

# Föryngring och bete på rönn

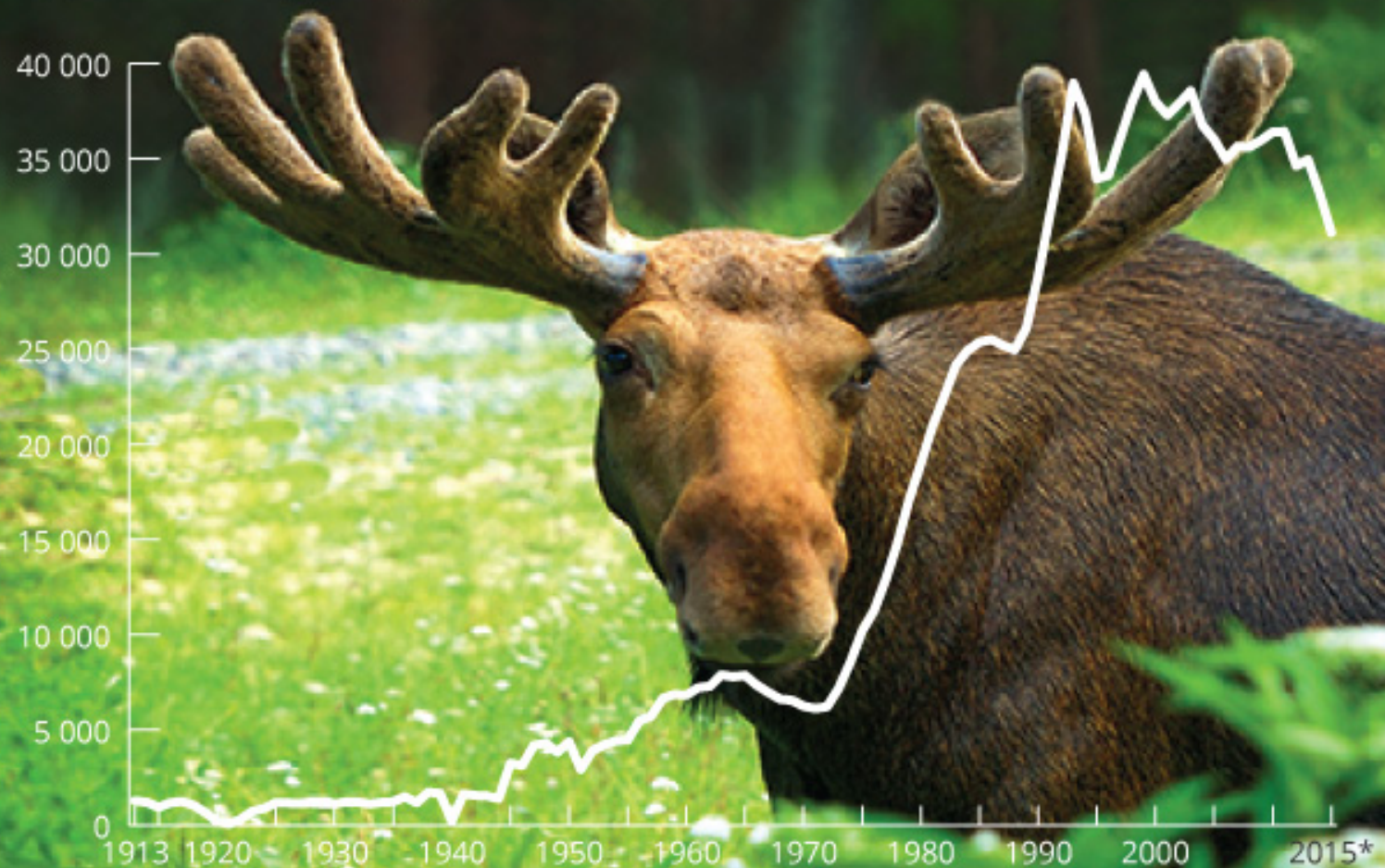
## Erfaringer fra Norge


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NTNU Vitenskapsmuseet, Norsk Institutt for Naturforskning (NINA)

# Innhold

- Hvordan har beitetrykket fra hjortevilt og husdyr endret seg i Norge de siste tiårene?
- Alt om rogn: Demografi for rogn i ulike regioner og hogstklasser. Data fra Landskogstakseringen i Norge fra 1990-tallet til i dag (7-11 takst).
- Hvor mye rogn er tilgjengelig for elgen (dbh < 60 mm), og klarer rogn å vokse ut av rekkevidde for elgen?
- Hva er effekten av elg- og hjortebeite på rekruttering og vekst av rogn? Data fra (1) landskogstakseringen, (2) uthegningstudier i Norge (SUSTHERB)

Figur 1. Felte elg i Norge



 Statistisk sentralbyrå  
Statistics Norway

# The moose is the new cow

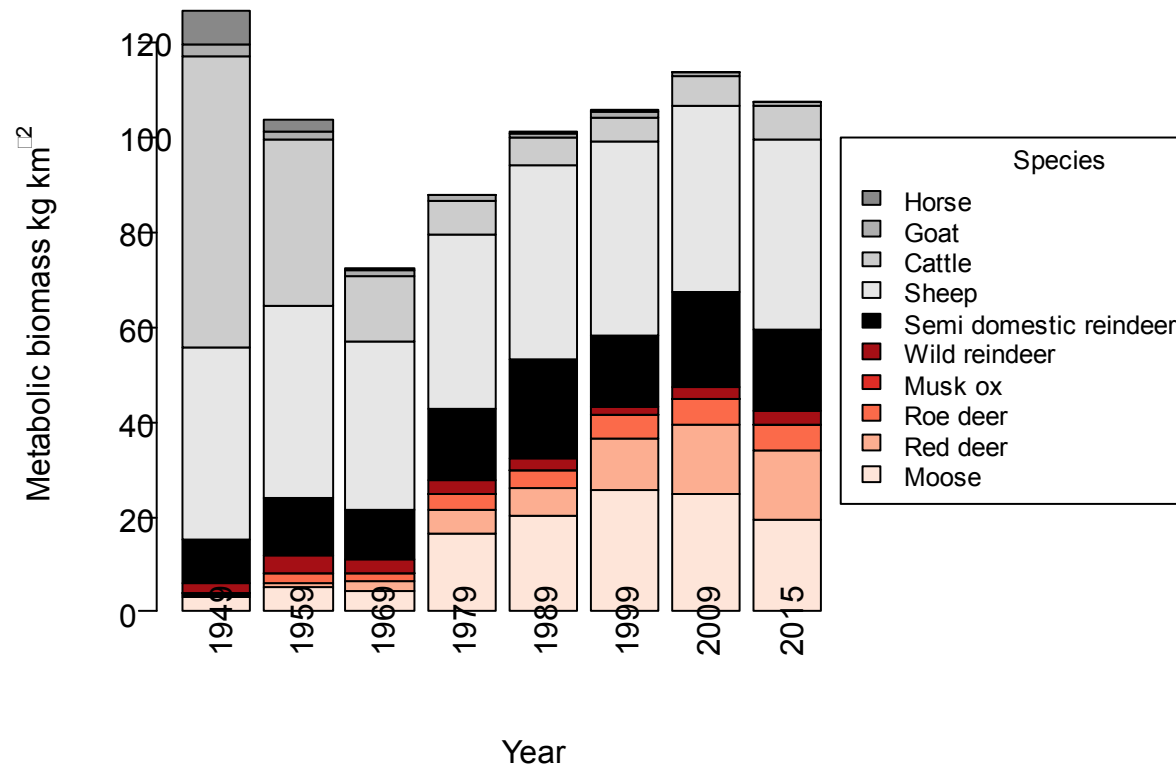
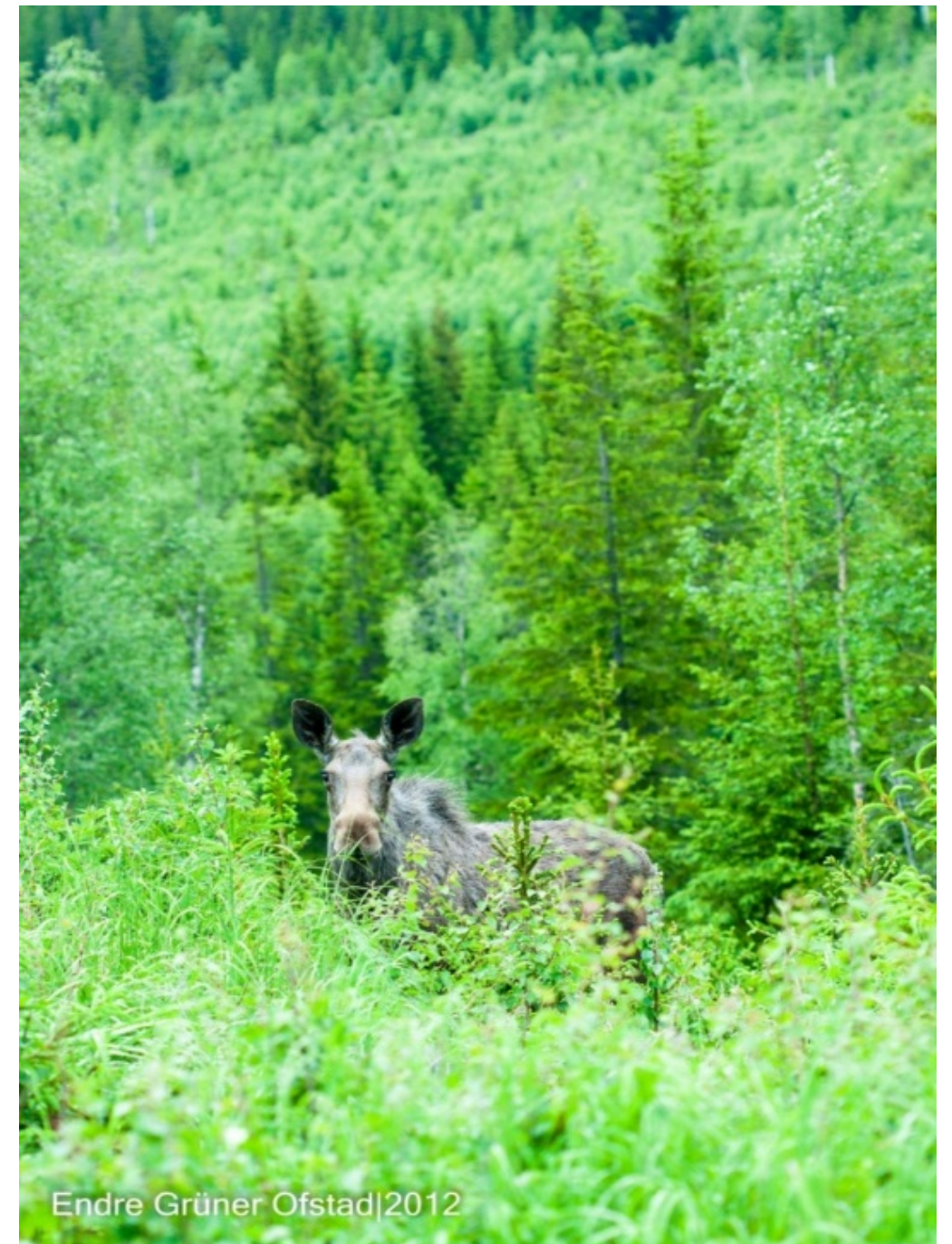
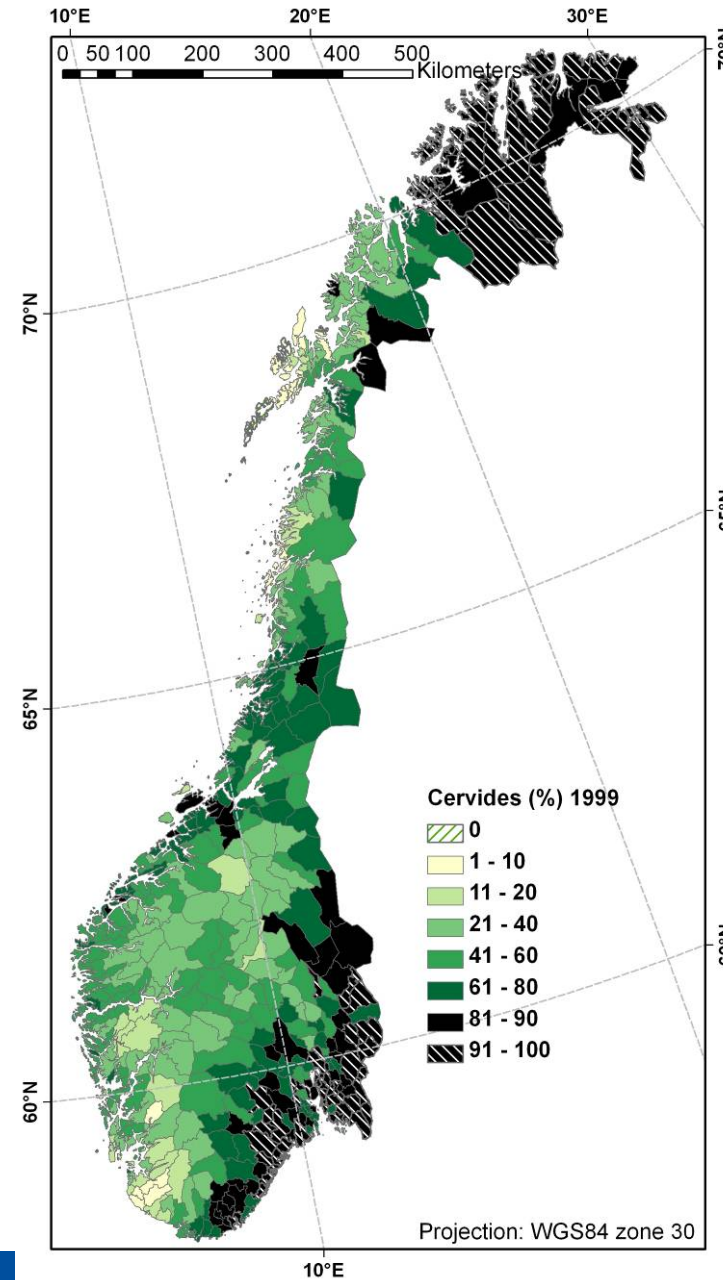
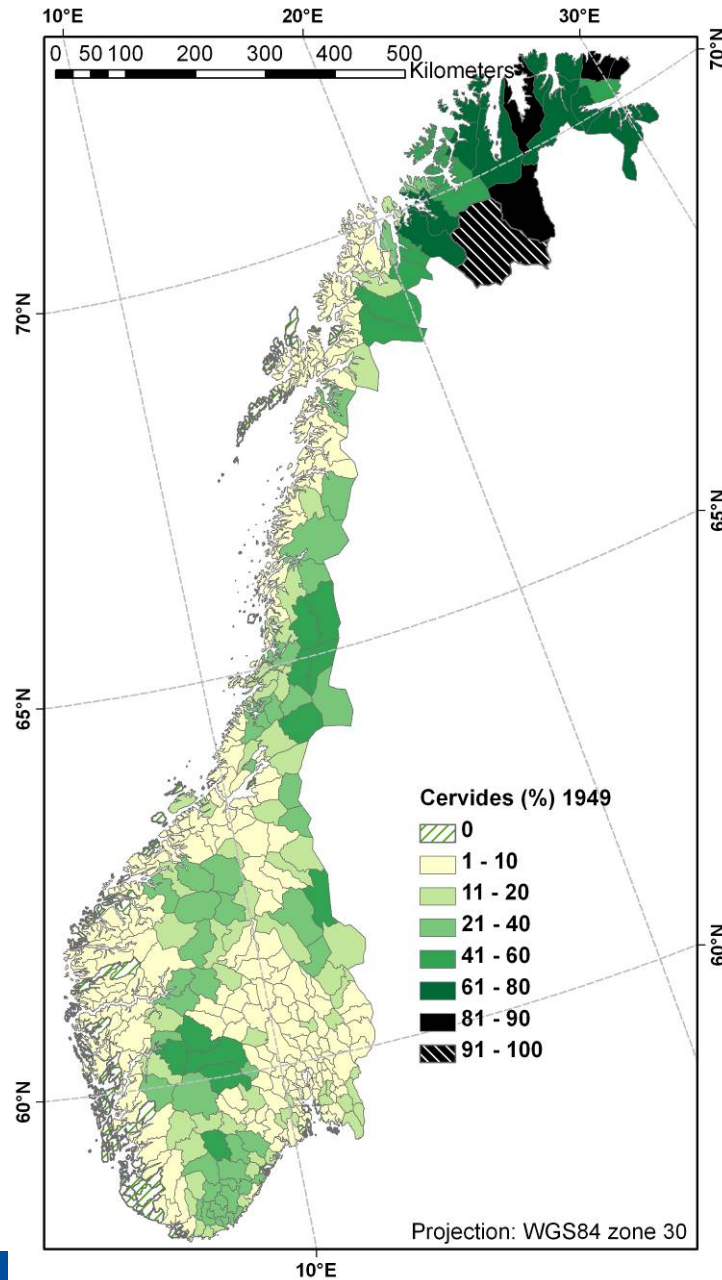


