Department of
Forest Resource Management

Annual Report 2024

Dear Reader,

Contents

Cover photo:
Sven Adler, SLU.
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Hans Petersson, SLU.
Editor and Layout:
Ylva Melin, SLU.

The Department of Forest Resource Management leads Swedish terrestrial environmental and resource monitoring through its environmental monitoring and assessment (EMA) activities, research, and teaching. We provide objective decision support for various stakeholders to meet society's needs. For future generations and ourselves, this support must be comprehensive and of high quality.

Our EMA flagships - the Swedish National Forest Inventory and the National Inventory of Landscapes in Sweden-track historical trends and the current state of forests, while the Heureka simulation system provides insights into the future. Our research focuses on enhancing monitoring methods (Forest Remote Sensing, Forest Inventory and Sampling, Mathematical Statistics) and promoting sustainable resource use (Forest Planning and Landscape Studies). We are proactive in identifying emerging challenges. Our teaching spreads knowledge and ensures a skilled workforce within and beyond SLU. To succeed, we prioritise an efficient organisation where support functions play a vital role, built on cooperation toward shared goals.

The Annual Report 2024 presents key highlights from the year. The department contributed to government and EU assignments, including carbon reporting under climate frameworks. The centenary celebration of the Swedish National Forest Inventory concluded with a well-received exhibition displayed in various locations - from castles to cottages. Several grant applications were submitted, including NextGenCarbon (EU) and SAGE (EU), both led by Professor Ruben Valbuena, STS4ForestStress (Formas) led by Dr. Langning Huo, and Large-scale analysis of tree growth response to stand and environmental conditions in Sweden's forests (Skogssällskapet) led by Dr. Alex Appiah Mensah. All EMA flagship programmes were successfully delivered, and our support functions remained efficient and service-minded. I am proud to work alongside a dedicated team where everyone contributes to our important mission.

A lot happened on the personnel side:

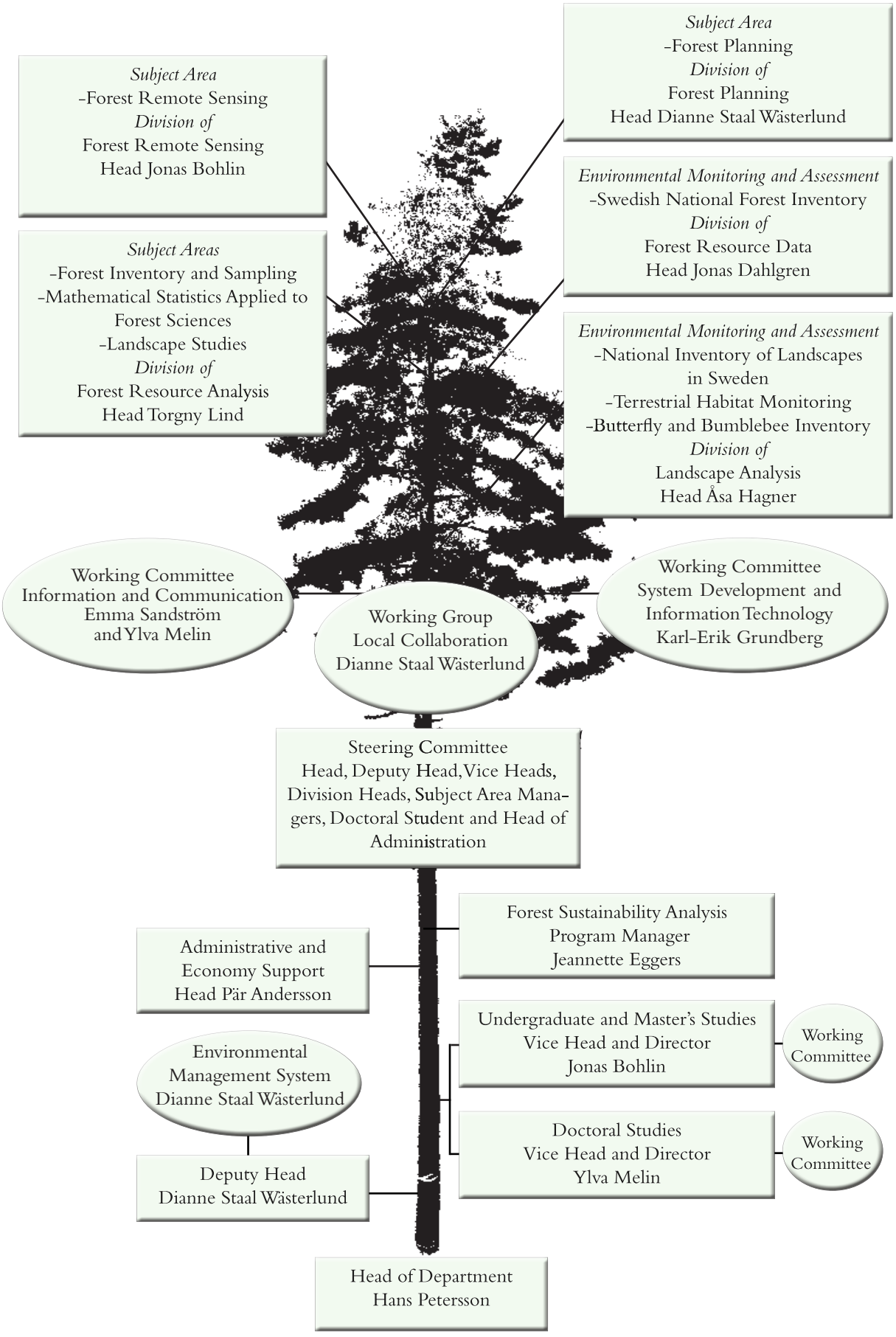
- José Martins and Donato Morresi were recruited as postdocs at the Division of Forest Remote Sensing
- Mona Forsman was recruited as a research engineer at the Division of Forest Remote Sensing
- Sabina Klausmeyer was recruited as a project leader at the Division of Forest Remote Sensing
- Juha Niemi was recruited as a research assistant at the Division of Forest Remote Sensing
- Azin Khosravi was recruited as an IT technician at the Division of Forest Remote Sensing
- Luiz Henrique Elias Cosimo, Ansgar Jörgenfeldt, Jacob Parry and Shivam Rawat were recruited as doctoral students at the Division of Forest Remote Sensing
- Magnus Ekström and Anton Grafström were recruited as professors at the Division of Forest Resource Analysis
- Wilmer Prentius was recruited as a researcher at the Division of Forest Resource Analysis
- Felix Ecker was recruited as a university assistant professor at the Division of Forest Resource Analysis
- Benjamin Allen was recruited as a post-doctor at the Division of Forest Resource Analysis
- Fabio Carrer was recruited as a doctoral student at the Division of Forest Resource Analysis
- Isabella Hallberg-Sramek and Teresa Lopez-Andujar Fustel were recruited as researchers at the Division of Forest Planning
- Ossian Kynman, Alva Lindhagen and Cilla Wännberg were recruited as system developers at the Division of Forest Planning
- Victor Göransson was recruited as a doctoral student at the Division of Forest Planning
- Peter Andersson and Ulrika Lundqvist were recruited as system developers at the Division of Forest Resource Data
- Jessica Wallström was recruited as a personnel administrator at the Administrative Unit
- Tomas Lämås, Gun Lidestav and Kenneth Nyström retired after long and loyal service
- Anna Allard was honoured with the Award for Zeal and Integrity in the Kingdom's Service for having served the government for 30 years

