The Swedish LULUCF reporting system

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Overview of the presentation

- Key features of the system
- About the Swedish National Forest Inventory
- Estimation of areas of land use categories, transfers, ARD, and FM
- Estimation of changes in carbon pools
- Current system development status
- Conclusion

Key features of the system

- Based on about 35 000 permanent sample plots (the Swedish National Forest Inventory)
- Areas of land use categories, land use changes, ARD, and FM – if elected - from sample plot assessments
- Changes in carbon pools in forests mainly by repeated measurements on sample plots
- Changes in carbon pools in other land use categories by measurements, modeling, and default assumptions

About the Swedish National Forest Inventory

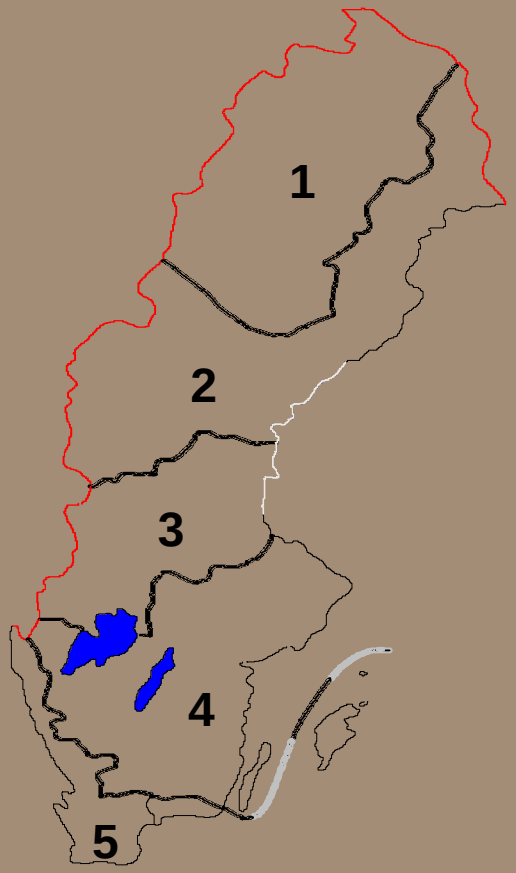
- An annual sample survey inventory that every year covers the whole country
- Based on a combination of permanent and temporary plots. Annually it comprises:
  - About 7000 permanent plots
  - About 4000 temporary plots
- Permanent plots are remeasured with a 5 yrs cycle

Objectives of the National Forest Inventory

Provision of data for:

- Strategic analysis of multi-resource forestry
- Environmental monitoring
- Research and education
- Reporting to international conventions etc. (including UNFCCC/KP)

