



NORWEGIAN
NATIONAL FOREST
INVENTORY
1919-2019



#1 #2 #3 #4 #5 #6 Cont.
1919 2019

A century of national forest inventories – informing past, present and future decisions

Celebrating the 100-year anniversary of the Norwegian National Forest Inventory
May 19th - 23rd 2019
Sundvolden Hotel, Norway

Welcome to Sundvollen

It is a great pleasure to welcome you to the 100-year anniversary conference of the Norwegian National Forest Inventory. Around 200 attendees from 32 countries are united to share exciting research and views within the field of national forest inventories (NFIs).

In Norway's NFI, fieldwork started in 1919; just a few years later similar monitoring programs were established in the other Nordic countries and elsewhere. While concern about declining forest resources triggered the establishment of Norway's NFI one hundred years ago, new environmental and societal challenges related to forests have become more evident in the last decades, both in Norway and internationally. This has in turn widened the scope of the world's NFIs from being almost exclusively timber-oriented towards providing information about other ecosystem services including biodiversity, the climate mitigation potential of forests, as well as forest health and non-timber goods and services.

Thus, NFIs are more important today than ever before as a source of information about

our forests and as a vital data source for a wide range of research purposes.

The program of this jubilee conference covers both the historical aspect of NFIs, lessons learned, and presentations demonstrating novel use of data from NFIs to provide better answers to different stakeholders, ranging from forest managers to policy makers. You will also get the opportunity to listen to several interesting presentations on the development of cutting-edge technologies and methodologies that will contribute to even better data and information about our forests in the second century of NFIs.

We have received financial support to arrange this jubilee conference from the Nordic Council of Ministers through the CARISMA and Forest Inventory SNS networks, and the Norwegian Research Council. We would also like to use this opportunity to thank the sponsors, and our colleagues in the other Nordic NFIs for contributing to the conference's field excursion program.

We hope you will enjoy the conference and the stay at Sundvollen.

Aksel Granhus and Johannes Breidenbach

Institutional sponsors



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Organizations supporting conference activities



A century of National Forest Inventories – informing past, present and future decisions

Programme at a glance

	Sunday	Monday	Tuesday	Wednesday	Thursday
08:00		Registration	Registration	Registration	
		Welcome	Keynote 3	Keynote 6	Excursion
09:00		Keynote 1	The value of international cooperation	Remote sensing based countrywide wide NFI products - nice to have or must have?	
10:00		History			
		Break, poster display and company exhibition	Break, poster display and company exhibition	Break, poster display and company exhibition	
11:00		Kaleidoscope	Ecosystem services and policy	Proximal sensing	
12:00		Lightning talks 1	Lightning talks 3		
		Lunch	Lunch	Lunch	
13:00					
		Keynote 2	Keynote 4	Keynote 7	
14:00		Inference	Carbon and mitigation	Inference	
15:00					
		Break, poster display and company exhibition	Break, poster display and company exhibition	Break, poster display and company exhibition	
16:00		Special Session by Erkki Tomppo: Multisource NFIs in the next decade – foundations for the way forward	Keynote 5	Modelling	
17:00			Ecosystem services		
		Lightning talks 2	Lightning talks 4		
18:00	Registration	Poster session and company exhibition	Poster session and company exhibition	Wrap up	
19:00	Icebreaker, poster display and company exhibition	Dinner	Conference dinner	Dinner	
20:00		Systematic night			
21:00			...		

Sunday 19th May

18.00 Registration

19.00 Icebreaker, poster display and company exhibition

Monday 20th May: Improving future NFIs by learning from the past

07.45 Registration

Welcome

08.15 Introduction, conference overview, and some statistics
Aksel Granhus and Johannes Breidenbach, NFI NIBIO

08.40 Long-term forest research and monitoring to support sustainable development
Nils Vagstad, Director of NIBIO

History

Co-chairs: Gerard Kändler and Gro Hysten

09.00 **Keynote: National level forest inventories
– of rigour and relevance at the science-policy interface**
Christoph Kleinn, Professor and head of the Forest Inventory and Remote Sensing team in the Faculty of Forest Sciences, University of Göttingen, Germany

