

Reindeer pasture changes in northern Finland 1995 - 2005



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Research history

- Pasture inventory 1995
- Pasture inventory update 2000
- Pasture inventory 2005



Finnish Game and Fisheries
Research Institute,
Reindeer research

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- Jouko Kumpula
- Marja Anttonen
- Timo Kumpula
- Ari Tanskanen

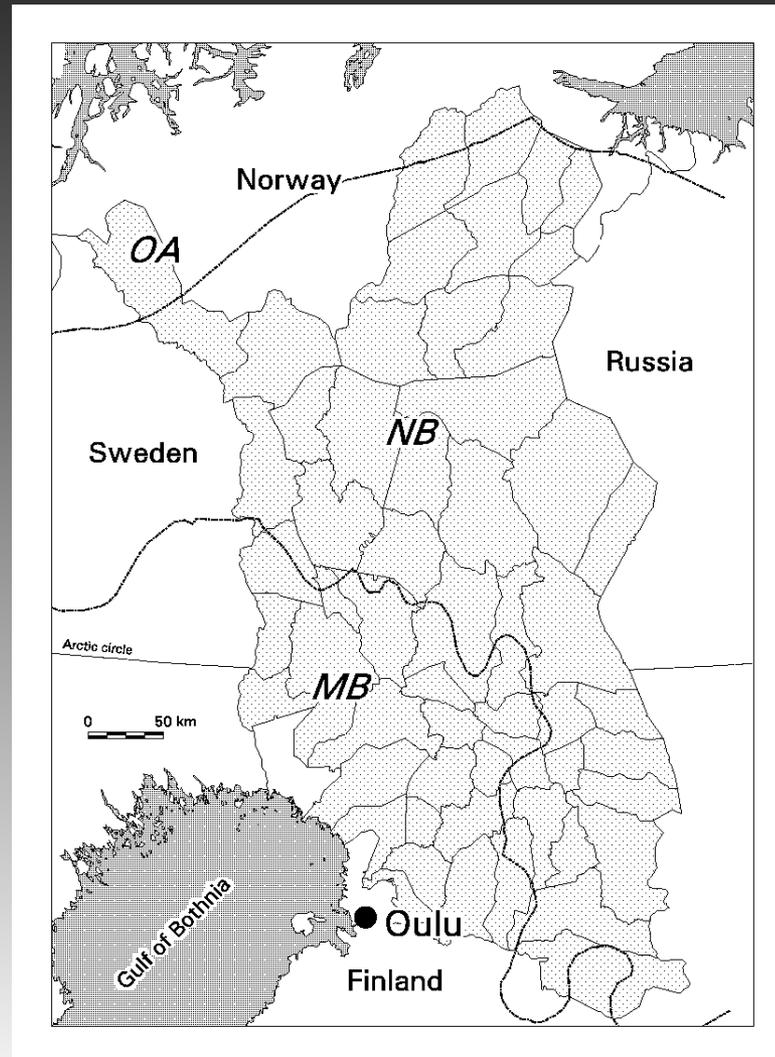


Finnish reindeer management area

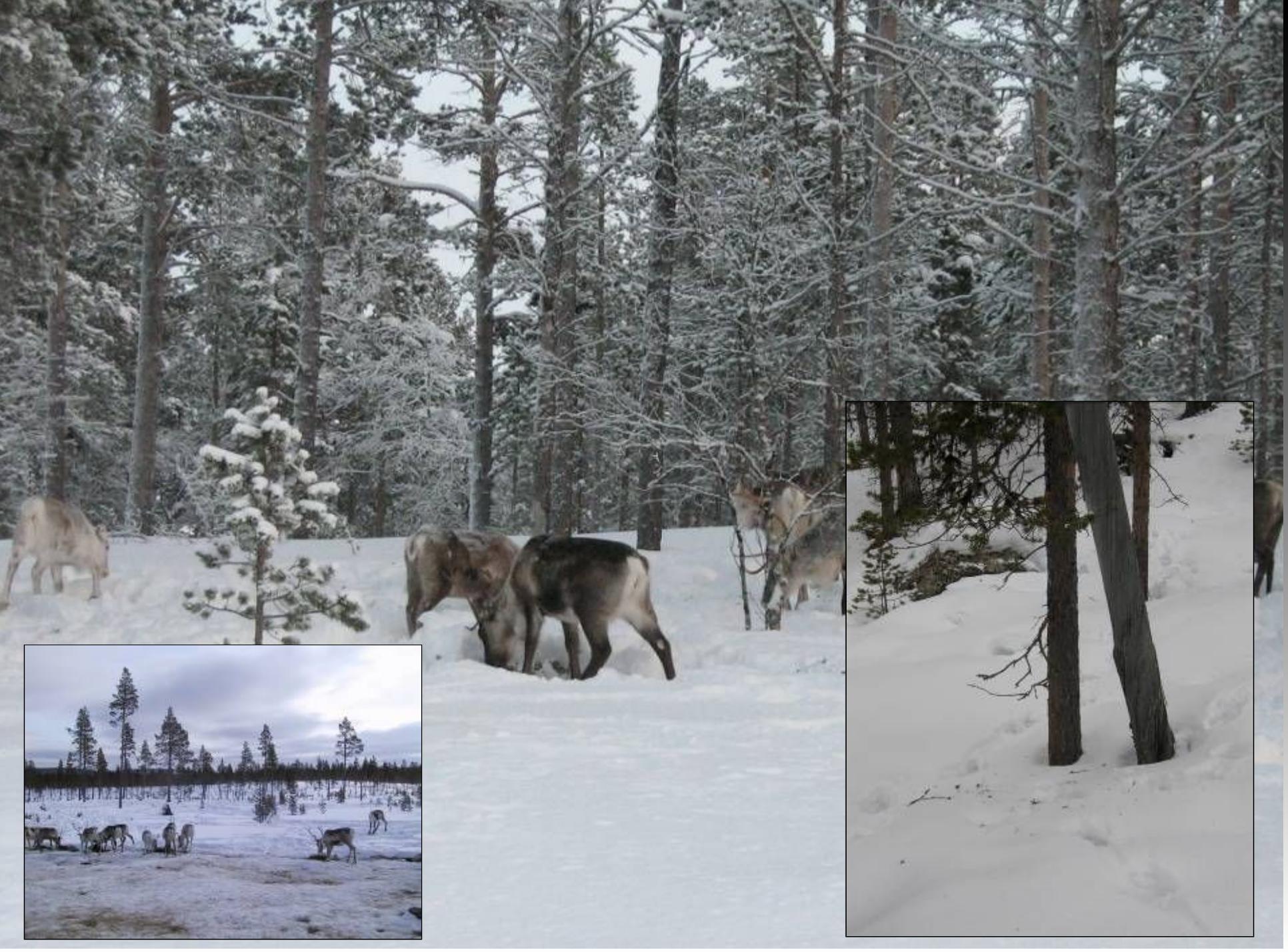
oro-Arctic

northern Boreal

middle Boreal







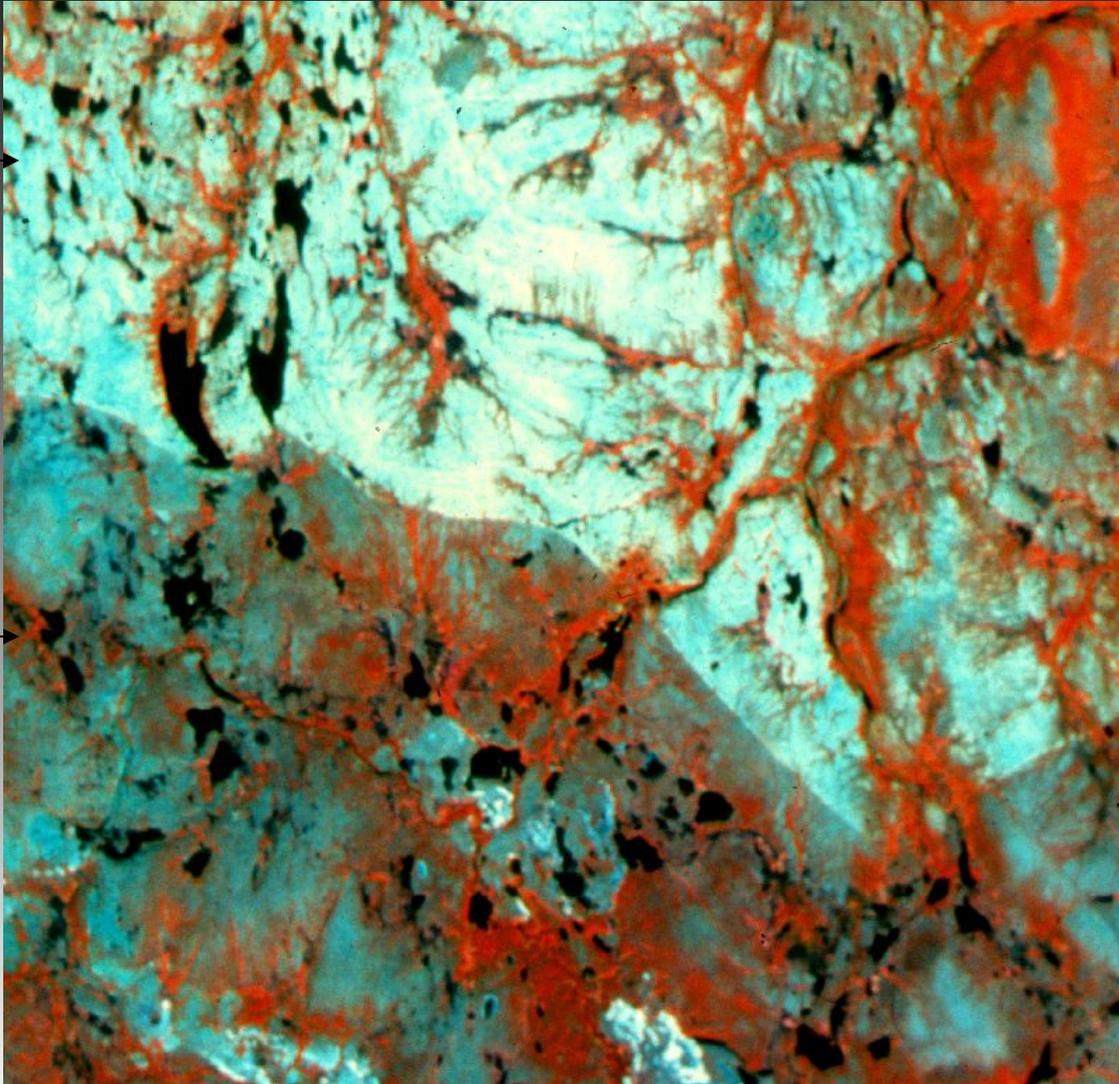
Finnish reindeer herd 1960 - 2009



Landsat TM 1987 satellite image Finnish – Norwegian border