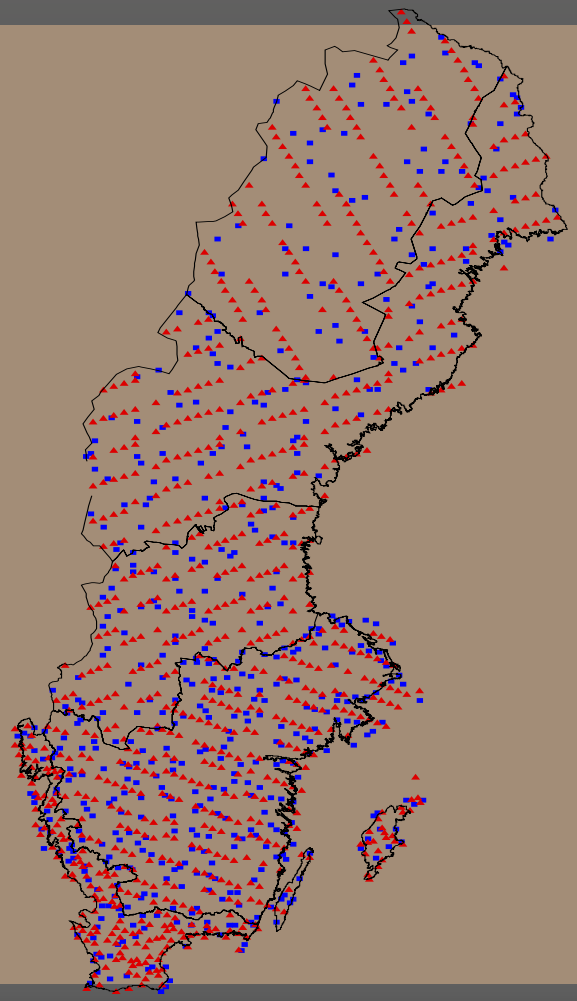
Survey regions



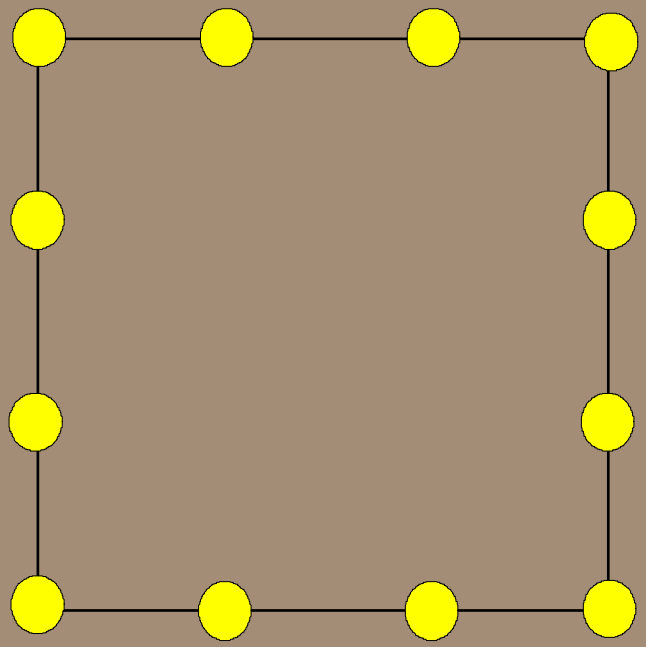
