Forest SOC monitoring in Sweden – challenges and needs for the future

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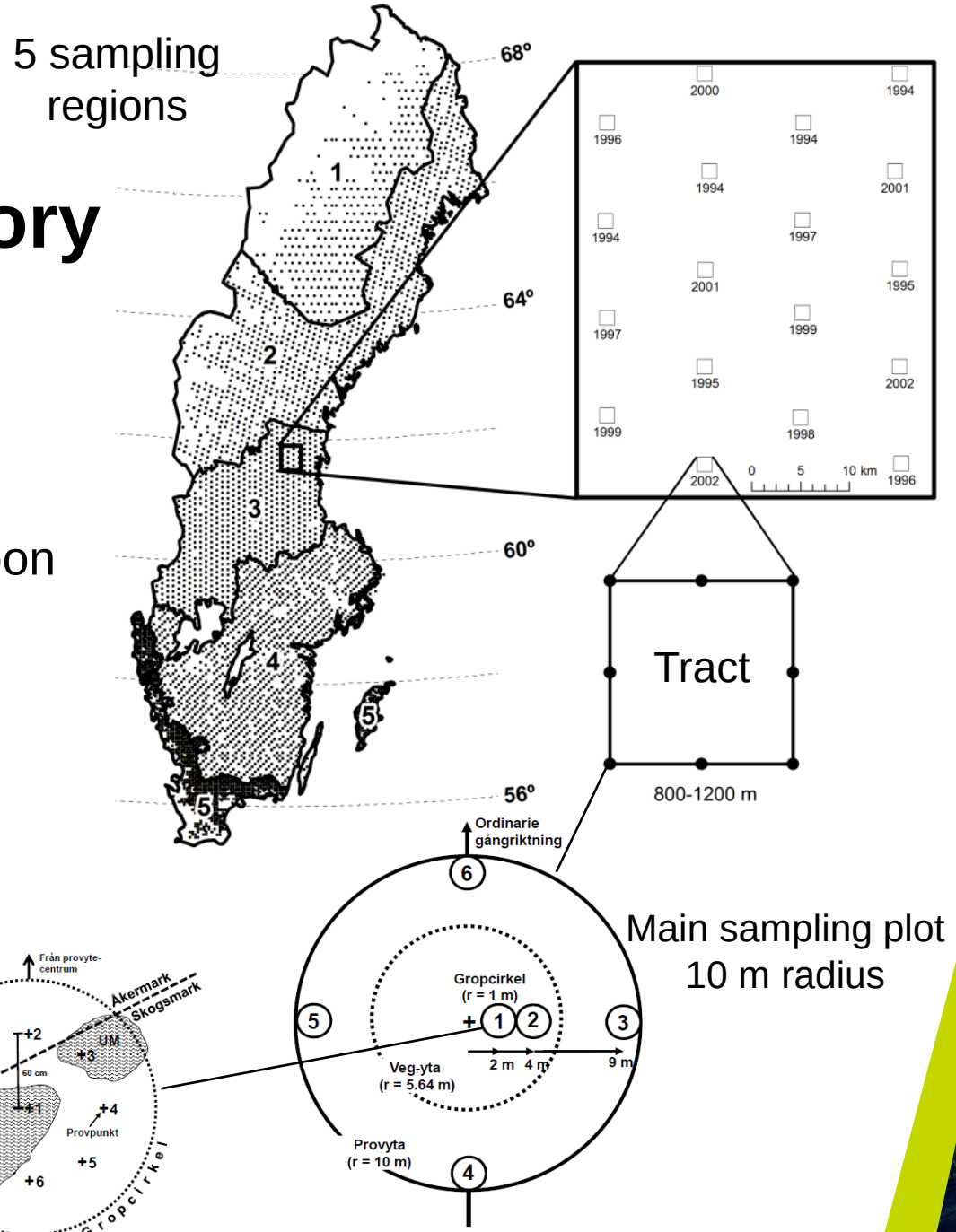
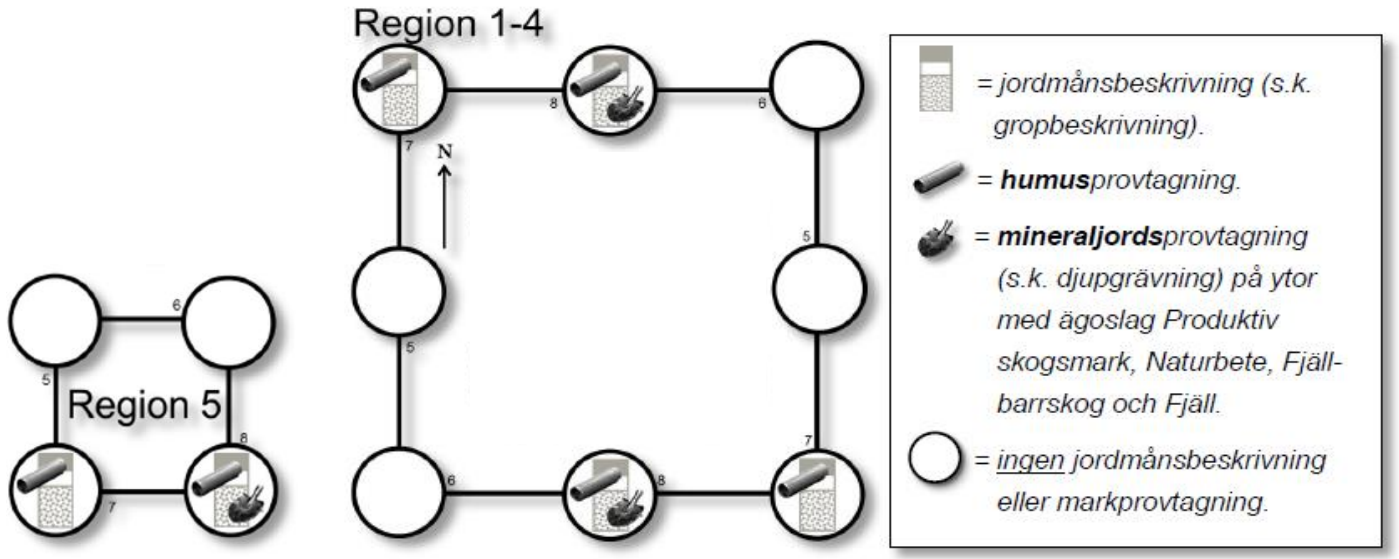
Swedish Forest Soil Inventory

