Habitat Monitoring (THUF) was initiated in 2006 with the aim to develop efficient methods for monitoring and assessment of terrestrial habitats of high conservation status and later also organizing necessary data collection, analysis and reporting.

The Swedish National Forest Inventory (NFI) and National Inventory of Landscapes in Sweden (NILS) are two on-going programs at the Department that already collects data on coverage and status of terrestrial habitats. In 2008, additional habitat variables were included in these programs and assessment shows that the Swedish NFI and NILS are both able to deliver accurate habitat information on common habitats. However, for less abundant habitat types the precision is too low to fulfil the reporting requirements.

The Life+ project, Monitoring of Terrestrial Habitats (MOTH), was a collaboration between SLU and the Swedish Environmental Protection Agency (EPA). The objective of the project was to develop and demonstrate a fully functional monitoring programme including all necessary steps; sampling design, data collection, data management, analysis and reporting. The project developed two novel habitat surveys targeting sparse habitats based on two-phase sampling methodology. The project also developed and tested methods for combining estimates from several data sources. The project was financed by the European Commission, Swedish EPA and SLU. The full name of the project is Demonstration of an integrated North-European system for monitoring terrestrial habitats, and the project code is LIFE08 NAT/S/000264. The project started in January 2010 and ended in December 2014. The total budget was 4.8 million Euros. More information is available at the project home page http://www.slu.se/moth. The final report was delivered to the European commission in March 2015.

The seashore habitat inventory will resume again during 2015 with a slightly modified design. The inventory was initially developed and demonstrated during two field seasons in the Life+ MOTH project. The inventory is focused on the terrestrial parts of the Swedish marine shores. The survey was based on 260 sample units (5.0 km x 2.5 km) randomly placed along the Swedish marine coastline. A hexagonal grid was placed over an aerial photograph of each sample unit, and a photo interpreter scrutinized every intersection between the grid and shoreline and made a rough classification of the habitat based on substrate, vegetation, degree of exploitation, etc. Points likely to represent interesting habitat types are later randomly selected for field surveys. At each selected point, field workers placed a 10 m wide transect across the shore. Habitats are classified, and variables such as land use, plant species and marine debris were noted. When the data from all points are compiled, the total area of shore habitats can be calculated and their overall conservation status can be assessed.

Pasque flower.

Hans Gardfjell
Project Leader

Staff
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Helena Forsman
Henrik Hedenås
Åsa Hagner

The program also uses other employees within the Department's subject areas and environmental monitoring and assessment programs.

External collaborators: Gudrun Norstedt, Henrik Weibull, Johan Abenius and Conny Jacobson.

Text: Hans Gardfjell, SLU.
Photo: NILS field staff, SLU.

Forest Sustainability Analysis

Long-term landscape-level projections of forest development on NILS sample squares

Tomas Lämås
Program Manager

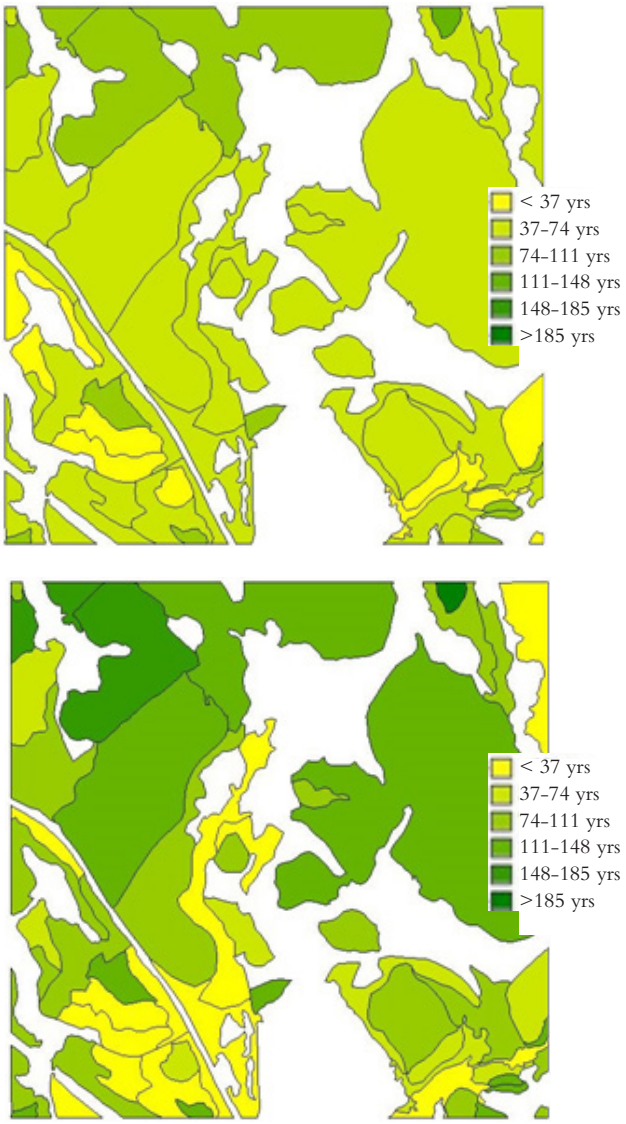
Staff
Mona Bonta Bergman
Hampus Holmström
Anders Lundström
Peder Wikström
Karin Öhman

The program Forest Sustainability Analysis is a leading actor providing the target group with decision support tools and analyses related to long-term forest resource development including the production of goods and services.

Text and Figures:
Tomas Lämås, SLU.