09.45 100 years of NFI in Norway
Aksel Granhus

10.00 Major changes in the Nordic forests over the last 100 years – trends and maps based on National Forest Inventory data
Anna-Lena Axelsson

10.15 NFI in the USA: Development of the Forest Inventory and Analysis (FIA) program
Richard W. Guldin

10.30 ***Break, poster display and company exhibition***



NFI fieldworkers and their equipment in 1919. Photo: Aasmund Vigerust

Kaleidoscope

Co-chairs: *Adrian Lanz and Annika Kangas*

- 11.00 Bridging the gap: toward a French MS-NFI for territories
Jean-Pierre Renaud
- 11.15 Reflections from 35 years of National Forest Inventory in Germany: Challenges and lessons learned
Heino Polley, Thomas Riedel
- 11.30 The role of NFI sample plots and multi-temporal remote sensing for keeping forest management plans continuously updated
Håkan Olsson
- 11.45 Using Drone-based in situ data for estimating timber volume – a comparison with a field-based approach
Stefano Puliti
- 12.00 **Lightning talks I**
- 12.05 Modeling tree growth, harvesting and regeneration from National Forest Inventory data: A case study of Southern Belgium forest resources evolution
Perin Jérôme
- 12.08 The French NFI: flexibility at the heart of the design
François Morneau
- 12.11 Evolution of data acquisition and information processing technology in Poland's NFI
Andrzej Talarczyk and Longina Sobolewska
- 12.14 Using data from the Swiss National Forest Inventory to assess the economic efficiency of the Swiss forest road network
Marielle Fraefel
- 12.17 National Forest Inventory planning in Myanmar (Burma): Learning from past and present experiences and developing a demand driven NFI approach with a view on long term sustainability
Franz-Eugen Arnold
- 12.20 Half-century development of National Forest Inventory in Lithuania
Andrius Kuliešis
- 12.23 Using consecutive National Forest Inventories to validate StandsSIM regional forest simulator – a Portuguese application
Susana Barreiro
- 12.26 Management and economic potential of private forests at national level – Croatia case study
Karlo Beljan
- 12.30 **Lunch**



Inference

Co-chairs: Andreas Hill and Thomas Riedel

- 13.30 **Keynote: Use of auxiliary information in NFIs**
Göran Ståhl, Professor of forest inventory and Dean, Swedish University of Agricultural Sciences
- 14.15 Small area estimation on multiple scales – with a focus on stand-level estimates
Johannes Breidenbach
- 14.30 A small area estimation tool for FIA applications
Gretchen Moisen
- 14.45 Using airborne and satellite remote sensing to support forest inventory in interior Alaska
Hans-Erik Andersen
- 15.00 Usefulness of past inventory data as prior information in the future inventory
Annika Kangas
- 15.30 **Break, poster display and company exhibition**



NFI "data management" in 1937. Photo: Aasmund Vigerust



**Special session by Erkki Tomppo:
Multisource NFIs in the next decade – foundations for the way forward**

Co-chairs: Erik Næsset and Rasmus Astrup

- 16.00 Field plots and RS technologies – a common future for NFIs?
Klemens Schadauer
- 16.30 A primer on model-based inference for remote sensing-assisted forestry applications
Ron McRoberts
- 17.00 Remote sensing aided forest inventories – past, present and future
Erkki Tomppo
- 17.30 **Lightning talks II**
- 17.35 Tree species proportions and site index as an error source in forest management planning
Arto Haara and Annika Kangas
- 17.38 Revisiting the main attributes of Polish forests
Marek Jabłoński and Bożydar Neroj
- 17.41 Post-stratification based on satellite imagery for downscaling information on forest resources
Helena Haakana
- 17.44 Variance estimation of total growing stock volume in spatially balanced National Forest Inventory sampling
Minna Rätty
- 17.47 Standing volume and assortment estimation based on stem shape measurement and stem quality assessment
Martin Černý
- 17.50 Comparison of photogrammetric canopy models from archived and made-to-order aerial imagery in forest inventory
Sakari Tuominen
- 17.53 A large-scale forest dynamic model to estimate wood resources in the French forests based on NFI information
Audinot Timothée
- 17.56 Taper models as a basic concept for estimation of standing and merchantable volume – an example from the German NFI
Gerald Kändler
- 18.00 **Poster session and company exhibition**
- 19.00 **Dinner**
- A systematic night**
Co-chairs: Svetlana Saarela and Ron McRoberts
- 20.15 In search of a robust variance estimator for systematic sampling in forest inventories
Steen Magnussen
- 20.30 Local difference estimators of variance in systematic sampling
Juha Heikkinen
- 20.45 Evaluation of the new sampling strategy for the Swedish national forest inventory
Anton Grafström