We 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!

Hans Petersson
Head of Department

Organisation

Schematic View of the Department



Steering Committee Staff:

Pär Andersson
Jonas Bohlin
Pernilla Christensen
Jonas Dahlgren
Magnus Ekström
Åsa Hagner
Torgny Lind
Ylva Melin
Raul de Paula Pires
Hans Petersson
Cornelia Roberge
Stefan Sandström
Göran Ståhl
Dianne Staal Wästerlund
Ruben Valbuena
Karin Öhman

Administrative and Economy Staff:

Head of Administration
Pär Andersson

Staff

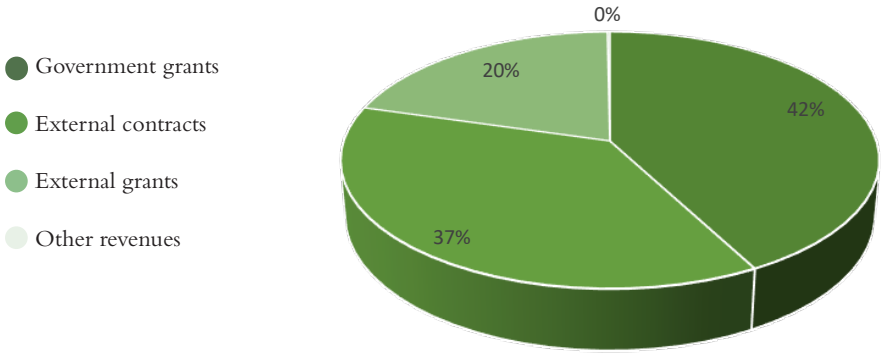
Sofia Forbord
Nanna Hjertkvist
Patrik Isaksson
Tobias Johansson
Ylva Jonsson
Sofia Kollin
Linda Nahlén
Veronika Resolut
Jessica Wallström

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

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	3 643	23 222	44 110	0	70 975
External contracts	357	3 332	58 629	386	62 704
External grants	743	30 136	3 154	264	34 297
Other revenues	39	249	13	0	301
Total	4 782	56 939	105 906	650	168 277



Costs

Costs (1000 SEK)	Undergraduate and Master's Studies	Research and Doctoral Studies	Environmental Monitoring and Assessment	Support Function	Total
Staff	2 198	39 393	57 833	9 795	109 219
Premises	563	3 441	2 427	-366	6 065
Other operative expenses	366	8 742	21 670	2 511	33 289
Depreciation	105	1 204	404	0	1 713
Overhead	1 387	13 670	17 431	-11 291	21 197
Total	4 619	66 450	99 765	650	171 483

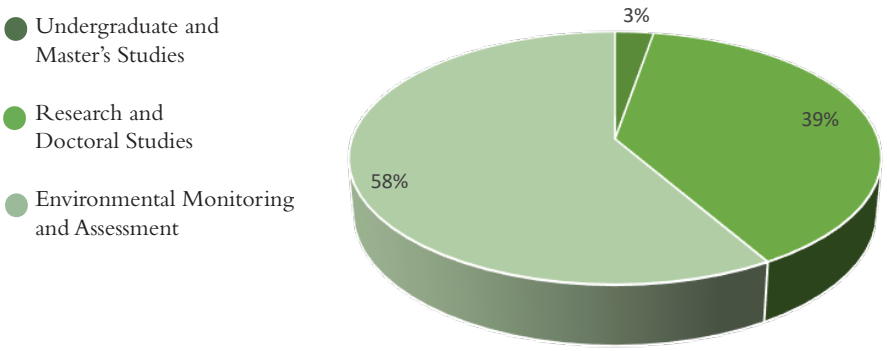


Table & Figure:
Ylva Jonsson, SLU.