For natural resource management, long-term monitoring is of great importance. Besides such monitoring, projections and scenario analyses are, though, of equal importance. The Department runs a couple of large-scale monitoring programs of forests and landscapes. The Swedish National Forest Inventory (NFI) is a sample plot-based field survey providing detailed information on Swedish forests. As it started in the 1920s, it shows long-term (historical) forest development. The NFI is based on a systematic sample of fairly small sample plots, with a plot radius of 7–10 m. The small plot size makes it hard to consider spatial aspects in analyses, such as forest fragmentation. The role of landscapes (whether outstanding or of ordinary character, as well as every day or degraded) for achieving a sustainable future is frequently recognized as expressed in, for example, the European Landscape Convention. At the Department, landscape level monitoring is performed of the program for the National Inventory of Landscapes in Sweden (NILS). The inventory is based on aerial-photo interpretation of 1 km x 1 km permanent sample landscapes systematically located all over Sweden (n=631) and a field survey with twelve sample plots and twelve line transects within the 1 km x 1 km square.
Data from the NFI have for decades been used as the basis for long-term forest scenario analysis like the recently performed Forest Impact Analyses 2015 ("SKA 15"). For management and policy-making, projections and scenario analysis of entire landscapes are of interest, contrary to projections based on the small size sample plots used in "SKA 15".

In 2014-2015, a Foma Skog funded project at the Department studied the possibilities of making projections of forests within NILS sample squares. In the study, 41 NILS squares within Västerbotten were used. The squares contained in total 2045 stands on productive forest land delineated in the ordinary NILS aerial-photo interpretation. Site data (e.g. vegetation type) and tree layer data (e.g. mean tree height) were also provided from the photo interpretation. Data were then imported to Heureka PlanWise (RegWise, the Heureka software used in "SKA 15", could have been used as well) and forest development within the sample squares was then projected for a 100-year period. The approach makes it possible to study, for example, the fragmentation and isolation of old or deciduous rich forests, and whether or not key habitats and set asides will in some periods be isolated in a landscape dominated by young forests. In forthcoming studies, it is of interest to combine data from NILS and the basic forest data ("Skogliga grunddata") that is based on NFI data and the nationwide airborne laser scanning performed by "Lantmäteriet" (Swedish Mapping, Cadastral and Land Registration Authority). Another potential data source is future versions of the nationwide forest map *k*NN Sweden that probably will be based on airborne laser scanning as well as on satellite data. A problem noted in the performed study was the estimation of initial stand age which might pose a problem also in the future. Project leader: Tomas Lämås (SHa)
Project participants: Saskia Sandring (NILS) and Hampus Holmström (SHa)



Thematic maps of stand age in year 2020 (top) and 2070 (bottom) in a certain scenario of a NILS sample square. Projection made by PlanWise, a software within the Heureka suite of forest analysis and planning tools.

Environmental Management System

Integration of the Department's goals and environmental goals

Dianne Staal Wästerlund
Co-ordinator

During 2015 we worked with our own environmental management system while at the same time assisting SLU with the development of a system that will cover the departments at SLU in Umeå as well as the field stations of the Faculty of Forest Sciences. For the work in our own system we were highly commended by the auditor for integrating the system in our daily work. Our measurements showed that we continue to meet our goals except for traveling by air. The development of an environmental management system for SLU in Umeå according to the new ISO 14001 standard adopted in 2015, progressed during the year and is expected to result in a certification in the spring of 2016. The Department will join this new system.

Text: Dianne Staal Wästerlund, SLU.
Photos: Viktor Wrange, SLU.

Publications

The publication list below includes work that was published during 2015. The publications are presented for each of the Department's subject areas and environmental monitoring and assessment programs separately. Peer reviewed scientific articles are listed first followed by proceedings, book chapters and reports. In the end of the publication list, articles in popular science are listed.

