

# Use of exotic tree species in afforestation in Norway – role, benefit and challenges

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PhD (For)

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# Main topic

- Afforestation – resources in coastal Norway
- Exotic species, plantations – importance
- Is Sitka spruce an invasive conifer?
- Growing xenophobia for exotic trees – scientifically based?
- Communication – the value of forests

# The wood-age (?)

- 2/3 of the wood cut worldwide now comes from forest plantations. 1/3 of these are covered by exotic tree species
- In 2011: 240 mill hectares, 50 mill ha in Europe, 10% exotic tree species
- Population growth – growing demand for wood



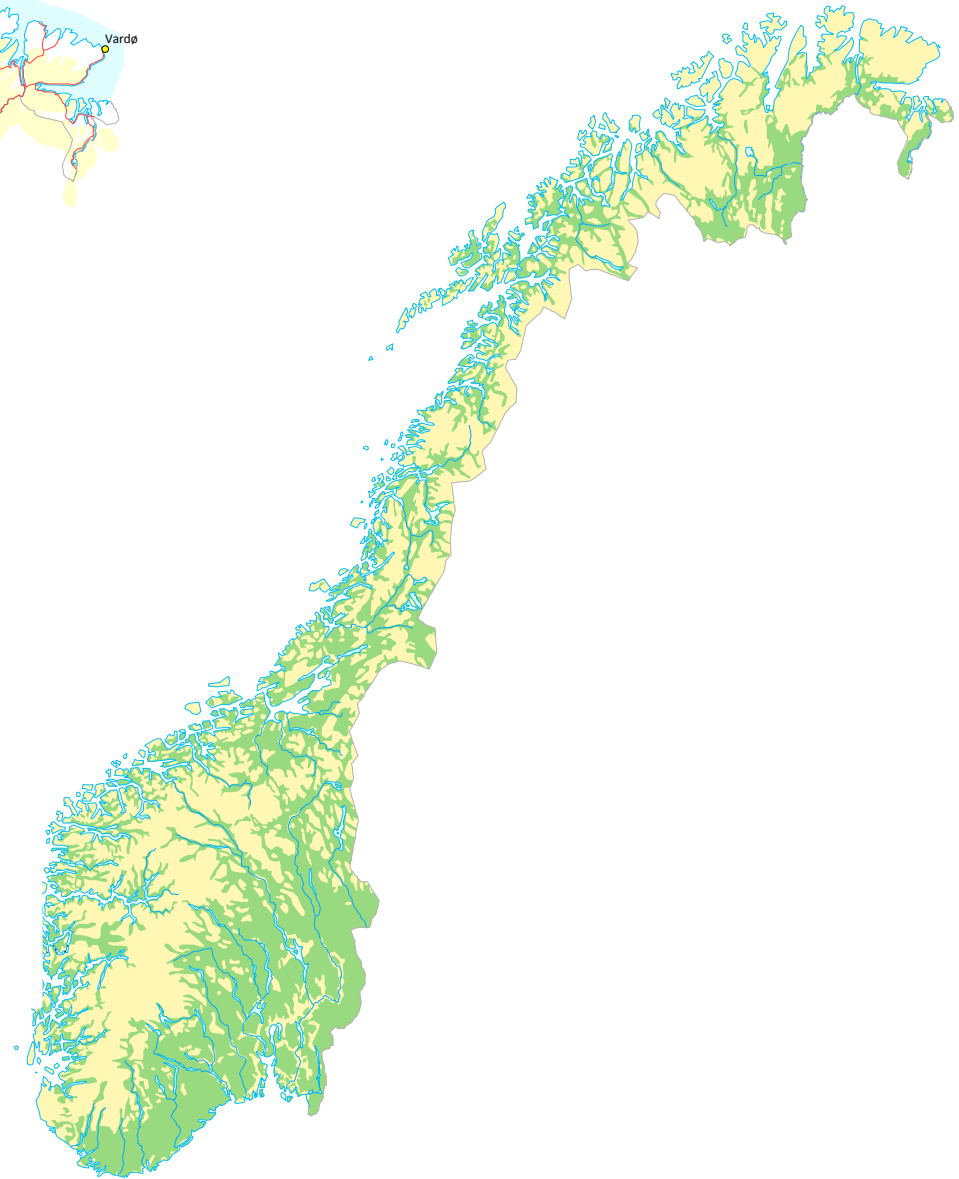
Source: FAO, 2012

## Elevation - Infrastructure



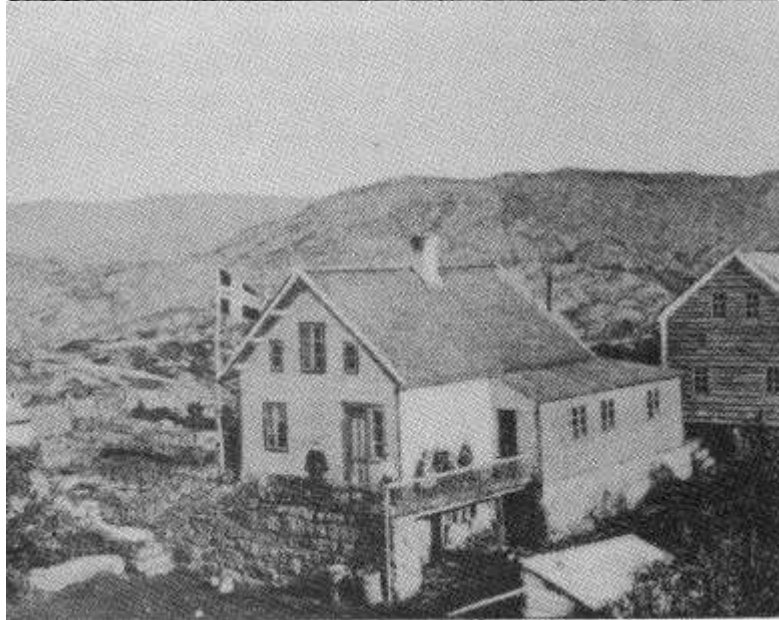
Land area: 324 000 km<sup>2</sup>

## Forest - Mountains



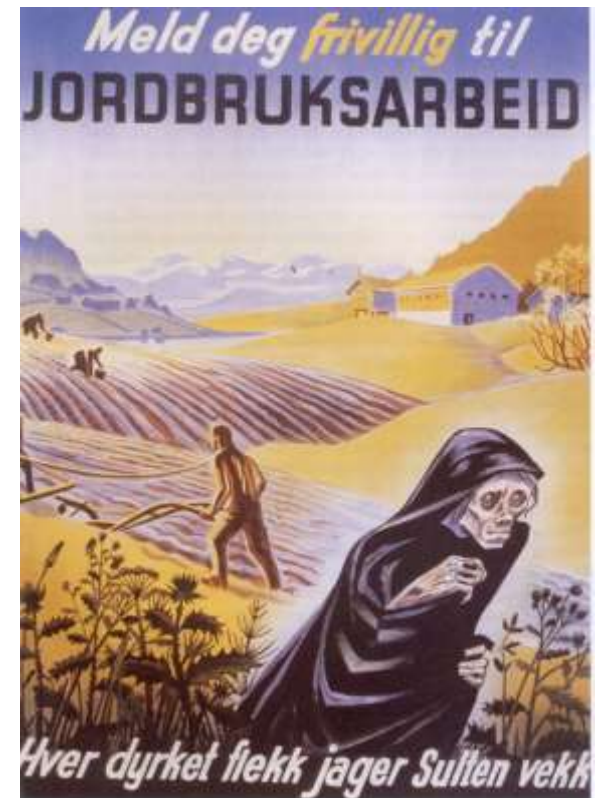
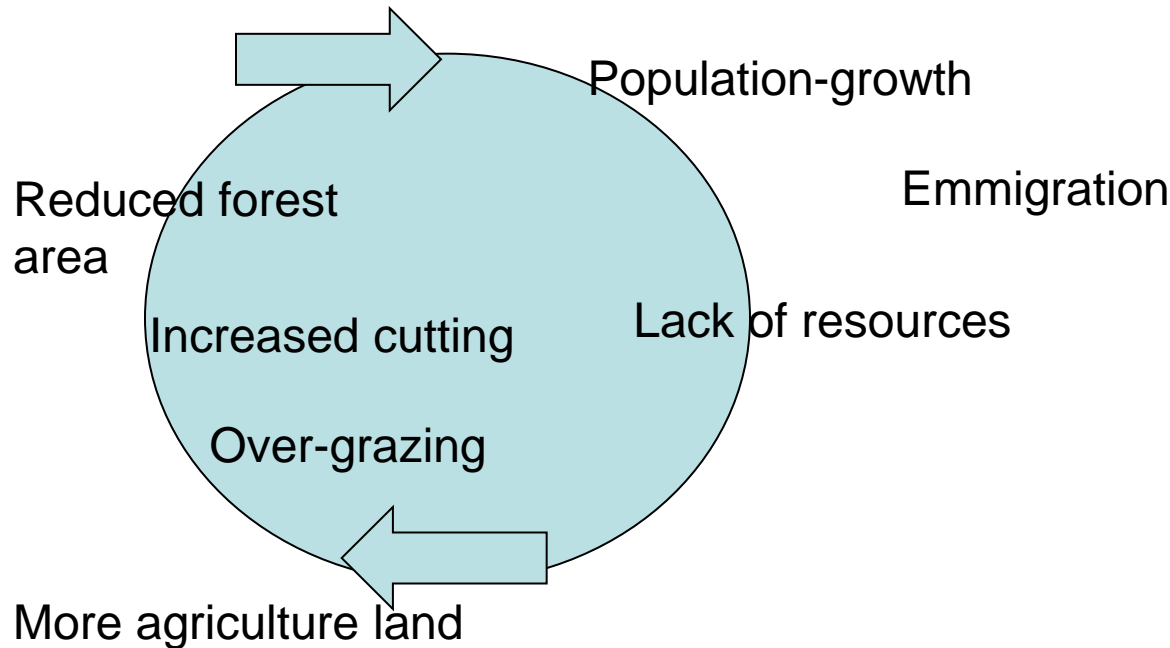
Forest cover: 1/3

# Poverty, lack of resources



# "Push"-factors for afforestation in coastal areas of Norway

## The poverty circle



# "Pull" factors (1946-1980s)



- Stimulation of district economy, capital into long term investments, planting, tending, infrastructure and wood based industry
- Within 60 years serve the great demand for firewood and timber, locally and regionally
- Restructure farming – find new alternatives for land use. Restore degraded farmlands.
- Establish jobs
- Plant 350 000 ha in coastal sites!



