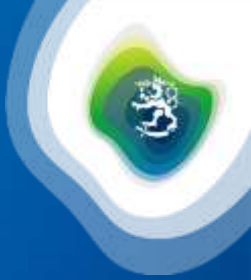


Forest monitoring in Finland

Forest Academy for Decision Makers

Erno Järvinen
Ministry of Agriculture and Forestry of Finland
Senior Ministerial Adviser, Head of Forest and Bioenergy unit
21st September 2023
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Two inventory systems in Finland



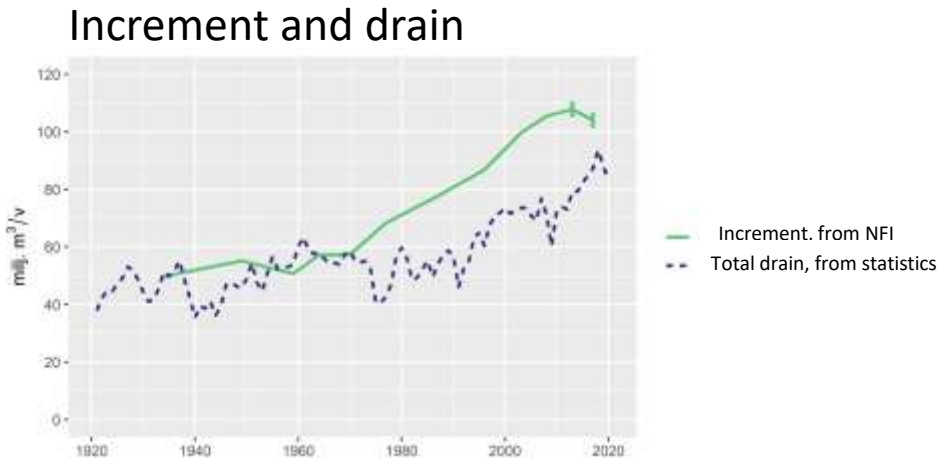
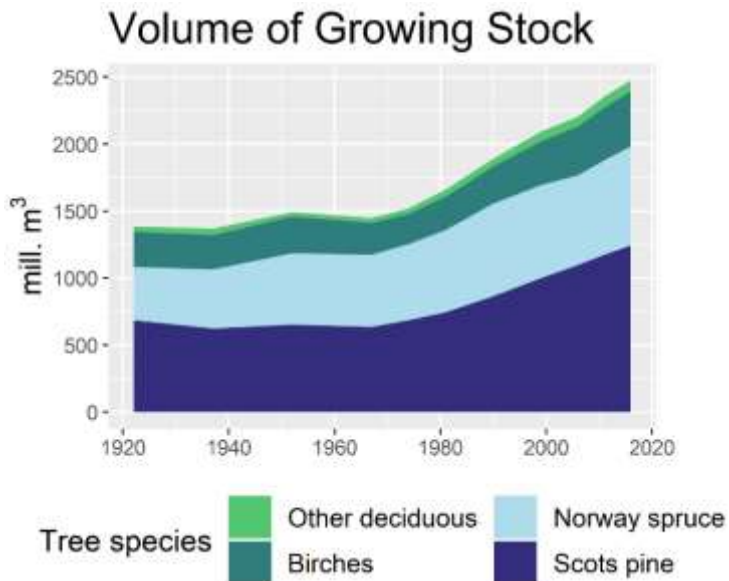
- **National forest inventory (NFI)**
 - For regional and national statistics & policy planning
 - Implemented by Natural Resources Institute Finland (Luke)
 - Statistical sampling & satellite images

- **Forest management inventory**
 - For operational forestry: silvicultural decisions at stand level
 - Implemented by Finnish Forest Centre + companies
 - Airborne LiDAR, aerial photography & ground truthing

Statistical sampling is the base of NFI

- NFI provides unbiased mean/total estimates and their reliability in **regional and country-level**
- NFI requires detailed field measurements, e.g.
 - Site and soil data for the modeling of soil carbon
 - Forest type & Natura habitat classification
 - Naturalness
 - Tree age, increment
 - Damages, causing agents etc.
- Sentinel satellite images are used to improve the accuracy of statistics (post-stratification)
- Long time series information
- Based on permanent and temporary sample plot data field measurements
- Complementing public maps of the basic forest variables based on satellite imagery

