The future of monitoring forest biodiversity

– the monitoring of habitats in Finland

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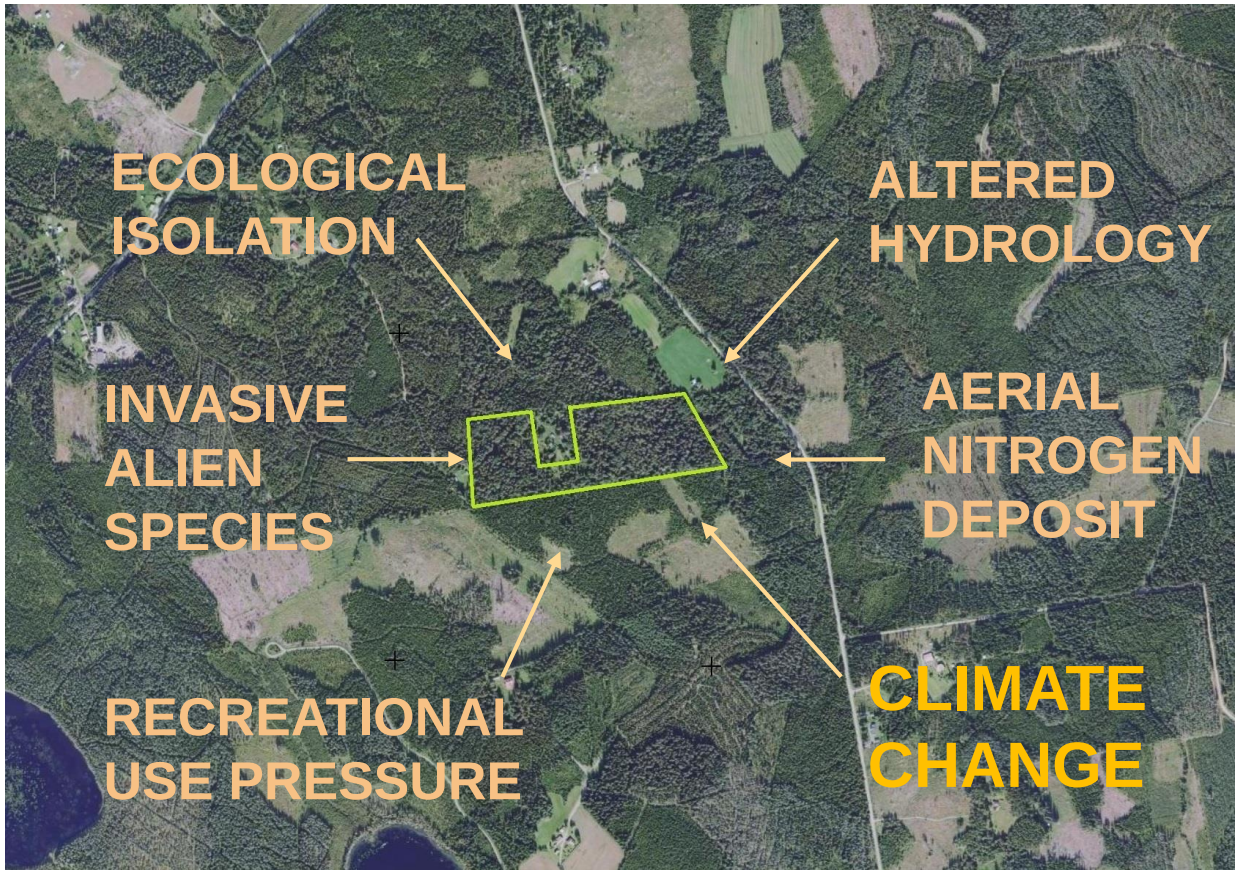
Why do we need monitoring of forest habitats?

Monitoring data → the basis for common understanding → public discussion & policy making

- In the modern era of anthropocene, all ecosystems and their functions are under direct and indirect human influence – even in protected areas
- Through research and observations from the field, we have *qualitative* understanding of the undergoing changes…

  …but we largely lack *quantitative* measurements on a large scale, and long-term monitoring programmes for them
- The climate change will inevitably lead to *changes that are still largely unknown and hard to predict*