- Initiated in 1983
- Permanent plots of the NFI
- Monitors site productivity, acidification & carbon
- Soil fungal biodiversity since 2015
- Forest land, wetland, grassland, mountain areas (not arable land, mountains)
- 10 year inventory interval



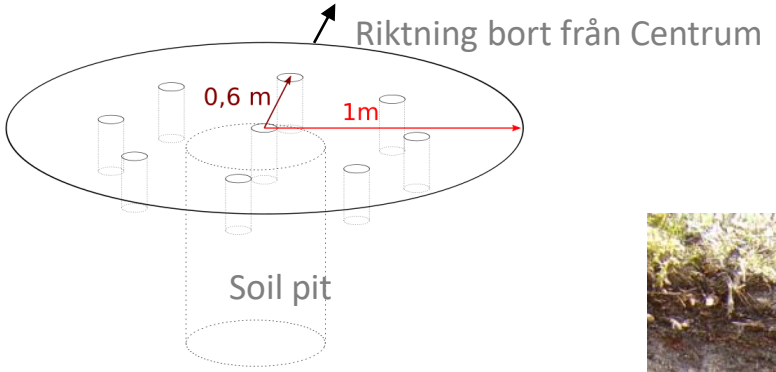
Inventory tracts

- 8 plots per tract (4 plots in southwest)
- Size: 800 – 1200 meters (region 1-4), 300 meter (region 5)
- Sampling
  - Topsoil on 50% of the plots (~10 000)
  - Mineral soil on 25% of the plots (~4500)