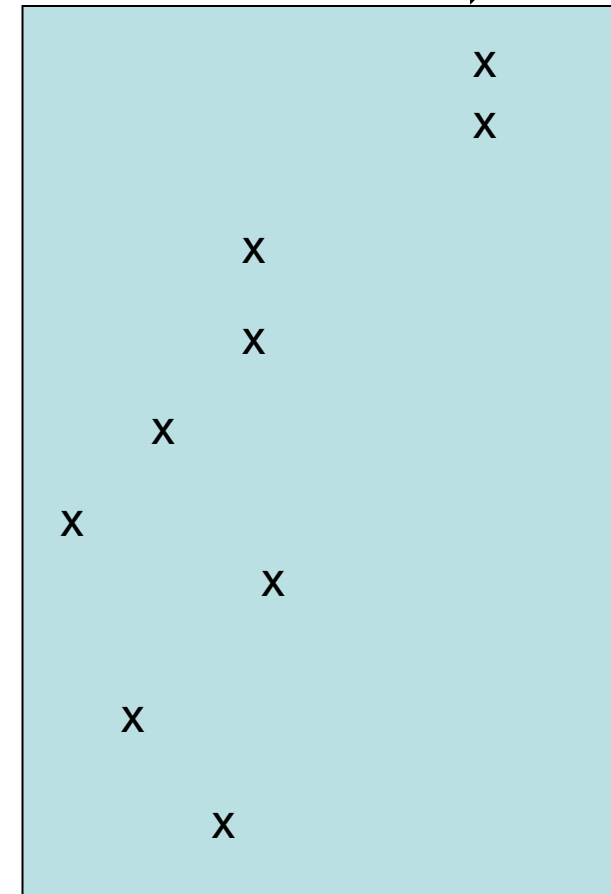


# Causes of deforestation

Relative importance



- Overcutting
- Heavy browsing
- Mining (Cu, Fe, others)
- Salt production
- Chalk and potash
- Tar production, Charcoal
- Shipbuilding
- Fisheries (barrels, boats)



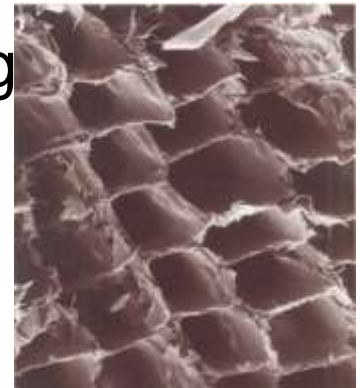
Local

Regional

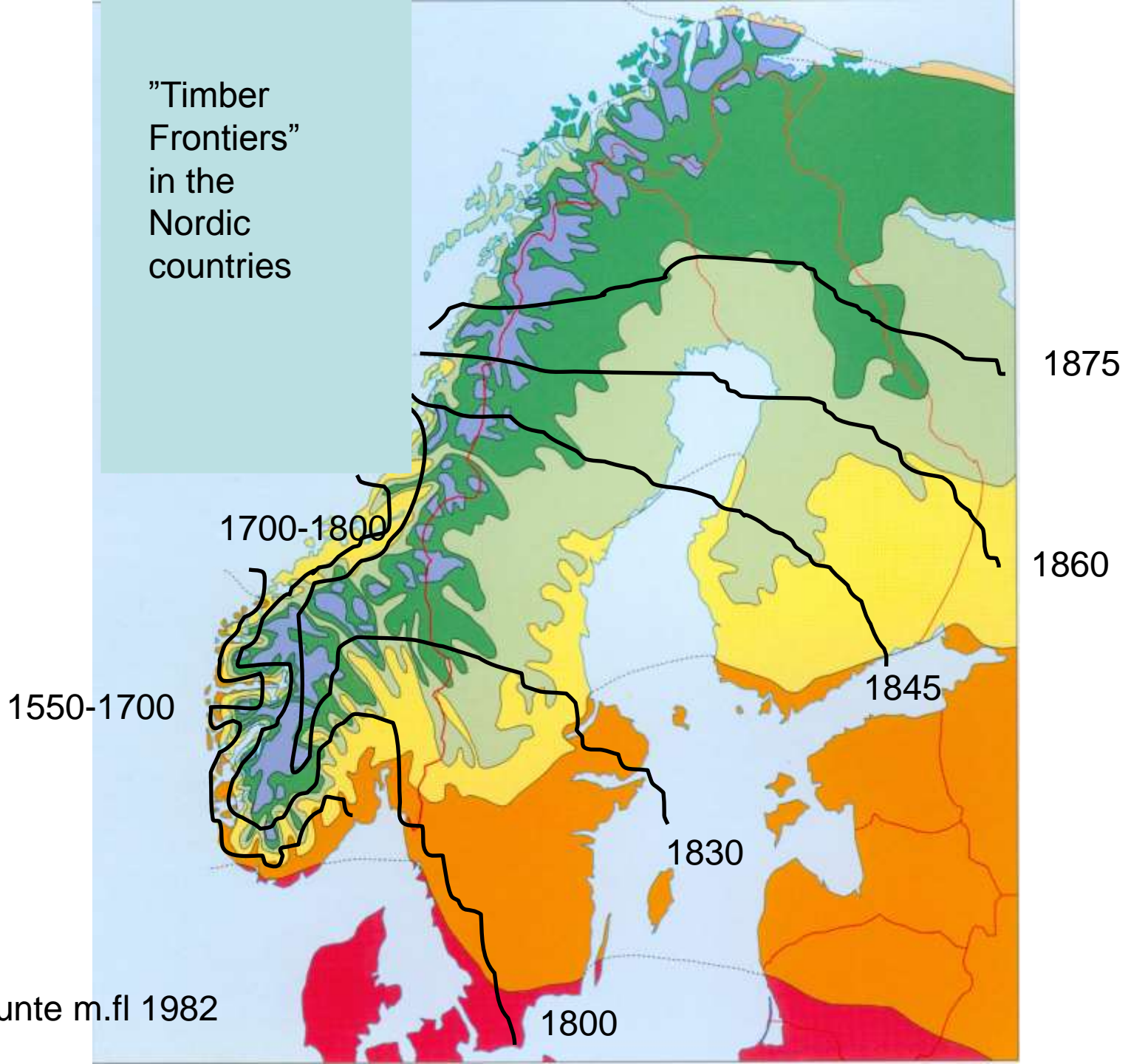
X forest fires, X climate, X bog formation

# Eras in afforestation process in Norway

- Exploitation phase 1 (1550 - 1860)
- Exploitation phase 2 (1860 - 1940)
- Alert phase (1740 - 1930)
- Forest science (1920s-1950s)
- New forest policy phase (1862-1940)
- Planning phase (1935-1955)
- The great working years (1955-1990)
- Consolidation phase (1990-2010)
- Exploitation phase 3 (bioeconomy)/the wood ag