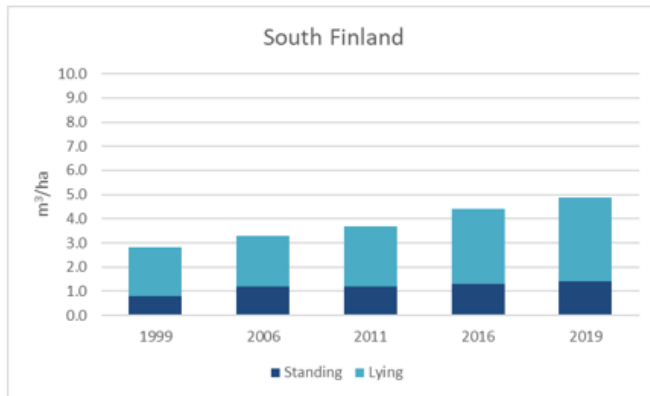
Base line information on forest resources



NFI produces forest biodiversity relevant data 1*



Volume of dead wood



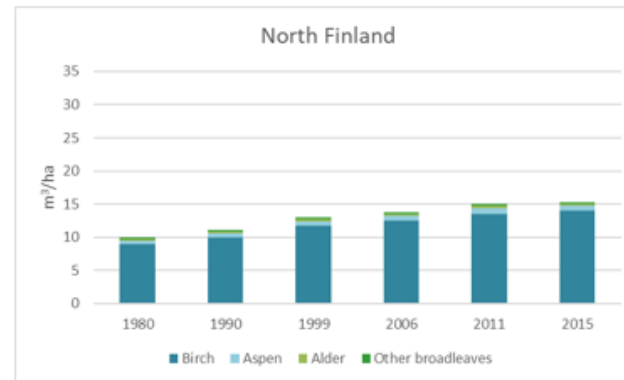
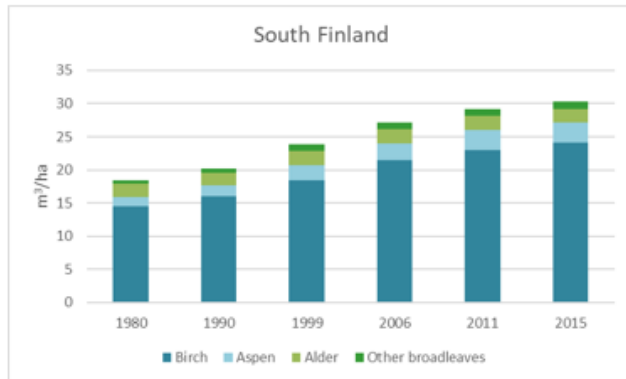
*Based on report:

Korhonen, K.T., Ihalainen, A., Kuusela, S., Punttila, P., Salminen, O., Syrjänen, K. 2020. Metsien monimuotoisuudelle merkittävien rakennepiirteiden muutokset Suomessa vuosina 1980–2015. Metsätieteen aikakauskirja 2020: 26 s. [Development of forest biodiversity indicators in Finland 1980 – 2015. In Finnish]

NFI produces forest biodiversity relevant data 2



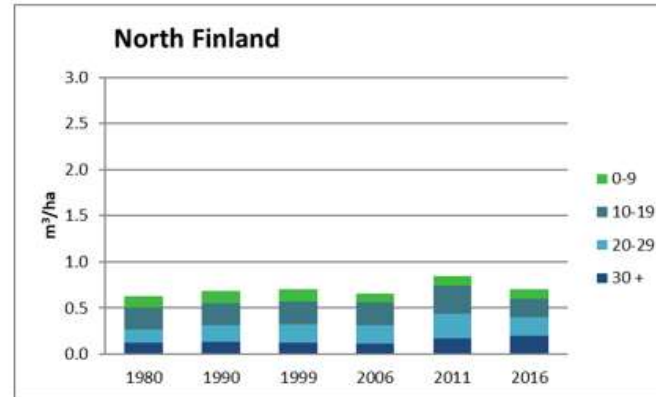
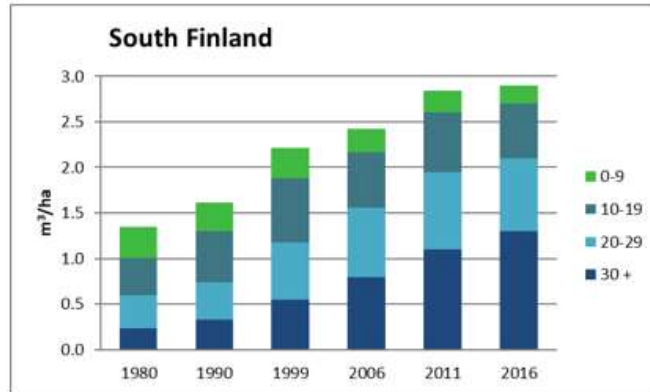
Volume of broadleaved trees