Tuesday 21st May: NFIs today and in the future

07.45 Registration

The value of international cooperation

Co-chairs: Alexandra Freudenschuss and Stein Tomter

08.30 **Keynote: Importance of NFIs in the international context**

Anssi Pekkarinen, Head of the Global Forest Resources Assessment team, Food and Agriculture Organization of the United Nations, Rome, Italy

09.15 SAR DEM differencing for biomass estimation – potential for global applications
Svein Solberg

09.30 EFISCEN Space – a high-resolution, empirically-based forest simulator for Europe
Mart-Jan Schelhaas

09.45 Harmonisation of stem volume estimates in European NFIs
Thomas Gschwantner

10.00 The GFBI data center: Global-level integration of national and local forest inventories using BigData technology and advanced computing
Sergio de Miguel

10.15 Key outcomes of the H2020 project DIABOLO
Markus Lier

10.30 **Break, poster display and company exhibition**

Ecosystem services and policy

Co-chairs: Sara Franceschi and Klemens Schadauer

11.00 Using National Forest Inventory data to assess ecosystem service levels on public and private ownerships
Donald G. Hodges

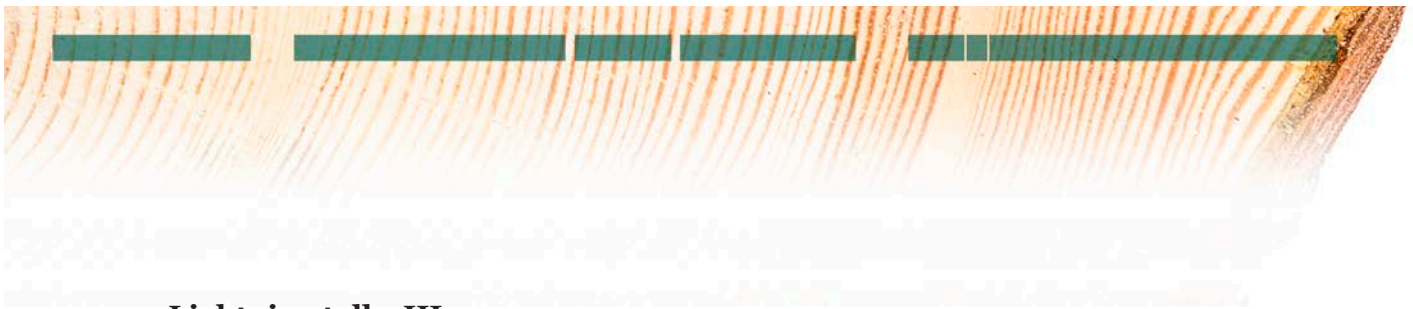
11.15 Integrating the risk of natural disturbances in forest management using NFI data
Olalla Díaz-Yáñez

11.30 NFI data – a proper source for policy analysis of future forest management?
Ljusk Ola Eriksson

11.45 Effect of forest management practices on forest biodiversity – analyses with NFI data
Kari T. Korhonen



NFI fieldwork in Eggedal 1978. Photo: Kjetil Vistad, NIBIO



12.00 **Lightning talks III**

12.05 Using National Forest Inventory data to model changes in tree species diversity in the southern United States

Andrew J. Hartsell

12.08 Trade-offs and synergies between preventing disturbances and the provision of ecosystem services in Swiss forests

Christian Temperli

12.11 Characterisation of forest types in the Iberian peninsula

Francisco Castro Rego

12.14 Two-phase estimation of wood productivity of poplar plantations in northern Italy exploiting Sentinel-2 data as auxiliary information