Norway

Finland



Old growth forest



Clear cut



Land cover / use change

Continuous logging activity

Increasing use for recreation

Increase in mining activities

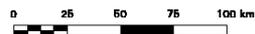
Increased grazing pressure

Inventory 1995

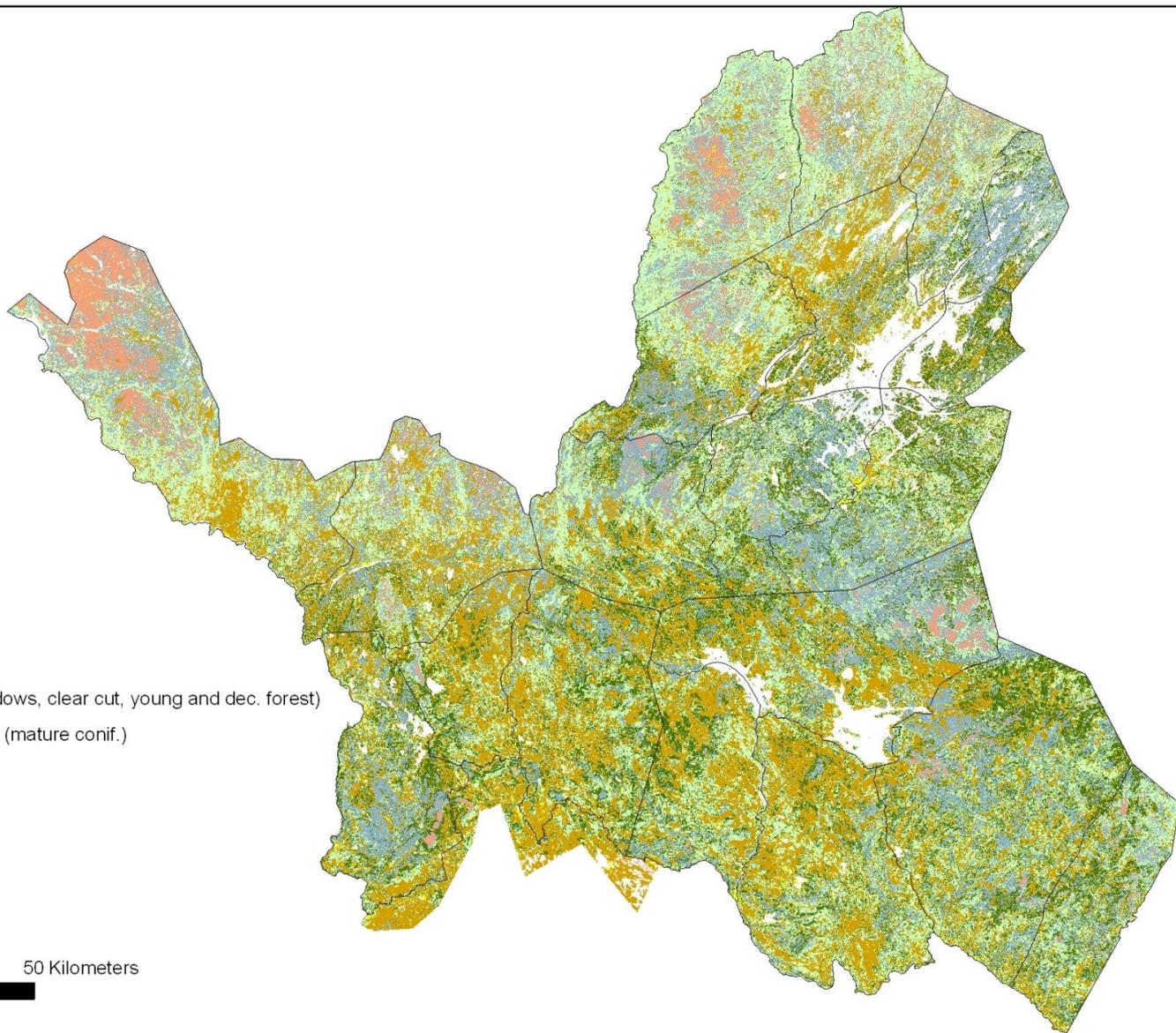
Reindeer winter pastures

Legend

- Ground lichen pasture
- Arboreal lichen pasture
- Green vegetation
- Mires and fens
- Field
- Bare rock and gravel
- Water
- Cloud



Inventory 2008



Legend

-  Lichen pasture
-  Summer pastures (meadows, clear cut, young and dec. forest)
-  Arboreal lichen pastures (mature conif.)
-  Bogs and mires
-  Build up, sand and rock
-  Mountain heather
-  Water