NFI produces forest biodiversity relevant data 3



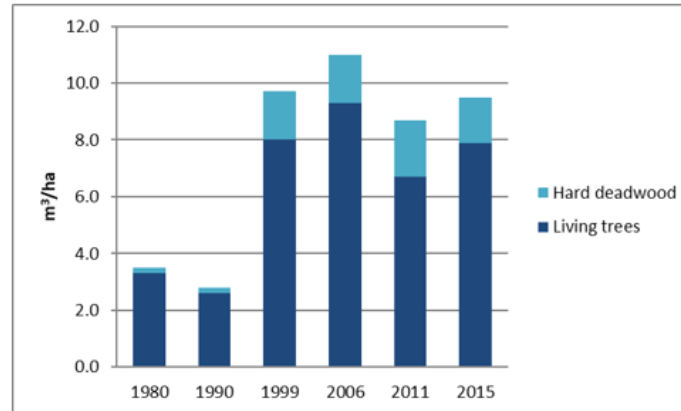
Volume of aspen by diameter class



NFI produces forest biodiversity relevant data 4



Volume of retention trees on clear cut sites



European NFIs cooperate: ENFIN



www.enfin.info

ENFIN to support European forest monitoring system

- NFI data can be harmonized to produce relevant information at European level
- Continuous cooperation of NFIs is necessary to guarantee flow of relevant data from NFIs to data users
- Luke is ready to strengthen the institutional status of ENFIN to facilitate this development



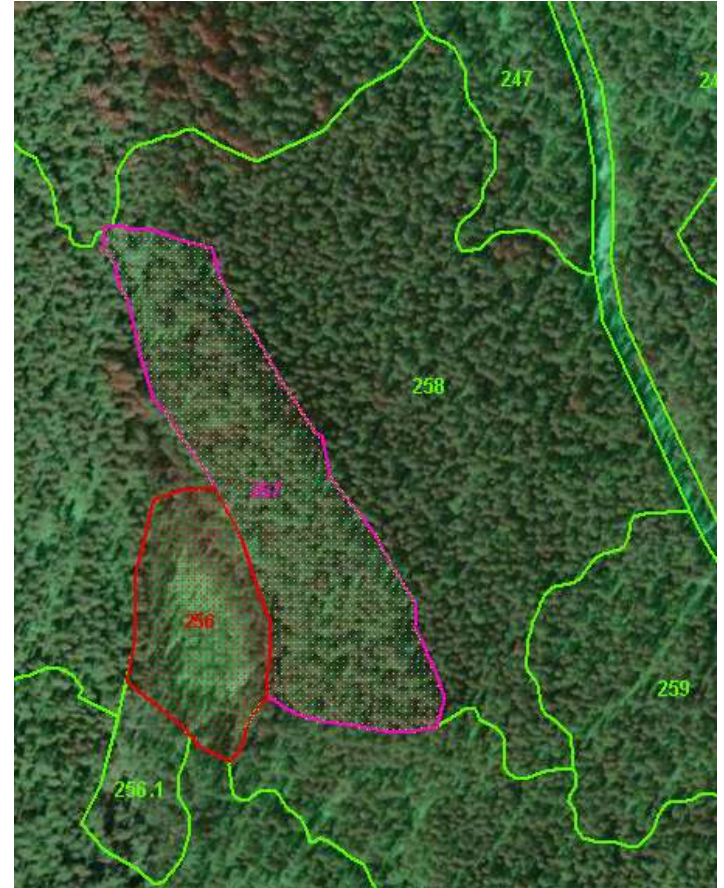
Forest management inventory in Finland

- Finnish Forest Centre provides open Forest data to forestry sector in Finland.
- Remote sensing based forest inventory data (standing timber estimates to stand level):
 - 22 inventory areas/year. ~800 field reference sample plots are measured from each area.
 - Airborne LiDAR 5 points/sqm
 - Aerial Photos 40 cm gsd
 - Non-parametrical statistical modeling between the air and field data. Every area gets its own modeling.
- Stand level forest data is kept up to date between inventories.
- National Forest Data Standardization