"Timber Frontiers"  
in the  
Nordic  
countries



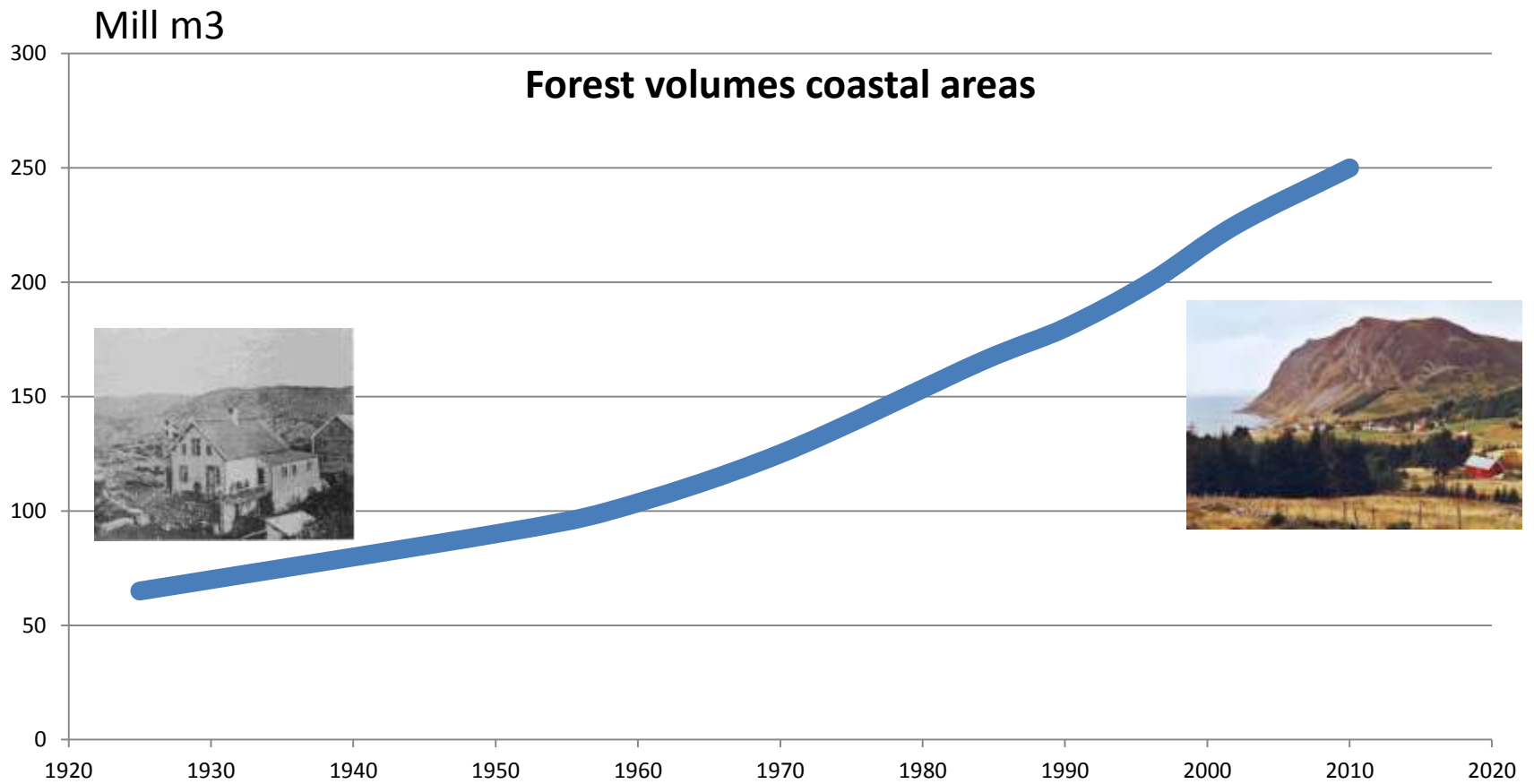
Source: Bunte m.fl 1982



year:1890



år:2010



Source; NFLI 1923-2012

Coastal areas: Rogaland-Finnmark counties

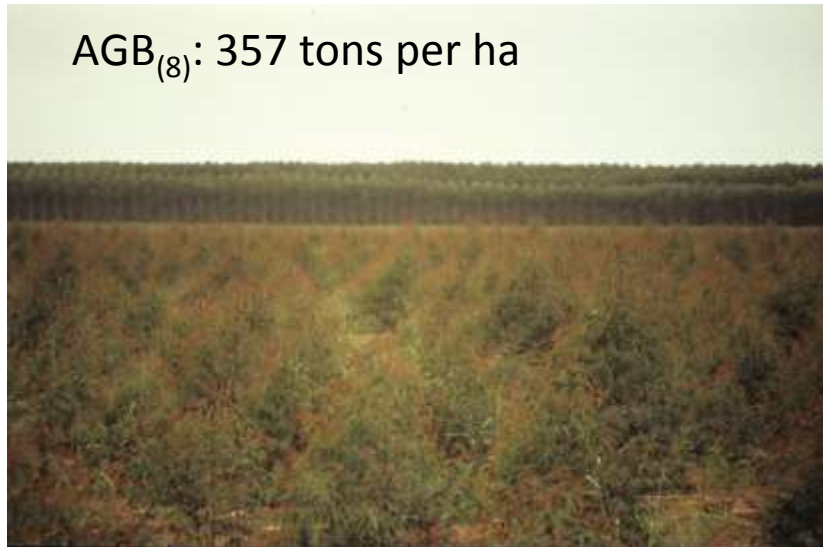
## *Eucalyptus saligna* – Eastern Brazil, Aracruz



8 yr rotation

YC: 38 m<sup>3</sup>/ha/yr

AGB<sub>(8)</sub>: 357 tons per ha



# Picea sitchensis – West coast of Norway

- Rotation age: 75 years
- YC: 18 m<sup>3</sup>/ha/yr
- AGB<sub>(75)</sub>: 525 tons per ha



1974



1987



2008



# When did the exotic tree species arrive to Norway?

- *Fagus*, 8th century (?)
- *Malus*, *Pyrus*, *Prunus*; 12th century
- *Acer pseudoplatanus*, European poplar, *Aesculus*: 1750s
- *Abies alba*, 1760s
- European larch, 1760s, 1772
- *Picea glauca*, *Abies balsamea*, *Thuja occidentalis*  
Tamarack, Weymouth pine, 1790s
- *Abies sibirica*, *Larix sibirica*, *Pinus cembra*, 1840s
- Conifers NW USA/Canada, 1850s
- Conifers Japan, 1870s
- Chinese and E Asia conifers, 1920s
- *Nothofagus*, 1920s
- *Metasequoia*, 1950s



# Forestry, applied exotics in Norway (80 000 ha)

- Sitka spruce; 50 000 ha
- Lutz spruce; 5 000 ha
- Lodgepole pine; 8 000 ha
- Dwarf m pine; 3 000 ha
- Mountain pine; 3 000 ha
- Siberian larch; 1 000 ha
- Hybrid larch; 1 000 ha
- European larch; 1 500 ha
- European fir; 1 000 ha
- Mountain fir ; 1 000 ha



Tested about 80 tree species in field trials

# Coastal areas in Norway: Great changes within decades!



Increased forest cover, denser forest

**Plot no. 115, Ritland**

Prov:Harz, Germany

Site index: H40=23

Planted: 1927

Cut 2004 (80 yr)

Volume:1250 m<sup>3</sup>/ha

Sawtimber: 90%

Pulp/energy: 10%

Timber price: 427 NOK/m<sup>3</sup>

Gross: 475 500 NOK/ha

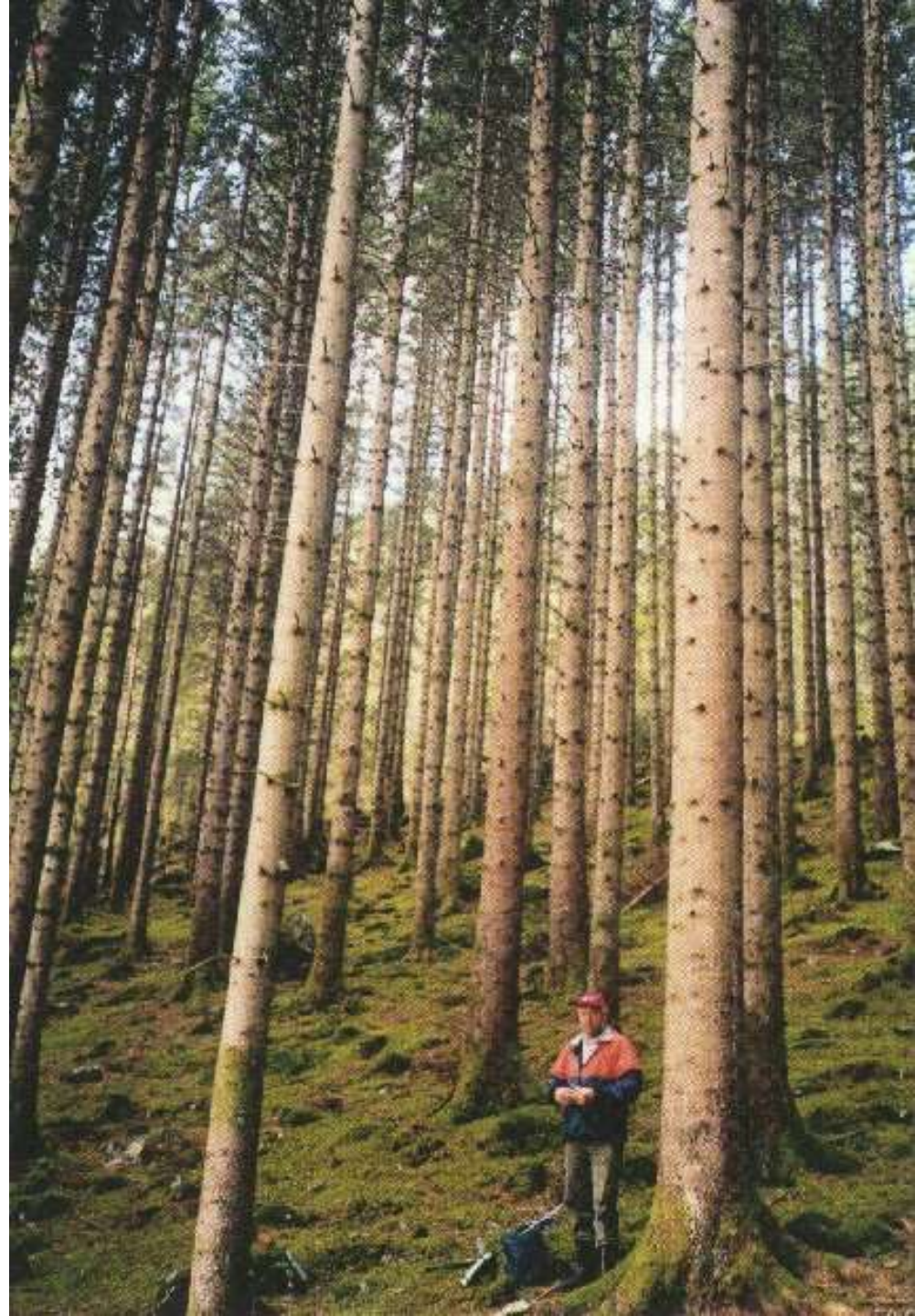
Net: 365 000 NOK/ha

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Investment: 240 NOK/ha (1927)