Remote Sensing

Scientific Articles

- Eysn, L., Hollaus, M., Lindberg, E., Berger, F., Monnet, J-M., Dalponte, M., Kobal, M., Pellegrini, M., Lingua, E., Mongus, D. and Pfeifer, N. 2015. A benchmark of lidar-based single tree detection methods using heterogeneous forest data from the alpine space. Forests, vol. 6, no. 5, pp. 1721-1747.
- Gilichinsky, M., Demidov, N. and Rivkina, E. 2015. Morphometry of volcanic cones on Mars in perspective of astrobiological research. International Journal of Astrobiology, vol. 14, no. 4, pp. 537-545.
- Granholm, A-H., Olsson, H., Nilsson, M., Allard, A. and Holmgren, J. 2015. The potential of digital surface models based on aerial images for automated vegetation mapping. International Journal of Remote Sensing, vol. 36, no. 7, pp. 1855-1870.
- Karlson, M., Ostwald, M., Reese, H., Sanou, J., Tankoano, B. and Mattsson, E. 2015. Mapping tree canopy cover and aboveground biomass in Sudano-Sahelian woodlands using Landsat 8 and Random Forest. Remote Sensing, vol. 7, pp. 10017-10041.
- Lindberg, E., Roberge, J-M., Johansson, T. and Hjältén, J. 2015. Can airborne laser scanning (ALS) and forest estimates derived from satellite images be used to predict abundance and species richness of birds and beetles in boreal forest? Remote Sensing, vol. 7, no. 4, pp. 4233-4252.
- Lindgren, N., Christensen, P., Nilsson, B., Åkerholm, M., Allard, A., Reese, H. and Olsson, H. 2015. Using optical satellite data and airborne lidar data for a nationwide sampling survey. Remote Sensing, vol. 7, no. 4, pp. 4253-4267.
- Nyström, M., Lindgren, N., Wallerman, J., Grafström, A., Muszta, A., Nyström, K., Bohlin, J., Willén, E., Fransson, J.E.S., Ehlers, S., Olsson, H. and Ståhl, G. 2015. Data assimilation in forest inventory: First empirical results. Forests, vol. 6, no. 12, pp. 4540-4557.
- Reese, H., Nordkvist, K., Nyström, M., Bohlin, J. and Olsson, H. 2015. Combining point clouds from image matching with SPOT 5 multispectral data for mountain vegetation classification. International Journal of Remote Sensing, vol. 36, no. 2, pp. 403-416.
- Santoro, M., Beaudoin, A., Beer, C., Cartus, O., Fransson, J.E.S., Hall, R.J., Pathe, C., Schmullius, C., Schepaschenko, D., Schvidenko, A., Thurner, M., Wegmüller, U. 2015. Forest growing stock volume of the northern hemisphere: Spatially explicit estimates for 2010 derived from Envisat ASAR. Remote Sensing of Environment, vol. 168, pp. 316-334.
- Santoro, M., Eriksson, L.E.B and Fransson, J.E.S. 2015. Reviewing ALOS PALSAR backscatter observations for stem volume retrieval in Swedish forest. Remote Sensing, vol. 7, no. 4, pp. 4290-4317.
- Solberg, S., Gizachew, B., Naesset, E., Gobakken, T., Bollandsås, O.M., Mauya, E.W., Olsson, H., Malimbwi, R. and Zahabu, E. 2015. Monitoring forest carbon in a Tanzanian woodland using interferometric SAR: A novel methodology for REDD+. Carbon Balance and Management, vol. 10, no. 14, pp. 1-14.
- Soja, M.J., Persson, H. and Ulander, L. M.H. 2015. Estimation of forest biomass from two-level model inversion of single-pass InSAR data. IEEE Geoscience and Remote Sensing Letters, vol. 53, no. 9, pp. 5083-5099.
- Soja, M.J., Persson, H. and Ulander, L.M.H. 2015. Estimation of forest height and canopy density from a single InSAR correlation coefficient. IEEE Transactions on Geoscience and Remote Sensing, vol. 12, no. 3, pp. 646-650.
- Soja, M.J., Persson, H. and Ulander, L.M.H. 2015. Corrections to estimation of forest biomass from two-level model inversion of single-pass InSAR data. IEEE Geoscience and Remote Sensing Letters, vol. 53, no. 10, pp. 5795-5795.

Proceedings

- Bohlin, J., Blombäck, J., Wallerman, J. and Fransson, J.E.S. 2015. Updating the National Forest Attribute Map using stereo matching of aerial images, the national terrain model and data from the National Forest Inventory. Proc. SilviLaser 2015: 14th Conference on Lidar Applications for Assessing and Managing Forest Ecosystems, La Grande Motte, France, 28-30 September, 2015.
- Granholm, A-H., Lindgren, N., Olofsson, K., Allard, A. and Olsson, H. 2015. Estimating vertical canopy cover with dense point cloud data from matching of digital aerial photos. Proc. the 35th EARSeL Symposium European Remote Sensing: Progress, Challenges and Opportunities, Stockholm, Sweden, 15-19 June, 2015.
- Holmgren, J., Olofsson, K., Nyström, M. and Olsson, H. Estimation of tree stem attributes using ground based and airborne laser scanning. Proc. SilviLaser 2015: 14th Conference

on Lidar Applications for Assessing and Managing Forest Ecosystems, La Grande Motte, France, 28-30 September, 2015..

- Lindberg, E., Roberge, J-M., Johansson and T., Hjältén, J. 2015. Does detailed vegetation structure derived from airborne laser scanning (ALS) contribute to prediction of abundance and species richness of birds and beetles in boreal forest? Proc. IUFRO Landscape Ecology Conference 2015 Book of Abstracts, IUFRO-LE WG Conference, Tartu, Estonia, 2015.
- Lindberg, E., Roberge, J-M., Johansson, T., Hollaus, M., Holmgren, J., Hjältén, J. 2015. Individual tree properties from ALS data as input to habitat analysis in boreal forest. Proc. SilviLaser 2015: 14th Conference on Lidar Applications for Assessing and Managing Forest Ecosystems, La Grande Motte, France, 28-30 September, 2015.
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- Nilsson, M., Nordkvist, K., Jonzén, J., Lindgren, N., Axensten, P., Wallerman, J., Egberth, M., Larsson, S. and Nilsson, L. 2015. A nationwide forest attribute map of Sweden derived using airborne laser scanning data and field data from the national forest inventory. Proc. SilviLaser 2015: 14th Conference on Lidar Applications for Assessing and Managing Forest Ecosystems, La Grande Motte, France, 28-30 September, 2015.
- Nyström, M., Lindgren, N., Wallerman, J., Grafström, A., Muszta, A., Nyström, K., Ståhl, G. and Olsson, H. 2015. Data assimilation in forest inventory, first empirical results using ALS data. Proc. SilviLaser 2015: 14th Conference on Lidar Applications for Assessing and Managing Forest Ecosystems, La Grande Motte, France, 28-30 September, 2015.
- Nyström, M., Lindgren, N., Wallerman, J., Ehlers, S., Grafström, A., Muszta, A., Nyström, K., Willén, E., Fransson, J.E.S., Bohlin, J., Olsson, H. and Ståhl, G. 2015. Assimilating remote sensing data with forest growth models. Proc. the 35th EARSeL Symposium European Remote Sensing: Progress, Challenges and Opportunities, Stockholm, Sweden, 15-19 June, 2015.
- Persson, H. and Fransson, J.E.S. 2015. Analysis of tree height growth with TanDEM-X data. Proc. the 35th EARSeL Symposium European Remote Sensing: Progress, Challenges and Opportunities, Stockholm, Sweden, 15-19 June, 2015.
- Persson, H., Soja, M.J., Ulander, L.M.H. and Fransson, J.E.S. 2015. Detection of thinning and clear-cuts using TanDEM-X data. Proc. IGARSS 2015, IEEE International Geoscience and Remote Sensing Symposium, Milan, Italy, 26-31 July, 2015.
- Persson, H., Fransson, J.E.S. and Nilsson, M. 2015. Storskalig kartering av virkesförråd med radarinterferometri, Fjärranalysdagarna, Stockholm, Sweden, 25 September, 2015.
- Soja, M.J., Persson, H. and Ulander, L.M.H. 2015. Detection of forest change and robust estimation of forest height from two-level model inversion of multi-temporal, single-pass InSAR data. Proc. IGARSS 2015, IEEE International Geoscience and Remote Sensing Symposium, Milan, Italy, 26-31 July, 2015.
- Wallerman, J., Nyström, K., Bohlin, J., Persson, H., Soja, M.J. and Fransson, J.E.S. 2015. Estimating forest age and site productivity using time series of 3D remote sensing data Proc. IGARSS 2015, IEEE International Geoscience and Remote Sensing Symposium, Milan, Italy, 26-31 July, 2015.