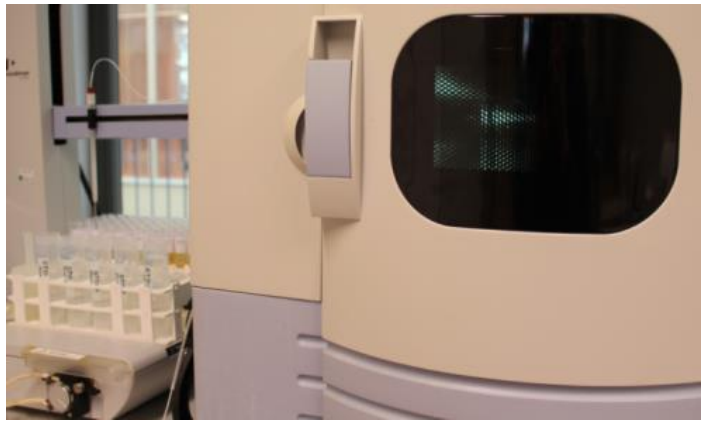
Soil sampling (2003-)

- 3-5 samples depending on soil type
- Topsoil sampled with auger (to max 30 cm)
- Mineral soil in small pit (w. small spade)
  - Bulk density by pedotransfer functions
- Peat sampling at two depths
  - 0-30 cm and 40-50 cm



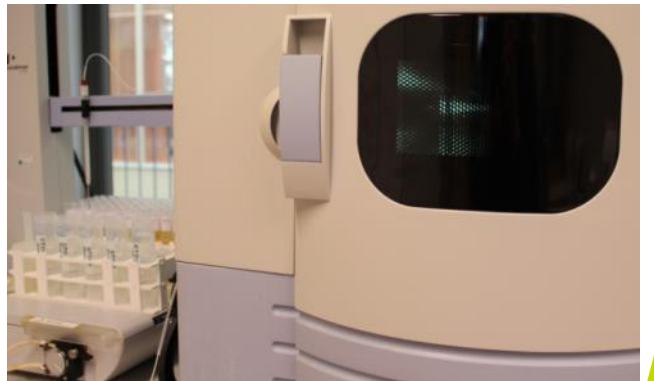
Sample preparation

- Totally ca 2000 soil samples/year
- Samples dried 3-6 months (ca 35 °C)
- Sample preparation
  - Milling of topsoil samples
  - Sieving of mineral samples
  - Fine and coarse fraction separated (2 mm)
- Archiving of soil samples

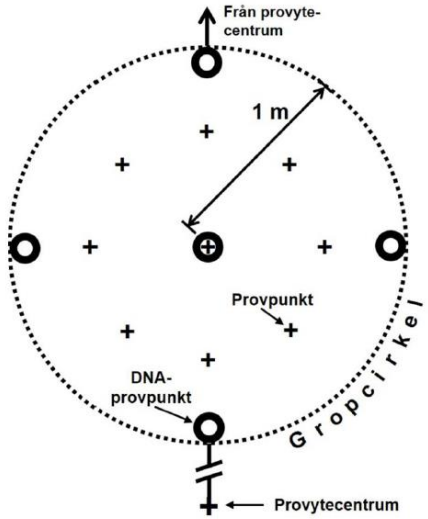


Soil chemical analyses

	Approx.no./year
Dry substance (105 °C)	2000
pH (H_2O)	2000
pH ($CaCl_2$)	2000
Total C, N, S (Dry combustion)	2000
Base cations (NH_4Ac extraction, ICP/AES)	1500
Al (KCl extraction, ICP/AES)	1500
pH (KCl)	1500
Total Acidity (NH_4Ac extraction)	1500
	Totally ca 14 000/year



DNA based fungal inventory since 2015



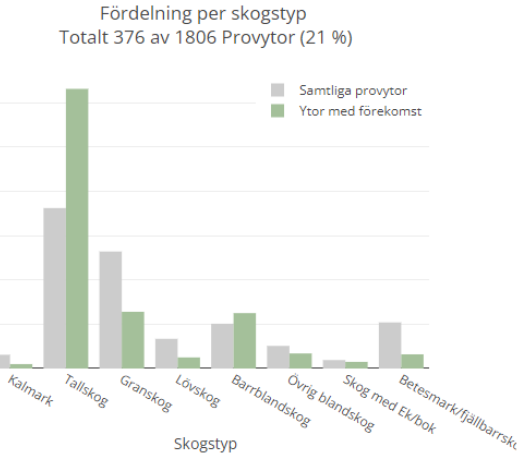
Sampling

DNA-extraction

PCR amplification of fungal “barcodes”