External Contracts and Grants

Financier	Revenues (million SEK)
Swedish Environmental Protection Agency	42.5
EU	8.5
Formas	5.4
Arbio	4.1
Swedish Forest Agency	3.4
Stora Enso skog AB	2.8
Swedish Board of Agriculture	2.2
The Swedish Forest Society	2.2
Swedish Foundation for Strategic Research	2.1
Kempe Foundations	1.2
Holmen Skog	0.8
Ljungberg's Foundation	0.8
Forestry Research Institute of Sweden	0.7
Saami Parliament	0.5
Vinnova	0.5
Sveaskog	0.5
Statistics Sweden	0.5
Bo Rydin Foundation for Scientific Research	0.3
Foundation Seydlitz MP bolagen	0.3
SCA	0.3
Nils and Dorthi Troëdsson Foundation	0.3
Swedish Forest-Owner Plans AB	0.3
Regeringskansliet	0.3
NFA Forestry Automation AB	0.3
County Administrative Boards	0.2
Hildur and Sven Wingquist's Foundation	0.2
The Church of Sweden	0.2
Swedish Research Council	0.2
NIBIO (Norwegian Institute of Bioeconomy Research)	0.1
Nordic Forest Research Co-operation Committee	0.1
Billerudkorsnäs Skog och industri AB	0.1
The Royal Swedish Academy of Agriculture and Forestry	0.1
Kopparfors skogar	0.1
Wageningen University	0.1
The National Property Board of Sweden	0.1
Others	14.9
Total	97.2

Personnel Categories

Staff	Number of Work-Years★
Senior advisor	0.5
Professors	3.2
Senior lecturers	2.9
Associate senior lecturers	0
Researchers	18.3
Postdoctoral researchers	1.4
Doctoral students	17.7
Other teachers	1.9
Administrative staff	9.2
Technical staff	36.2
Technical staff (field)	38.2
Total	129.7

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

Table: Sofia Forbord, SLU
Ylva Jonsson, SLU.

Undergraduate and Master's Studies

Vice Head and Director Undergraduate and Master's Studies
Jonas Bohlin

The department is a large contributor to the undergraduate and master education within the forest faculty. Our education in forest mensuration, forest modelling and forest planning are core topics in the university's responsibility of being a sector university for forestry. Therefore we are largely involved in the BSc and MSc programs in forestry but also other programs within the university. Our course offering amounts to about 70 ECTS credits at the undergraduate level and 50 ECTS credits at the Master's level. We offer courses in the following five subjects: remote sensing and geographic information systems (GIS); forest inventory; forest planning; mathematical statistics; and organisation and leadership. The individual courses for each subject are shown in the table below, divided into undergraduate and Master's levels.

Master's Theses

Forest Remote Sensing

Zrnovský Jan, 2024. ForesTRACE.jl: Raytracing Analysis for Utilising Lost Information in Laser Scanning Methods. Supervisor: Cameron Pellet.

Forest Inventory and Sampling

Gavelin Andreas, 2024. Simulation of dead wood - model compared to reality. Supervisor: Torgny Lind.

Larsson Sara, 2024. Long-term forest planning with alternative objectives- Water supply and reindeer husbandry. Supervisor: Torgny Lind.

Forest Planning

Bergenheim Jens, 2024. Bilberry cover and its relationship to silvicultural strategies. Supervisor: Karin Öhman.

Göransson Victor, 2024. Assessment of recreational values in peri-urban forests - A comparison of different recreational indices and their relationship with local users' opinions. Supervisor: Karin Öhman.

Nord Saga, 2024. SLU employees' views on sustainable forest management in Sweden - a survey study. Supervisor: Jeannette Eggers.

Ramberg Håkan, 2024. Klimatanpassning inom svenskt skogsbruk – Strategier och utmaningar bland nyckelaktörer. Supervisor: Isabella Hallberg-Sramek.

Courses

Subject	Undergraduate Level (years 1-3) 15-40 students per course	Master's Level (years 4-5) 10-30 students per course
Remote Sensing and GIS, Forest Inventory and Mathematical Statistics	Applied Remote Sensing in Forestry, 7.5 ECTS GIS and Forest Remote Sensing, 7.5 ECTS Mathematical Statistics with Forest Applications, 7.5 ECTS Science Theory and Method, 7.5 ECTS	Forest Remote Sensing, 7.5 ECTS Geographic Information Technology II, 7.5 ECTS Remote Sensing and Forest Inventory, 15 ECTS
Forest Planning	Forest Planning, 15 ECTS Planning and Analyses of Forest Ecosystem Services, 7,5 ECTS Planning and Analyses with the Heureka System - a Forest Decision Support System, 15 ECTS	Forest Sustainability Analysis, 7.5 ECTS
Organisation and Leadership		The Forestry from Organisational Theory Related Perspective, 15 ECTS

Text: Jonas Bohlin, SLU.
Table: Sofia Forbord, SLU.

Doctoral Studies

Through course work, seminars and participation in focused research projects, the doctoral programme trains students how to develop and address questions within the doctoral education subjects of forest management, technology, biology and mathematical statistics. Within these subjects, students are supported by a team of experienced supervisors and a network of national and international experts. Additionally, the department offers the unique experience of collaboration with environmental analysts and specialists involved in two major national monitoring programmes, i.e. the Swedish National Forest Inventory and the National Inventory of Landscapes in Sweden.