Forest Inventory and Empirical Ecosystem Modeling

Scientific Articles

- Berg, S., Valinger, E., Lind, T., Suominen, T. and Tuomasjukka, D. 2015. Comparison of co-existing forestry and reindeer husbandry value chains in northern Sweden. Silva Fennica, vol. 50, no. 1, pp. 1384.
- Ramezani, H. and Holm, S. 2015. Sample-based estimation of "contagion metric" using line intersect sampling method (LIS). Landscape and Ecological Engineering, vol. 11, no. 2, pp. 239-248.
- Ramezani, H. and Ramezani, F. 2015. Potential for the wider application of national forest inventories to estimate the contagion metric for landscapes. Environmental Monitoring and Assessment, vol. 187, no. 3, pp. 1-7.
- Saarela, S., Grafström, A., Ståhl, G., Kangas, A., Holopainen, M., Tuominen, S., Nordkvist, K. and Hyyppä, J. 2015. Model-assisted estimation of growing stock volume using different combinations of LiDAR and Landsat data as auxiliary information. Remote Sensing of Environment, vol. 158, pp. 431-440.
- Saarela, S., Schnell, S., Grafström, A., Tuominen, S., Nordkvist, K., Hyyppä, J., Kangas, A. and Ståhl, G. 2015. Effects of sample size and model form on the accuracy of model-based estimators of growing stock volume. Canadian Journal of Forest Research, vol. 45, no. 11, pp. 1524-1534.
- Schnell, S., Altrell, D., Ståhl, G. and Kleinn, C. 2015. The contribution of trees outside forests to national tree biomass and carbon stocks-a comparative study across three continents. Assessment of contaminant levels and trophic relations at a World Heritage Site by measurements in a characteristic shorebird species.

Environmental Monitoring and Assessment, vol. 187, no. 1, pp. 1-18.

- Schnell, S., Kleinn, C. and Ståhl, G. 2015. Monitoring trees outside forests: A review. Environmental Monitoring and Assessment, vol. 187, no. 9, pp. 1-17.

Report

- Lundblad, M., Karltun, E., Petersson, H., Wikberg, P-E. and Lindgren, A. 2015. Land use, land-use change and forestry (CRF sector 4). National Inventory Report Sweden 2015: Greenhouse Gas Emission Inventories 1990-2013. United Nations Framework Convention on Climate Change and the Kyoto Protocol, pp. 326-364.

Forest Planning

Scientific Articles

- Biber, P., Brukas, V., Trubins, R., Wallin, I., Sallnäs, O. and Eriksson L.O. 2015. How sensitive are ecosystem services in European forest landscapes to silvicultural treatment? Forests, vol. 6, no. 5, pp. 1666-1695.
- Carlsson, J., Eriksson, L.O., Öhman, K. and Nordström, E-M. 2015. Combining scientific and stakeholder knowledge in future scenario development - A forest landscape case study in northern Sweden. Forest Policy and Economics, vol. 61, pp. 122-134.
- Eggers, J., Holmström, H., Lämås, T., Lind, T. and Öhman, K. 2015. Accounting for a diverse forest ownership structure in projections of forest sustainability indicators. Forests, vol. 6, no. 11, pp. 4001-4033.
- Lämås, T., Sandström, E., Jonzén, J., Olsson, H. and Gustafsson, L. 2015. Tree retention practices in boreal forests: What kind of future landscapes are we creating? Scandinavian Journal of Forest Research, vol. 30, no. 6, pp. 526-537.
- Nordström, E-M., Dolling, A., Skärbäck, E., Grahn, P., Stoltz, J. and Lundell, Y. 2015. Forests for wood production and stress recovery: Trade-offs in long-term forest management planning. European Journal of Forest Research, vol. 134, no. 5, pp. 755-767.
- Roberge, J-M., Lämås, T., Lundmark, T., Ranius, T., Felton, A. and Nordin, A. 2015. Relative contributions of set-asides and tree retention to the long-term availability of key forest biodiversity structures at the landscape scale. Journal of Environmental Management, vol. 154, pp. 284-292.
- Saad, R., Wallerman, J. and Lämås, T. 2015. Estimating stem diameter distributions from airborne laser scanning data and their effects on long term forest management planning. Scandinavian Journal of Forest Research, vol. 30, no. 2, pp. 186-196.
- Vacik H., Borges, J.G., Garcia-Gonzalo, J. and Eriksson, L. O. 2015. Decision support for the provision of ecosystem services under climate change: An editorial. Forests, vol. 9, no. 6, pp. 3212-3217.