Figure 1 Metabolic biomass ( $\text{kg km}^{-2}$ ) of large herbivores across Norway between 1949 and 2015. Livestock species are shown in shades of grey and wild herbivore species in shades of red.

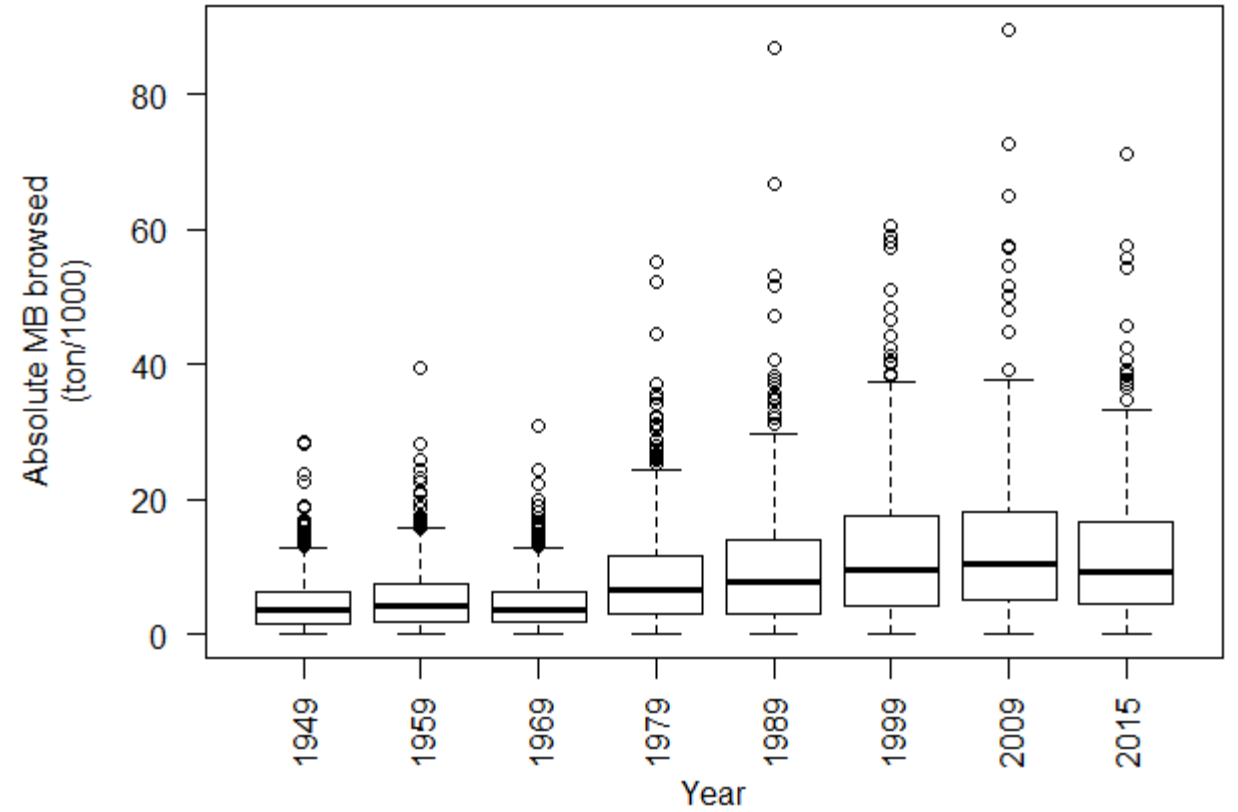
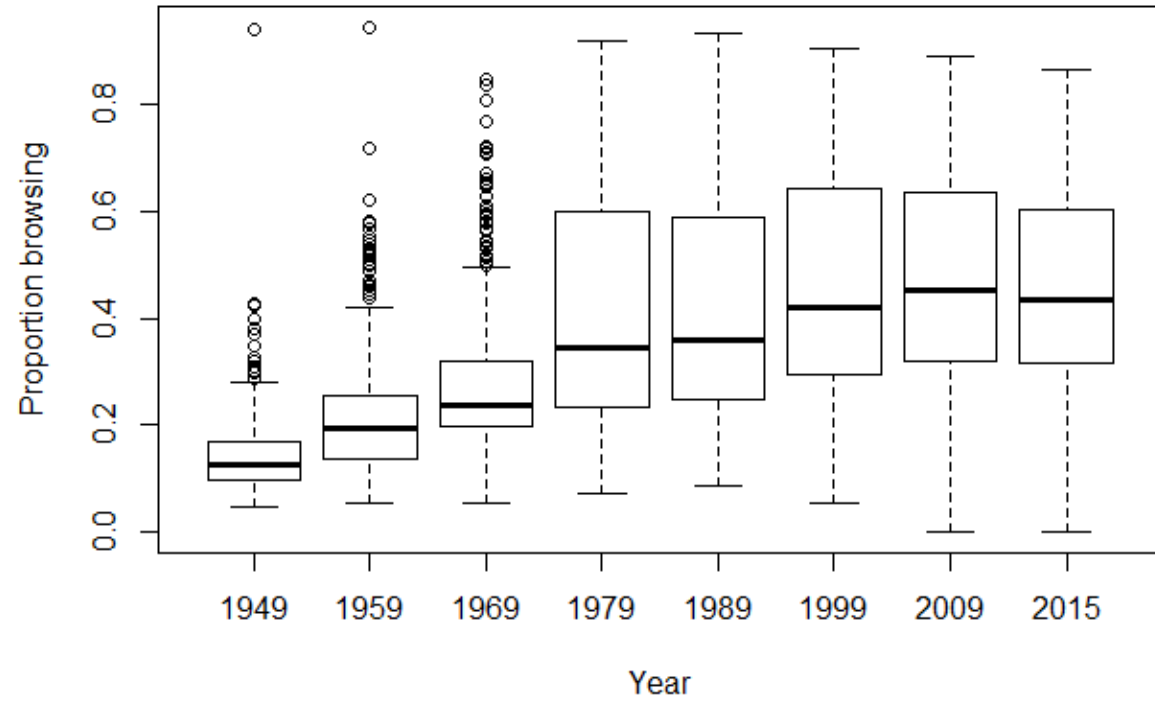
Austrheim et al. 2011, Speed et al. In prep