Doctoral Theses

Doctorate - Forest Remote Sensing

Ritwika Mukhopadhyay
Forest Attribute Prediction and Mapping using 3D Remote Sensing Data. Acta Universitatis Agriculturae Sueciae.

Doctorate - Forest Inventory and Sampling

Carl Vigren
Pushing the envelope - Empirical Growth Models for Forest at Change. Acta Universitatis Agriculturae Sueciae.

Doctorate - Forest Planning

Teresa López-Andújar Fustel
Contributions to the Theory of Environmental Sampling. Acta Universitatis Agriculturae Sueciae.

Courses

Title	Credits	Participants	Responsible
Introduction to image analysis for forest sciences	4.5 ECTS	21	Eva Lindberg
Forest Change detection with remote sensing and high-performance cloud-computing	5.0 ECTS	23	Jonas Bohlin
Statistics I: Basic statistics	4.0 ECTS	14	Wilmer Prentius
Statistics IV: Generalized Linear Models	4.0 ECTS	11	Magnus Ekström

Text: Ylva Melin, SLU.
Table: Sofia Forbord, SLU.
Photo: Emma Sandström, Carl Vigren, Mona Bonta Bergman, SLU.

Forest Remote Sensing

Within forest remote sensing, we work with research, education and development of remote sensing of forests and other terrestrial vegetation. We also help with the processing of remote sensing data as part of SLU's environmental monitoring and assessment. We usually utilise data from optical, laser, or radar sensors. Traditionally, sensor platforms have included satellites, aircraft and drones. Increasingly, we also use sensors placed on the ground or in vehicles to depict trees from the side.

Subject Area Manager
Ruben Valbuena

Staff
Christoffer Axelsson
Peder Axensten
Jonas Bohlin
Wei-Ling Chen
Mikael Egberth
Mona Forsman
Johan Holmgren
Langning Huo
Jonas Jonzen
Sabina Klausmeyer
Jakob Lagerstedt
Eva Lindberg
Victor Manabe
Juha Niemi
Mats Nilsson
Kenneth Olofsson
Henrik Persson
Emma Sandström
Niina Valbuena
Jörgen Wallerman
Xiaoming Wang

Postdoctoral Researcher
Alexandre Changenet
José Martins
Donato Morresi

Doctoral Students
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Louisa Eurich
Ansgar Jörgenfelt
Ritwika Mukhopadhyay
Raul de Paula Pires
Jacob Parry
Cameron Pellett
Shivam Rawat
Jon Söderberg

Guest Doctoral Students/Researchers
Aurora Bozzini
Sam Koch
Katri Mäkinen
Chiara Zabeo

Text:
Ruben Valbuena, SLU.

Publications

Scientific Articles

- Alibakhshi, S., Valbuena, R., Heinlein, D., Haeme, L., and Pellikka, P. (2024) Stereo vision from space to track tree fall incident. Natural Hazards, 10.1007/s11069-024-07016-y
- Calbi, M., Boenisch, G., Boulangeat, I., Bunker, D., Catford, J.A., Changenet, A., ... Weisser, W.W., and Roccotiello, E. et al. (2024) A novel framework to generate plant functional groups for ecological modelling. Ecological Indicators, 166, 112370, 10.1016/j.ecolind.2024.112370
- D'Amicoa, G., Nilsson, M., Axelsson, A, and Chirici, G. (2024) Data homogeneity impact in tree species classification based on Sentinel-2 multi-temporal data case study in central. International Journal of Remote Sensing, 45(15):5050-5075, 10.1080/01431161.2024.2371082
- Gessler, A., Schaub, M., Bose, A., Trotsiuk, V., Valbuena, R., Chirici, G., and Buchmann, N. (2024) Finding the balance between open access to forest data while safeguarding the integrity of National Forest Inventory-derived information. New Phytologist, 242(2):344-346, 10.1111/nph.19466
- Gschwantner, T.,.. , Di Cosmo, L.,.. Nilsson, M., Pesty, B., Schadauer, K., Sroga, R., Talarczyk, A., and Westerlund, B. et al. (2024) Improved large-area forest increment information in Europe through harmonisation of National Forest Inventories, Forest Ecology and Management, 562, 10.1016/j.foreco.2024.121913
- Huo, L., Koivumäki, N., Oliveira, R.A., Hakala, T., Markelin, L., Näsi, R., Suomalainen, J., Polvivaara, A., Junttila, S., and Honkavaara, E. (2024) Bark beetle pre-emergence detection using multi-temporal hyperspectral drone images: Green shoulder indices can indicate subtle tree vitality decline. ISPRS Journal of Photogrammetry and Remote Sensing, 216:200-2016, 10.1016/j.isprsjprs.2024.07.027
- Huo, L., Persson, H.J., and Lindberg E. (2024) Analyzing the environmental risk factors of European spruce bark. European Journal of Forest Research, 143(3):985–1000, 10.1007/s10342-024-01662-4
- Indirabai, I., and Nilsson, M. (2024) Estimation of above ground biomass in tropical heterogeneous forests in India using GEDI. Ecological Informatics, 82, 102712, 10.1016/j.ecoinf.2024.102712
- King, S., Agra, R., Zolyomi, A., Keith, H., Nicholson, E., de Lamo, X., Portela, R., Obst, C., Alam, M., Honzák, M., Valbuena, R., Nunes, P.A.L.D., Santos-Martin, F., Equihua, M., Pérez-Maqueo, O., Javorsek, M., Alfieri, A., and Brown, C. (2024) Using the system of environmental-economic accounting ecosystem accounting for policy: A case study on forest ecosystems. Environmental Science & Policy, 152, 103653, 10.1016/j.envsci.2023.103653
- Li, N., Huo, L., and Zhang, X. (2024) Using only the red-edge bands is sufficient to detect tree stress: A case study on the early detection of PWD using hyperspectral drone images. Computers and Electronics in Agriculture, 217, 108665, 10.1016/j.compag.2024.10866
- Martinez-Garcia, E., Nilsson, M.B., Laudon, H., Lundmark, T., Fransson, J. E. S., Wallerman, J., and Peichl, M. (2024) Drought response of the boreal forest carbon sink is driven by understorey–tree composition. Nature Geoscience, 17(3):197-204, 10.1038/s41561-024-01374-9
- Mashhadi, N., Sanchez-Azofeifa, A., and Valbuena, R. (2024) LiDAR-derived Lorenz-entropy metric for vertical structural complexity: A comparative study of tropical dry and moist forests. Remote Sensing of Environment, 318, 114545, 10.1016/j.rse.2024.114545
- Mukhopadhyay, R., Ekström, M., Lindberg, E., Persson, H.J., Saarela, S., and Nilsson, M. (2024) Computation of prediction intervals for forest aboveground biomass predictions using generalized linear models in a large-extent boreal forest region. Forestry, 1-11, 10.1093/forestry/cpae006
- Persson, H.J., and Huuva, I. (2024) Polarimetric Measures in Biomass Change Prediction Using ALOS-2 PALSAR-2 Data. Remote Sensing, 16:953, 953, 10.3390/rs16060953
- Persson, H.J., Kärvemo, S., Lindberg, E., and Huo, L. (2024) Large-scale wall-to-wall mapping of bark beetle damage and forest practices using the distance red swir index and operational harvester data. Ecological Indicators, 162, 112036, 10.1016/j.ecolind.2024.112036
- Pires, R.D., Lindberg, E., Persson, H.J., Olofsson, K., and Holmgren, J. (2024) Mobile laser scanning as reference for estimation of stem attributes from airborne laser scanning. Remote Sensing of Environment, 315, 114414, 10.1016/j.rse.2024.114414
- Udali, A., Persson, H.J., Talbot, B., and Grigolato, S. (2024) SAR Data and Harvesting Residues: An Initial Assessment of Estimation Potential. Earth, 5(4):945-962, 10.3390/earth504004