Agnese Marcelli & Piermaria Corona

12.17 Defining near-optimal harvesting techniques using Swiss National Forest Inventory data

Christoph Fischer

12.20 Predicting tree growth from a wide range of variables including climate and species mixing effects

Brigitte Rohner

12.23 Models of coarse woody debris dynamics based on the Finnish, Norwegian and Swedish NFI data

Tuomas Aakala

12.26 Use of sample cores collected in Romanian National Forest Inventory on forest trees growth study

Gheorghe Marin

12.30 **Lunch**

Carbon and mitigation

Co-chairs: Esther Thürig and Aksel Granhus

13.30 **Keynote: From NFI statistics to policy**

– What users need for climate reporting and MRV

Ellen Bruzelius Backer, Policy Director for Environmental Integrity at Norway's International Climate and Forest Initiative

14.15 Standing volume, dead wood and carbon dynamics in coniferous stands older than logging maturity age

Jogeir N. Stokland

14.30 Simulation of forest reference level under current management practice

– a Suisse case study for the greenhouse gas inventory

Esther Thürig

14.45 Continuous NFI as a monitoring system of CC impacts onto forest growth:

An exploratory analysis on coniferous tree species in France

Clementine Ols (Jean-Daniel Bontemps)

15.00 Using NFI-data and the Heureka system for evaluating the bioenergy potential in Swedish forests


Karin Öhman

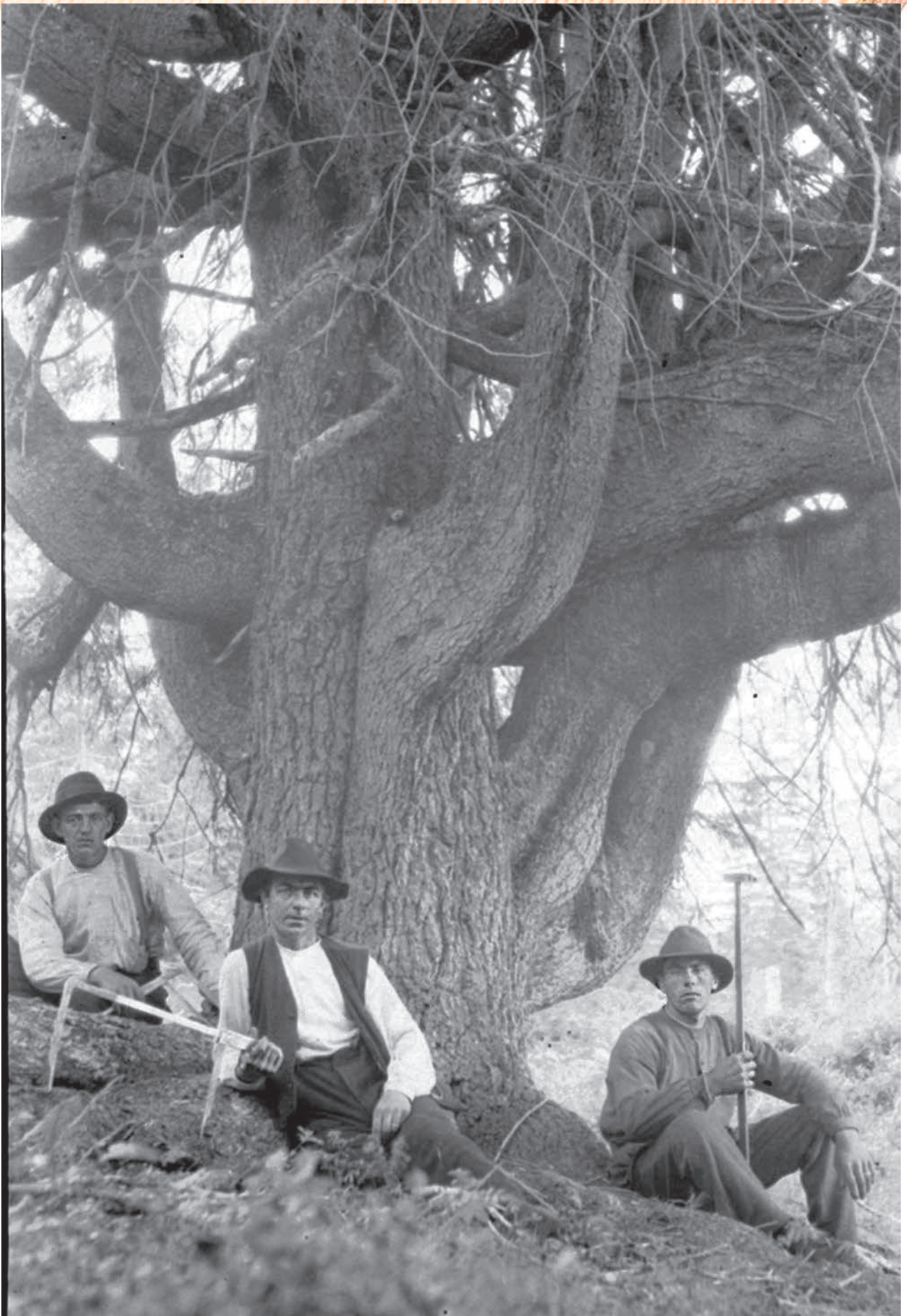
15.30 **Break, poster display and company exhibition**