# Percent cervides in Norway 1949 and 1999

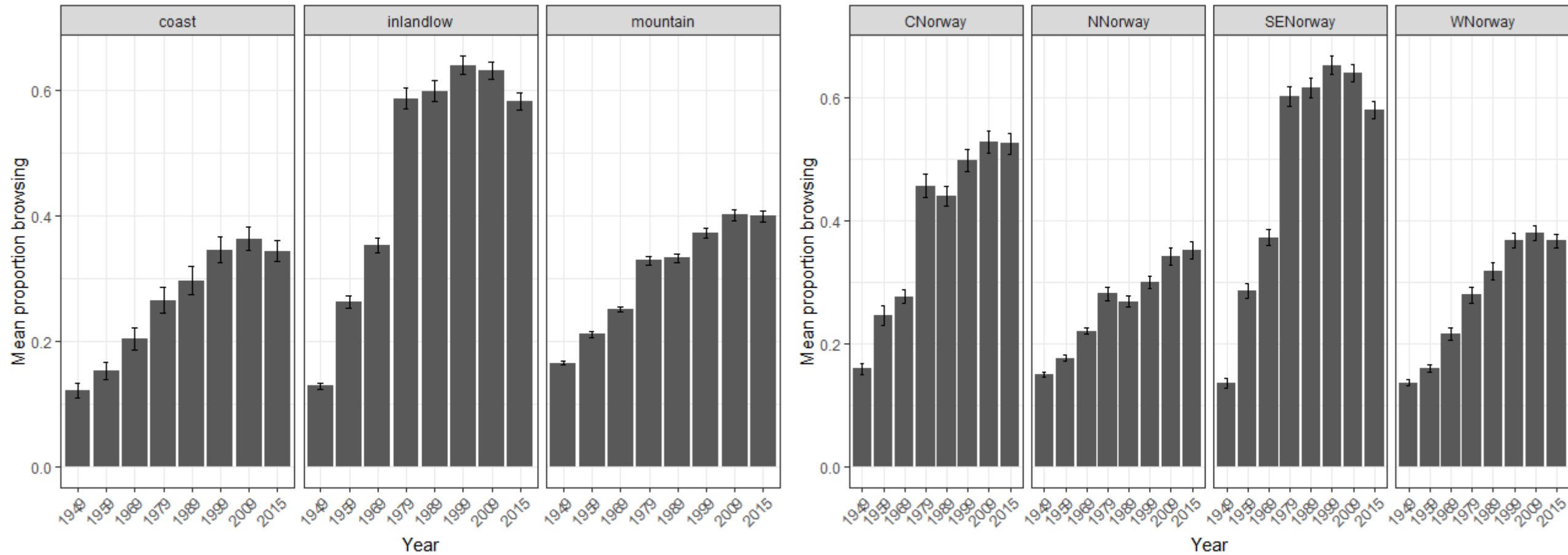


# From grazing to browsing



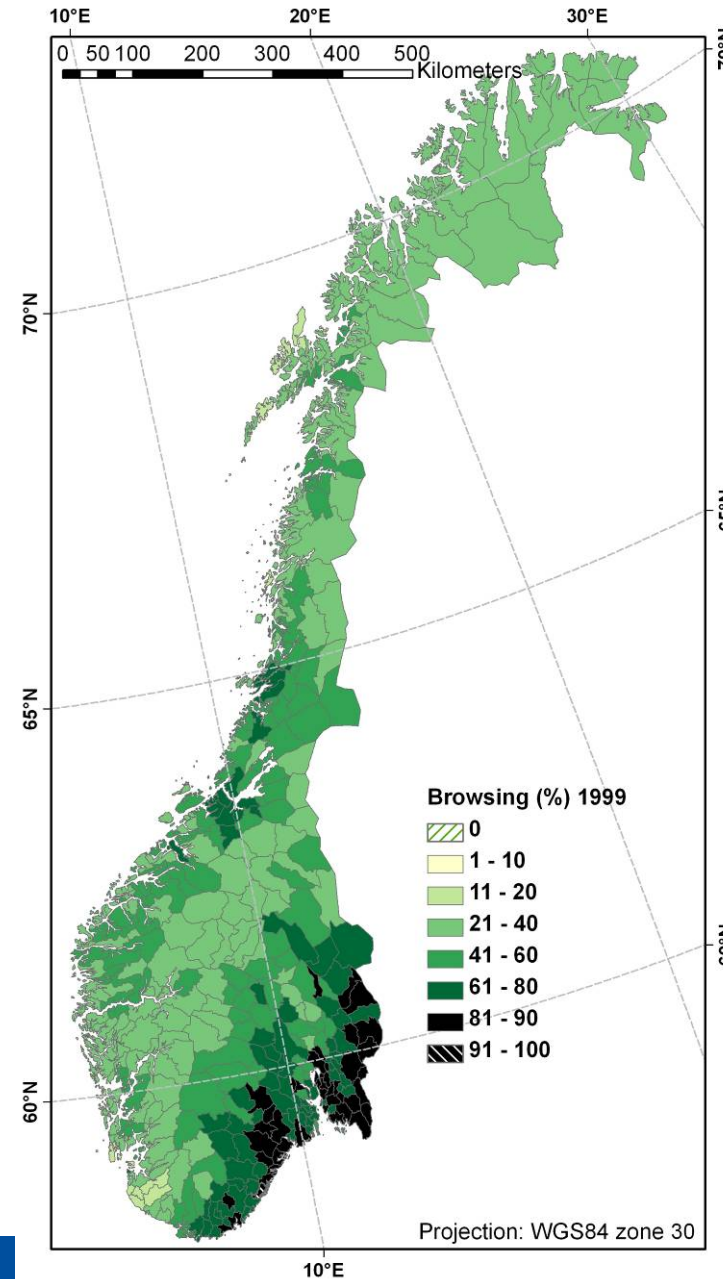
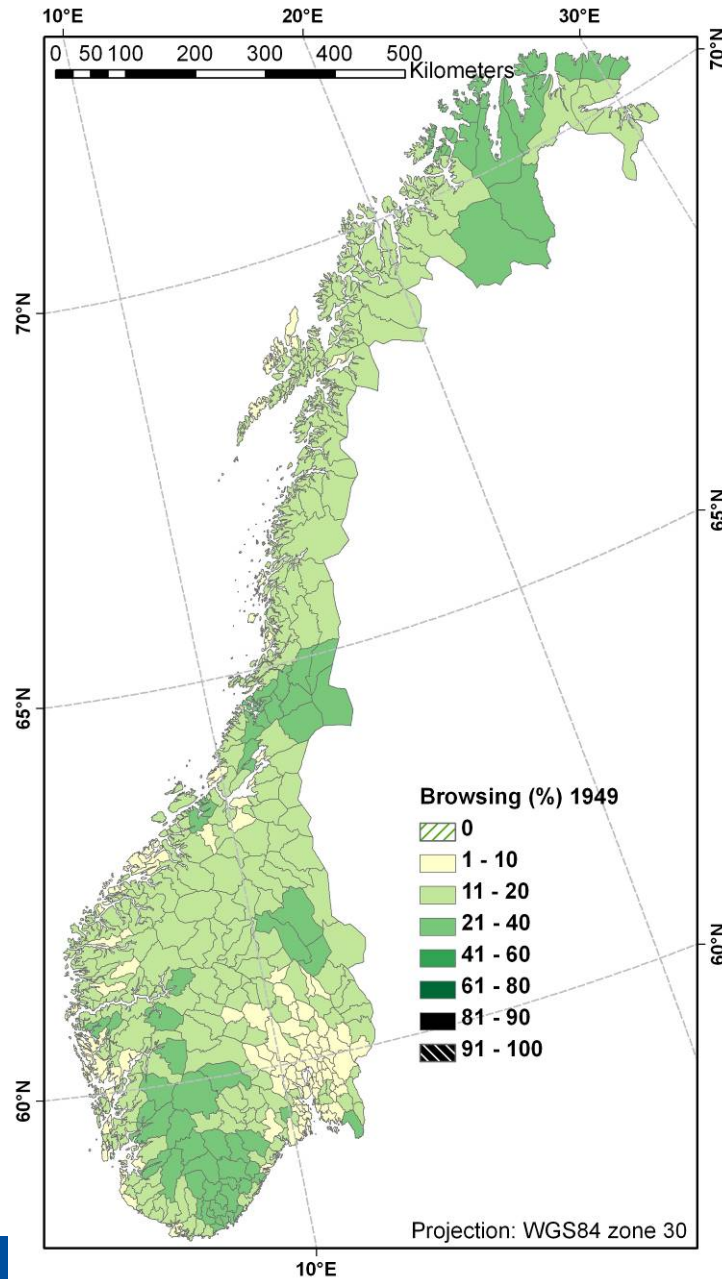
- Increased proportion of browsing (woody plants)

Absolute amount of browsing



Browsing pressure varies between bioclimatic regions and geographic regions

# Percent browsing vs. grazing in 1949 and 1999

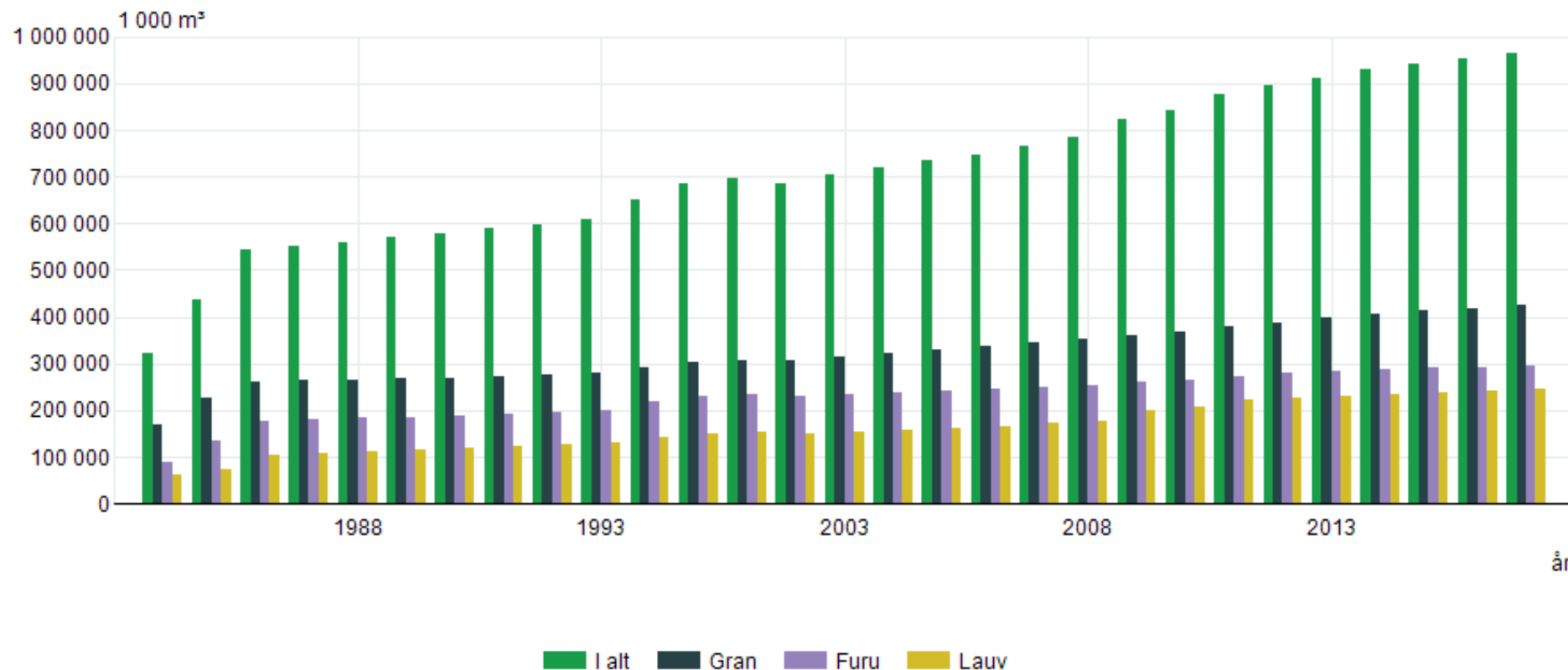




## Landskogstakseringen /NFI:

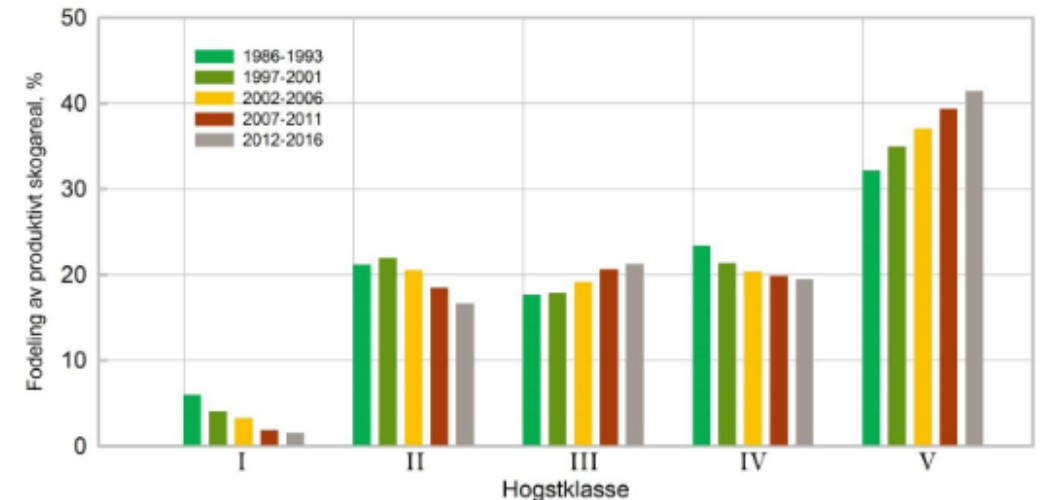
Increase of forest and  
also deciduous  
trees in Norway the  
latest 30 years

Stående kubikkmasse under bark og årlig tilvekst under bark (1 000 m<sup>3</sup>) etter treslag og år. Stående kubikkmasse.



Kilde: Statistisk sentralbyrå

# Andel av ulike hogstklasser i produktiv skog i Norge. Hogstklasse 2 går tilbake på nasjonalt nivå



Utvikling av arealet med produktiv skog som kan anvendes til skogbruk i de forskjellige hogstklassene. Utviklingen er vist for de samme prøveflatene som har vært med i takseringen gjennom hele tidsperioden. Kilde: NIBIO - Landsskogtakseringen.

Skog i ulike hogstklasser, Selbu

# The National forest inventory (NFI):

## History:

- Started in 1919 due to over-exploitation and general insecurity about the state of the forest resources
- Since then, there has been 10 inventory cycles (11<sup>th</sup> just started)
- Variation in sampling method and parameters, but overall a consistent design
- NFI is currently a part of NIBIO (Norwegian Institute for Bioeconomy Research)

## Purpose:

- Document the extent of forest resources, e.g. area distribution, growing stock (volume) and tree species distribution
- Document how resources are changing over time, e.g. land use, stock increment, drain of wood etc.
- Document the extent and development of other environmental conditions
- Document how forestry affects the forest ecosystem
- Assess long term changes due to external impact (climate)

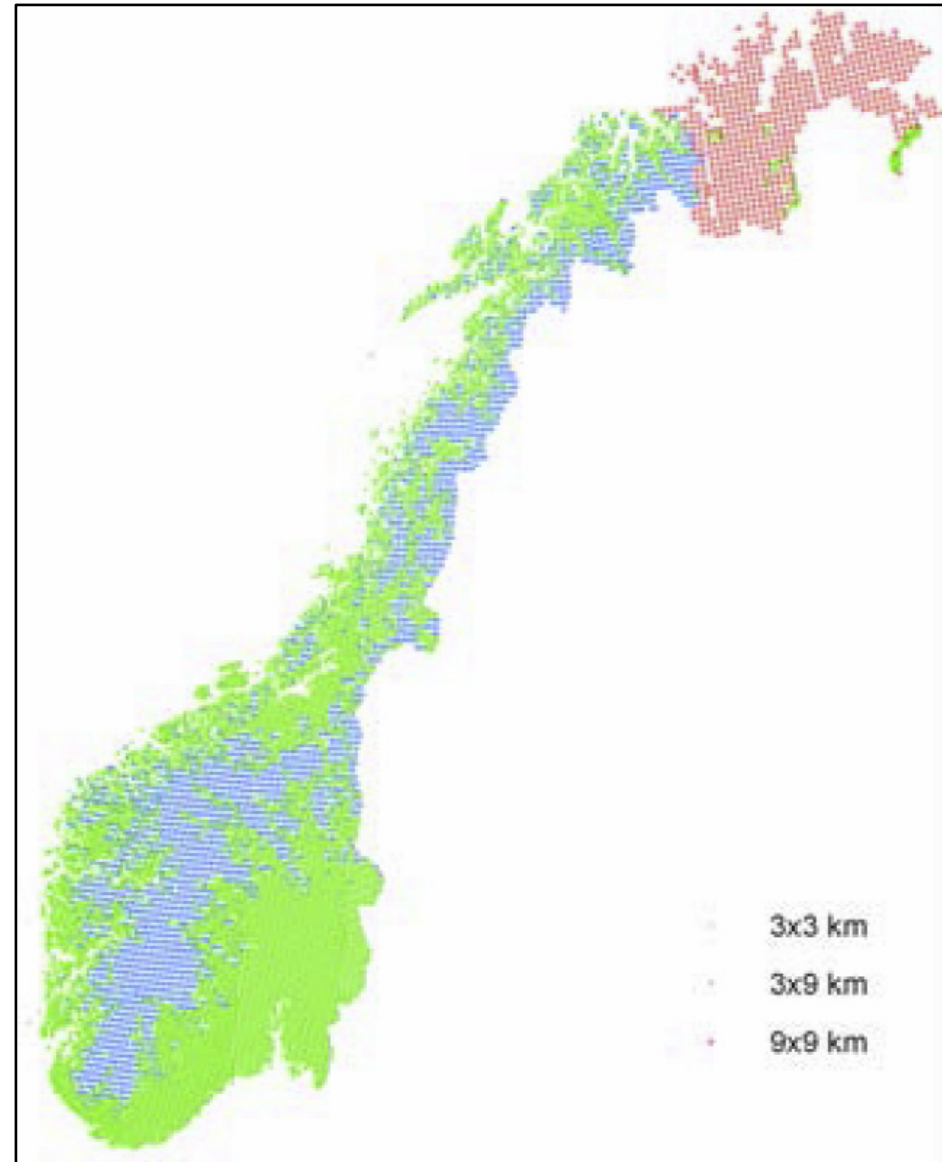
## Historical development

Inventory cycle	Period	Reference year	Method
1st	1919-1930	1925	Line survey
2nd	1937-1956	1950	Line survey (plots from 1954)
3rd	1956-1964	1958	Quadratic clusters with plots
4th	1964-1976	1970	Quadratic clusters with plots
5th	1980-1986	1984	Quadratic clusters with plots
★ 6th	1986-1993	1990	Permanent plots
7th	1994-1998	1996	Permanent plots (5 year cycle)
8th	2000-2004	2002	Permanent plots (5 year cycle)
★ 9th	2005-2009	2007	Permanent plots (5 year cycle)
10th	2010-2014	2012	Permanent plots (5 year cycle)