IRR, one rotation: 5,4%

IRR (incl subsidies) 6,3%

**Norway spruce afforestation  
species No 1 !**





66 N.lat, Northern Norway, windexposed coastal site  
Sitka spruce, Seward, YC 20, planted 1967  
Volume 900 m<sup>3</sup>/ha, age 45. Simulated harvesting; IRR=6.2%



Current situation in coastal Norway; only 1/5 of the annual increment is harvested. The share of non-economic -areas is substantial and increasing; few roads, long distance to industry.

## Forestry sector, negligible?

Estimated value metals in Norway, infinity;

1 388 000 000 000 NOK

37%

Source: NGU 2012

Estimated value «Norw pension fund abroad» 2012

3 727 000 000 000 NOK

100%

Source: NBIM 2012

Estimated values Norwegian forest sector 1880-  
2010 – C-storage excluded;

5 000 000 000 000 NOK

135%

Alt det vi foretar oss, har en virkning. Men det kloke og riktige vi gjør, fører ikke alltid til et gunstig resultat, og det gale vi gjør, bringer ikke alltid ugunstige følger, ofte virker det stikk motsatt.

Johann W von Goethe (1749-1832)





landscape – culture – traditions –  
where to live – jobs – forests and land  
to maximize social benefits

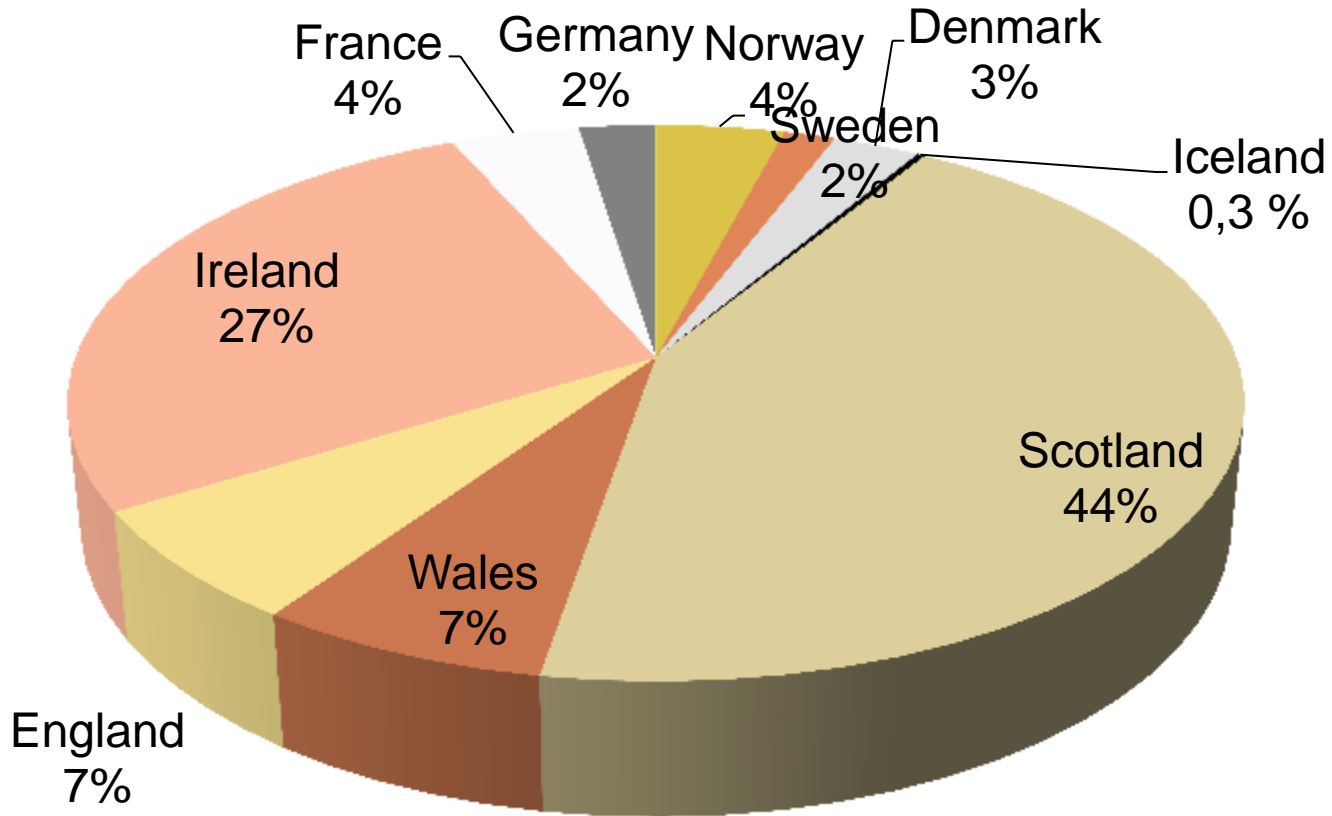


## Sitka spruce

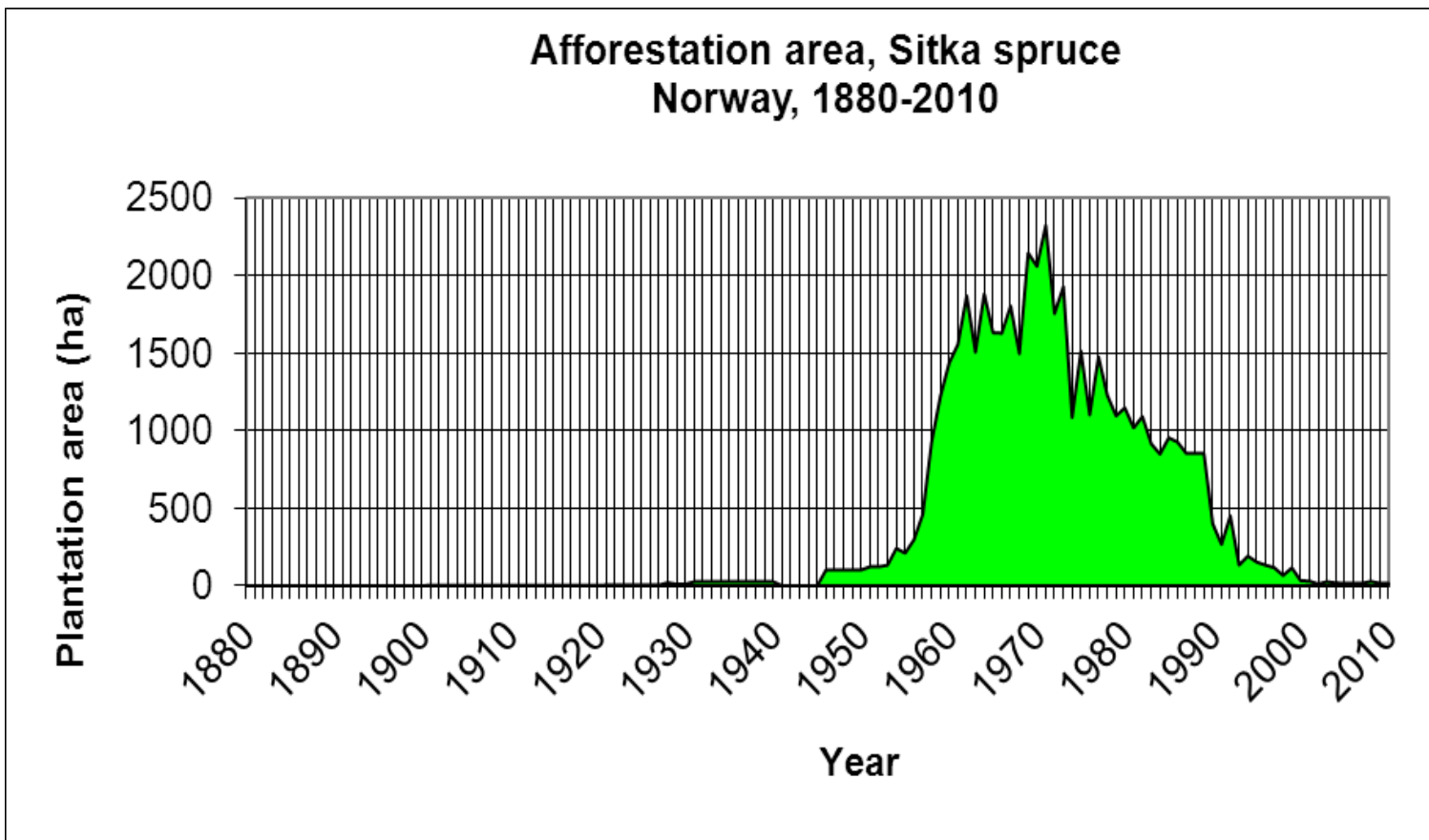
- To evaluate the ability of SS to spread from plantations in coastal areas in Norway
- To refine models for sustainable forest management of SS in coastal Norway