Ecosystem services

Co-chairs: *Iciar Alberdi and Thomas Nord-Larsen*

- 16.00 **Keynote: Are NFIs ready for ecosystem services assessment?**
Gherardo Chirici, Associate Professor, chair of Forest inventory and remote sensing, University of Florence, Italy
- 16.15 Remote sensing based mapping and monitoring of natural forests in Norway
Hans Ole Ørka
- 16.30 Linking NFI to the sustainable urban development agenda – a new perspective for NFI reporting
Christoph Fischer (Anders Busse Nielsen)
- 16.45 Dead wood patterns in Mediterranean forests
Iciar Alberdi
- 17.30 **Lightning talks IV**
- 17.35 Biomass ratio varies along geographic gradients and forest stands composition: An analysis based on wood density data collected by the French NFI
Baptiste Kerfriden
- 17.38 Quantification of phenological observations of tree crowns with UAV-based multispectral imagery
Stuart Krause
- 17.41 Toward a complete C balance of forests for GHG inventories – data requirements for National Forest Inventories
Markus Didion
- 17.44 Comparison of various approaches of forest carbon estimation using National Forest Inventory data from Poland
Karol Bronisz
- 17.47 More than forest – monitoring amenity values in the Danish NFI
Thomas Nord-Larsen (Frank Søndergaard Jensen)
- 17.50 How much can airborne laser scanning based forest inventory by tree species benefit from auxiliary optical data?
Lauri Korhonen
- 17.53 The influence of outliers in image matching point clouds on estimating canopy height models and growing stock estimations
Christian Aufreiter
- 17.56 Effects of truncating the angle count sampling method on the proceedings of the Austrian NFI
Ambros Berger
- 18.00 **Poster session and company exhibition**
- 19.00 **Conference dinner**
Toastmaster: Marius Hauglin
- The difference between knowing and not knowing
Thomas Nord-Larsen
- 



NFI fieldworkers around 1938. Photo: Aasmund Vigerust



Wednesday 22nd May: Cutting edge and futuristic inventory techniques and technologies

07.45 Registration

Remote sensing based countrywide NFI products

– nice to have or must haves?

Co-chairs: Lars T. Waser and Helena Haakana

08.30 **Keynote: NASA Earth observation programs and NFIs**

– how can we achieve synergies?

