

# Declining macrolichens respond to forest management in boreal forests

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# Terricolous macrolichens in the boreal zone

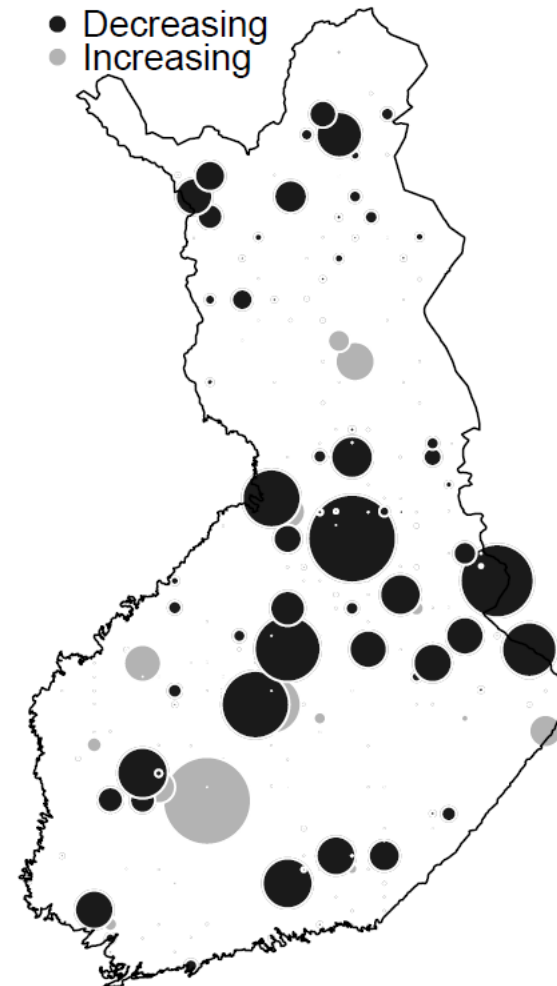


Photos: Luke / Erkki Oksanen, Tiina Tonteri



# Background

- Terricolous lichens have declined in boreal and temperate forests during the last decades
- In Finland, a decline has been observed both in 1951-1995 and in 1985-2006.



Cover changes of *Cladina* spp. lichens between 1985 and 2006 in Finland (Tonteri et al. 2016).

# Why are the terricolous lichens declining?

- Northern Finland: reindeer grazing is the major cause of the decline.
  - Several studies
- However, in 1985-2006 a decline also in Southern Finland and in forests with all kinds of treatments (Level I / BioSoil plots).
  - No studies including both northern (with reindeer grazing) and southern (no reindeer grazing) areas
- Since the 1950's, clear changes in forest structure, management, and vegetation



# Aims

We aim at analysing the role of

- **stand and site characteristics,**
- **forest management** and
- **dwarf shrubs** in the decline of lichens.

Are there differences in patterns between the subzones of the boreal zone?

Comparison of results on a total sum of terricolous lichens to those on a sum of reindeer lichens (*Cladonia sectio Cladina*).