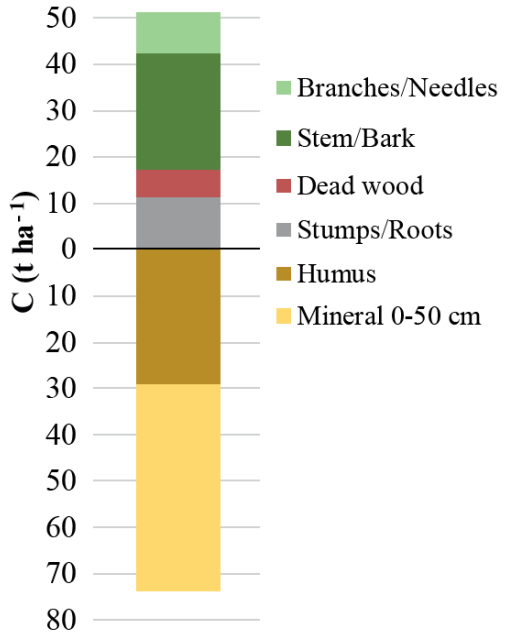
Sequencing (PacSequel)

Miljödata – *Boletales*

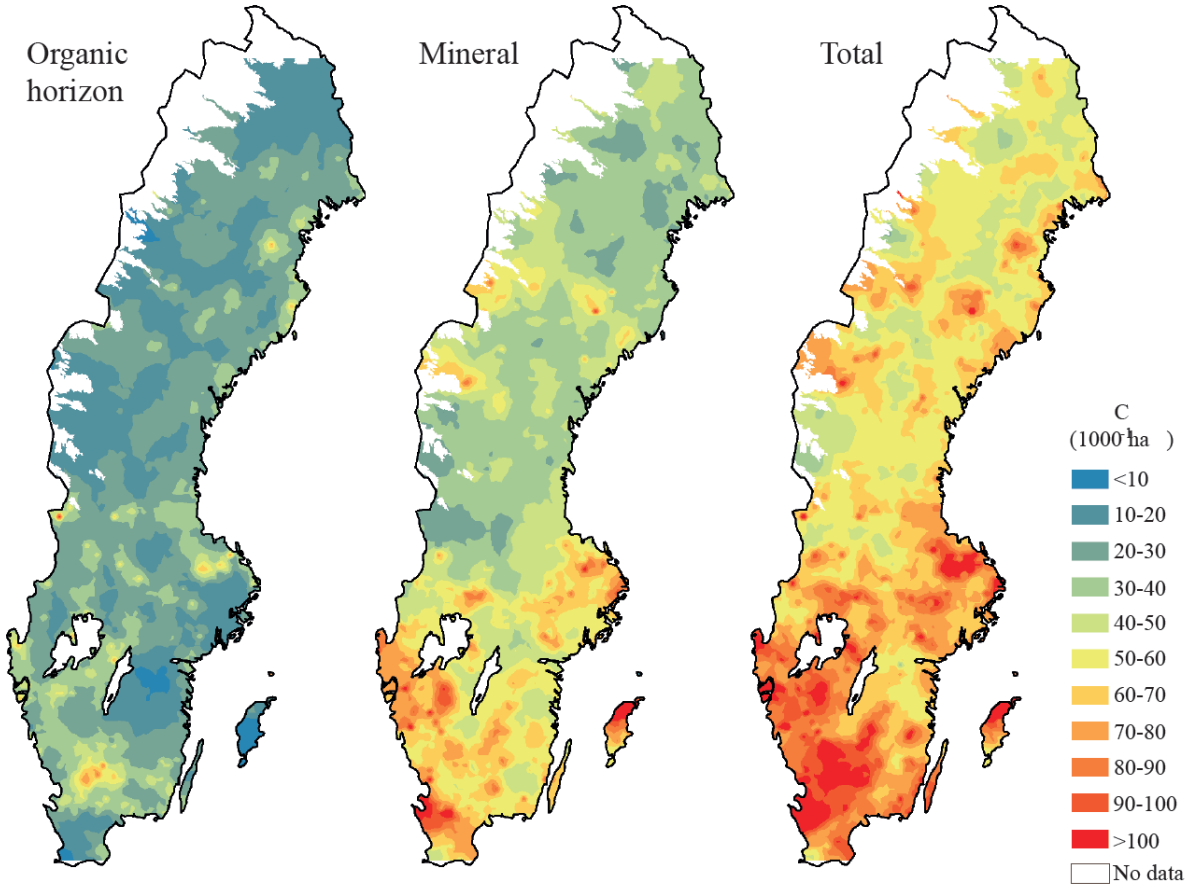


Carbon stocks of Swedish forest soils