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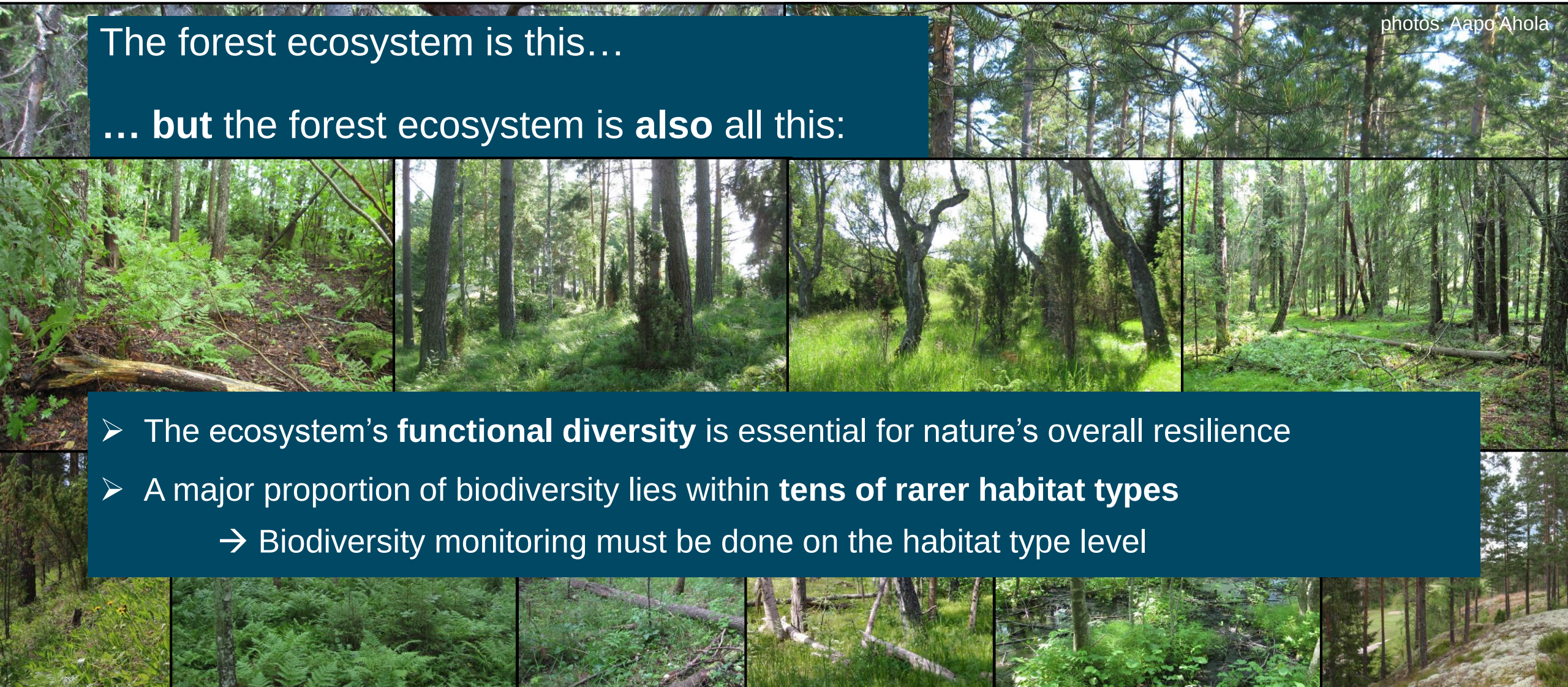
Remotely monitoring on a country level is not enough



photos: Aapo Ahola

The forest ecosystem is this…

… **but** the forest ecosystem is **also** all this:

- The ecosystem's **functional diversity** is essential for nature's overall resilience
- A major proportion of biodiversity lies within **tens of rarer habitat types**

  → Biodiversity monitoring must be done on the habitat type level

Monitoring requires several systems that are complementary to each other

- Field monitoring is essential
  - Many habitat types and many ecological variables can only be reliably measured in the field
  - Accurate ground validation data is essential for remote sensing
- NFIs have limitations due to the fact that they were built for different purposes
  - NFI sampling system cannot cover the more uncommon habitat types
  - NFI personnel is not trained to register ecological variables or species

→ We are developing NFI with new bd variables

→ Training for NFI field personnel

→ Need for a **complementary field monitoring system**

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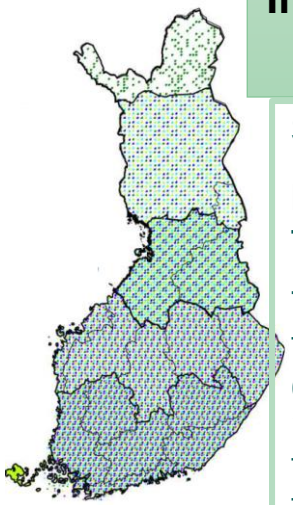
Forest biodiversity monitoring infrastructure: 3 systems