**NFI is now into the 11th inventory cycle: 2015-2019**

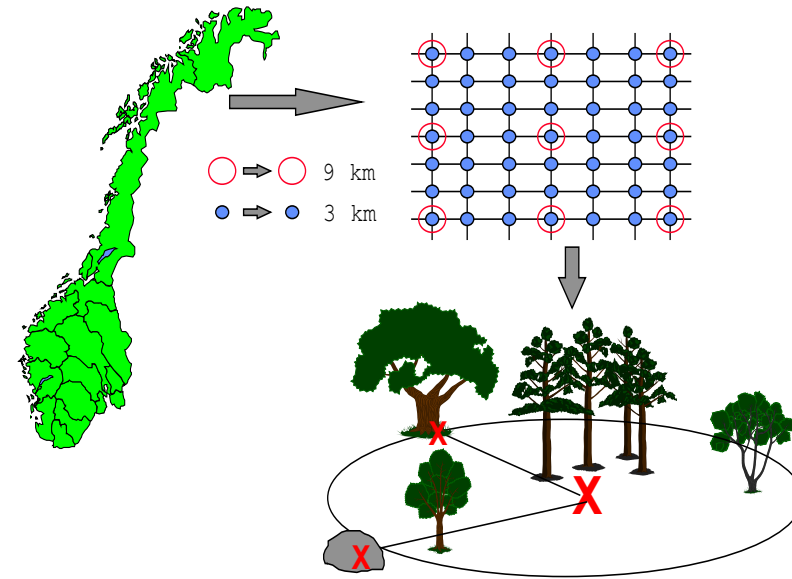
## Number and distribution of permanent plots:

- **About 22,000 sample plots**
  - 250 m<sup>2</sup> (radius=8,92m)
    - georeferenced
  - Ca. 13,500 plots outside Finnmark
  - Roughly 11,500 in forests
- **Systematically distributed**
  - 3x3 km below coniferous tree line
  - 3x9 km above coniferous tree line (since 9th cycle)
  - 9x9 km in Finnmark (since 9th cycle)
- **Sample plots are split if large differences in area type**



# Main sampling parameters:

- **Sample plot data** (250 m<sup>2</sup>):
  - **Basic data** (e.g. location, altitude, area type, area use)
  - **Operational condition** (e.g. slope, distance to roads etc.)
  - **Forest and environment data** (e.g. vegetation type, tree species distribution, stand age, forest damage, browsing pressure, silviculture practice, soil conditions, dead wood)
  - **Productive forest data** (e.g. development class, productivity)
  - **Small tree data** (e.g. species and number of trees 0,3m - 49mm dbh)



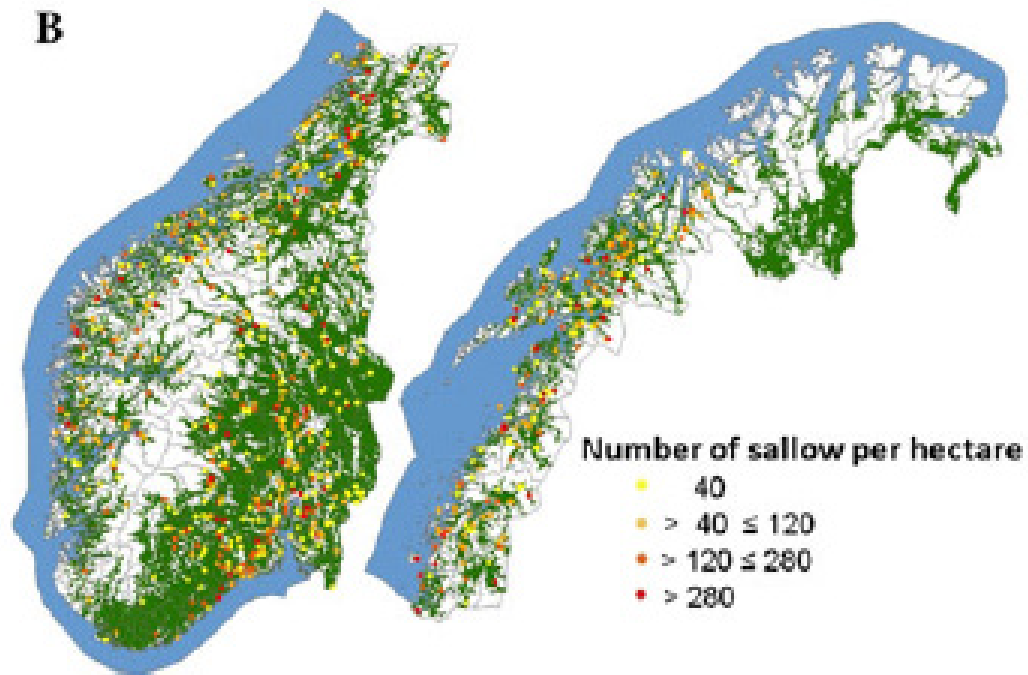
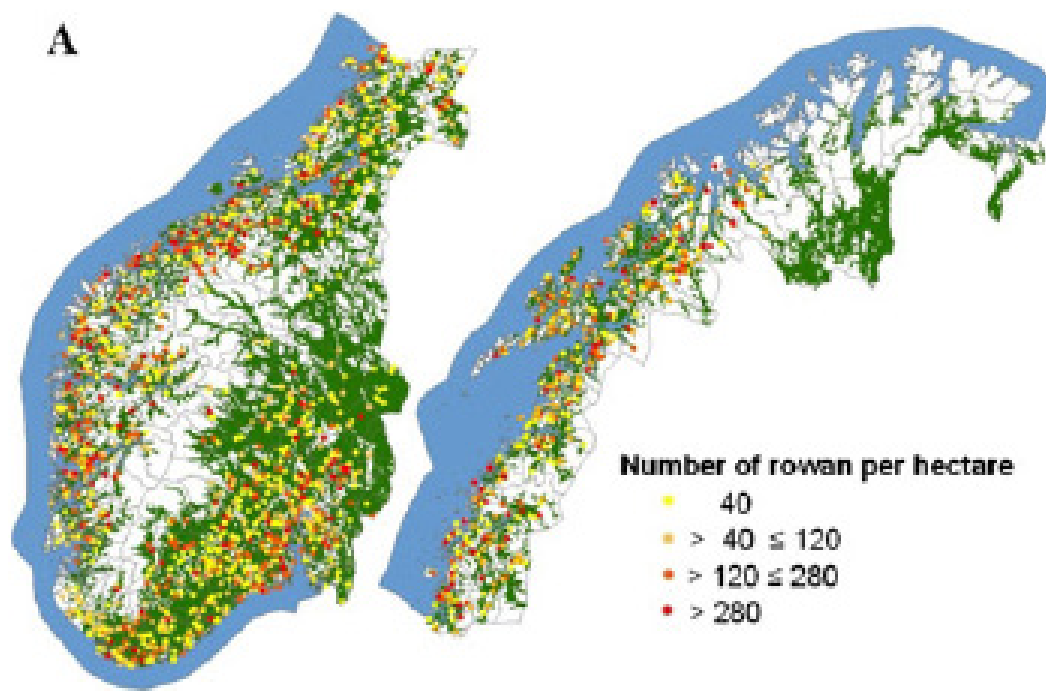
## Main sampling parameters:

- **Tree data** (trees  $\geq 50$  mm dbh on plot):
  - **Basic data** (e.g. location, species, state, and diameter at breast height (dbh) of all trees)
  - **Sample tree data** (e.g. tree height, age, crown height and density)
- **Environmental assessment (MiS):**
  - **Biodiversity and cultural relicts**
    - Since 2003
    - 0,2 ha



# Utbredelse og tetthet av rogn og selje i Norge med unntak av Finnmark.

Vanlig i hele landet



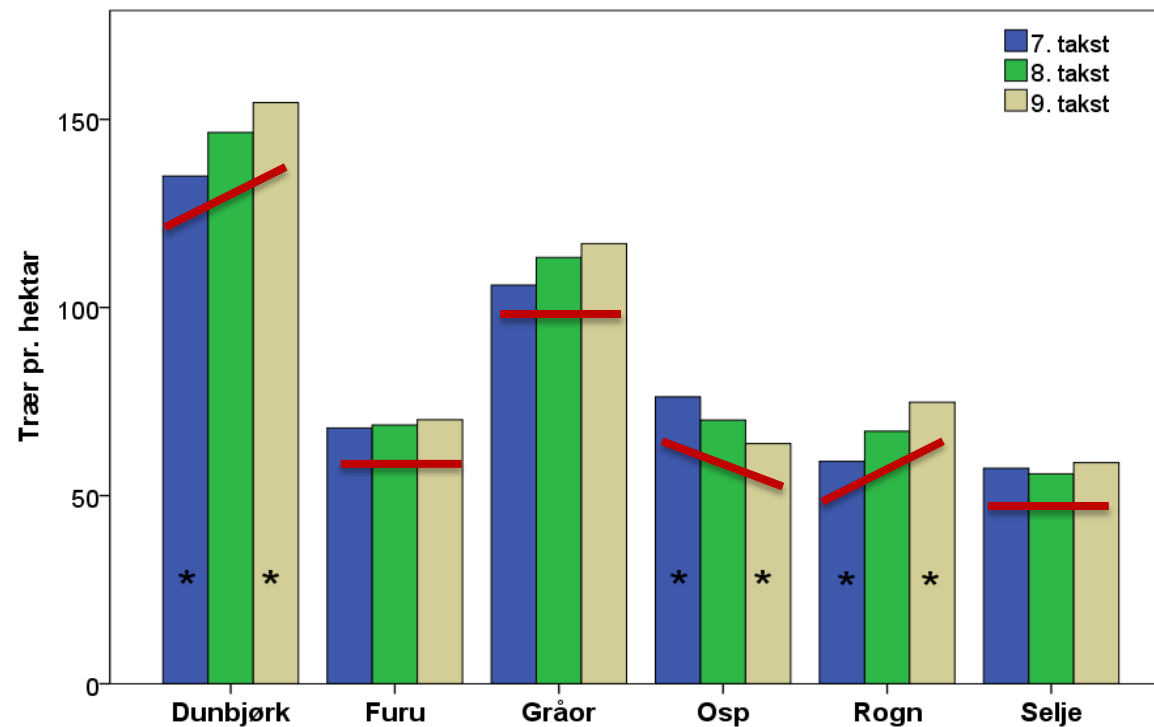
Data fra Landskogstakseringen 9 takst 2005-2009.  
Grønne arealer er områder nedenfor bartregrensen  
Solberg et al (2012) [De viktige ROS-artene - en framtid i norsk natur. Hjorteviltet.](#)