# Hypotheses

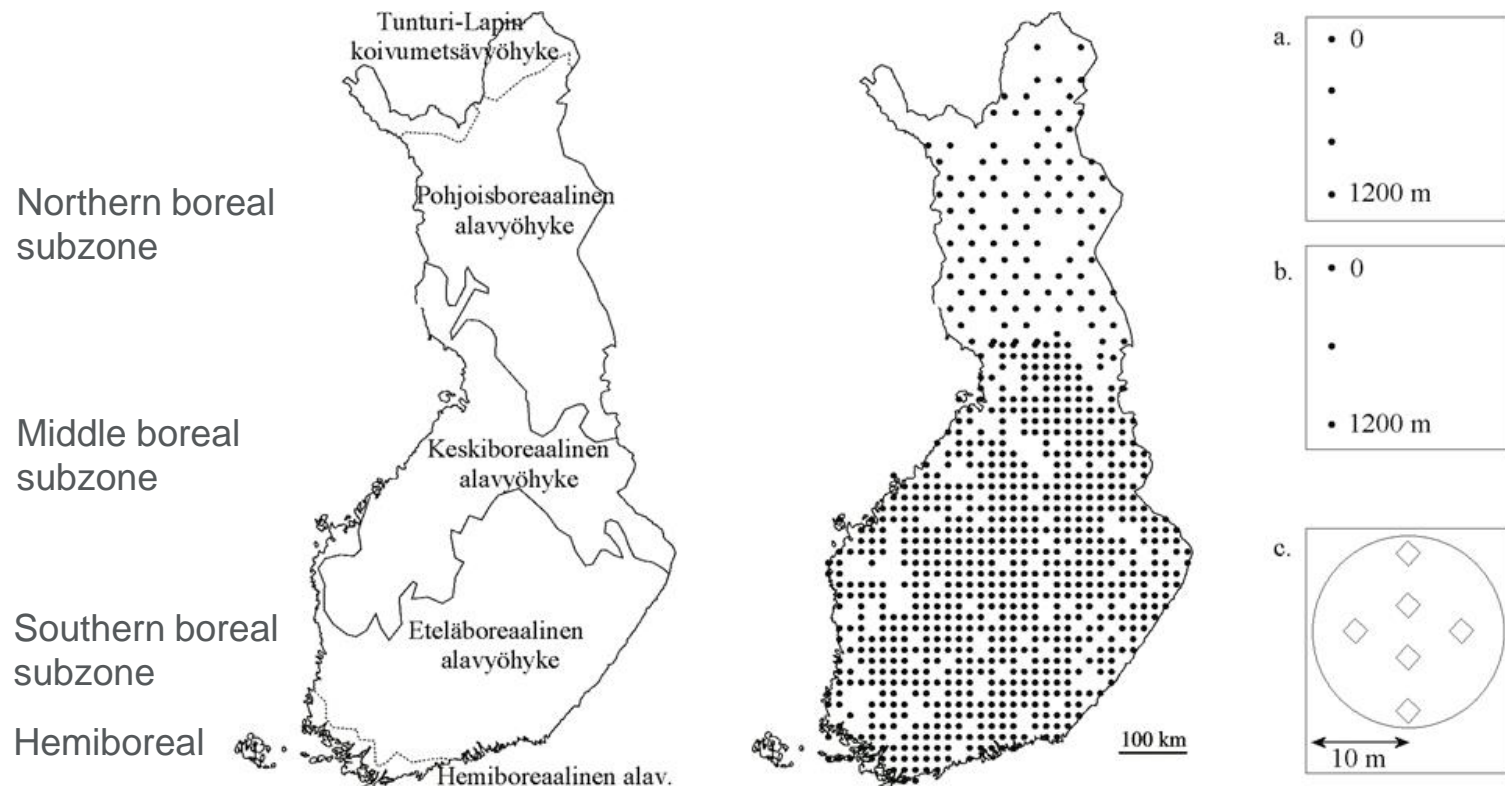
1. Forest cuttings and soil preparation decrease the cover of lichens – the stronger the treatment the heavier the impact.
2. Dwarf shrubs have a negative influence on cover of lichens.  
→ Faster growing dwarf shrubs outcompete lichens. Their litter suppresses lichens and increases nutrient input to the ecosystem.

We test these hypotheses for both a total sum of terricolous lichens and reindeer lichens (*Cladonia spp.*)



# Material and methods

- Vegetation, site and stand variables measured on 1730 plots, inventoried in 1985-1986 in connection with 8<sup>th</sup> NFI.



- Method: generalized linear mixed models (GLMM). Both a sum of all lichens as well as reindeer lichens were used as y variables.



# Results

Significant factors, variables and interactions in the two models:

Model for all lichens	Model for reindeer lichens
<b>Subzone</b>	
Temperature sum	Temperature sum
Site_type	Site_type
Stand_age	Stand_age
Canopy cover	Canopy cover
% of Norway spruce	% of Norway spruce
Dwarf shrubs	Dwarf shrubs
Cutting	Cutting
Soil treatments	Soil treatments
Subzone:Site type	
Subzone:Dwarf shrubs	