Ground data for validation & AI learning

NFI

National Forest Inventory



Systematic sampling

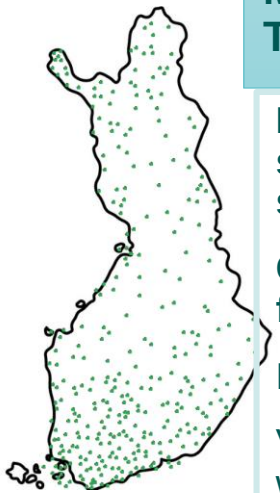
Most common forest types well represented

The only existing long-term, spatially and qualitatively inclusive monitoring infrastructure for terrestrial habitat types

More biodiversity variables to be included from 2024-

GFM

General Field Monitoring of Habitat Types



Random stratified sampling + targeted sampling

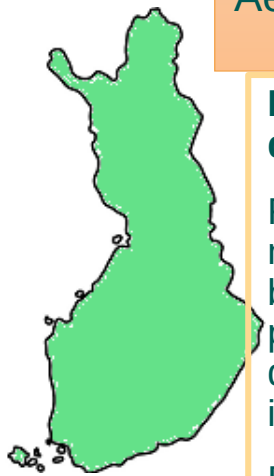
Covers uncommon forest habitat types

Not in operational use yet

Variables harmonized with NFI
+ extra biodiversity variables for special habitat types

Remote Sensing

Aerial & satellite



Nationwide, wall-to-wall datasets

Finland is launching a national co-operation to better coordinate the production of both input datasets & output indicators

European collaboration for harmonization & development is vital

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Identifying the essential biodiversity variables
& harmonizing the methods for measuring them

Forest monitoring
Directive Annex I habitats monitoring
Restoration Act monitoring
National status assessment monitoring

- Grassland habitats
- Mire habitats
- **Wooded habitats**
- Coastal habitats
- Freshwater habitats
- Rocky habitats
- Alpine habitats

- General locus variables
- Tree and stand variables
- Vegetation & soil variables
- Hydrology & topography
- Human impact variables

- Naturalness of stand composition
- Amount and continuum of dead wood
- Decaying branches of broad-leaved trees
- Canopy layers, dominant species for each layer + other species, middle height of each layer, average diameter/species, number of stems
- Bd-enriching microhabitats: dead canopies, cavities, scars, resin...
- Basal area per species
- Bushes and tree saplings
- Old and thick trees
- Horizontal distribution of trees
- Number and diameter for rare broad-leaved tree species
- Old stumps
- Marks of old forest fires
- Canopy shares of spruce, pine and broad-leaved trees
- Stand height and height variance
- Forestry activity
- Total canopy area
- Detecting forests with a single canopy layer
- Overgrowth, emerging of new trees
- Occurrence of natural disturbances (biotic, flood, wind, dryness...)