# Sitka spruce, NW Europe: Area 1.21 million hectares



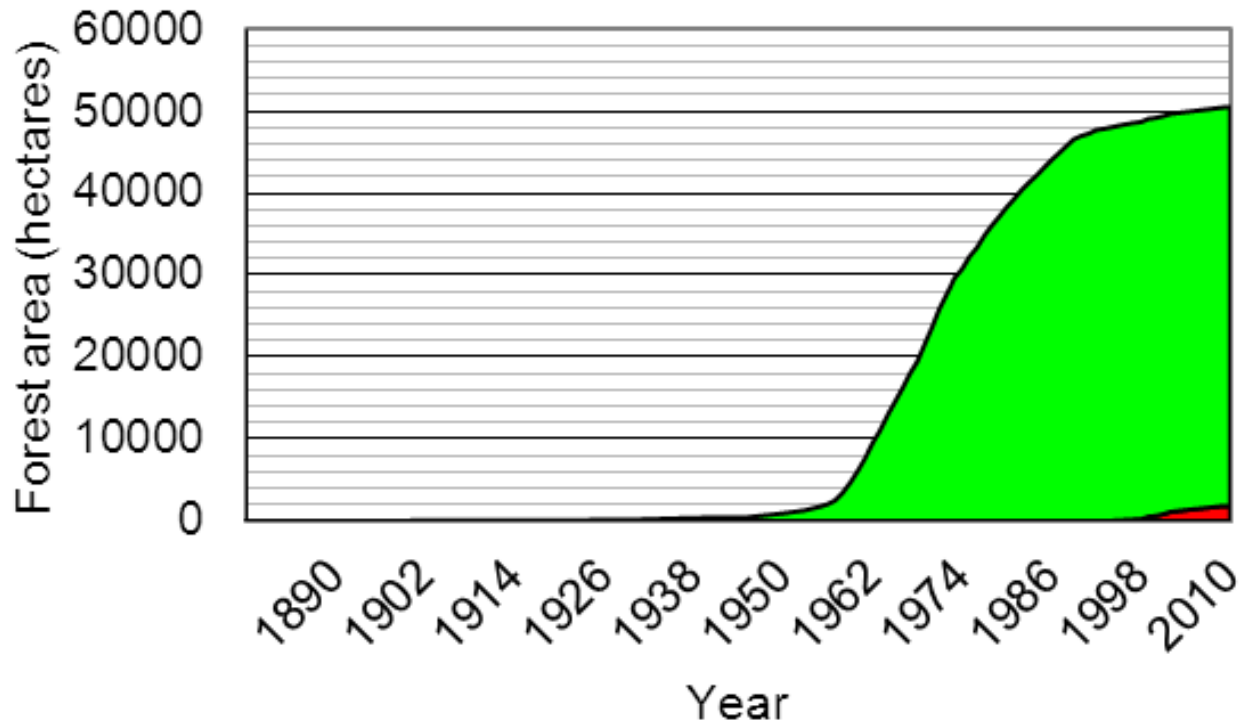
Yield timber: ~15 mill m<sup>3</sup>/yr



Source: Annual statistics, Ministry of Agriculture

Sitka spruce, 50 000 ha = 0.15% of land area  
 = 0.6 % of the prod. forest area  
 = ~ 6 % of prod. land in outer coastal districts

## Plantation area, Sitka spruce, Norway, 1880-2010



### Sitka spruce, National Forest Inventory

SW: 30 000 ha (63%)

Central: 6 000 ha (12%)

NW: 12 000 ha (25%)



## Methods

Stratified sampling

Apply long-term experiments with Sitka spruce

Identify «even» edges

Record Sitka spruce saplings using GPS

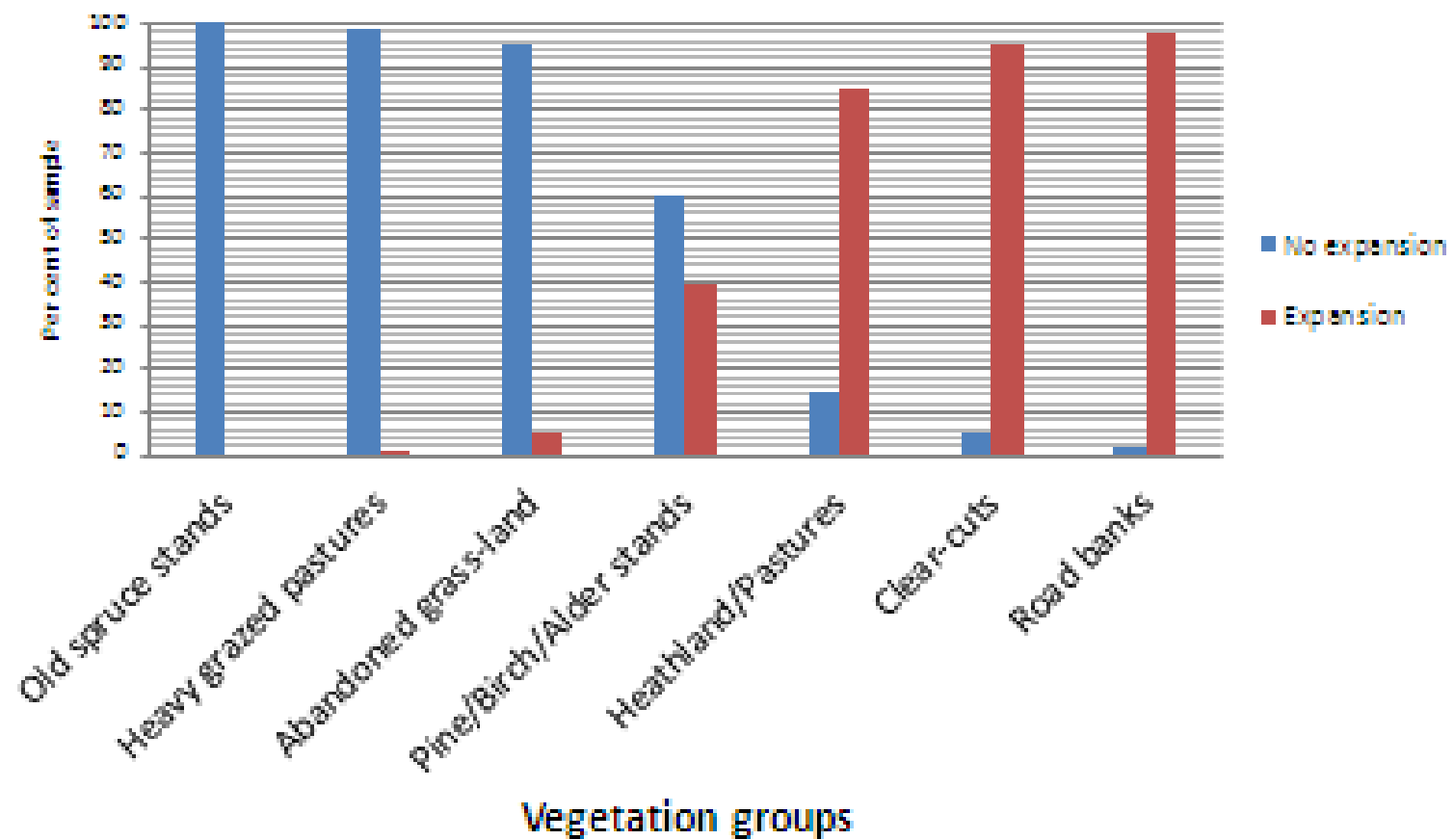
Landscape analysis GIS ArcMAP

Statistical modeling





# Where is Sitka Spruce expanding its position in W. Norway?



N=29 blocks of Sitka spruce

# Range parent stands

- Age: 30-75 yrs
- Mean height: 14-29 m
- Basal area: 44-78 m<sup>2</sup>/ha
- Standing volume: 150-990 m<sup>3</sup>/ha
- Site index ( $H_{40}$ ): 15-30 m
- Yield Class: 7.5-22.0 m<sup>3</sup>/ha/yr