Book Chapter

- Bosela, M., Larocque, G.R., Baycheva, T., Valbuena, R., and Lier, M. (2024) Criteria and Indicators of Sustainable Forest Management. In: Ecological Forest Management Handbook, CRC Press, 30p, ISBN 9781003431084

Forest Inventory and Sampling

Forest inventory and sampling includes general theory for sampling, field-based forest and landscape inventory, as well as related modelling and development of inventory systems that utilize multiple data sources. Today, forest inventory focuses on features related to several ecosystem services in addition to information on trees and growing stock, such as information on biological diversity and greenhouse gas balances. Within sampling, general methods are developed which also underpin important parts of the forest inventory area. The subject area contributes knowledge for a large number of applications in practical forestry and environmental monitoring.

Publications

Scientific Articles

- Aldea, J., Dahlgren, J., Holmström, E., and Löf, M. (2024) Current and future drought vulnerability for three dominant boreal tree species. Global Change Biology, 30(1), e17079, 10.1111/gcb.17079 https://doi.org/10.1111/gcb.17079
- Andersen, H-E., Ståhl, G., Cook, B.D., Morton, D.C., and Finley, A.O. (2024) Model-assisted estimation of domain totals, areas, and densities in two-stage sample survey designs. Canadian Journal of Forest Research, 55(12):1425-1442, 10.1139/cjfr-2024-0039
- Astigarraga, J., Esquivel-Muelbert, A.,... Dahlgren, J..., and Pugh, T.A.M. et al. (2024) Relative decline in density of Northern Hemisphere tree species in warm and arid regions of their climate niches. PNAS, 121(28), 10.1073/pnas.2314899121
- Avitabile, V., Pilli, R.,.. Fridman, J..., and Mubareka, S. et al. (2024) Harmonised statistics and maps of forest biomass and increment in Europé. Scientific Data, 11(1):274, 10.1038/s41597-023-02868-8
- Bouchard, E,.. Fridman, J.,.. Westerlund, B.,.., and Paquette, A. et al. (2024) Global patterns and environmental drivers of forest functional composition. Global Ecology and Biogeography, 33(2):303-324, 10.1111/geb.13790
- Jha, N.,... Ståhl, G., and Betts, M.G. et al. (2024) Vicarious calibration of GEDI biomass with Landsat age data for understanding secondary forest carbon dynamics. Environmental Research Letters, 19(4), 044062, 10.1088/1748-9326/ad3661
- Larson, J., Vigren, C., Wallerman, J., Ågren, A.M., Appiah Mensah, A., and Laudon, H. (2024) Tree growth potential and its relationship with soil moisture conditions across a heterogeneous boreal forest landscape, Scientific Reports, 14(1), 10.1038/s41598-024-61098-z
- Laudon, H., Appiah Mensah, A., Fridman, J., Näsholm, T., and Jämtgård, S. (2024) Swedish forest growth decline: A consequence of climate warming? Forest Ecology and Management, 565, 122052, 10.1016/j.foreco.2024.122052
- Liu, D.,...Fridman, J.,.. and Pugh, T.A.M. et al. (2024) Mapping multi-dimensional variability in water stress strategies across temperate forests. Nature Communications, 15(1), 8909, 10.1038/s41467-024-53160-1
- Mensah, A.A., and Petersson, H. (2024) Carbon concentration of living tree biomass of Pinus sylvestris, Picea abies, Betula pendula and Betula pubescens in Sweden. Scandinavian Journal of Forest Research, 39(3-4):145-155, 10.1080/02827581.2024.2332439
- Prentius, W., and Grafström, A. (2024) How to find the best sampling design: A new measure of spatial balance. Environmetrics, 35(7), 10.1002/env.2878
- Saarela, S.,.. and Ståhl, G. et al. (2024) A Separable Bootstrap Variance Estimation Algorithm for Hierarchical Model-Based Inference of Forest Aboveground Biomass Using Data From NASA's GEDI and Landsat Missions. Environmetrics, 36(1), 10.1002/env.2883