# Hvordan har rekrutteringen vært for viktige treslag som rogn, osp og selje?

## Utviklingen på landsnivå

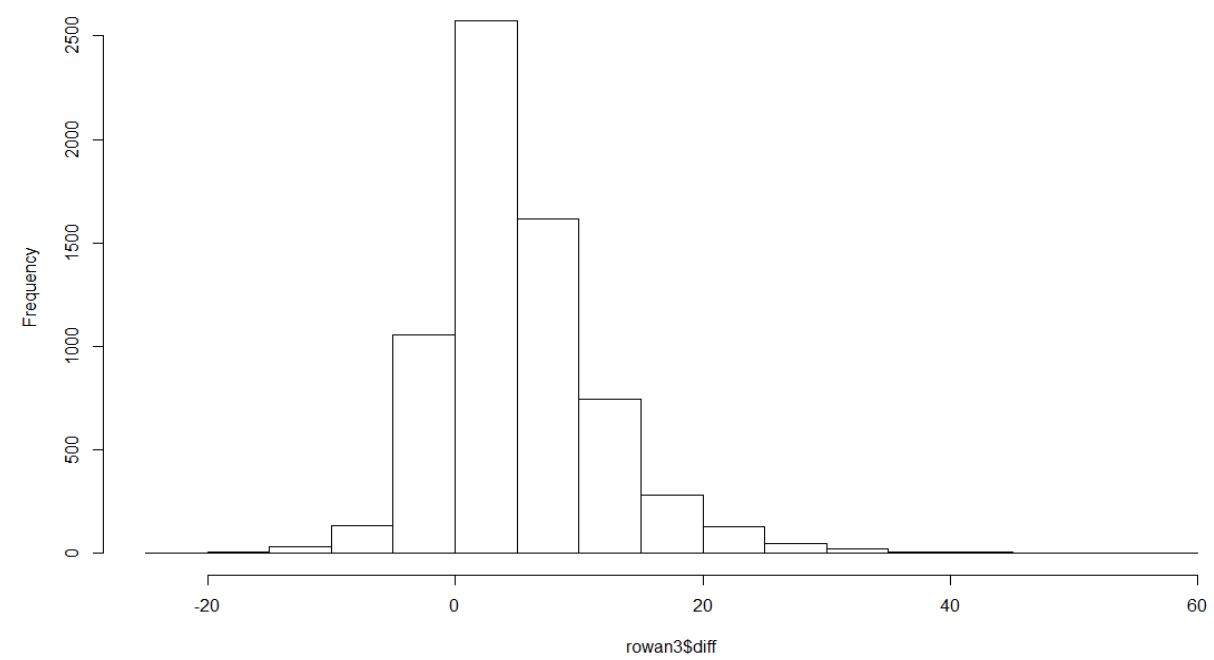
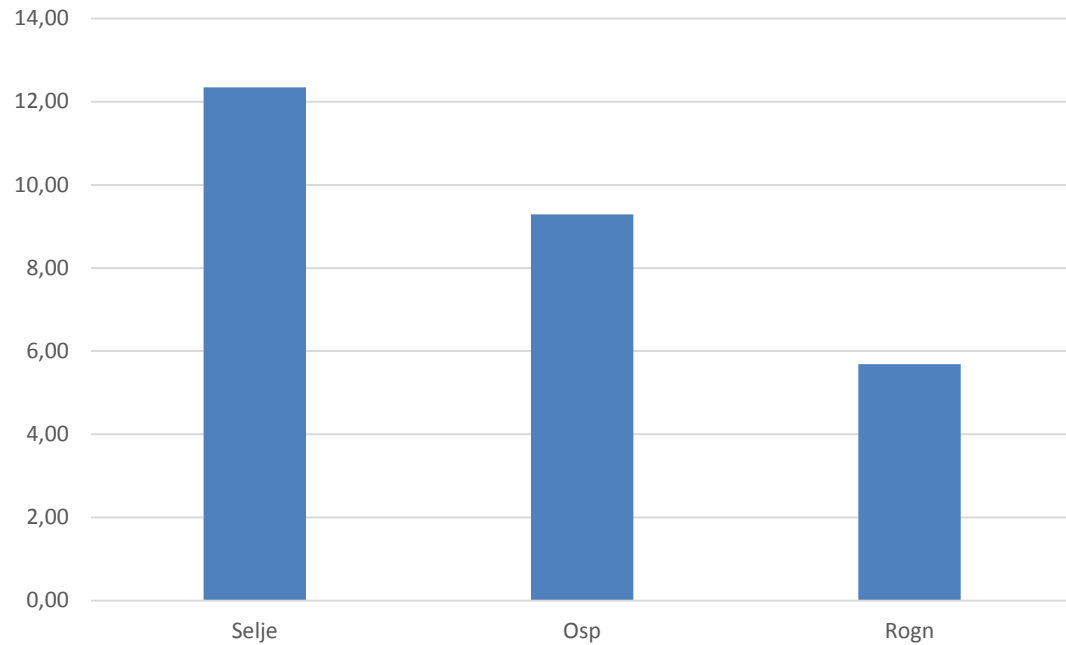
- Stabile forhold for furu, gråor og selje (ingen signifikant endring)
- Økning i antall bjørk (10 %) og rogn (25 %)
- Nedgang i antallet osp (-20 %)



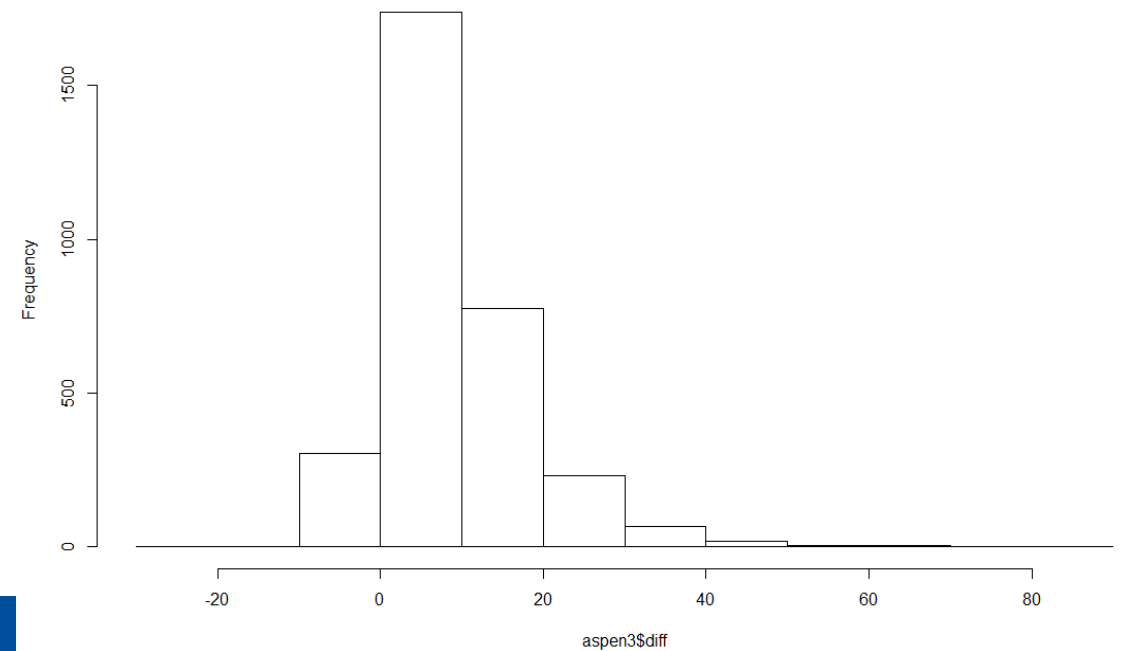
# Hvor mye vokser en rogn på 5 år?

Data for alle prøvetrær av rogn, osp og selje på nasjonalt nivå, gitt som diameter brysthøyde (mm)

Gjennomsnittlig vekst fra takst 9 til 10



Histogram of aspen3\$diff

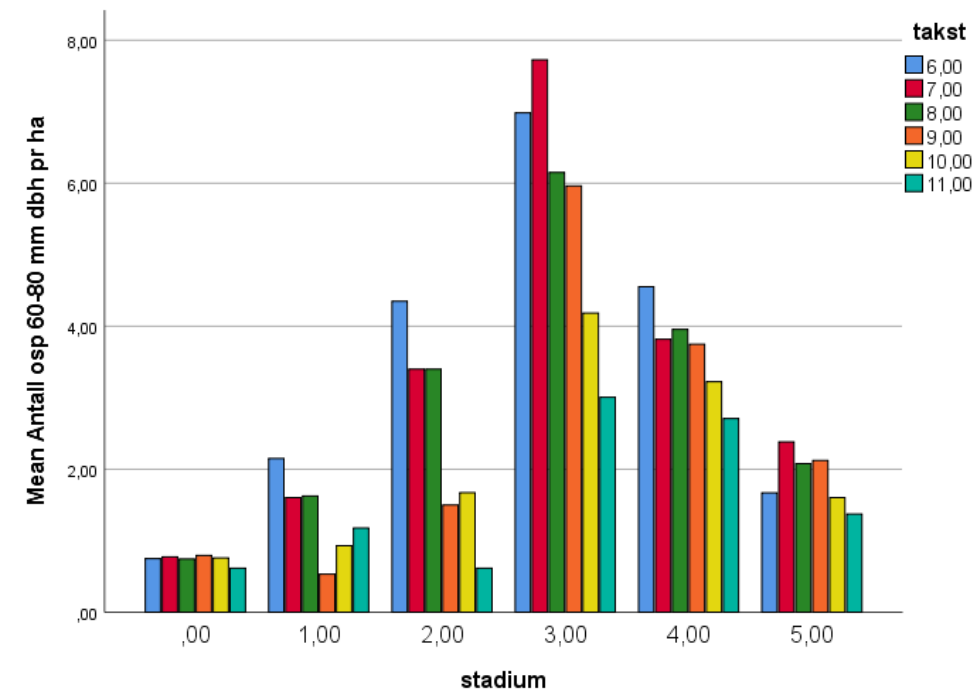
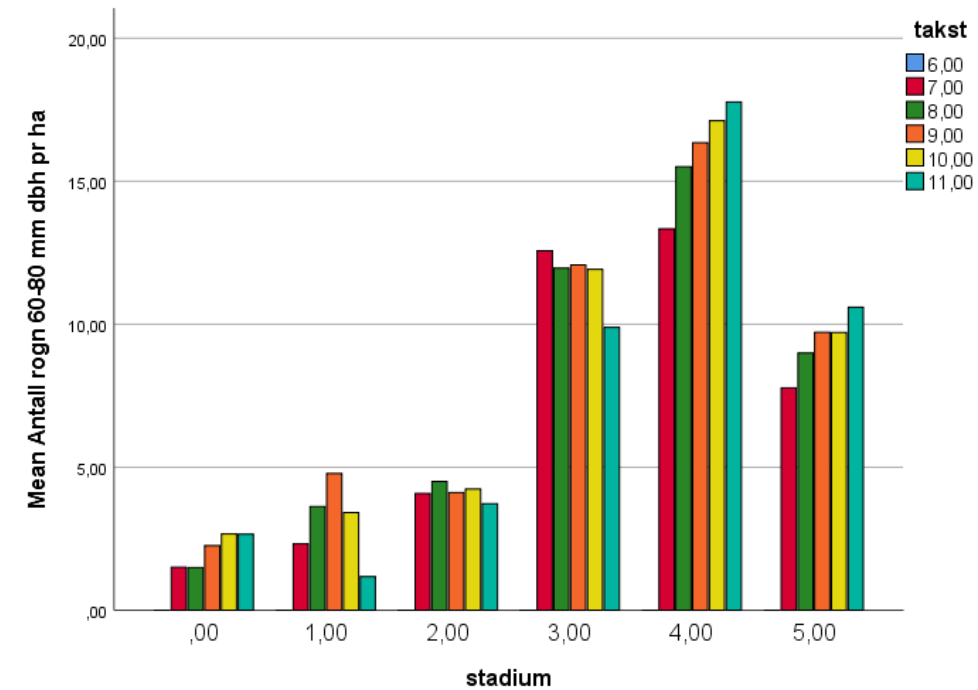


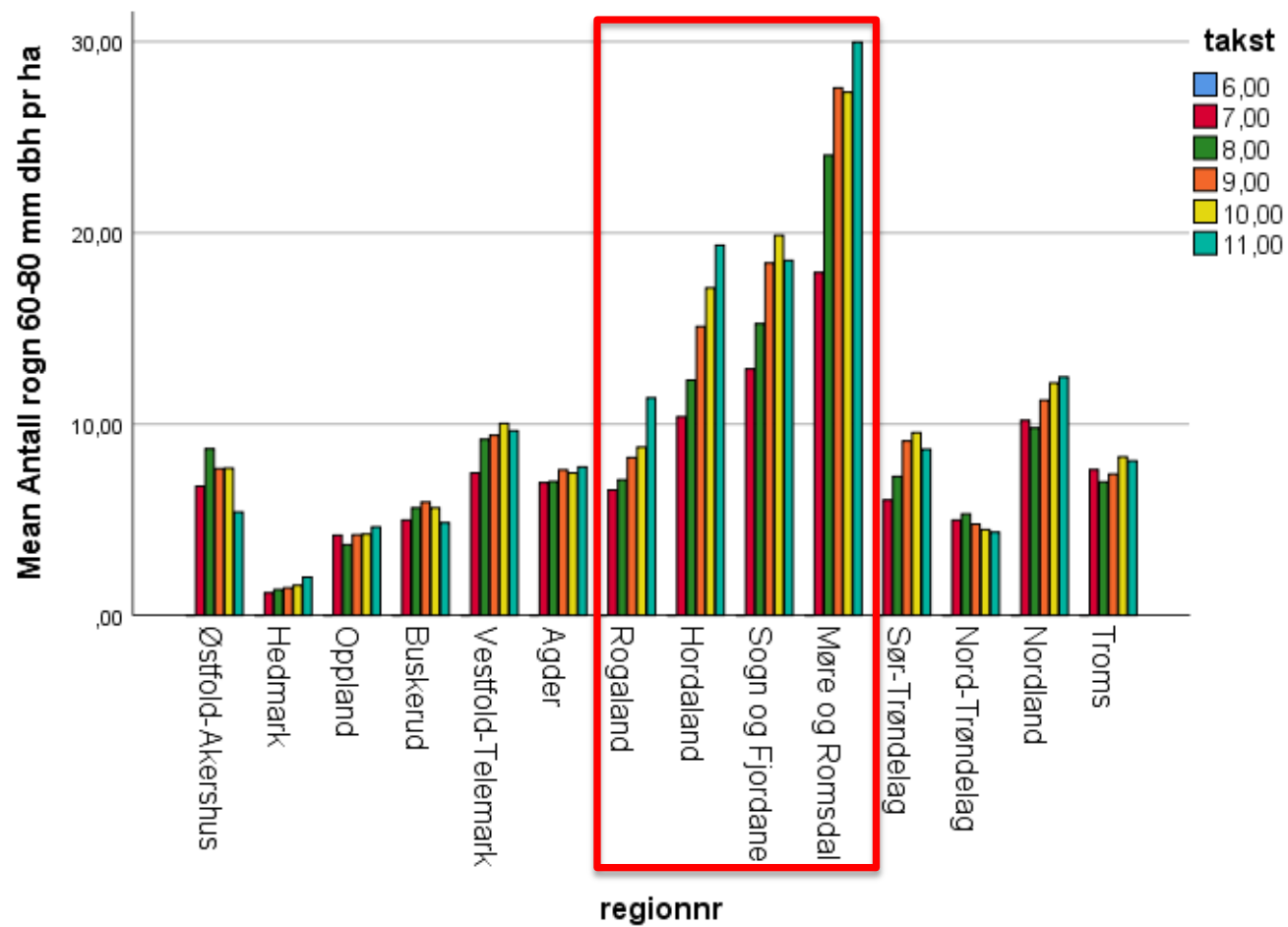
# Hvordan fordeler antall rogn seg på ulike hogstklasser?