Mathematical Statistics Applied to Forest Sciences

Scientific Articles

- Grafström, A. and Matei, A. 2015. Co-ordination of conditional poisson samples. Journal of Official Statistics, vol. 31, no. 4, pp. 649-672.
- Karlsson, L., Nyström, K., Bergström, D. and Bergsten, U. 2015. Development of Scots pine stands after first biomass thinning with implications on management profitability over rotation. Scandinavian Journal of Forest Research, vol. 30, no. 5, pp. 416-428.
- Pommerening, A. and Muszta, A. 2015. Methods of modelling relative growth rate. Forest Ecosystems, vol. 2, no. 1, pp. 1-9.

Book Chapter

- Pommerening, A. 2015. Handbook of Spatial Point-Pattern Analysis in Ecology. Edited by Wiegand, T. and Moloney, K.A. (2014). In Biometrical Journal vol. 2, no. 57, pp. 360-361.

Forest in Rural Studies and International Forestry

Scientific Articles

- Appelstrand, M. and Lidestav, G. 2015. Women entrepreneurship - A shortcut to a more competitive and equal forestry sector? Scandinavian Journal of Forest Research, vol. 30, no. 3, pp. 226-234.
- Keskitalo, C., Legay, M., Marchetti, M., Nocentini S. and Spathelf, P. 2015. The role of forestry in national climate change adaptation policy: Cases from Sweden, Germany, France and Italy. International Forestry Review, vol. 1, no. 17, pp. 30-42.
- Ottander, C., Wilhelmsson, B., Lidestav, G. 2015. Teachers intentions for outdoor learning: A characterisation of teachers objectives and actions. Teaching and Educational Research, vol. 13, no. 2, pp. 208-230.
- Poudyal, M., Lidestav, G., Sandström, P. and Sandström, S. 2015. Supporting community governance in boreal forests by introducing participatory GIS through Action Research. International Journal of Action Research, vol. 11, no. 3, pp. 236-264.
- Sandewall, M., Kassa H., Wu, S., Khoa, P.V., He, Y. and Ohlsson, B. 2015. Policies to promote household based plantation forestry and their impacts on livelihoods and the environment: Cases from Ethiopia, China, Vietnam and Sweden. International Forestry Review, vol. 17, no. 1, pp. 98-111.
- Skarin, A., Nellemann, C., Rönnegård, L., Sandström, P. and Lundqvist, H. 2015. Wind farm construction impacts reindeer migration and movement corridors. Landscape Ecology, vol. 30, no. 8, pp. 1527-1540.

Proceedings

- Lidestav, G., Ni, D.A. and Karppinen, H. 2015. Forest owner types in Europe: Diversity and trends. Proc. Mid-term Proceedings of the COST Action FP1201 Forest Land Ownership. Changes in Europe: Significance for Management and Policy, Vienna, Austria.

Book Chapter

- Sandewall, M. and Sahilu, M.G. 2015. An approach for assessing changes of forest land use, their drivers, and their impact to society and environment. Precious Forests - Precious Earth, pp. 259-277.

Reports

- Andersson, E. and Lidestav, G. 2015. Jämställdhet som branschgemensam strategi i skogsbrukssektorn 2013-2015. Arbetsrapport, Sveriges lantbruksuniversitet, Institutionen för skoglig resurshushållning, vol. 444.
- Lidestav, G., Lind, T., Appelstrand, M., Keskitalo, C., Westin, K. and Wilhelmsson, E. 2015. Forest land ownership change in Sweden. COST Action FP1201 Country Report.

National Forest Inventory

Reports

- Claesson, S., Duvemo, K., Lundström, A. and Wikberg, P-E. 2015. Skogliga konsekvensanalyser 2015 - SKA 15. Rapport 10:2015, Skogsstyrelsen.
- Eriksson, H., Fahlvik, N., Freeman, M., Fries, C., Jönsson, A.M., Lundström, A., Nilsson, U. and Wikberg, P-E. 2015. Effekter av ett förändrat klimat - SKA 15. Rapport 12:2015, Skogsstyrelsen.
- Nilsson, P., Cory, N., Kempe, G. and Fridman, J. 2015. Skogsdata 2015. Aktuella uppgifter om de svenska skogarna från Riksskogstaxeringen. Tema: Riksskogstaxeringens permanenta provytor.
- Wulff, S. 2015. Nationell riktad skogsskadeinventering (NRS) 2015. Arbetsrapport, Sveriges lantbruksuniversitet, Institutionen för skoglig resurshushållning, vol. 447.

National Inventory of Landscapes in Sweden

Scientific Articles

- Gao, T., Busse, Nielsen, A. and Hedblom, M. 2015. Reviewing the strength of evidence of biodiversity indicators for forest ecosystems in Europe. Ecological Indicators, vol. 57, pp. 420-434.
- Hübener, T., Adler, S., Werner, P., Schwarz, A. and Dreßler, M. 2015. Identifying reference conditions for dimictic north German lowland lakes: Implications from paleoecological studies for implementing the EU-Water Framework Directive. Hydrobiologia, vol. 742, no. 1, pp. 295-312.
- Ignatieva, M., Ahrné, K., Wissman, J., Eriksson, T., Tidåker, P., Hedblom, M., Kätterer, T., Marstorp, H., Berg, P., Ericsson, T. and Bengtsson, J. 2015. Lawn as a cultural and ecological phenomenon: A conceptual framework for transdisciplinary research. Urban Forestry & Urban Greening, vol. 14, no. 2, pp. 383-387.