Laura Duncanson, Assistant professor, University of Maryland, College Park, USA

09.15 Remote sensing based countrywide NFI products – must-haves or nice-to-haves?

Lars T. Waser

09.30 The Norwegian forest resource map SR16

Marius Hauglin

09.45 A new Swedish forest attribute map predicted using 3D data from aerial images and field data from the National Forest Inventory

Jörgen Wallerman (Mats Nilsson)

10.00 Mapping of potentials for biodiversity - ecosystem services at multiple scales

Vivian Kvist Johannsen

10.15 Time-series models for every single 10x10m-pixel of Austrian forests – Assessing dynamics on different temporal scales

Markus Löw

10.30 Estimating forest stock age using NFI field data and National Land Survey airborne laser scanning data of Finland

Matti Maltamo

10.45 ***Break, poster display and company exhibition***

Proximal sensing

Co-chairs: Stefano Puliti and Nataliia Rehush

11.15 XDM project, a new method for improving the quantification and mapping of the forest biomass

Jean-Michel Leban

11.30 Is there a role for terrestrial laser scanning in National Forest Inventories?

Mark J. Ducey

11.45 Applicability of terrestrial photogrammetry based on Structure from Motion for deriving plot-level forest parameters

Livia Piermattei

12.00 Toward the development of total volume and biomass functions using terrestrial lidar and NFI data

Olivier Bouriaud (Cédric Vega)

12.15 UAS-LiDAR supported forest inventories: possibilities and limitations

Hollaus Markus

12.30 ***Lunch***

Inference

Co-chairs: *Minna Rätty and Mark J. Ducey*

- 13.30 **Keynote: Mutualisms between Forest Monitoring and Forest Inventory**
Arne Nothdurft, Professor for Forest Monitoring and head of the Institute of Forest Growth at the University of Natural Resources and Life Sciences, Vienna
- 14.15 Spatial analysis of airborne laser scanning point clouds for predicting forest variables
Mari Myllymäki
- 14.30 Utilizing remote sensing data in Germany's National Forest Inventory
Sebastian Schnell
- 14.45 Design-based mapping of forest resources from two-phase inventories
Piermaria Corona
- 15.00 Mixed-effects models to generalize sample tree height information: implications to National Forest Inventories
Lauri Mehtätalo
- 15.15 Hierarchical model-based inference for biomass assessment using a fusion of remotely sensed data
Svetlana Saarela
- 15.30 Scalable pan-European model-assisted biomass estimation
Adrian Lanz
- 15.45 **Break, poster display and company exhibition**

Modelling

Co-chairs: *Arne Nothdurft and Clara Antón-Fernández*

- 16.15 Norway's forest reference level
Clara Antón-Fernández
- 16.30 Development of forest reference levels and national forestry accounting plans: the implications for forest and land use policy in Lithuania
Gintaras Kulbokas
- 16.45 Using the 3PG model to project forest dynamics under different scenarios. An application to the Portuguese production forest using NFI data as input
Margarida Tomé
- 17.00 What data accuracy suffices for stand management decisions?
Jari Vauhkonen
- 17.15 Modelling ingrowth for empirical forest prediction systems
Jürgen Zell
- 17.30 A Monte Carlo simulation approach to estimate historical forest-related GHG emissions in Fiji
Philip Mundhenk
- 17.45 Effects of different Swiss NFI sampling designs regarding tree regeneration on assessing ungulate browsing
Andrea D. Kupferschmid
- 18.00 Wrap up
Chair: Rasmus Astrup



- 19.00 **Dinner**



Posters

Analysing the reproducibility of Swiss NFI field survey measurements

Berthold Traub

Harmonisation of NFI information to characterize the vertical structure of forest fuels at the European scale

Leónia Nunes

Using radio positioning for mapping trees on sample plots

Pekka Savolainen

Deadwood dynamics – a bayesian approach for turnover estimation

Markus Didion

National Forest Inventory design in Poland

Andrzej Talarczyk, Stanisław Zajczkowski, Longina Sobolewska and Bożydar Neroj

Regional Harvest, Stocking, and Sustainability in a Complex Forest: What Can We Learn from NFI Data?