Product

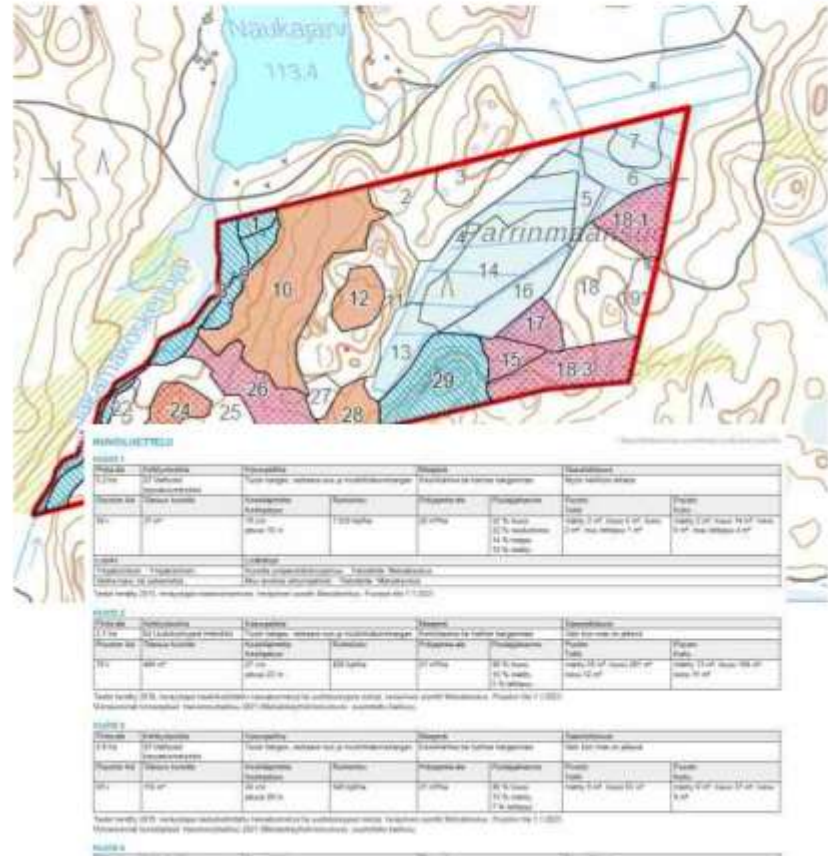
- Accurate standing timber estimation (16 by 16 meter grid, forest stands)
 - Total volume +- 9-11 % (RMSE%)
 - DBH +- 7-9 %
 - Density +- 8-10 %
 - Height +- 3-5 %
- Keeping data up to date
 - Simulation of growth and forestry operations
 - Updating of forestry operations (data from harvesters, other data sources)
- Environmental values are also included. With these fieldwork is still needed.
- Other products: CHM or harvestability maps (carrying capacity of the soil).
- Estimated benefits are way bigger than the cost of this inventory.
- <https://arcg.is/1jCLmb0>