Reports

- Christensen, P., Eriksson, Å.I. and Sandring, S. 2015. Jordbrukslandskapet. Arbetsrapport, Sveriges lantbruksuniversitet, Institutionen för skoglig resurshushållning, vol. 445.
- Fredman, P. and Hedblom, M. 2015. Friluftsliv 2014: Nationell undersökning om svenska folkets friluftsvanor. Naturvårdsverket rapport 6691, Friluftsliv 2014.

Popular Science

- Aronsson, M., Gardfjell, H. and Sjödin, M. 2015. Serpentinfloran i Tärnaby - endemiskt växtsamhälle hotat av gruvnäring. Fauna och flora, vol. 2, no. 110, pp. 12-24.
- Hedenås, H., Christensen, P. and Svensson, J. 2015. Det föränderliga fjällandskapet. Skog & mark 2015: Om tillståndet i svensk landmiljö, pp. 4-8.
- Jougda, L., Sandström, P., Sandström, S., Svensson, J. and Hedenås, H. 2015. Samebyarnas renbruksplaner bidrar till miljöövervakning. Skog & mark, pp. 28-31.
- Lundell, Y., Dolling, A., Nordström, E-M., Stoltz, J., Skärbäck, E., Van den Bosch, M. and Grahn, P. 2015. Rehabiliteringsskog och virkesproduktion: går de att kombinera? Fakta Skog, no. 6, SLU.
- Lämås, T., Roberge, J-M., Felton, A., Gustafsson, L., Jonzén, J., Lundmark, T., Nordin, A., Olsson, H., Ranius, T. and Sandström, E. 2015. Generell naturhänsyn och frivilliga avsättningar - mängden död ved och grova träd ökar i framtidens skogslandskap. Fakta Skog no. 10, SLU.
- Persson, H., Soja, M.J., Olsson, H. and Fransson, J.E.S. Satellitbaserade 3D-data till hjälp för skogliga skattningar. Fakta Skog, no. 1, SLU.
- Pommerening, A., Vítková, L., Zhao, X. and Pallares, R.C. 2015. Towards understanding human tree selection behaviour. Fakta Skog no. 9, SLU.
- Schroeder, M., Kärvemo, S. and Wulff, S. 2015. Ny kunskap om skaderisker. Skogseko, no. 3, pp. 15-15.
- Schroeder, M. and Wulff, S. 2015. Ökade barkborreskador i norra Sverige. Skogseko, no. 4, pp. 23-23.

Field Staff

Every year the Department organizes and implements extensive inventories of forests and landscapes in Sweden. To carry out this work a number of field workers are employed.

National Forest Inventory

Leif Andersson
Tommy Andersson
Axel Bengtsson
Lars Bengtsson
Albin Bergstedt
Johan Bergstedt
Pär Blomqvist
Ola Borin
Åke Bruhn
Stefan Callmer
Fiona Campbell
Bert Carlström
Jenny Dahl
Göran Dahlström
Hans Davidsson
Lars Davidsson
Adam Ekholm
Olof Enarsson
Christofer Engberg Hydén
Elisabet Gregersen
Bo Hansson
Jesper Hansson
Anders Henriksson
Lennart Ivarsson
Carl Jansson
Daniel Johansson
Fredrik Johansson
Johansson Linnéa
Mats Jonasson
Johan Kahlman
Bo Karlsson
Martin Karlsson
Anton Larsson
Otto Larsson
Ann-Sofie Lindén
Magnus Lindström
Juha Loenberg
Jonas Muntlin
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Charlotte Olofsson
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Mikael Rasmusson
Martina Saldner
Henrik Salo
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Jerk Sjöberg
Bernt Svensson
Ola Tjernberg
Sixten Walheim
Jonas Vesterlund
Linda Vikström
Staffan Williamsson
Fredrik Winterås
Sören Wulff
Hailu Zelleke

National Inventory of Landscapes in Sweden

Adrian Andersson Nyberg
Liza Andersson
Ylva Asklöf
Torun Bergman
Markus Engvall
Sofia Fast Emilsson
Sofie Fröberg
Björn Gunnarsson
Lisa Federsel
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Frida Nettelbladt
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Mikael Olofsson
Elisabet Ottosson
Jesper Paulsson
Andreas Press
Emma Sandler Berlin
Fredrik Schaerström
Anna Tauson
Albert Tunér
Johanna Yourstone

Histtax-project

Erik Fernholm
Adam Dahlén
Mari Nilsson
Örjan Norling
Kent Stenman
Anita Tillberg

Special Events

Per Nilsson traditionally nails Skogsdata to the plank. The theme 2015 was the National Forest Inventory permanent sample plots. Jonas Dahlgren is helping him.