- Productive forest land
- Non-organic soils



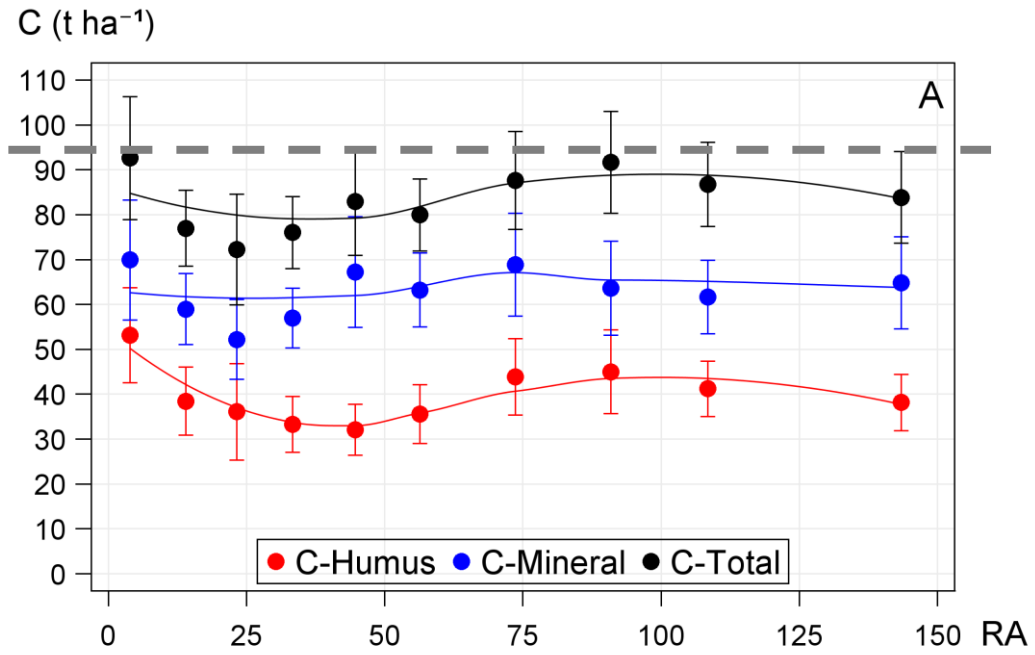
The Swedish Forest Soil Inventory
NFI Annual Report 2017