- Schadauer, K., Astrup, R., Breidenbach, J., Fridman, ...Paeivinen, R., and Riedel, T. et al. (2024) Access to exact National Forest Inventory plot locations must be carefully evaluated. New Phytologist, 242: 347–350, 10.1111/nph.19564
- Ståhl, G., Gobakken, T., Saarela, S., Persson, H.J., Ekström, M., Healey, S.P., Yang, Z., Holmgren, J., Lindberg, E., Nyström, K., Papucci, E., Ulvdal, P., ..., Olsson, H., and McRoberts, R.E. et al. (2024) Why ecosystem characteristics predicted from remotely sensed data are unbiased and biased at the same time – and how this affects applications. Forest Ecosystems, 11, 10.1016/j.fecs.2023.100164
- Ståhl, G., Nordin, A., Wikberg, P-E., Arnesson Ceder, L., and Lundmark, T. (2024) Potential consequences of a rapid transition from rotation forestry to continous cover forestry in Sweden. Scandinavian Journal of Forest Research, 39(7-8):367-376, 10.1080/02827581.2024.2437409
- Summers, R.W., Swallow, B., Fridman, J., Hokkanen, T., Newton, I., and Buckland, S.T. (2024) Irruptions of crossbills Loxia spp. in northern Europe – patterns and correlations with seed production by key and non-key conifers. IBIS international journal of avian science, 166:1172-1183, 10.1111/ibi.13328
- Varvia, P., Saarela, S., Maltamo, M., Packalen, P., Gobakken, T., Næsset, E., Ståhl, G., and Korhonen, L. (2024) Estimation of boreal forest biomass from ICESat-2 data using hierarchical hybrid inference. Remote Sensing of Environment, 311, 114249, 10.1016/j.rse.2024.114249
- Vospernik, S., Vigren, C., Morin, X.,... Pach, M., Ponette, Q., and Pretzsch, H. et al. (2024) Can mixing Quercus robur and Quercus petraea with Pinus sylvestris compensate for productivity losses due to climate change? Science of the Total Environment, 942, 173342, 10.1016/j.scitotenv.2024.173342
- Zhao, X., and Grafstrom, A. (2024) Estimation of change with partially overlapping and spatially balanced samples. Environmetrics, 35(1), e2825, 10.1002/env.2825
- Zheng, Y., Hou, Z., Ståhl, G., McRoberts, R.E., Zeng, W., Næsset, E., Gobakken, T., Li, B., and Xu, Q. (2024) Nexus of certain model-based estimators in remote sensing forest inventory. Forest Ecosystems, 11, 100245, 10.1016/j.fecs.2024.100245
- Zou, Y., Zohner, C.M.,... Dahlgren, J.,.. Ruiz-Benito, P., de Zavala, M.A., and Crowther, T. et al. (2024) Positive feedbacks and alternative stable states in forest leaf types. Nature Communications, 15(1), 4658, 10.1038/s41467-024-48676-5

Book Chapter

- Lundblad, M., Petersson, H., Karltun, E., Wikberg, P-E., Stendahl, J., Linddahl, A., and Bolinder, M. (2024) Land use, land-use change and forestry (CRT sector 4). In: National Inventory Report Sweden 2024 – Submitted under the UNFCCC, Swedish Environmental Protection Agency.

Subject Area Manager
Göran Ståhl

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Anton Grafström
Torgny Lind
Hans Petersson
Wilmer Prentius

Postdoctoral Researchers
Benjamin Allen

Doctoral Students
Fabio Carrer
Mateusz Grzeszkiewicz
Johan Lindman
Emanuele Papucchi
Carl Vigren

The publication list includes articles published within the Swedish National Forest Inventory.

Text:
Göran Ståhl, SLU.

Forest Planning

Subject Area Manager
Karin Öhman

Staff
Inka Bohlin
Mona Bonta Bergman
Jeannette Eggers
Hampus Holmström
Ossian Kynman
Alva Lindhagen
Johanna Lundström
Tomas Lämås
Ylva Melin
Eva-Maria Nordström
Jonathan Samuelsson
Isabella Hallberg-Sramek
Johannes Turesson
Cilla Wännberg
Dianne Staal Wästerlund
Jonatan Årevall

Doctoral Students
Lina Arnesson Ceder
Andreas Eriksson
Teresa López-Andújar Fustel
Victor Göransson
Mathias Kristoferqvist
Daniel M. Junior Mensah
Patrik Ulvdal

Many of the staff also work in the Forest Sustainability Analysis program.