Foto: Selbu, Trøndelag

Rogn gjør det best i hogstklasse 4  
Osp mest vanlig i hogstklasse 3



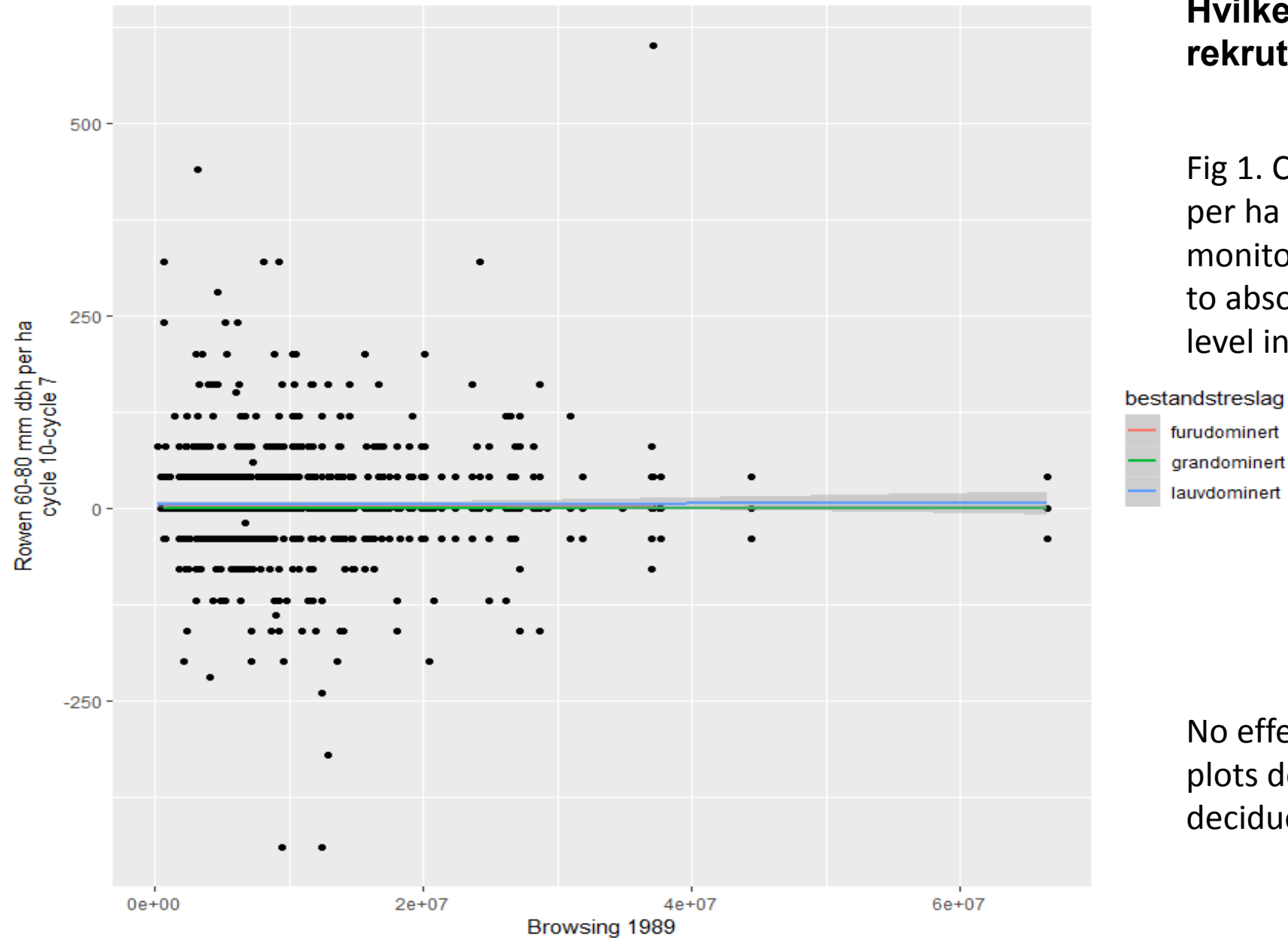


Rogn utenfor beitbar høyde (> 60 mm dbh)  
I ulike fylker i Norge.

Økning utenfor elgregionen (Vest-Norge),  
Ingen stor økning i fylker med mye elg

## Hvilken effekt har browsing på rekruttering av rogn?

Fig 1. Change in no. of rowen 60-80 mm dbh per ha in cycle 10 – cycle 7 including all monitoring plots (flater = ca 12 000), in relation to absolute browsing pressure at a municipality level in 1989.



No effect of browsing pressure. No effect for plots dominated by either pine, spruce or deciduous.

## Er effekten av browsing forskjellig I fylker med og uten elg?

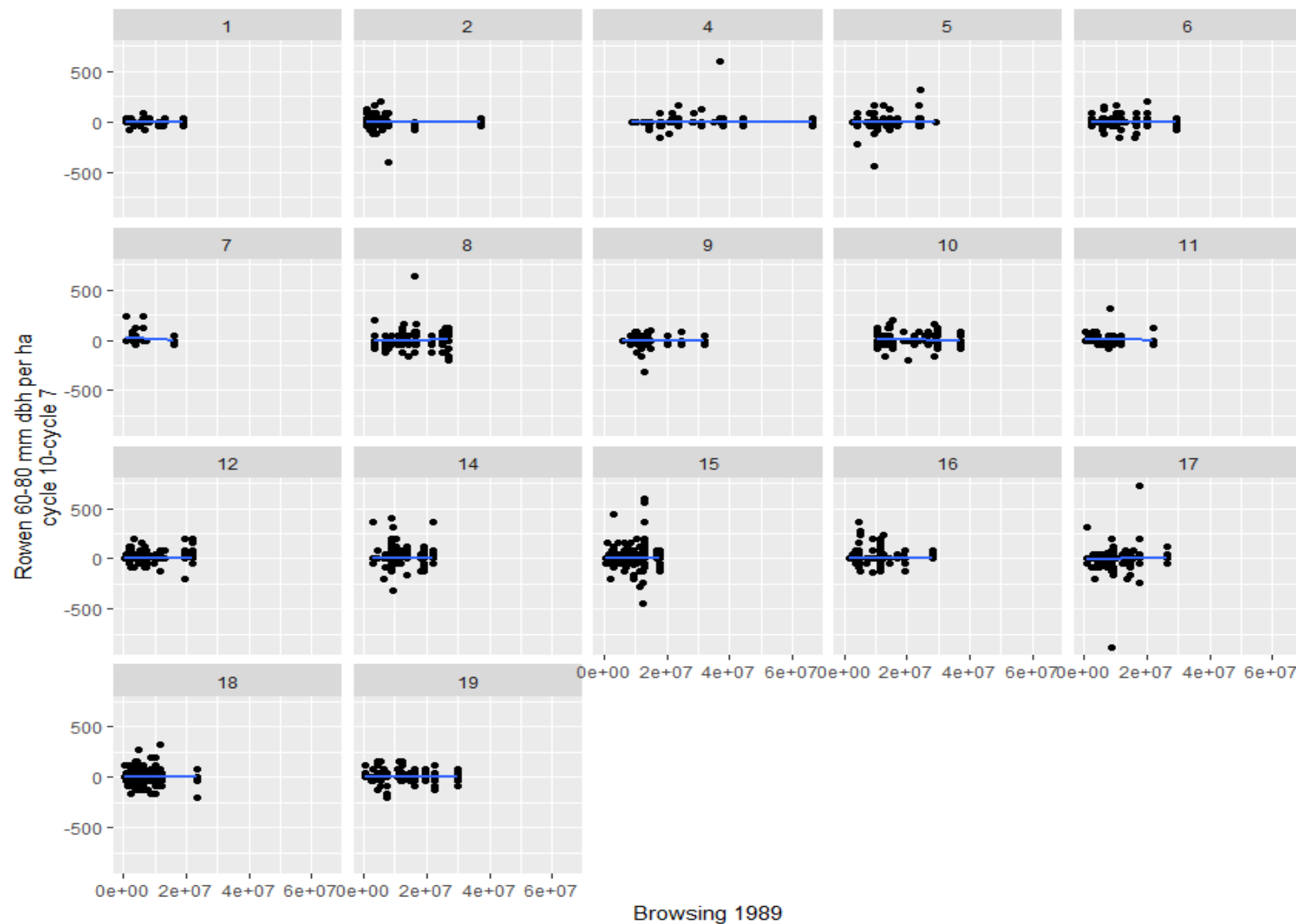
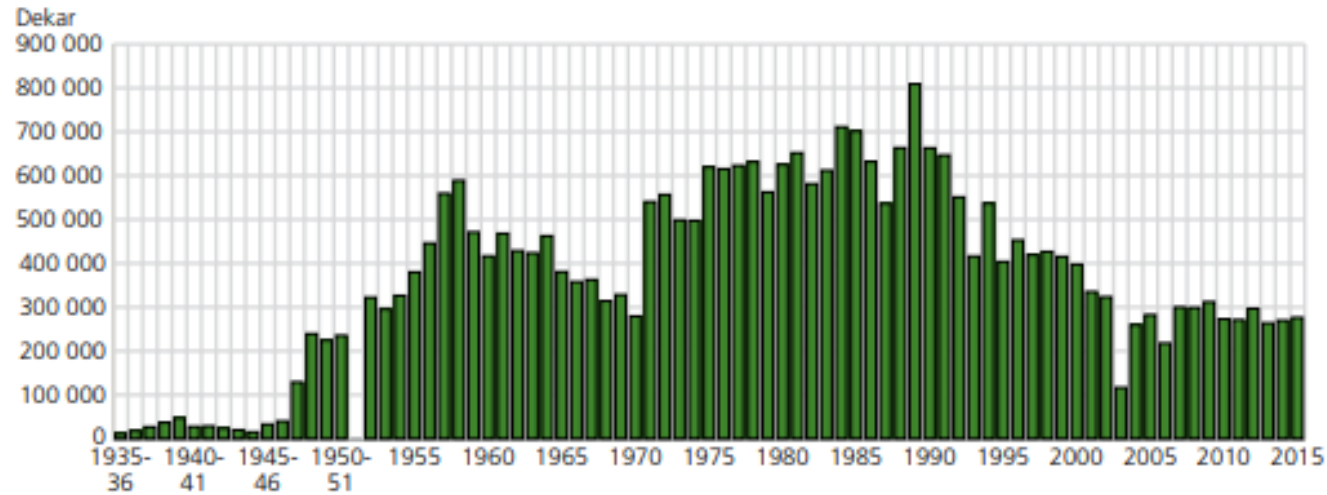


Fig 2. Change in no. of rowen 60-80 mm dbh per ha in cycle 10 – cycle 7 including all monitoring plots (flater = ca 12 000), in relation to absolute browsing pressure at a municipality level in 1989 plottet for each county (n = 19).

No effect of browsing pressure in any county

Figur 3.4.5. Ungskogpleie. Pleidd areal



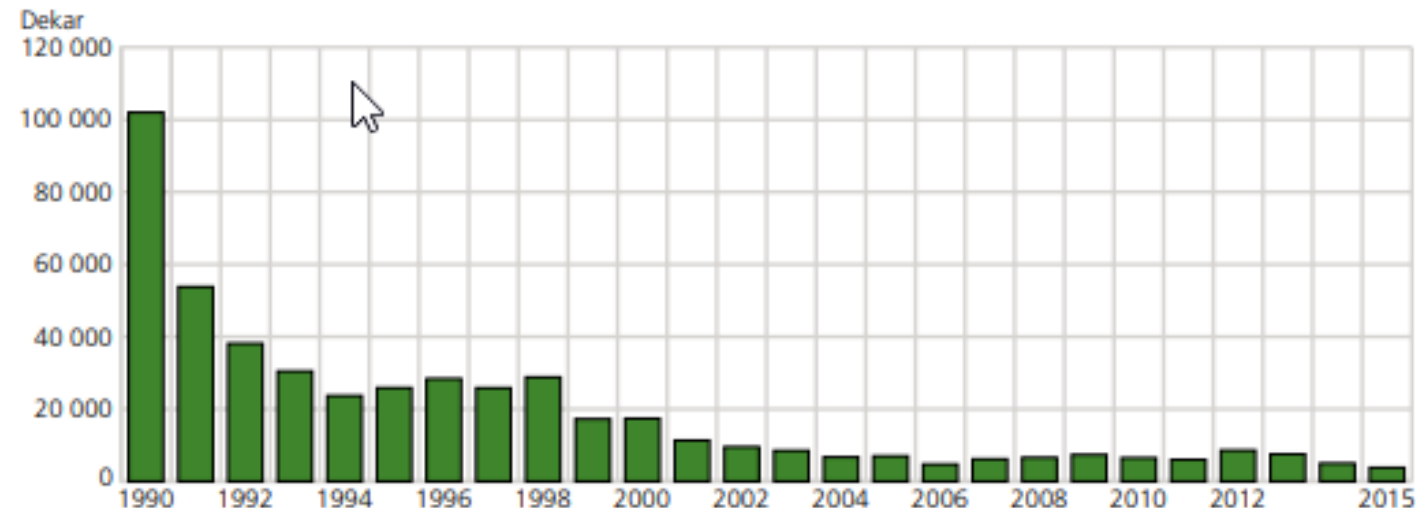
Kjelde: Skogkulturstatistikk, Statistisk sentralbyrå.

Hvilke andre miljøforhold påvirker veksten til rogn?

Deciduous trees also decrease due to forestry initiatives

- Cleansing,
- Use of pesticides

Figur 3.4.7. Kjemisk ugraskkontroll



Kjelde: Skogkulturstatistikk, Statistisk sentralbyrå.