Problems comparing historical classifications

Changes in RS platform

Changes in field methods

Changes in image processing software

Changes in computer hardware

Changes in classification scheme

Changes in processing methodology

Changes in personnel



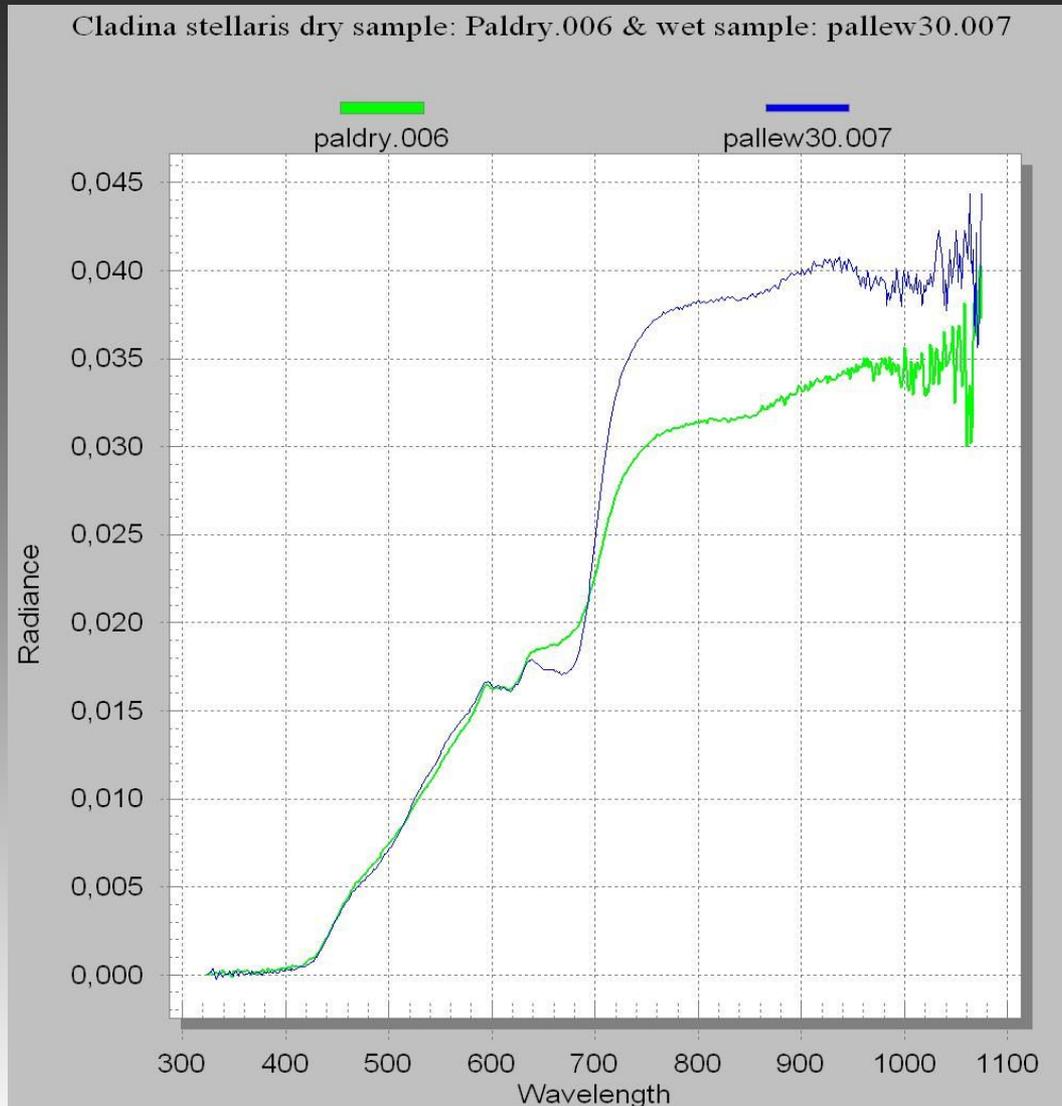
Reindeer lichen inventory.
Forest clear cut can increase
growth of ground lichens.

Spectral characteristics of lichens



Spectral characteristics of reindeer lichens are dampened upon moisture content.

Effect of moisture on spectral response of reindeer lichens



Change?

Small changes in processing methods produce considerable variation in classification results.

Differences in error matrixes will produce unpredictable direction of change vectors.

Grid based approach

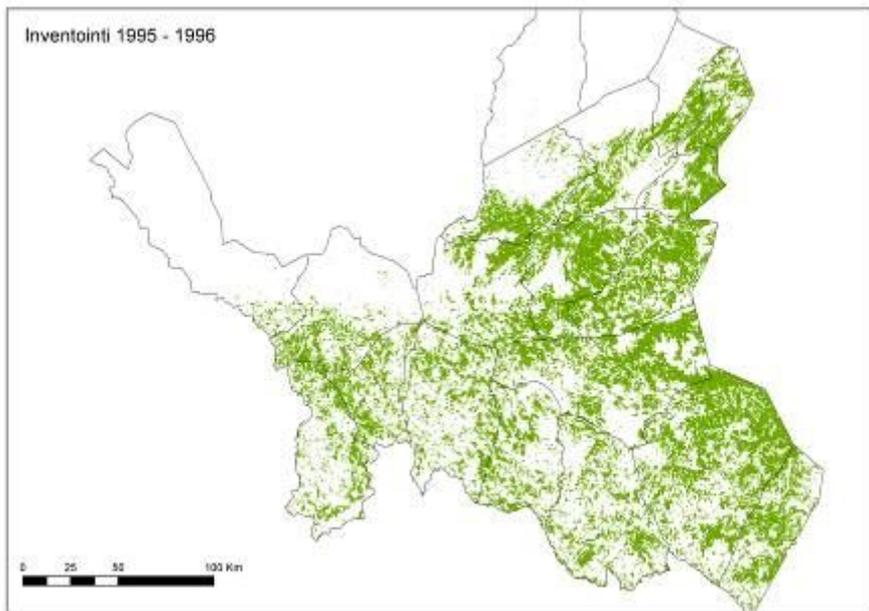
To eliminate spatial variation in evaluation of change the classified image is divided into 500 m square grid cells.