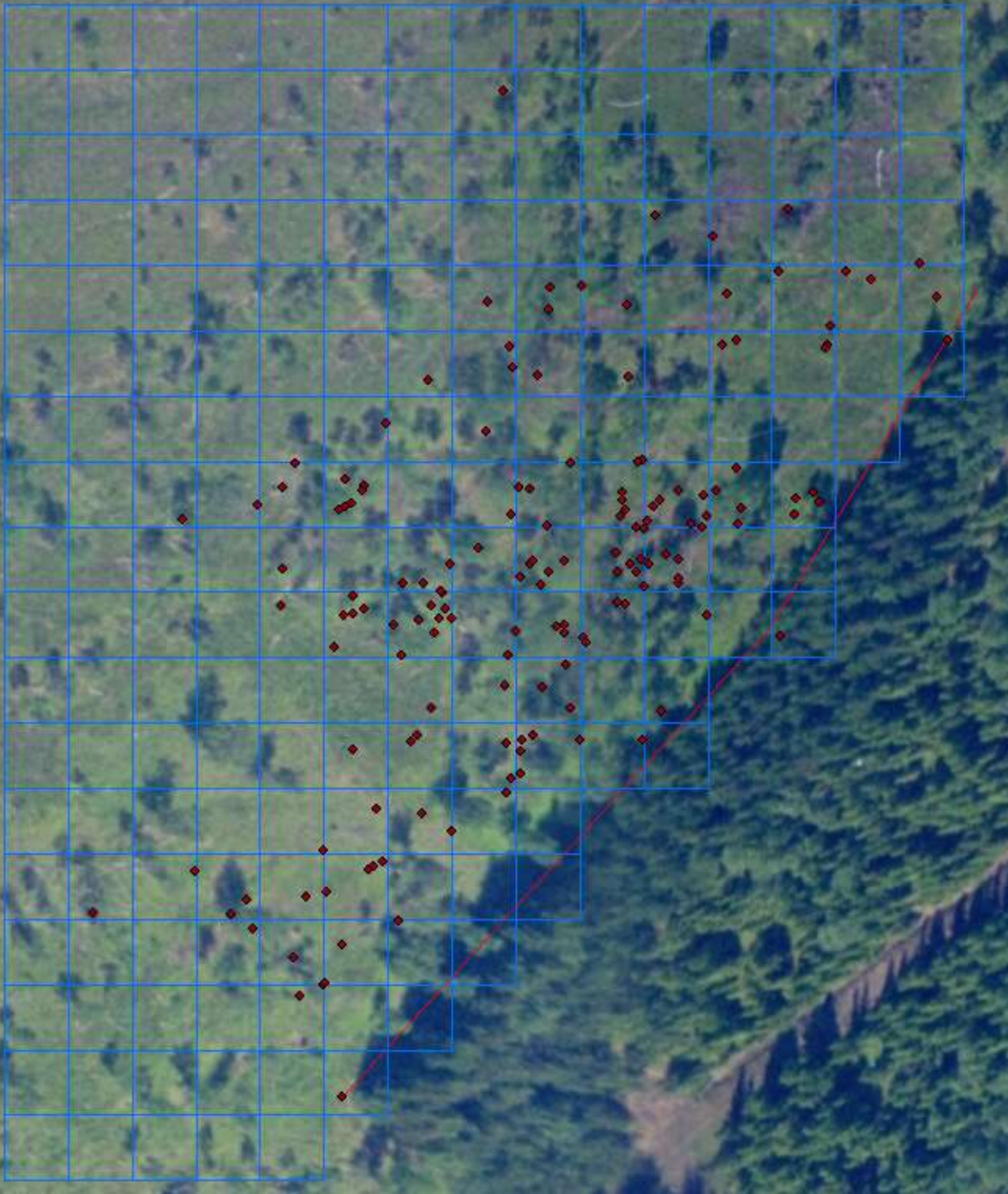


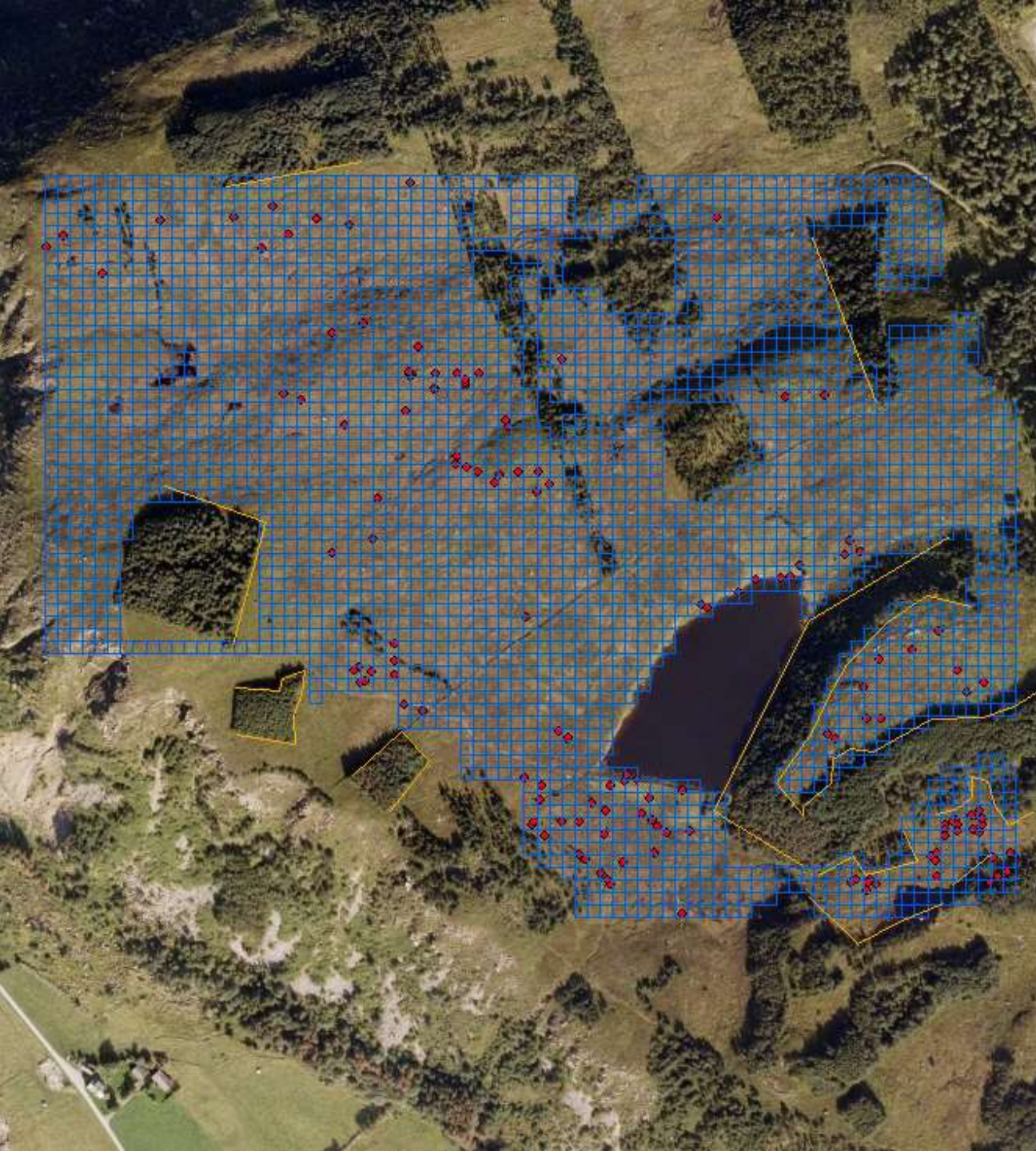
Bontveit-SW Norway



Steiro-NW Norway

Steiro-NW Norway  
Max distance from edge 78 m



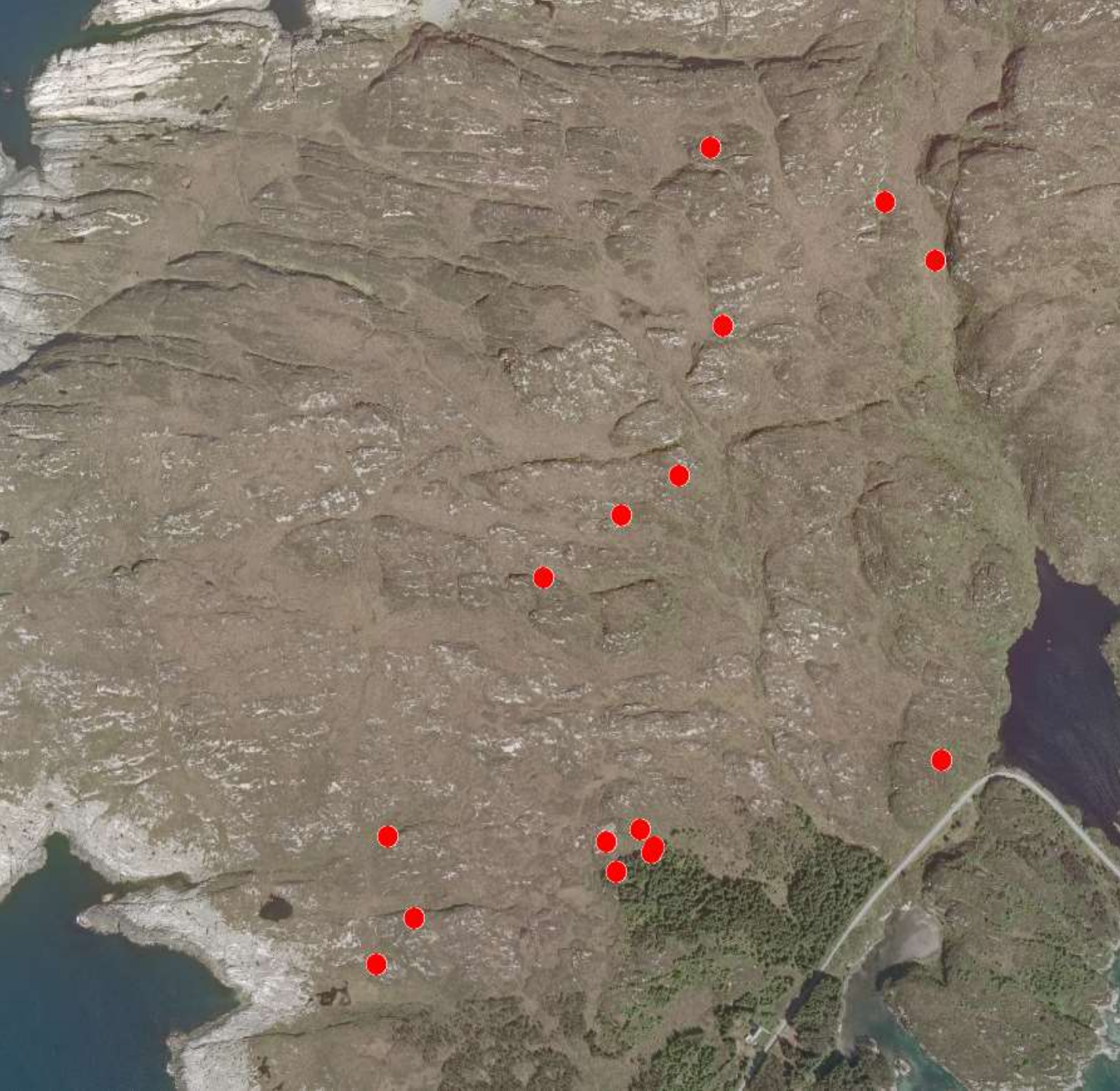


Haramsøy, SW Norway  
Max distance from nearest  
edge: 227 m  
Zero-square percentage:  
95.8