# SustHerb

Towards Sustainable Herbivore management



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## Contact

- Professor [Gunnar Austrheim](#), NTNU University Museum
- Senior Research Scientist [Erling Johan Solberg](#), Norwegian Institute for Nature Research (NINA)

## Main objective:

increase our knowledge of the relationship between moose, red deer and their ecosystems

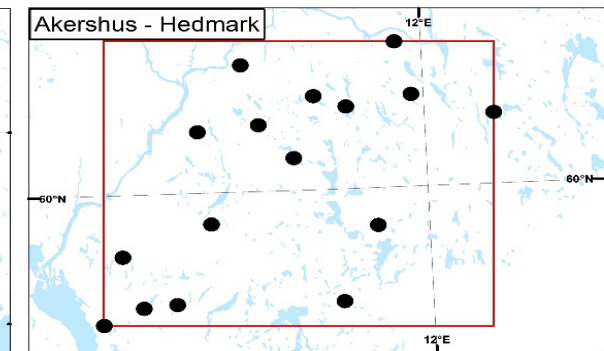
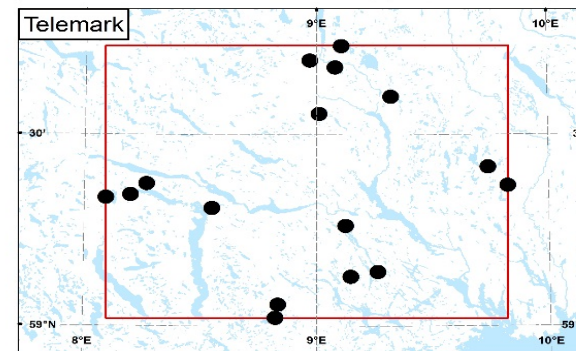
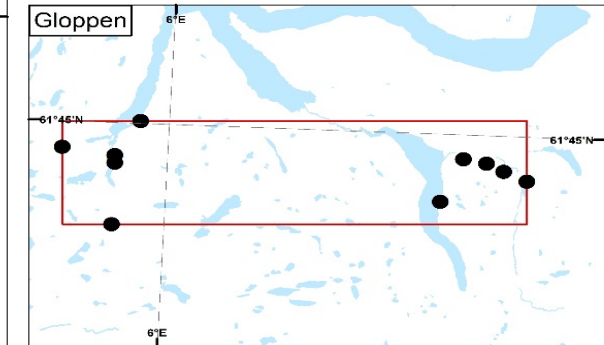
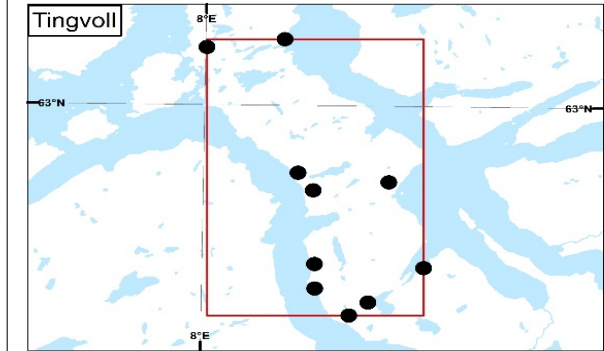
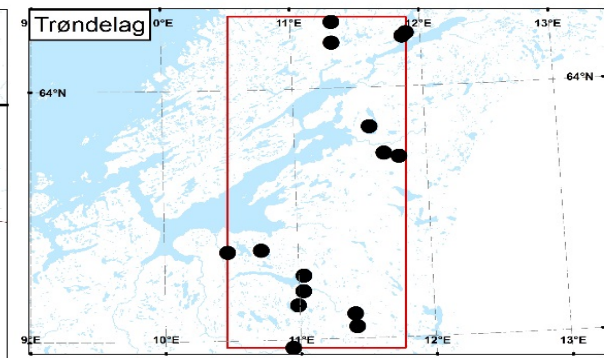
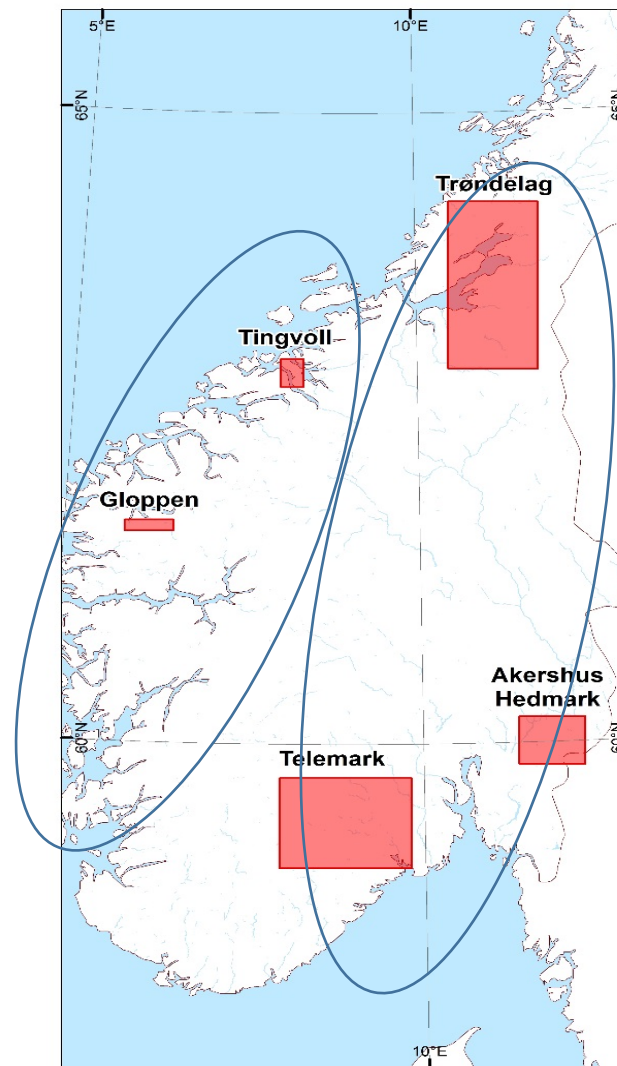
for a better basis for the management of cervides, biodiversity, ecosystem functions and services

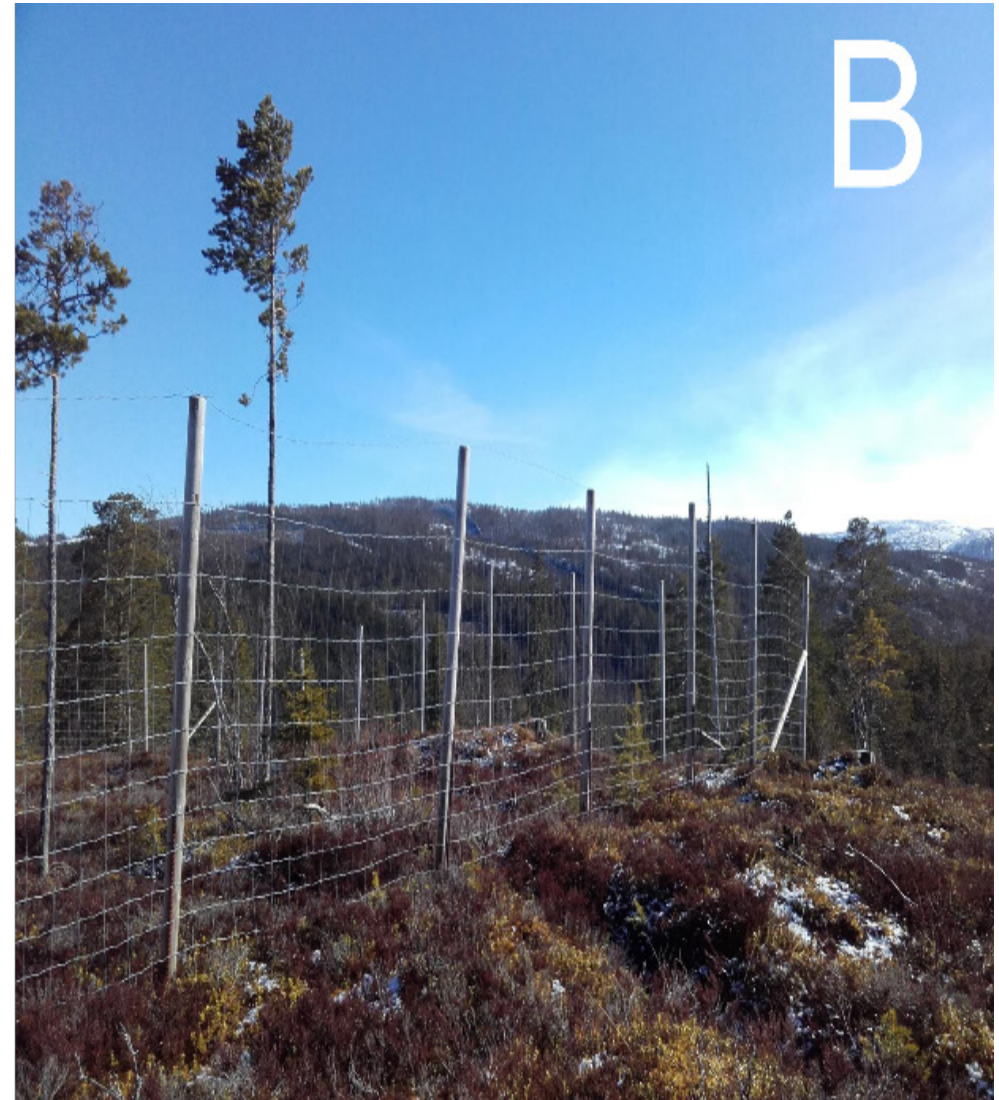
<https://www.ntnu.edu/web/museum/sustherb>



# Exclosure studies in Norway

- Exclosures + reference-plots
- Size: 20 x 20 m
  - Moose: 47 sites (3 areas)
  - Red deer: 20 sites (2 areas)
- Variables:
  - Productivity
  - Herbivore density

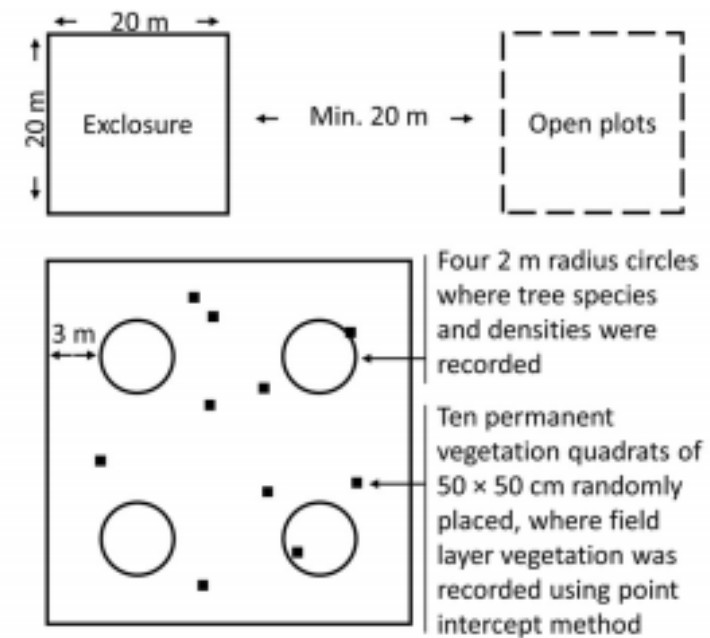




A: produktivt område med gran. B: lite produktivt område med furu



## Experimental design SUSTHERB



## Moose makes a difference....

Exclosure of moose 2011-2016. Aurskog

Høland:

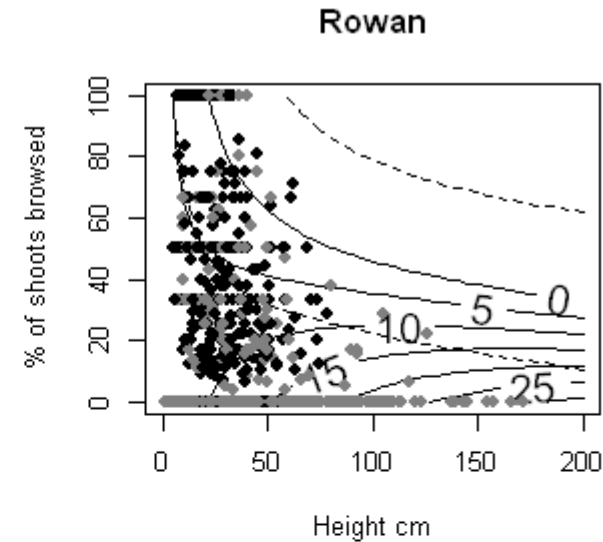
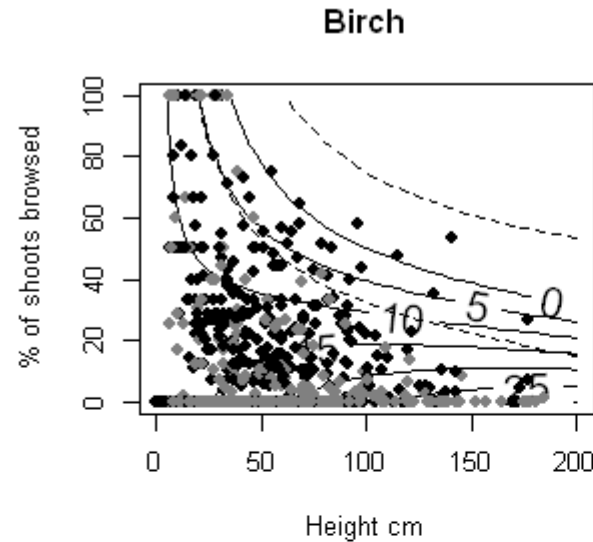
20 x 20 m exclosure