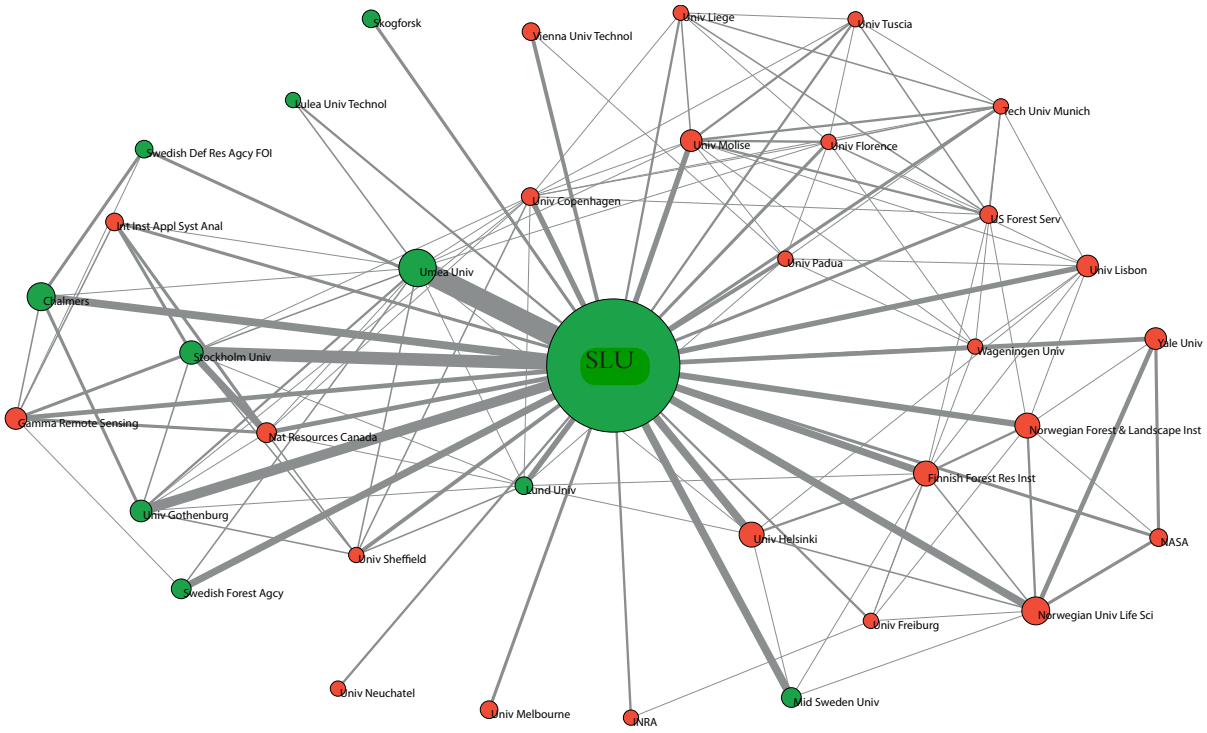
Gun Lidestav were honored in a special celebration for employees that have served the government for 30 years.

Thomas Kronholm defending his doctoral thesis: Forest owners´ associations in a changing society.

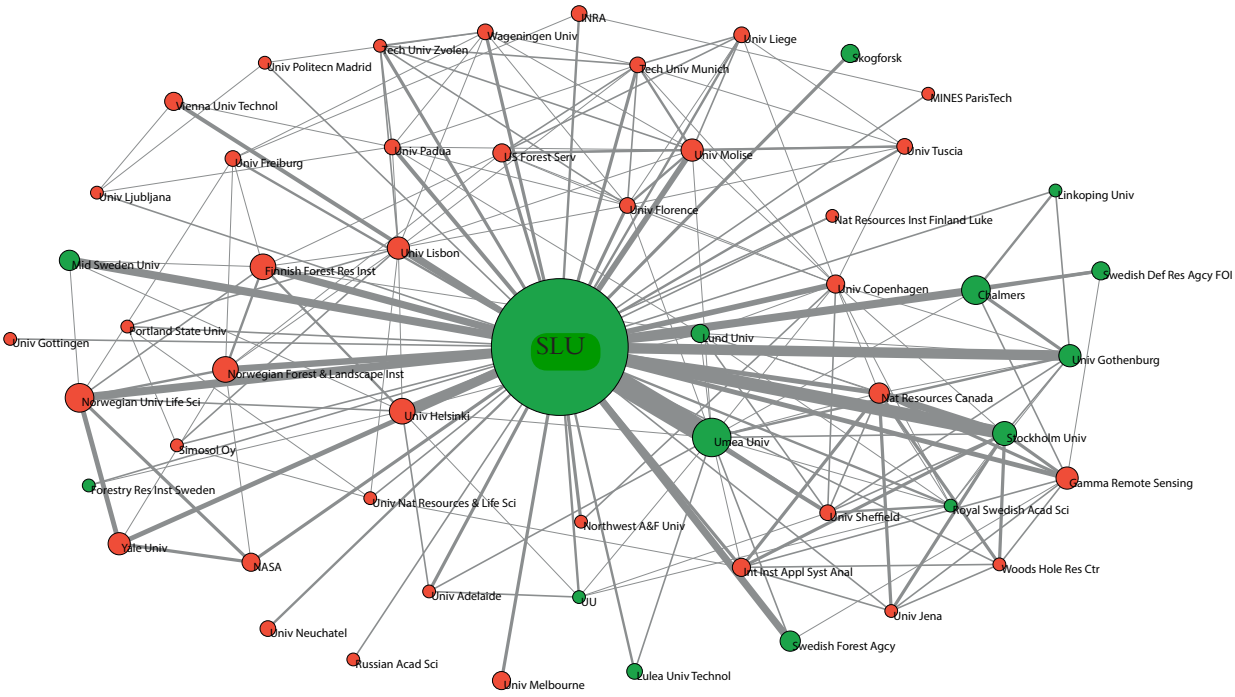
Ulf Söderberg retired from the Department after serving SLU for more than 30 years.

Text: Johan Fransson, SLU.
Photos: Employees at the Department of Forest Resource Management, SLU.