Forest planning provides methods and tools that contribute to the sustainable use of forest resources with regard to economic, ecological and social values, and uses these in different future analyses. Our research deals with planning issues both from a forest-owner perspective and from a stakeholder or societal perspective. The research focused on the perspective of forest owners primarily concerns quantitative methods and tools used to translate the owners' objectives into forest plans in the medium and long term. The stakeholder and societal perspective is expressed in research regarding how different stakeholders can together influence the future development of the forest landscape. The focus of our future analysis is how different ecosystem services are affected over time and space by different management strategies, and the identification of optimal management under various assumptions regarding objectives and climate change.

Publications

Scientific Articles

- Dahlgren Lidman, F., Lundmark, T., Sängstuvall, L., and Holmström, E. (2024) Birch distribution and changes in stand structure in Sweden's young forests. Scandinavian Journal of Forest Research, 39(3–4):167–175, 10.1080/02827581.2024.2349520
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- Fustel, T.L-., Öhman, K., Klapwijk, M., Nordkvist, M., Sängstuvall, L., Lämås, T., and Eggers, J. (2024) Impact of management strategies on forest susceptibility to spruce bark beetle damage and potential trade-offs with timber production and biodiversity. Forest Ecology and Management, 563, 121964, 10.1016/j.foreco.2024.121964
- Hallberg-Sramek, I., Lindgren, S., Samuelsson, J., and Sandström, C. (2024) Applying machine learning to media analysis improves our understanding of forest conflicts. Land Use Policy, 144, 107254, 10.1016/j.landusepol.2024.107254
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- Mazziotta, A., Kangas, A., Llorente, I.D.P, Tikkanen, O-P., and Eyvindson, K. (2024) Application of the Global Uncertainty and Sensitivity Analysis to assess the importance of deadwood characteristics for forest biodiversity. Stochastic Environmental Research and Risk Assessment, 38(5):1783–1802, 10.1007/s00477-023-02655-2
- Reimerson, E., Hallberg-Sramek, I., and Priebe, J. (2024) "Here and now, by us": Co-production of climate action pathways in forest landscapes. Environmental Policy and Governance, 1–17. 10.1002/eet.2140 / Överväg 2025 /
- Schulte, M., Jonsson, R., Hammar, T., Eggers, J., Stendahl, J. and Hansson, P-A. (2024) Climate change mitigation from increased paper recycling in Sweden: conserving forests or utilizing substitution? Environmental Research Communications, 6(7), 075002, 10.1088/2515-7620/ad5930
- Sikkema, R., Wilhelmsson, E., Ellison, D., and Petersson, H. (2024) Forest Owner Attitudes Toward Climate-Proof Forest Management in Sweden and the Netherlands—Between Forest Strategies and Practical Measures. Small-scale Forestry, 23(4):693–720, 10.1007/s11842-024-09576-0
- Wilhelmsson, P., Wallerman, J., Lämås, T., and Öhman, K. (2024) Dynamic treatment units in forest planning improves economic performance over stand-based planning. European Journal of Forest Research, 144:163–177, 10.1007/s10342-024-01748-z

Text:
Karin Öhman, SLU.
Photo: Anton Larsson, SLU.

Mathematical Statistics Applied to Forest Sciences

The application of mathematical and statistical methods in forest sciences is challenging due to the great amount of variations present in nature, with complex dynamics that involve variations in both time and space. A wide range of mathematical-statistical methods is studied, developed and applied for collecting, analysing, interpreting and presenting empirical data. Such methods make it possible to draw conclusions based on empirical data and can be used for description, decision-making and prediction within the forest sciences.

Publications

Scientific Articles

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Text: Magnus Ekström, SLU.
Photo: Sven Adler.

Landscape Studies

Through an interdisciplinary approach, landscape studies research focuses on the utilisation of landscapes, their multiple resources and their users. Through this research, we contribute to an increased understanding of the socioecological processes and how they change over time and in space. The connections between natural resource use, stewardship, ecosystem production and community development processes are of special interest. Our work builds upon capacities within environmental monitoring, forest impact assessment and work science, including gender studies, policy, and rural development studies.

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The publication list includes articles published within the NILS, THUF and FHIN programs.

Publications

Scientific Articles

- Nkya, S.E., Shirima, D.D., Masolele, R.N., Hedenås, H., and Temu, A.B. (2024) Mapping dominant tree species of miombo woodlands in Western Tanzania using PlanetScope imagery. Discover Applied Sciences, 6(10)578, 10.1007/s42452-024-06248-8
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- Ota, L., Lidestav, G., Andersson, E., Page, T., Curnow, J., Nunes, L., Goltiano, H., Gregorio, N., Ferreira dos Santos, N., and Herbohn, J. (2024) Reviewing gender roles, relations, and perspectives in small-scale and community forestry – implications for policy and practice. Forest Policy and Economics, 161, 10.1016/j.forpol.2024.103167
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- Nkya, S.E., Shirima, D.D., Masolele, R.N., Hedenås, H., and Temu, A.B. (2024) Modeling the Land Surface Phenological Responses of Dominant Miombo Tree Species to Climate Variability in Western Tanzania. Remote Sensing, 16(22)4261, 10.3390/rs16224261
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- a, I., Ólafsdóttir, R., Siikavuopio, S., Iversen, A., Robertsen, R., Bjerke, J., Engen, S., Tommervik, H., Bogadóttir, R., Moioli, S., Tuulentie, S., Rautio, P., Lynge-Pedersen, J., Lidestav, G., Edvardsdòttir, A.G., and Nygaard, V. (2024) Exploring land use conflicts arising from economic activities and their impacts on local communities in the European Arctic. Journal of Land Use Science, 19(1):186-210, 10.1080/1747423X.2024.2382676

Text: Stefan Sandström & Carina Keskitalo, SLU.
Photo: Isak Öhman, SLU.