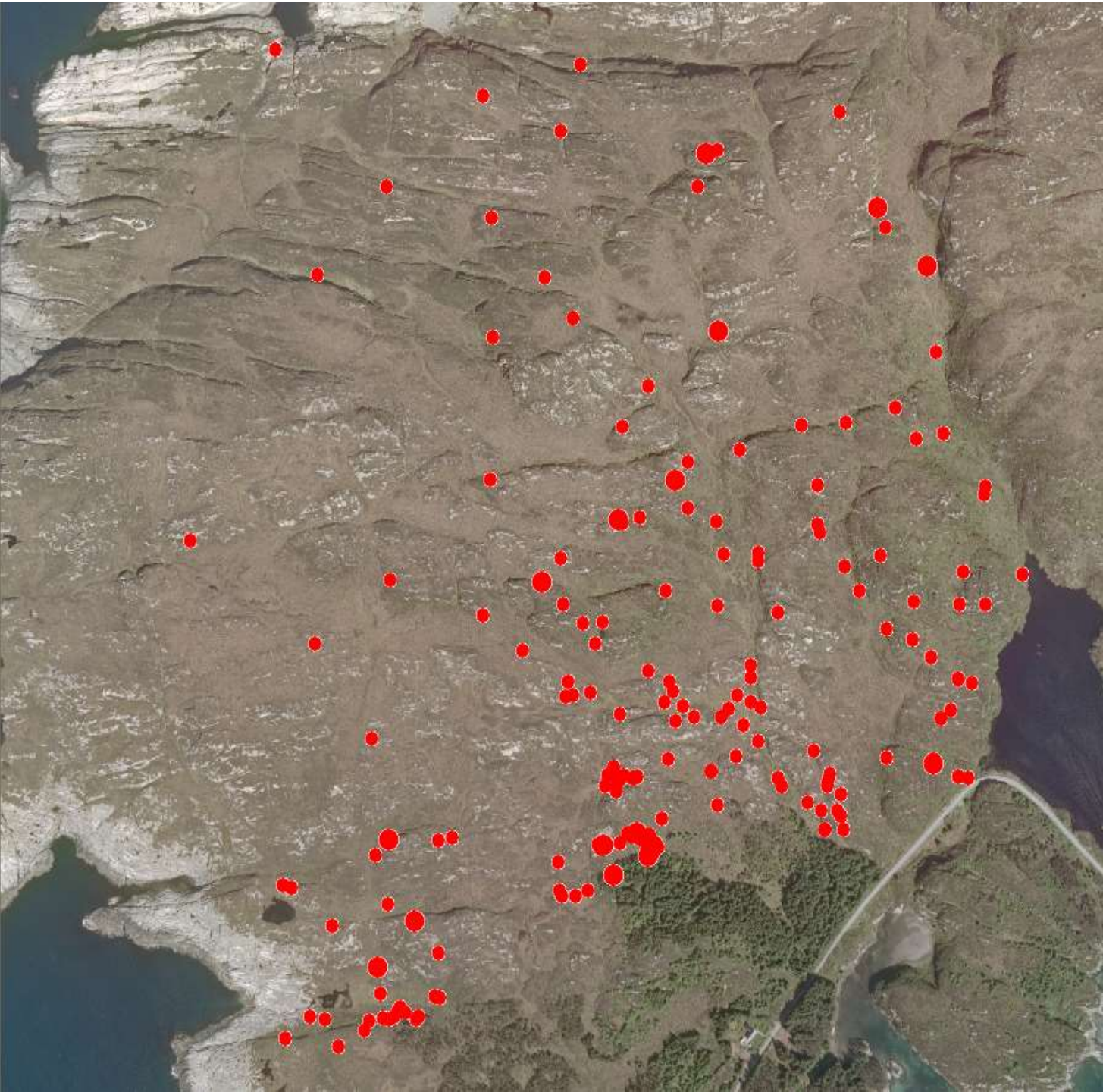
1975

Store Karlsøy  
SW Norway

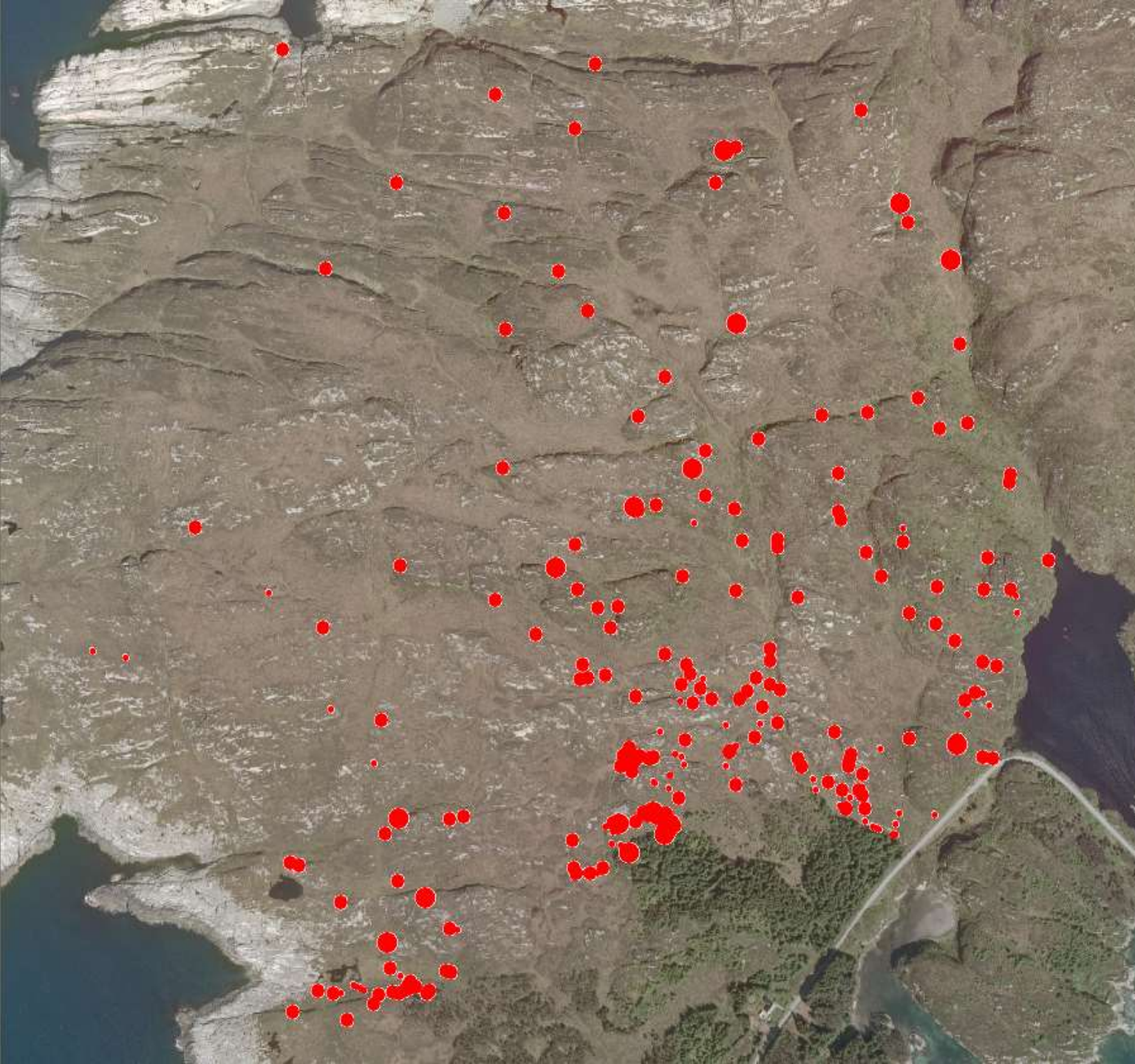


1985



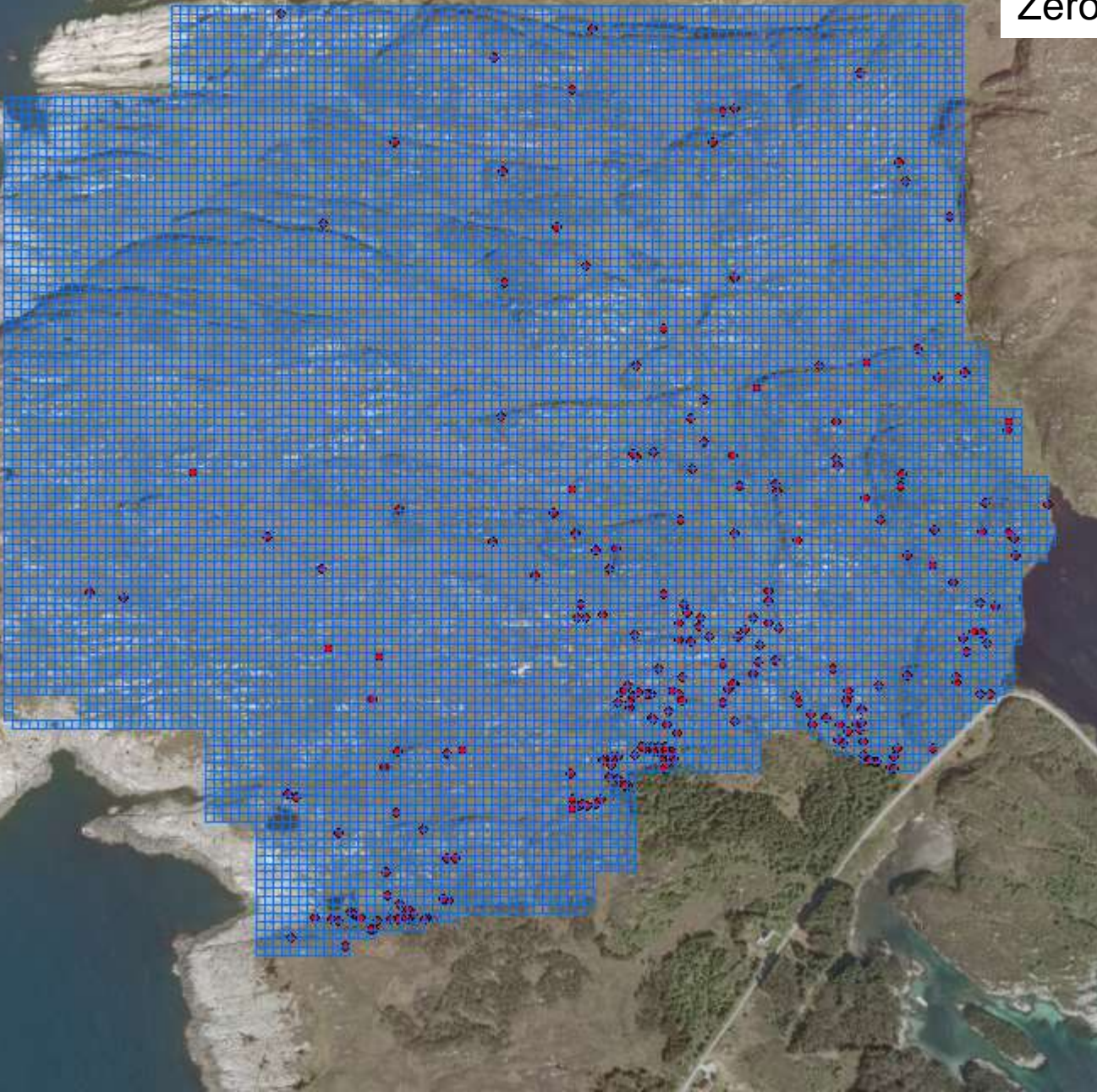


2000

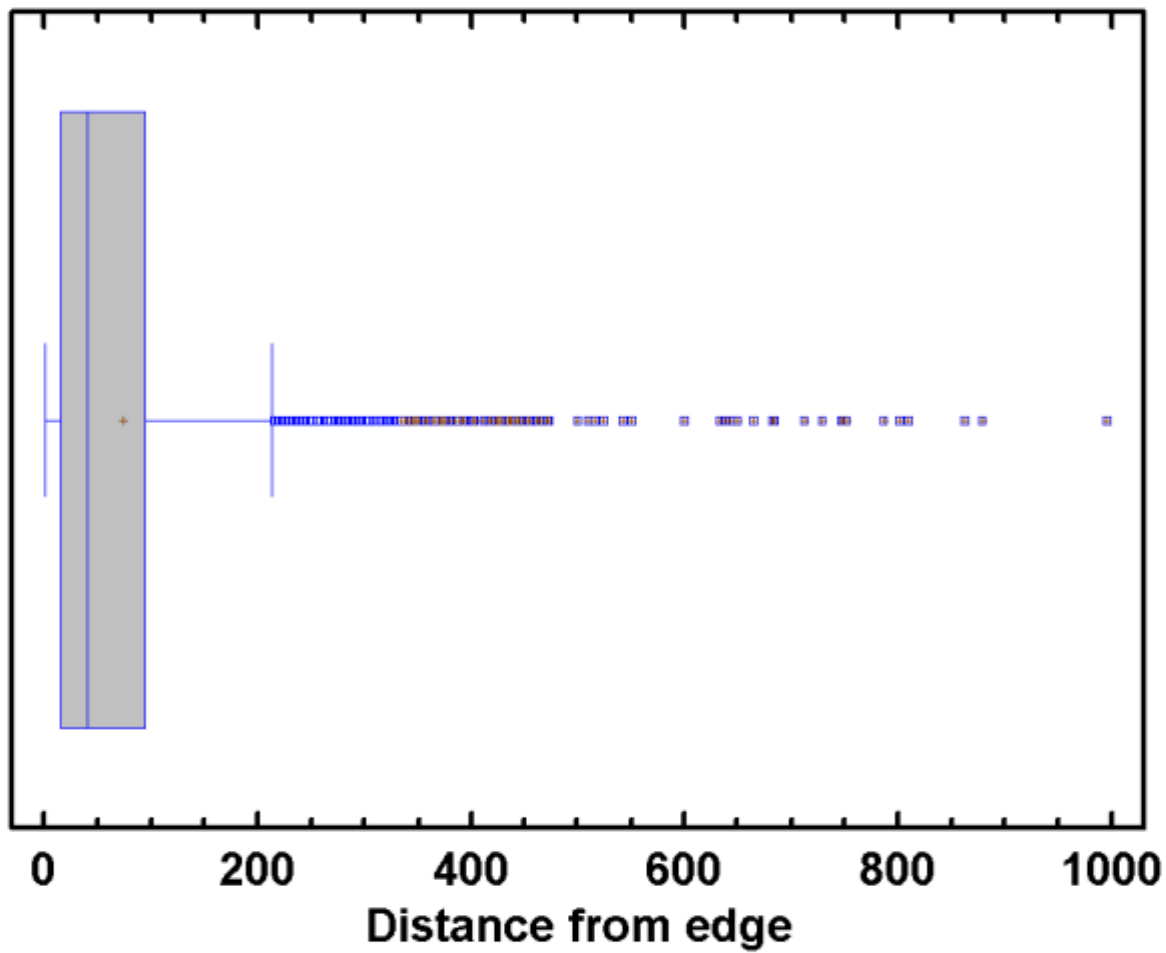


2010

Store Karlsøy, SW Norway  
Max distance from edge 996 m  
Zero-square percentage 97.8

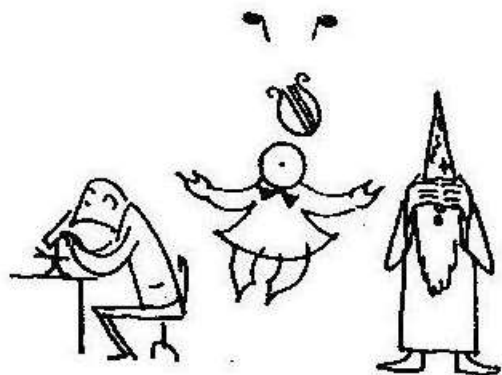


# Sitka spruce saplings



SW: 4 m per year

NW: 0,8 m per year



## DET VIDENSKABELIGE MANIFEST

Folk som undres  
på naturens spil  
kan jo granske sagen,  
hvis de vil.  
Hvis de ikke vil,  
kan de la være  
og med dèn begrundelse  
erklære:  
at det ikke  
går naturligt til.







*Pinus uncinata*, YC 3.



Western hemlock, YC 20

Exported to China, Net price per ha; 120 000 NOK



# Summary

- Sitka spruce the obvious (and only) choice for a commercial forestry in coastal W Norway and North Norway.
- Several fir species important for Christmas trees, greenery production
- SS put on the Norwegian Black List as a high risk species in 2012
- Exotic tree species in Norwegian forestry is next to banned - demonised; no planting or replanting goes on