The spatial extent of each land cover unit is tabulated for every cell.

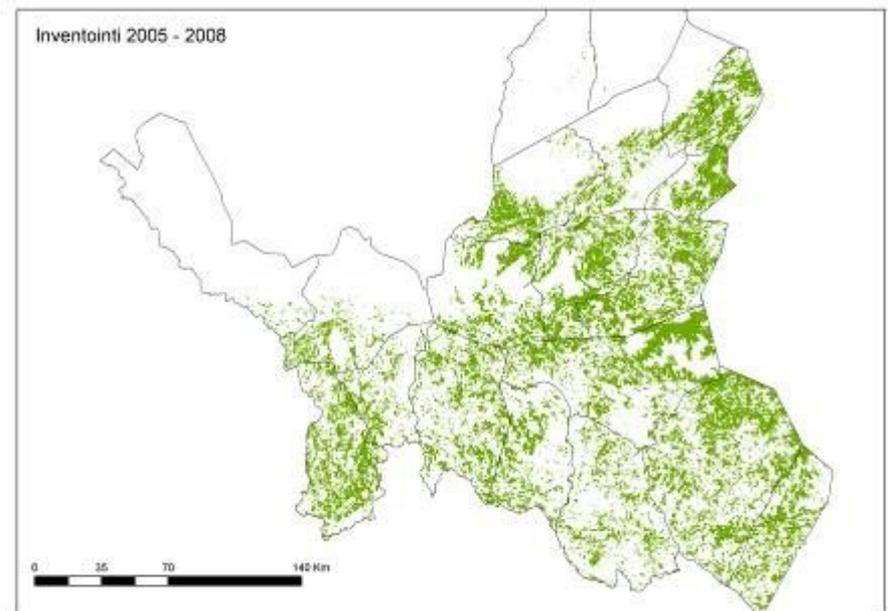
Thereafter variation of land cover units can be reduced by setting a threshold values (for example 40 %).

Change in forest landscape

Grid cells(0,5 x 0,5 km) with at least 40 % (10 ha) mature or old growth forest.