Survey tract distribution

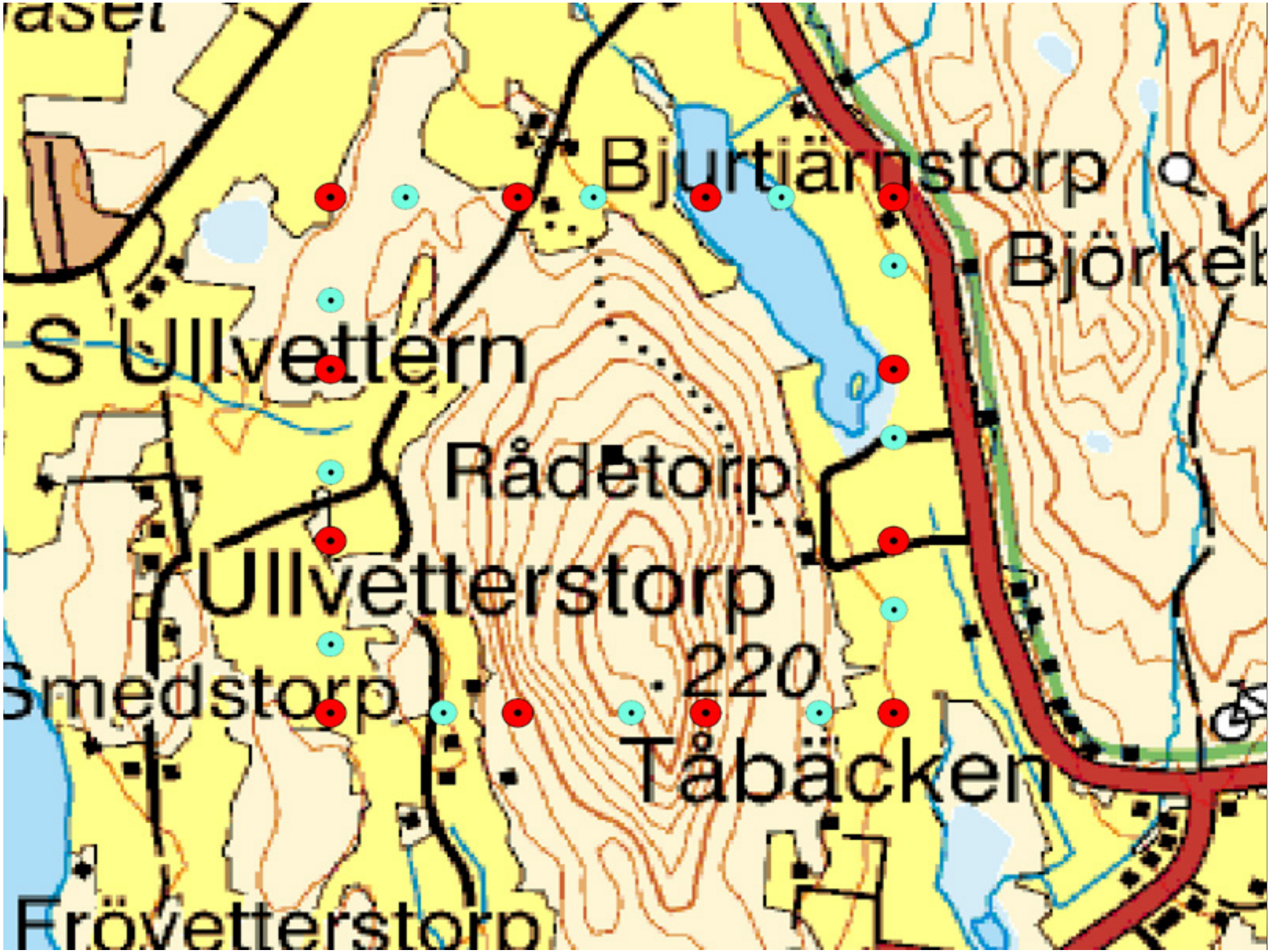
One-year sample (2004)