Using forest inventory data to promote sustainable use of forests



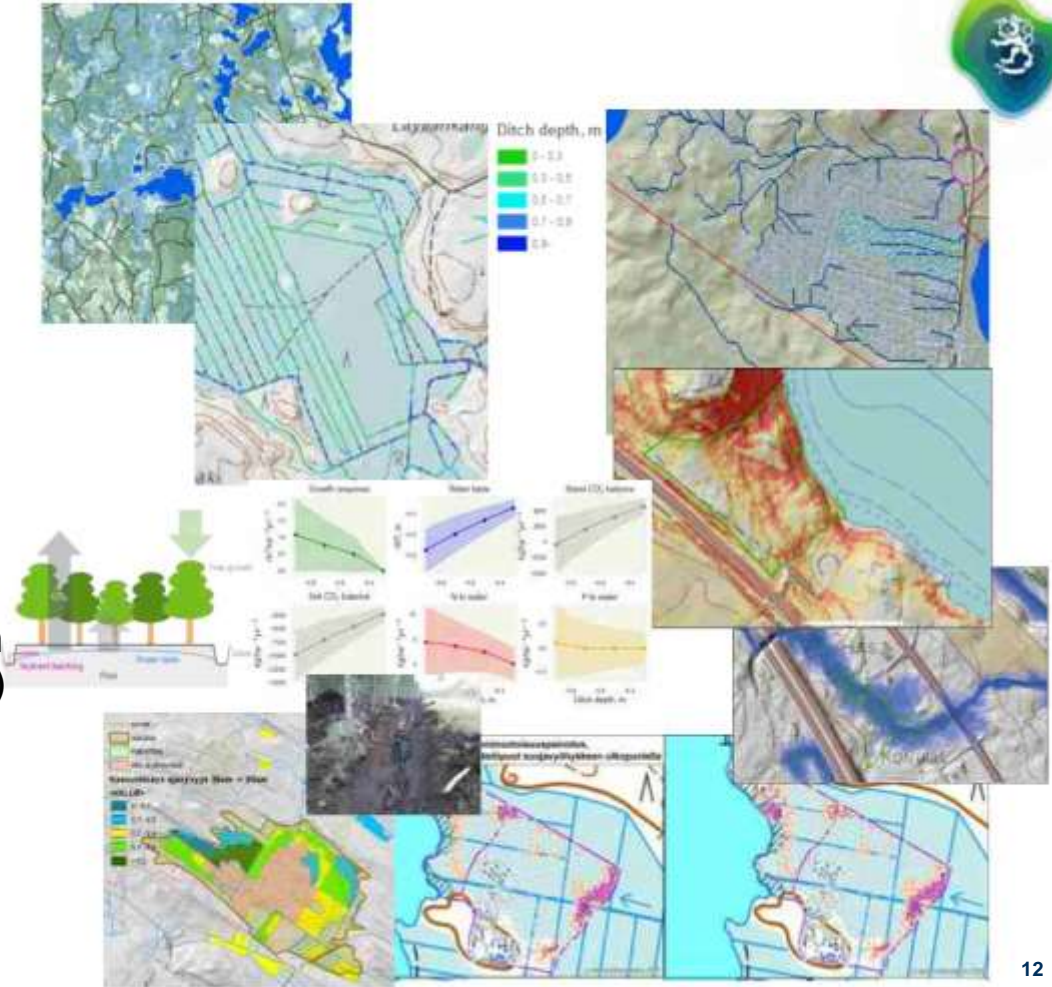
- Each compartment contain information of:
 - Volume, tree species, height, diameter, age, soil type, fertility
 - Next management operations during next five years based on common forest management guidelines
 - Tree stock growth & development is simulated each year after inventory, taking into account known harvesting operations -> up-to-date forest data
 - Provides basic information for drafting forest management plans with additional field data and owner specific targets and management strategies
 - [Metsään.fi](https://www.metsa.fi) e-service for private landowners: Detailed information, self-service interface for forest use declarations, state aid applications etc.





Further analysis

- Lidar-data derived modelling examples:
 - Flood risk maps
 - Machine learning based automated channel & trickle location and properties identification and classification
 - Soil trafficability maps
 - Peatland forest management, maintaining adequate drainage, controlling hydrology
 - Risk maps for pesticides outbreaks in forest (detection of fallen tree groups)
 - Forest fire and wind damage risk maps
 - Biodiversity in harvesting operations, retention tree groups optimization
 - Erosion prevention and varying width buffer zones along water courses



Other Use applications of Forest Inventory data

- Forest Inventory data is widely in use for different purposes in Finland
 - Wood Procurement
 - Timber trade in the web
 - Optimization of logging actions (John Deere Timbermatic)
 - Baseline data for forest planning
 - Marketing of forestry services
 - Real estate brokerage
 - Assessment of real estate value (<https://www.op-metsa.fi/>)
 - Banking
 - Planning of investments
 - Protecting environmental sites in forestry actions
- Globally our inventory data is the most accurate and spatially and temporally most comprehensive



Thank you for your attention

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