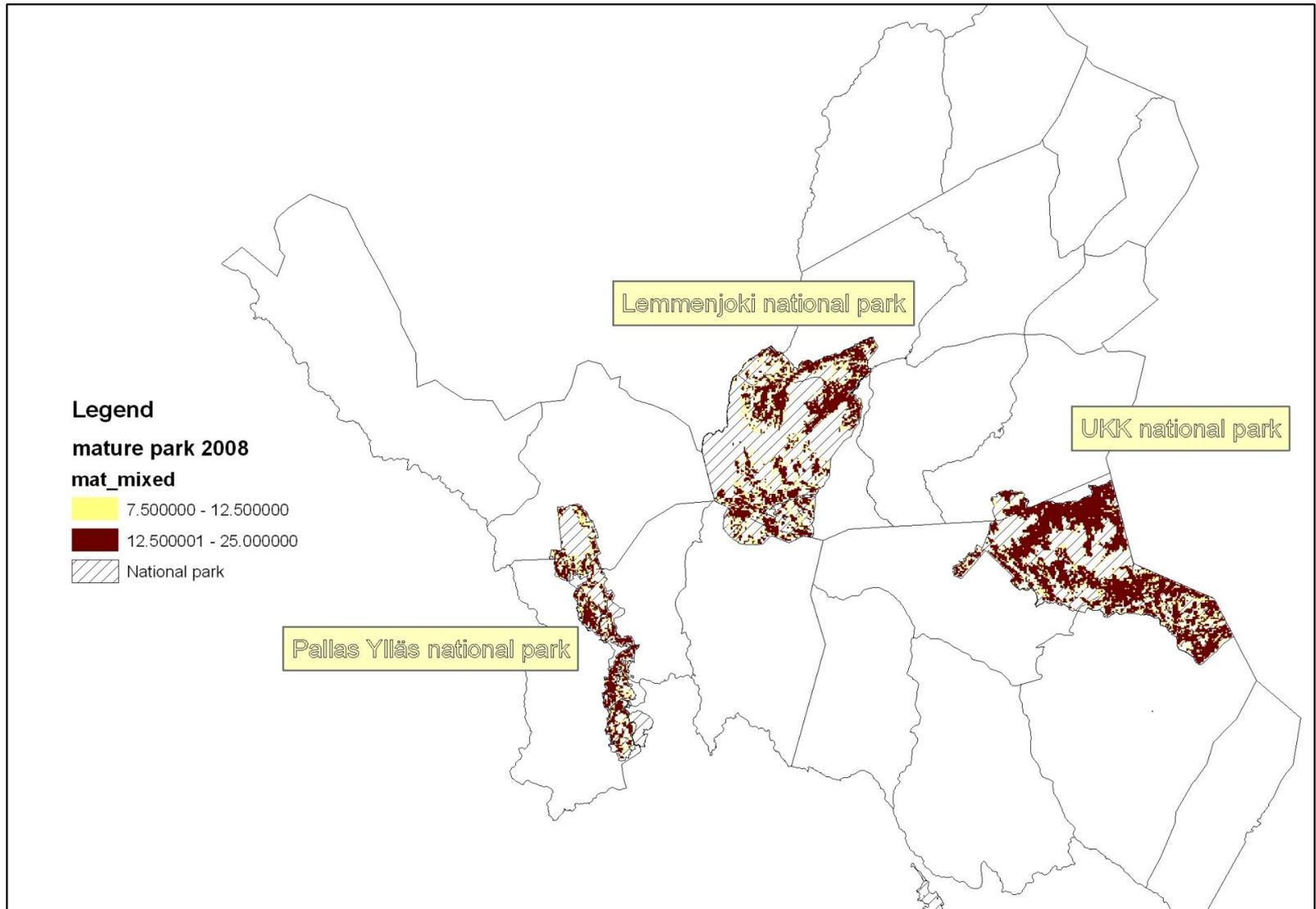
1995 N = 71 000



2005 N = 57 197

Change 19 %

Reference areas: national parks



Threshold 7.5 ha

Mature + mixed		Park	Other
2008	Ha	13065	76104
	Mean	17.24	14.6
33.30 %	Median	17.69	13.87
	SD	5.24	4.8
1995	Ha	13085	77255
	Mean	17.32	15.19
	Median	17.75	14.56
	SD	5.3	5.1
Change	%	≠0.15	≠1.49

Threshold 12.5 ha

Mature + mixed		Park	Other
2008	Ha	10007	45351
	Mean	19.47	17.82
50 %	Median	19.75	17.38
	SD	3.75	3.5
1995	Ha	9944	48426
	Mean	16.64	18.38
	Median	20	18.12
	SD	3.8	3.7
Change	%	0.63	≠6.35