Environmental Monitoring and Assessment

SLU is unique among Swedish universities with its strong focus on environmental monitoring and assessments (EMA). Within SLU, our department is also unique, as EMA is the dominating activity (roughly 60 per cent of the budget). For a large set of terrestrial variables, EMA is the long-term monitoring and assessment of stocks and changes in stocks. EMA includes data capture, analysis and reporting. Inventories in the field, remote sensing, or a combination of these two methods, are performed using area-based sampling designs adapted mainly to regional or larger scales. The idea is to carefully measure variables on the sample units, meaning that most of the uncertainty should arise from the fact that only a sample and not the entire population is measured. The uncertainty of estimates can be controlled by an efficient design and a large sample, and it is possible to predict the accuracy of the estimates. EMA is an efficient way to monitor "how much" without disturbing the population, while an experimental design focuses on explaining "why" in a well-defined manipulated area. Projections and scenarios about the future of terrestrial variables, often based on data from the monitoring programmes, are also considered part of EMA activities.

Head
Environmental Monitoring and Assessment
Hans Petersson

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Hans Petersson, SLU.

Swedish National Forest Inventory

SLU is the authority responsible for national official statistics in the area of forest state and change. Statistical products consist of area conditions, growing stock and tree biomass, annual growth, vegetation and habitat conditions, and forest damage. The Swedish National Forest Inventory (NFI) operates within the department to fulfil SLU's statistical responsibility and provides data for other EMA-programs and research. Through an annual field survey of sample plots spread across the entire country, data are collected for compilation and presentation of official statistics. The results are published annually in the publication Skogsdata, which can be downloaded in pdf format from our website. All official statistics are also available for download from our website in multiple formats, including APIs as well as on the Swedish and EU data portals.

Forest damage inventories

Directed forest damage inventories are also performed at the section and during 2024 one such inventory was carried out on behalf of the Swedish Forest Agency to estimate spruce bark beetle damage in south Sweden.

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Many of the staff also work in the THUF and FHIN programs.

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National Inventories of Landscapes in Sweden

The National Inventories of Landscapes in Sweden (NILS) collect, analyse, and present comprehensive data on the state and changes of the Swedish nature over time. NILS operates as a national environmental monitoring program integrating multiple inventories for efficient administration, analysis, data management, aerial inventory, fieldwork, and training - ensuring cost-effective and synergistic operations. Inventories primarily focuses on alpine regions, grasslands, old deciduous forests, raised bogs, and seashores. A key application of the collected data is reporting on the area and quality of habitats listed in Annex I of the EU's Habitat Directive. Furthermore, our data is used to monitor progress towards the Swedish Environmental Objectives and the development of national land cover data.

To address the challenge of surveying diverse natural environments, including both common and uncommon habitats, NILS has developed a flexible sampling design. This design enables tailor inventories based on specific factors, such habitat frequency habitats, regional requirements, and technological advances. The Swedish Environmental Protection Agency and the Swedish Board of Agriculture commission our inventories.

NILS Grassland inventory

A national inventory of all types of grassland, with extra focus on grasslands with high nature values, listed in Annex I of the EU's Habitat Directive. The inventory started in 2020.

NILS Deciduous forest inventory

A national inventory complementing the National Forest Inventory. It focusing on old deciduous forests including broad-leaf forests, swamp deciduous forests, alluvial deciduous forests and other old deciduous forests. The inventory started in 2020.

NILS Alpine inventory

A national inventory of the alpine area, with a focus on habitats with high nature values as designated in Annex I of the EU's Habitat Directive. The collected data contribute to the evaluation of the environmental objective a Magnificent Mountain Landscape. The inventory started in 2006 with a break during the years 2021 and 2022. The inventory started in 2021.

NILS Wetland inventory

NILS was tasked with designing a pilot study on wetlands, specifically focusing on raised bogs. In 2023, a national inventory of raised bogs was initiated, with particular attention given to those with high nature values as designated in Annex I of the EU's Habitat Directive.

THUF Seashore inventory

A national inventory of the Swedish coast and archipelago, concentrating on habitats included in Annex I of the EU's Habitat Directive. The inventory started in 2012.

FHIN Butterfly and bumblebee inventory

A long-term nationwide monitoring program assessing biodiversity and quality in semi-natural grasslands. The collected data contribute to the evaluation of the environmental objective a Varied Agricultural Landscape. The inventory started in 2006 with a break during the years 2021 and 2022.

NILS Initial Inventory 2003-2020

The initial NILS inventory aimed to monitor biodiversity in all terrestrial environments in Sweden, tracking changes in the everyday landscape. An important part of the program was to study changes in landscape composition and structure that may affect biodiversity.

By integrating these inventories under a unified program, NILS enhances efficiency and ensures comprehensive environmental monitoring across Sweden's diverse landscapes.

Program Manager
Jeannette Eggers

Many of the staff in Forest planning also work in the Forest Sustainability Analysis program.

Text: Johanna Lundström, SLU.

Forest Sustainability Analysis

The Forest Sustainability Analysis (SHa) programme works with qualitative and quantitative analyses of the potential of forest ecosystems to provide various forms of ecosystem services in the long term. Through the programme, policy-makers, decision-makers and planners within a range of sectors in society, e.g. forestry, environment and energy, have access to expertise, analytical tools and decision support for issues related to forest development. The Heureka decision-support system is a central tool in most SHa analyses.

Field Staff

Every year, the department organises and implements extensive inventories of forests and landscapes in Sweden. To conduct this work, we employ a number of field workers.

Swedish National Forest Inventory

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