NFI

National Forest Inventory

Habitat types: Heaths, heaths on peaty soil, part of wooded peatlands

GFI

General Field Monitoring of habitat types

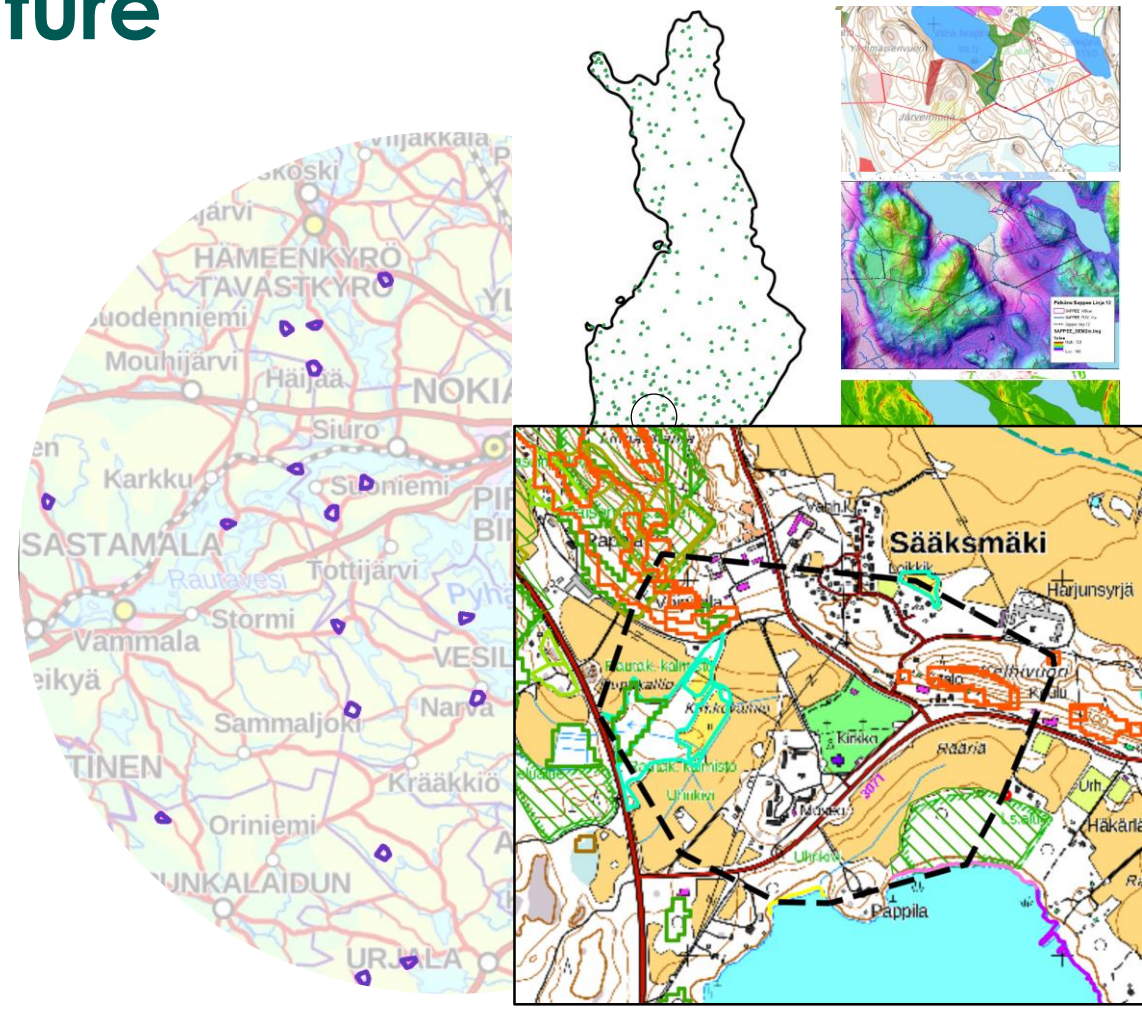
All habitats excluding heaths & heaths on peaty soil

Remote Sensing

Designing the General Field Monitoring of Habitat Types, a new infrastructure

Projected timeline for the development:

- 2021–23 Identification of monitoring variables
- 2022–24 System design, sampling, statistical testing
- 2024–27 Field monitoring methods, data management system
- 2025–2027 Apps, setup for data storage
- 2027–2029 Operational use



Collaboration with Sweden's **NILS** monitoring programme, https://www.slu.se/centrumbildningar-och-projekt/nils/

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Estimated costs for the forest biodiversity monitoring

NFI National Forest Inventory	GFM General Field Monitoring of Habitat Types	Remote Sensing Aerial & satellite
Investment costs (Development & setup phase)		
0.2 – 0.4 M€ *	**1.8 – 4.0 M€**	**0.6 – 1.8 M€**
Running costs / year		
0.4 M€ *	**0.4 – 0.8 M€ ****	**0.1 – 0.4 M€**

*) the new biodiversity variables to be added to the current NFI inventory

**) estimated costs for wooded habitats

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Summary and call for action

– for proper monitoring of biodiversity in forest ecosystems:

- **Set up and coordinate a combination of 1) National Forest Inventory, 2) Remote Sensing, and 3) a complementary field monitoring system targeted for biodiversity & rare habitat types.**
  - Many essential variables can only be observed through field inventory.
  - Availability of accurate ground validation data is a bottleneck for the implementation of new remote sensing methods.
  - The design of the sampling system is essential.
- **Invest in a complementary, systematic field monitoring of ecosystems – in Finland, *the General Field Monitoring of Habitat Types*.**
  - Biodiversity deserves similar rigorous and ambitious monitoring systems that we have for natural resources.
  - A well designed monitoring system can be achieved with a reasonable budget.
- **Identify the essential biodiversity variables and the methods for measuring them.**
  - Harmonize the variables & methods between different monitoring systems; incorporate them in the national NFIs.
- **Coordinate the use of the rapidly expanding remote sensing methods.**
  - Invest in the availability & homogeneity of input datasets (optical imagery, SAR & LIDAR, land use information).
  - Develop & harmonize automated protocols from input data to output products & indicators (involving AI & deep learning).

Thank you

Development of habitat type monitoring in Finland

Projects: LUSEK, LYSEK, FEO, NFI

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