Flyfoto: 2016

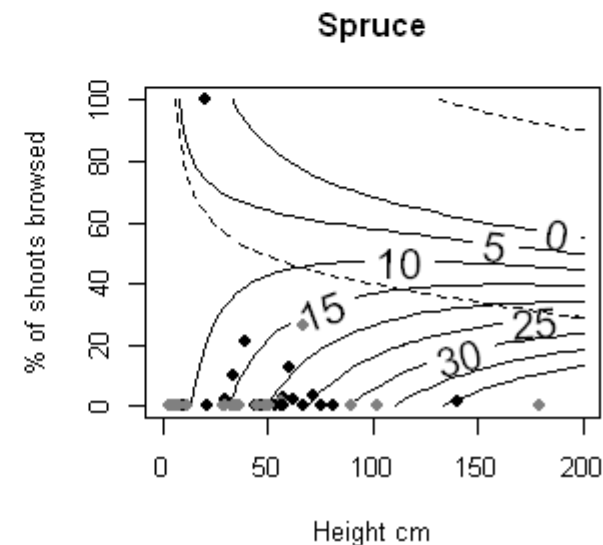
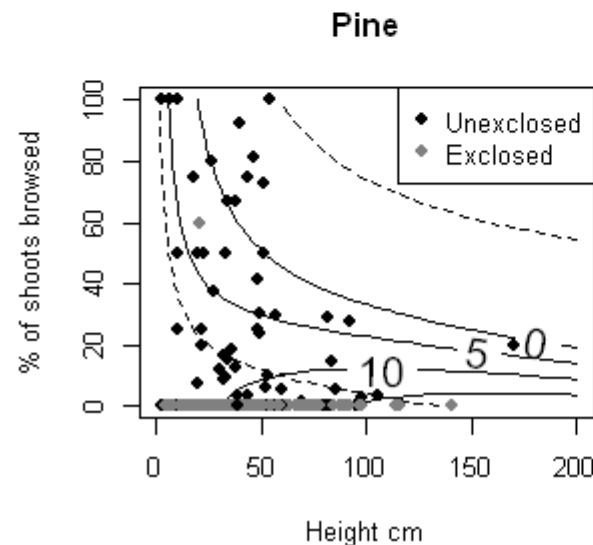


# Predicted growth of dominant tree species by height and browsing intensity

1m tall birch and rowan growth prevented when 40-50% shoots browsed



1m tall pine growth prevented when 30% shoots browsed



Sustherb sites in Trøndelag & Telemark

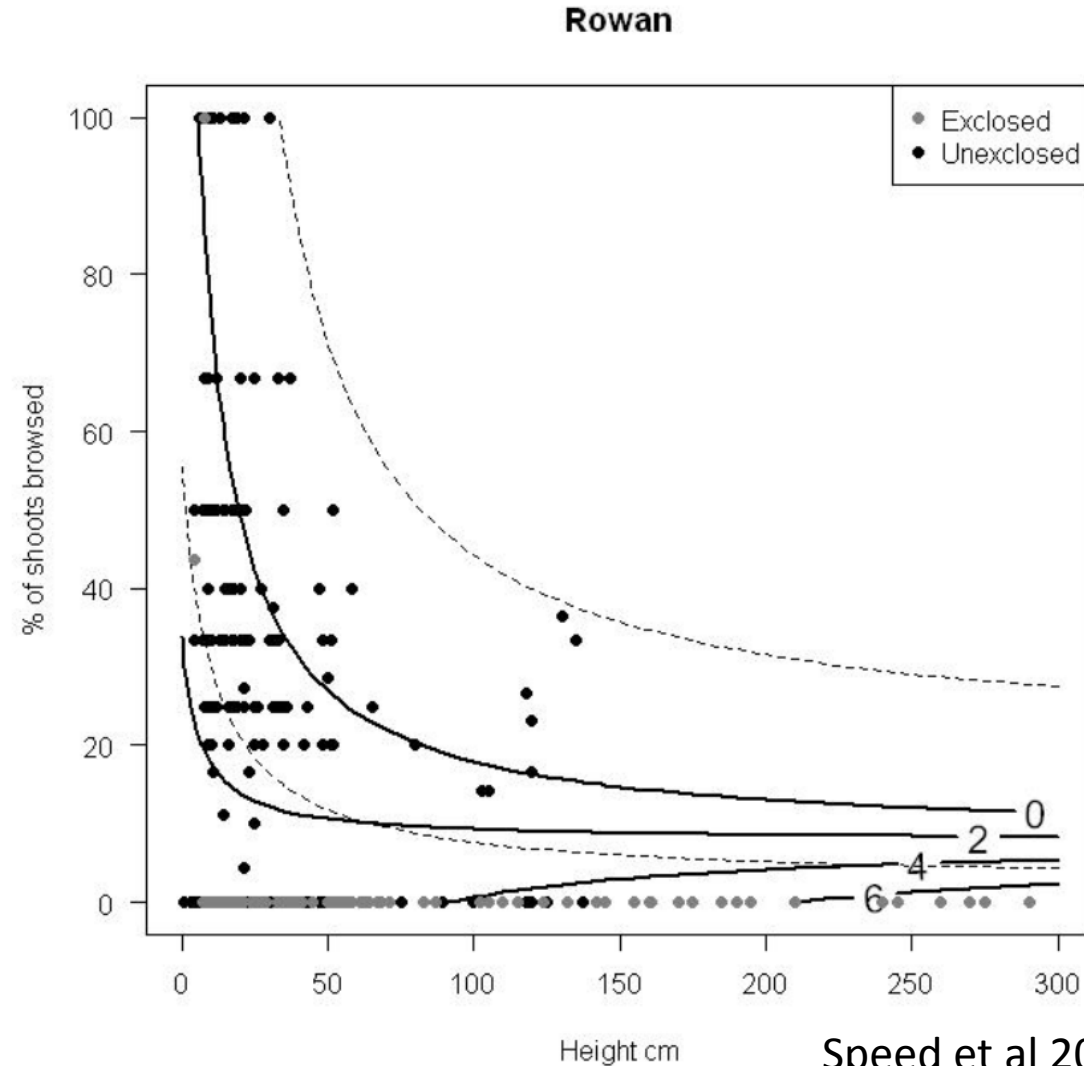
Speed et al 2013  
Forest Ecol. &  
Management

# Limitation of rowan height growth in established forest

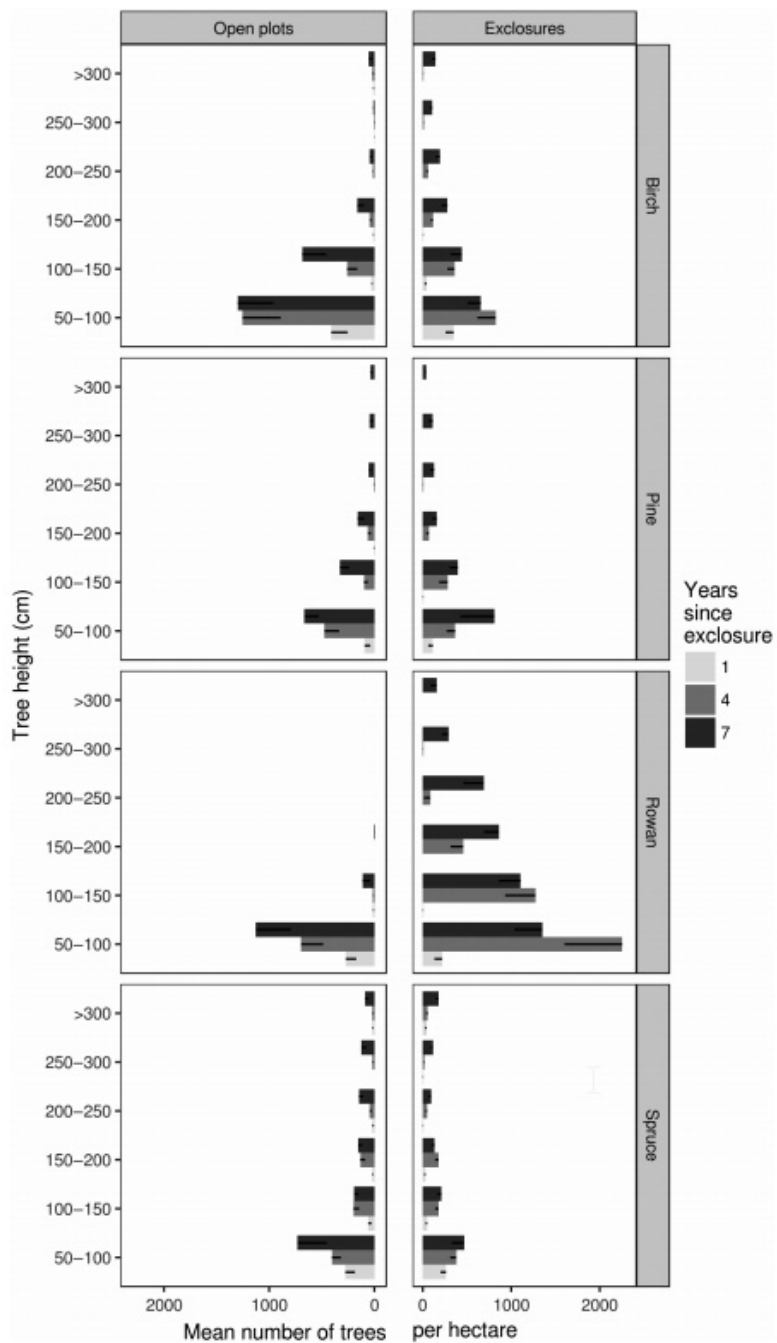
Height growth of 1 m tall rowan prevented at 20% of shoots browsed

c.f. 40% browsing in moose regions

Sustherb sites in Tingvoll  
Western Norway



Speed et al 2013. Ecoscience



## Hva er effekten på tetthet og høyde i hegn og beita kontroll?

Rowen are not able to recruit to higher stages in browsed plots in Trøndelag or Telemark, but tree density increases at low height after 7 years

Kolstad et al. 2018  
 Ecosphere  
<https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/ecs2.2458>

Fig. 2. Mean number of trees per height class of four boreal forest trees species at three time points (1, 4, and

## Hvor raskt vokser rogn uten beite av elg?

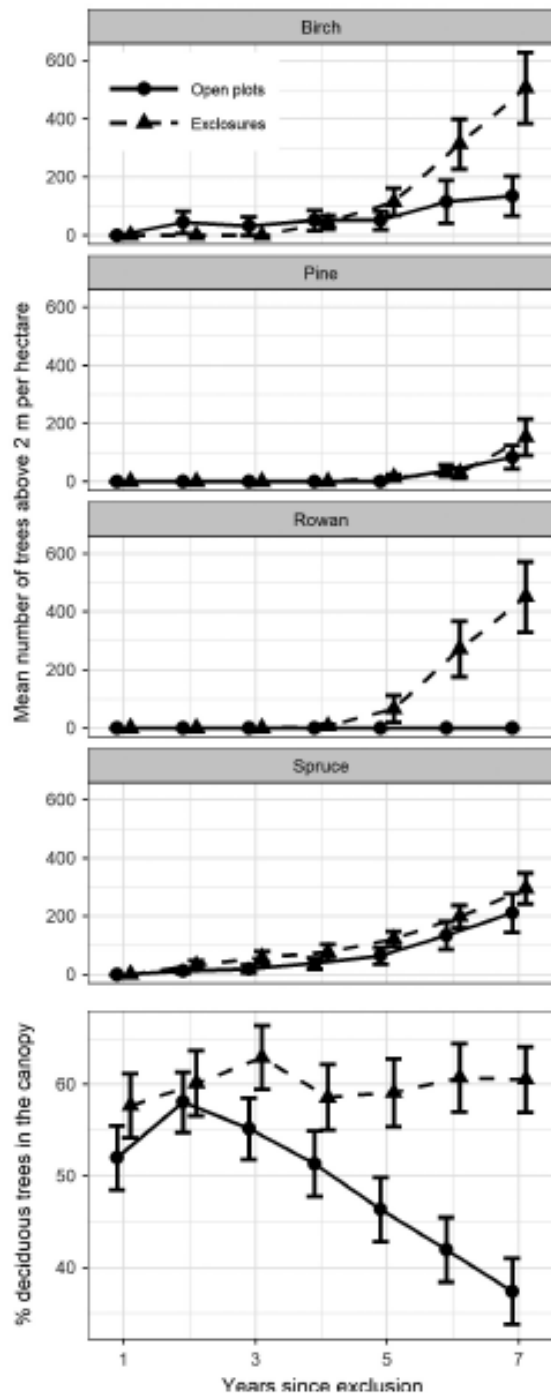


Fig. 3. The recruitment of boreal forest tree species above 2 m tall and the canopy composition in 31 recently clear-cut boreal forests where large herbivores were either excluded or not (means  $\pm$  SE). Plots were clear-cut few years before the experiment started. Values of tree recruitment are standardized against year one to remove any confounding differences due to remnant trees. Abbreviations are birch, *Betula pubescens* and *B. pendula*; pine, *Pinus sylvestris*; rowan, *Sorbus aucuparia*; spruce, *Picea abies*.

Kolstad et al. 2018 Ecosphere

<https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/ecs2.2458>



# Noen konklusjoner

- Uthegningsstudier viser at rogn ikke er i stand til å vokse over 0,5 til 1 m på beita hogstflater (10-15 siden hogst, 7 år siden uthegning).
- Rogn innenfor hegn viser rask vekst, med en vesentlig andel trær > 2 m etter 7 år. Antallet trær går ned sammenlignet med beita kontroll.
- Antallet rogn utenfor rekkevidde av elg (dbh 60-80 mm) går likevel fram på nasjonalt nivå. Rogn øker hovedsakelig i Vest-Norge der browsing-andelen er lav. Typiske elgfylker har en lav andel rogn. Rogn øker også i hogstklasse 4 og 5 men går tilbake i hogstklasse 2 og 3.
- Endring rogn fra 1996 til 2012 forklares ikke av økt andel browsing.
- <https://www.ntnu.edu/museum/sustherb/people>