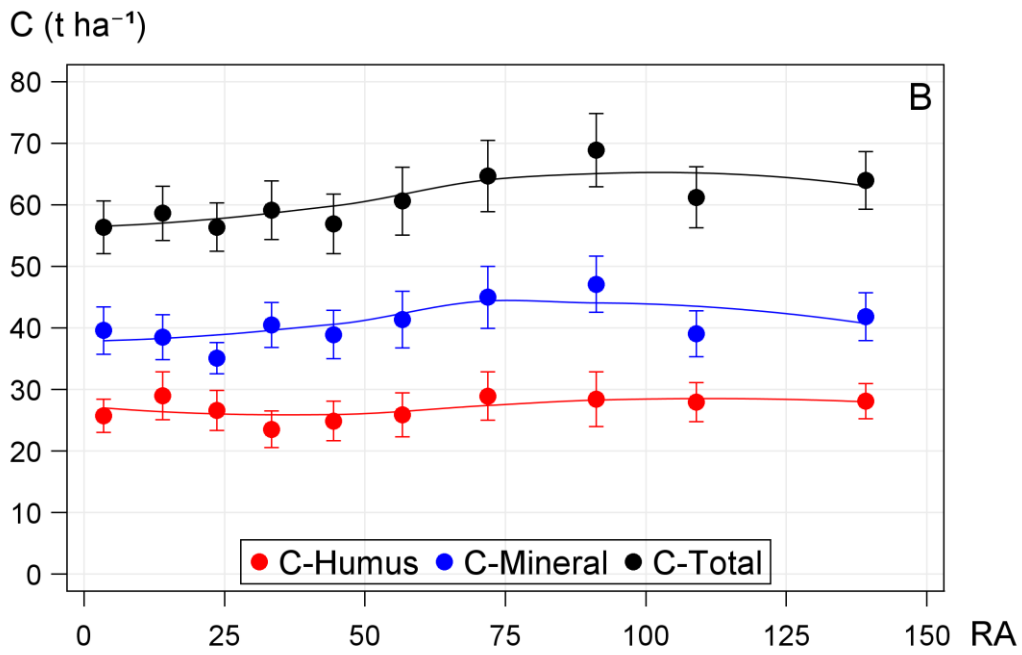
C-stock dynamics over stand age classes

- Initial reduction – less input, faster decay
- Recovery of sink after reforestation
- Moderat decline in C-stocks
- No increase in old forests