- Temporary tracts
- Permanent tracts



The tract design



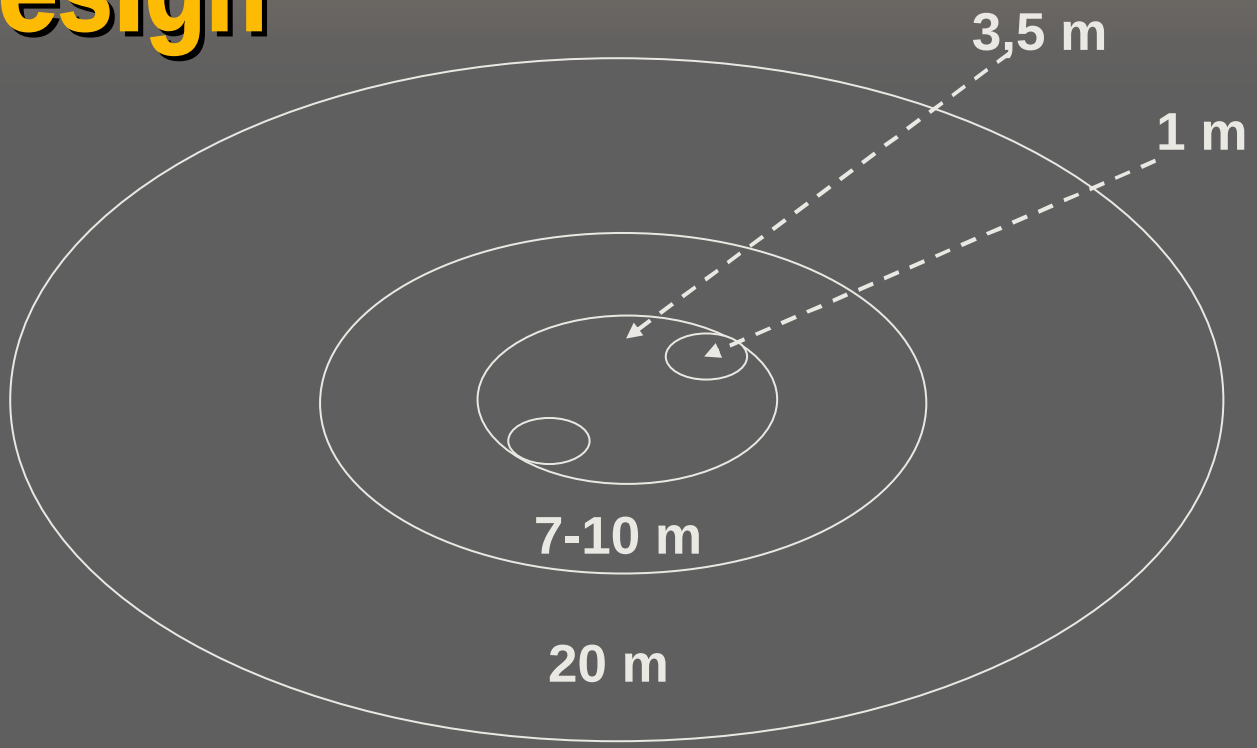

Bjurtjärnstorp
Björkeb
S Ullvettern
Rådetorp
Ullvetterstorp
220
Smedstorp
Tåbäcken
Frövetterstorp

Sample plot

LULUCF-relevant measurements and assessments

- Assessment of land use category, ARD, and FM
- All trees are calipered; additional measurements are made on sample trees
- All pieces of coarse woody debris are measured
- The cover of bushes and other non-tree vegetation is estimated
- A general site and soil description is made
- Soil sampling is conducted on a subsample of the plots (incl humus core sampling)

Plot design



(radii)

Areas of land use categories, changes, ARD, and FM

- By repeated assessments (every 5 yrs) of the ~35 000 permanent plots
  - Plots established in the period 1983-87; conditions 1990 known
- Time point of changes (incl ARD) can be determined based on registrations made on the plots
- Different options for the interpolation/extrapolation of plot data for annual reporting are currently being investigated

Identification of ARD lands

- By locating boundaries of areas that encompass units of ARD lands
- Probably by 1-5 different regions within Sweden
  - ARD activities are fragmented and ongoing in all parts of the country
  - Spatial location of plots recorded, which implies transparency in potential in-depth reviews

Forest definition

- ARD: the FAO definition (potentially with a slight deviation regarding treatment of forest roads)
- FM – if elected: the FAO definition – including forests within all kinds of managed lands and reserves

The carbon pools

- Aboveground biomass
  - Tree biomass above stump height (non-tree vegetation might be included at a later stage)
- Belowground biomass
  - Stumps and roots > 2 mm of living trees
- Dead wood
  - Aboveground standing or downed pieces of dead trees > 100 mm; dead stumps and roots > 2 mm
- Litter
  - Fine parts (< 100 mm) of dead trees; humic and fumic layers of soils
- Soil organic carbon
  - Organic carbon in mineral soils down to 500 mm, including fine roots (< 2 mm); the entire organic layer in organic soils

Aboveground biomass

- Changes in tree carbon pools by repeated measurements and application of single tree biomass functions
  - Biomass = f(tree species, dia, stand and site characteristics)
- Possibly non-tree biomass at a later stage by using rather crude regression models
  - Biomass = f(bush cover, cover of other non-tree vegetation)

Belowground biomass

- By repeated measurement of individual trees and application of biomass functions
  - Biomass = f(tree species, dia, stand and site characteristics)
- The functions provide stump and root biomass based on aboveground measurements; they have been derived by escavating the root system of trees