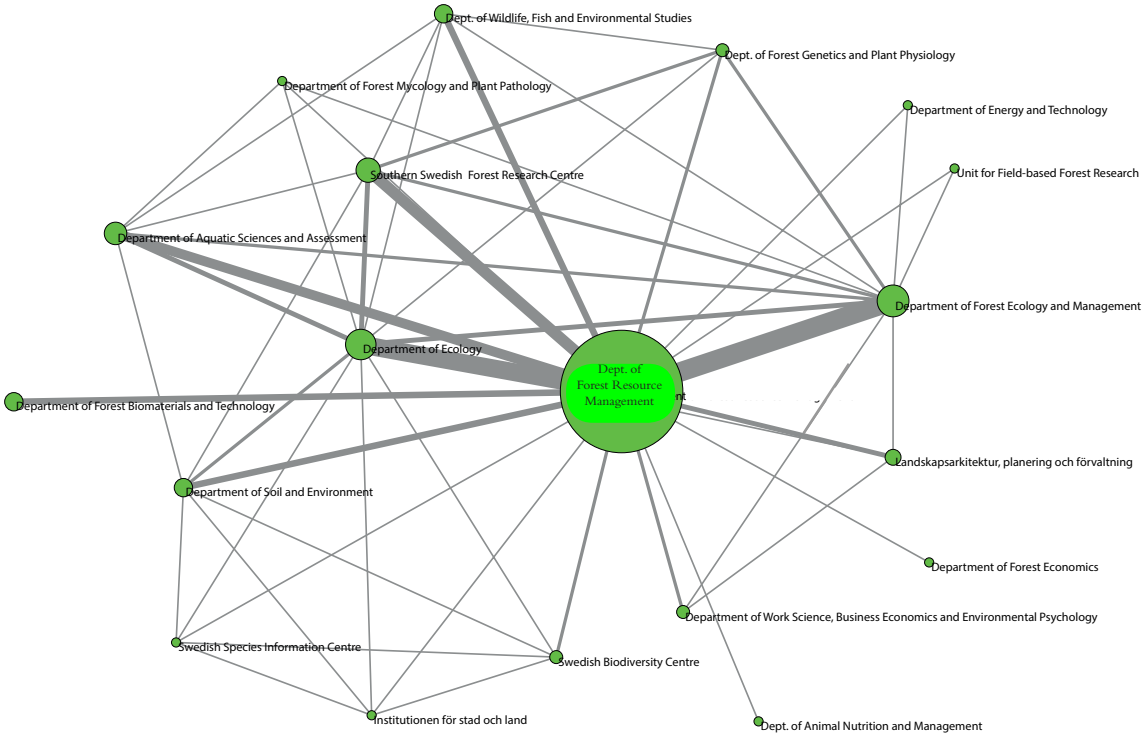
Visualization of the Department Co-Publication and Usage by Research Community



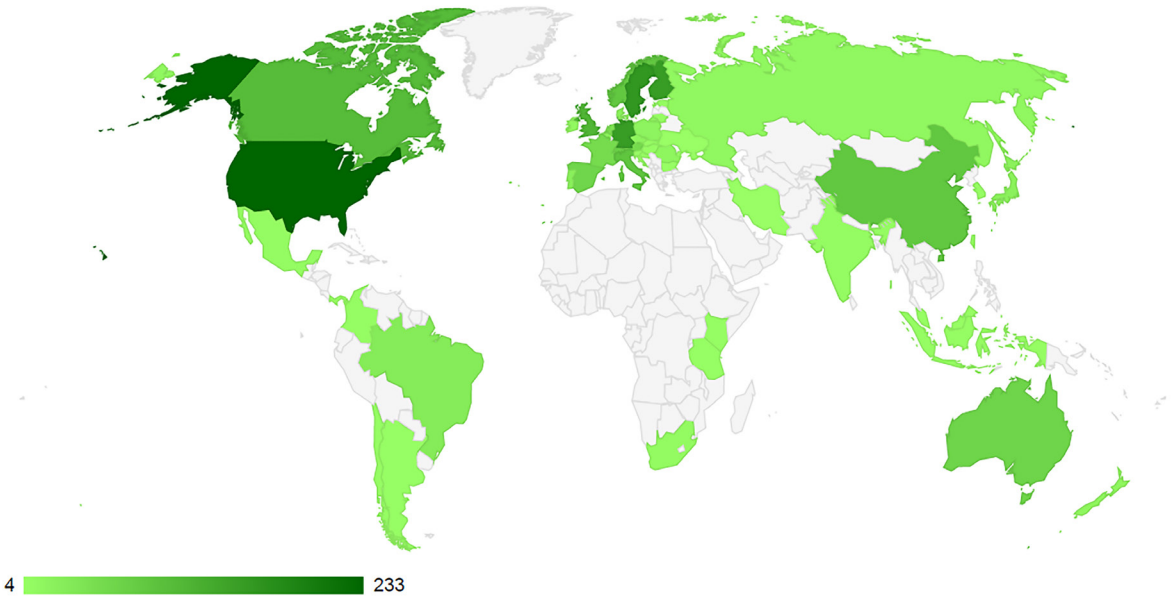
The map shows which organizations the Department has co-published together with, the threshold value is three co-published articles. Source: Web of Science Core Collection (Thomson Reuters), data from the SLU University Library.



The map shows which organizations the Department has co-published together with, the threshold value is two co-published articles. Source: Web of Science Core Collection (Thomson Reuters), data from the SLU University Library.



The map shows co-publication at SLU. Source: Web of Science Core Collection (Thomson Reuters), data from the SLU University Library.



The map shows which countries writers to cited articles (i.e. articles that cite articles authored by researchers from the Department) come from (2012-2015). The number of cited articles is 1073 and no self-citations are included. Source: Web of Science Core Collection (Thomson Reuters), data from the SLU University Library.

Source: All four maps are based on data from the Web of Science Core Collection (Thomson Reuters), data from the SLU University Library on the 29th of September 2016. Articles included are published by an author from the Department during the years 2012-2015 and are published in a journal indexed by the Web of Science.

Text and figures: Alejandro Engelmann, SLU University Library and Marie Stråhle, SLU University Library.

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