Conclusions

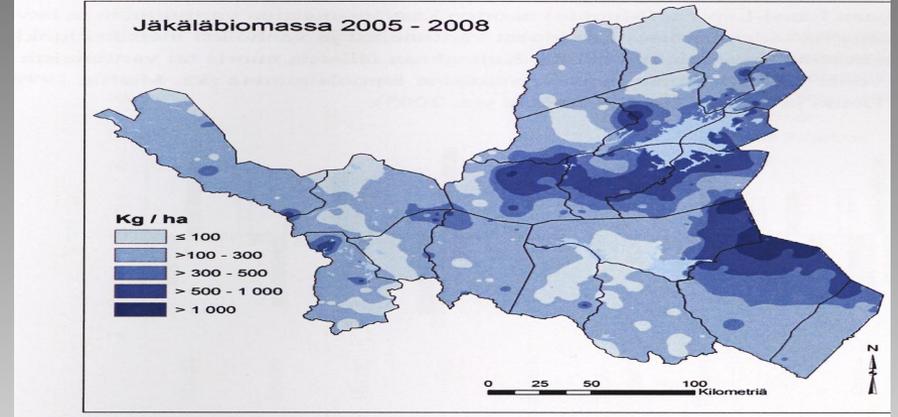
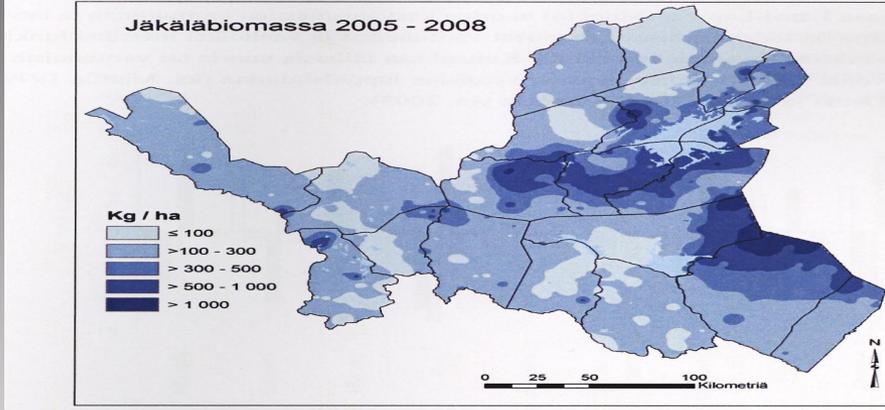
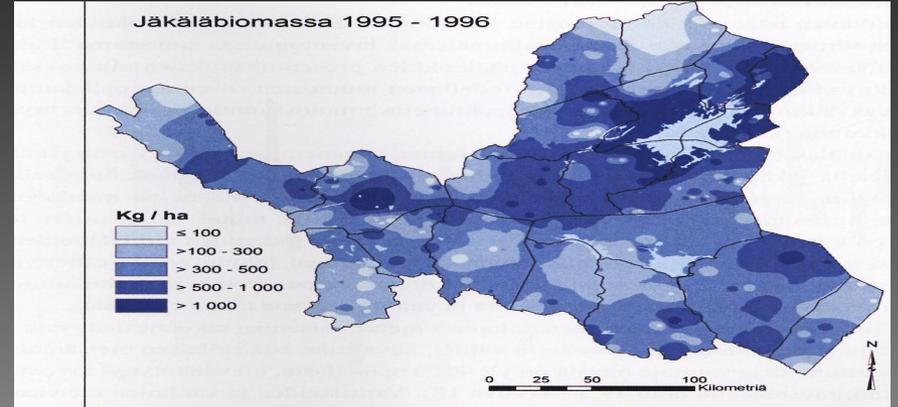
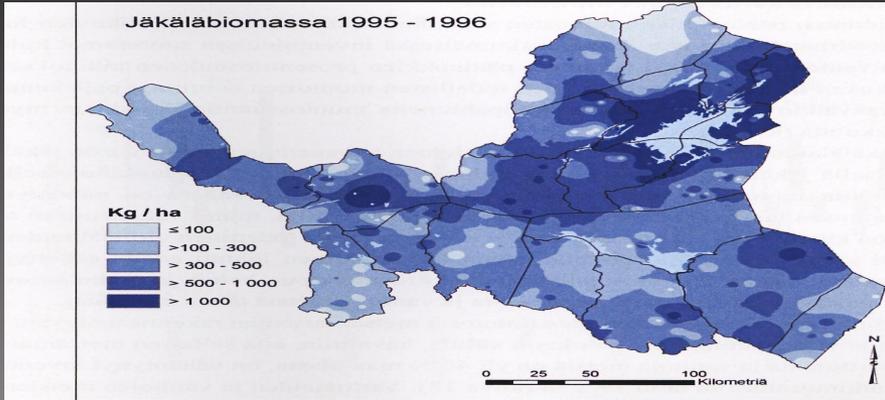
Grid method is a valid method to detect change in satellite image land cover classifications.

Stable areas like national forests can be used as reference areas.

Lichen biomass change

1995

2008



Further research

Study of infrastructure encroachment

Mining

Recreation

Wind power

Ecosystem services approach



The end