Dead wood

- By repeated measurement of individual pieces of dead wood, assessed by decay stage class
- Application of decay-stage-specific conversion factors from volume to carbon
  - Density by species and decomposition class
- Dead wood in dead root systems by applying crude decomposition rate factors
  - Biomass at time point of mortality/cutting of trees by applying biomass functions for living trees

Litter

- Humic and fumic layers by repeated measurements and lab analyses of carbon content
  - 10 yrs remeasurement interval in this case
- Other litter components by a combination of measurements, models and default figures

Soil organic carbon

- By repeated measurements and lab analyses of soil samples
  - 10 yrs remeasurement interval
- Only fine fractions sampled; amount of boulders and stones separately determined
- Soils with deep organic layers pose problems that are not yet fully solved

Carbon pool changes in croplands and grasslands

- Modelling (ICBM model) of changes in soil carbon pools
- Data on area proportions of different soil types from ”non-complete” agricultural soil surveys; total areas from National Forest Inventory data
- Tree biomass by repeated measurements

The problem to report annual data

- The transfer of basic reporting principles from the other sectors to the LULUCF sector has implied some complication...
- One of these concern the requirement to report annual values although surveys are made with 5 years intervals – at best.
- Thus, interpolation and/or extrapolation of the data available is needed
- Procedures depend on properties of the inventory, e.g. the remeasurement cycle of permanent plots

1	2	3	4	5
2003	2003	2003	2003	2003
2004	2004	2004	2004	2004
2005	2005	2005	2005	2005
2006	2006	2006	2006	2006
2007	2007	2007	2007	2007
2008	2008	2008	2008	2008
2009	2009	2009	2009	2009
2010	2010	2010	2010	2010
2011	2011	2011	2011	2011
2012	2012	2012	2012	2012

Example: Reporting for year 2010

- In principle required in late spring 2012
- Pre-reporting to EU in early spring 2012
- Pre-reporting to the responsible agency in Sweden in autumn 2011
- Data are available up until measurements performed in 2010 (possibly until 2011 in the future)

1	2	3	4	5
2003	2003	2003	2003	2003
2004	2004	2004	2004	2004
2005	2005	2005	2005	2005
2006	2006	2006	2006	2006
2007	2007	2007	2007	2007
2008	2008	2008	2008	2008
2009	2009	2009	2009	2009
2010	2010	2010	2010	2010
2011	2011	2011	2011	2011
2012	2012	2012	2012	2012

Basing the reporting on remeasured plots

- 1/5 of the material for the reporting of the actual year (2/5 if data availability can be speeded up)
- Recalculation based on the full material can be made for reported year minus 4 (i.e. for 2006 when reporting for year 2010)

Issues to consider

- Is annual reporting based on 1/5 (or 2/5) of the material enough?
  - Or should averages over several years be calculated for the annual reporting
  - Or should the annual reporting be based on growth modeling and harvesting statistics
- How often should recalculations be made?
- When should the final estimate for the period 2008-2012 be reported? Not until 2016 (or 2015) if the full material should be used!

About uncertainties

- The system has been evaluated and found to produce reliable estimates over 5 yrs periods (based on all plots)
- An advantage is that formal statistical estimates of precision (uncertainty) can be derived
- One weakness identified is the poor precision in estimates of deforestation; most likely this will be improved by using a combination of satellite remote sensing and field survey
- Change estimation based on repeated measurement is sensitive to systematic errors that vary over time. This is a potential problem mainly regarding the soil organic carbon?!

Status of system development

- Core parts are planned to be in place for application during 2005
- Improvement of details over a longer time
- Decision about whether of not to include FM not yet made
- System development is coordinated by the Swedish EPA, with major contributions from the Swedish University of Agricultural Sciences

Conclusion

- The Swedish LULUCF reporting system is planned to be:
  - Sample based, using the NFI plots as a basis
  - Largely based on repeated measurements of permanent plots
  - Straightforward to apply, since areas and carbon pools are estimated using the same sample plot system
  - Cost-efficient, since only minor modifications of the existing NFI system are needed

Thank you!