Mark J. Ducey

A flexible technology solution for multiple NFI programmes

Martin Černý

Effective forest inventories in small private forests – identifying and describing climate sensitive forest stands

Matthias Dees and Johannes Rahlf

Application of bio-geophysical methods in precise forestry

Majewski Robert

Forest resources monitoring using permanent sample plots from the National Forest Inventory in South Korea

Jongsu Yim

Integration of Small Area Estimation in Forest Management Planning

Andreas Hill

Terrestrial laser scanning for assessing ecologically relevant stem structures

Nataliia Rehus

Using TLS data for volumetric modelling – experiences from Finland

Timo P. Pitkänen

The Swiss National Forest Inventory: statistics and mapping

Adrian Lanz

The effect of climate and topography on the spatial distribution of boreal peatland

Jogeir N. Stokland

A generic Markov chain model to simulate the development of forest resources observed by the NFIs

Jari Vauhkonen

Long-term expansion in the growing stock of the French forests, an analysis based on National Forest Inventory statistics and ancient forest censuses

Clementine Ols (Jean-Daniel Bontemps)

Using TLS data for volumetric modelling – experiences from Finland

Timo P. Pitkänen

The multi-objective Spanish National Forest Inventory

Iciar Alberdi



Thursday 23rd May: Field trip

During the field excursion day, crews from Norway, Sweden, Finland, Denmark and Iceland will demonstrate how specific measurements and assessments are done in the different Nordic NFI's. The demonstrations will take place in the forest near Ringkollen, about half an hour with bus from the conference venue. Ringkollen belongs to the larger Krokskogen forest area, and is a popular starting point for many recreational visitors, also during winter as the area offers excellent opportunities for cross-country skiing. The area is situated ca. 600 m a.s.l and is dominated by Norway spruce, but Scots pine and stands with birch admixed are also common.

The concept of the demonstrations will be that the participants on the excursion will be split into five groups, which will circulate between the different "country posts" according to a time schedule allowing for one hour per group and post. Themes to be covered will be:

- Visualization of inventory design, plot sizes etc.
- Methods for measurement of dead wood
- Assessment of growing stock and increment
- Assessment of biodiversity/ecological value/other ecosystem services
- Assessment of need of silvicultural treatment and wood quality

Lunch will be served at the local Restaurant Ringkollstua, where we may enjoy a meal composed of local game meat.

There will also be the possibility to get more information about the products of the conference' sponsors.

The field trip will end at Sundvollen at 16:00 hours. One bus will go directly from Ringkollstua to Gardermoen airport, expected arrival time of 16.45. The regular airport shuttle leaves from Sundvollen at 16.05 and arrives at Oslo Gardermoen airport (OSL) at 17.45. Please notify the registration desk, in case you intend to use any of the shuttles.



NFI field trip around 1940. Photo: Aasmund Vigerust

Practicalities at the conference

Registration

The registration desk is in the conference lobby and is open throughout the conference to help you in case of any questions.

Name badge

Please wear your name badge during the conference. This makes contact with others easier and serves as an entrance ticket to the conference hall.

Mobile phone and internet

Due to respect for others, we kindly ask you to switch off or mute your mobile phone in the conference hall. WiFi is free of charge and available throughout the hotel area. The conference website is <https://nibio.pameldingssystem.no/nfi100years>. Stay tuned by following @NFI100 on Twitter.

Staying in the hotel

Check-in and check-out (before 10.00) is handled by each participant individually. If you participate in the field trip and do not stay in the hotel until Friday, please check out in the morning. Breakfast is served 7.00-9.00.

Icebreaker

You will receive one drink voucher at registration. Other drinks have to be settled individually. Tapas and snacks will be served.

Conference dinner

An aperitif, a beer or glass of white wine for the starter and two glasses of red wine with the main course are included. Other drinks have to be bought individually. Dress code is smart casual.

Field trip

The busses will leave 8.15 from the hotel. Please check out in the morning in case you do not stay in the hotel until Friday. In the field, we will be five groups. Your excursion group number is printed on your name badge

After the programme at Ringkollen, one of the busses will go directly to Oslo Gardermoen airport (OSL) with an expected arrival at 16.45. Please inform the registration desk in case you would like to use this bus. For the other participants, the field trip ends at Sundvollen at 16.00. An airport shuttle leaves from Sundvollen at 16.05 and arrives according to plan at Oslo Gardermoen airport (OSL) at 17.45. Please note the registration desk, in case you intend to take the shuttle.

Parking

Parking at the hotel parkinglot is free of charge for all conference participants.



Photo: Kjetil Vistad, NIBIO, 1978.