Southern Sweden



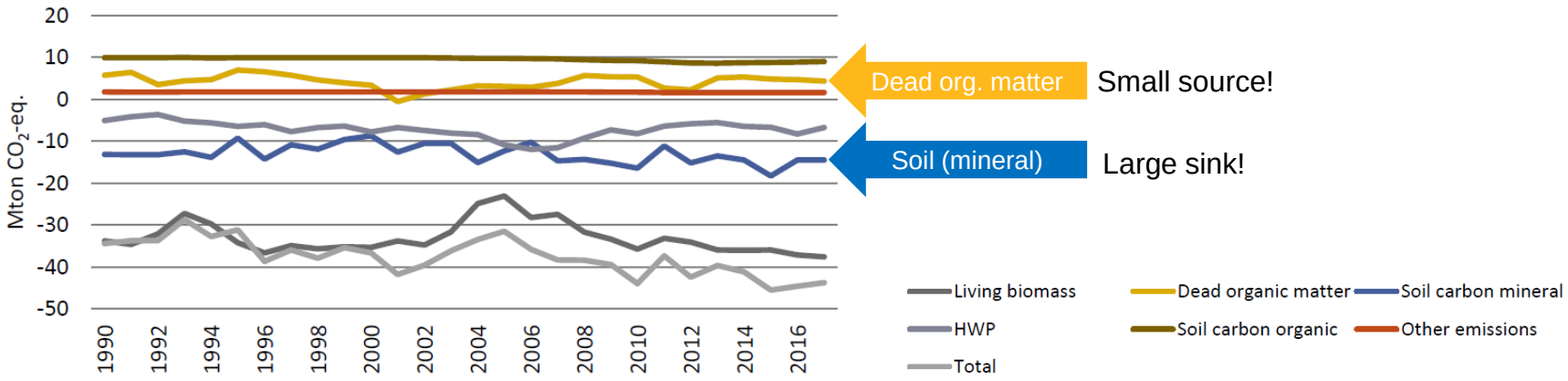
Northern Sweden

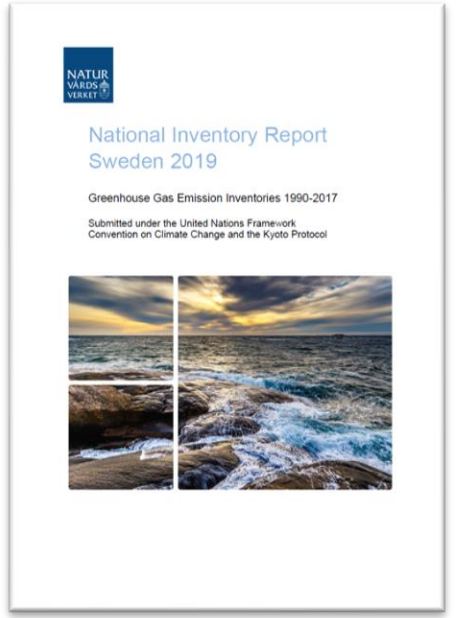


Data SFSI
Skogsdata 2017

RA=Relative age – normalized by allowed harvesting age

Sweden’s GHG Inventory (UNFCC, Kyoto)





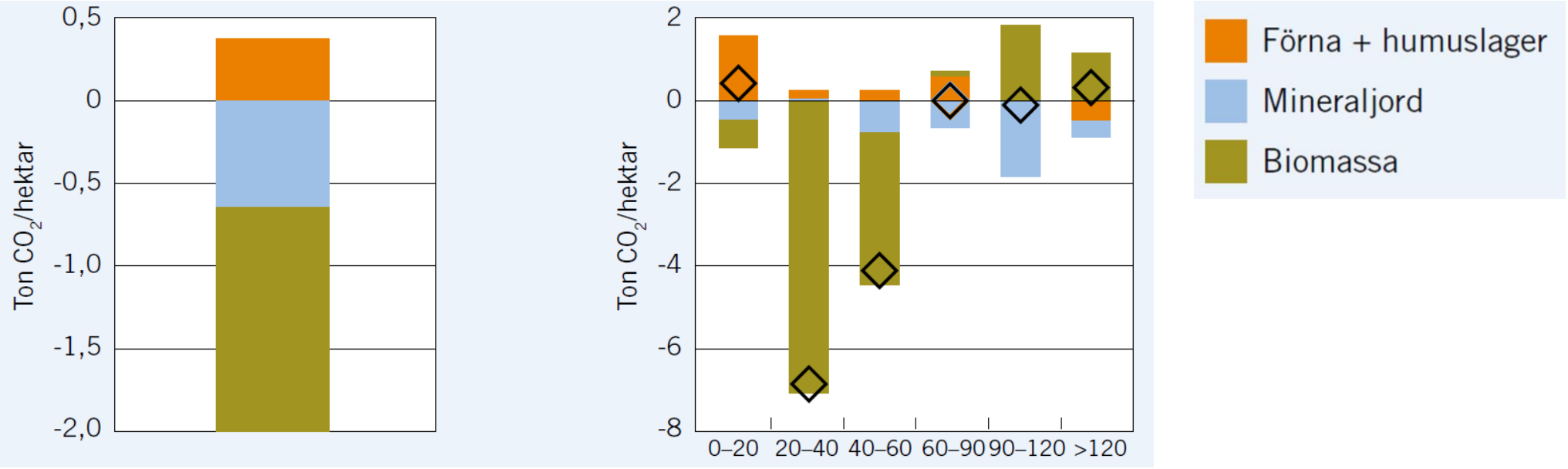
Annual submission

- LULUCF sector – Land Use Land Use Change and Forestry
- Trends in uptakes and emissions from e.g. managed forest land
- Living biomass, Dead organic matter (humus+dead wood), Soil etc.

Gains and losses of CO_2 – LULUCF data

- Largest sink in living biomass
- Dead organic matter a source
- Large sink in the (mineral) soil

- Largest sink in ages 20-60 years
- Small increase in soil sink with age



Data NFI + SFSI, Skog & Mark 2021

Challenges and needs for the future

- How to adopt long term monitoring to new needs
- Preventing methodological bias over time
  - Maintaining methodology, e.g. sampling and soil chemical analyses
  - Introduce necessary changes without influencing time series
- Integration with other data sources
  - How to integrate soil data with remote sensing
- Scale differences in soil sampling and forest properties
- Introducing eDNA methods for soil animals and bacteria
- Adopting to methodological developments in eDNA (metabarcoding) techniques without introducing bias