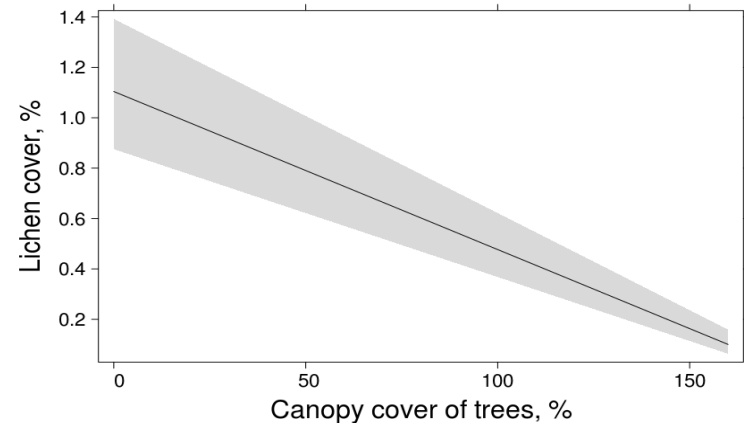
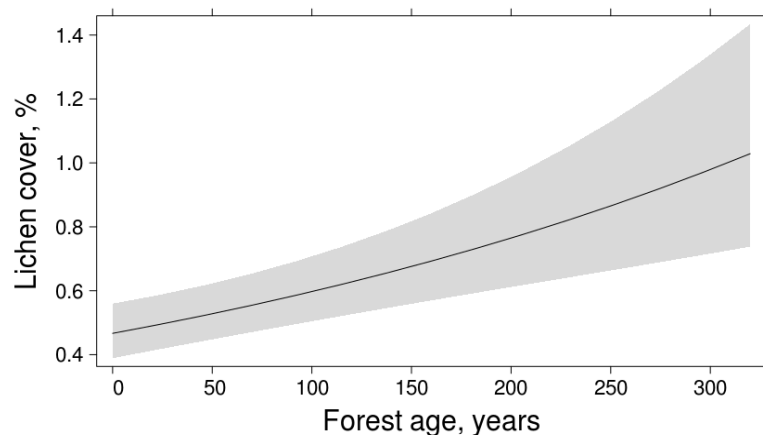
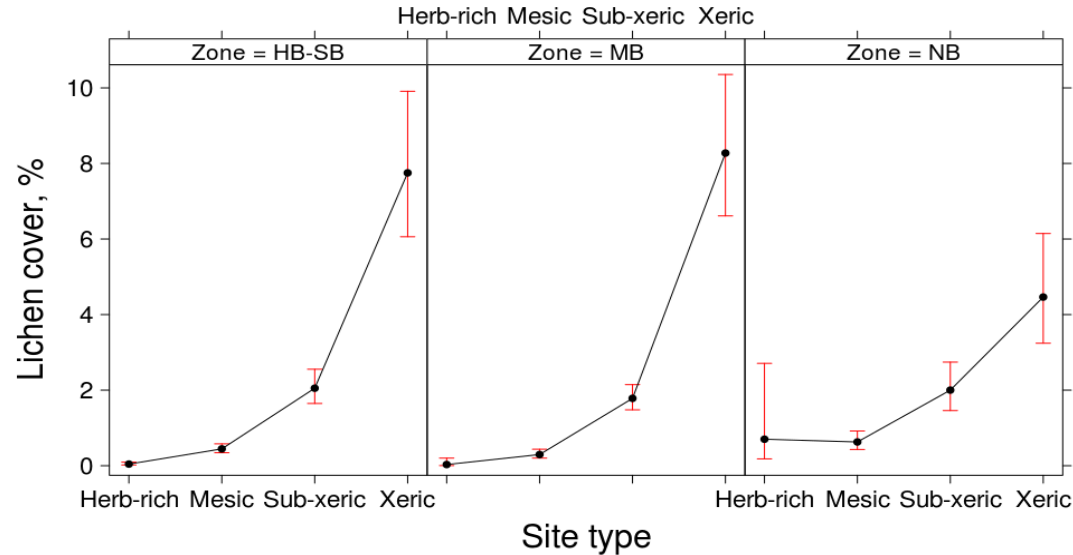
All lichens and reindeer lichens show rather similar patterns!

The effect of stand characteristics and forest management showed no differences between the vegetation subzones (interaction terms insignificant)

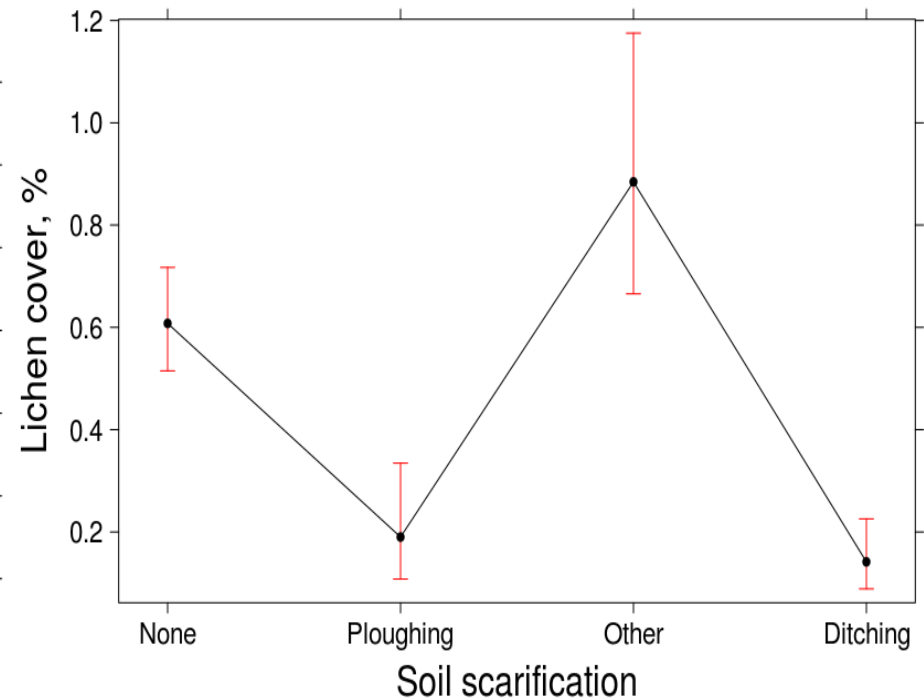
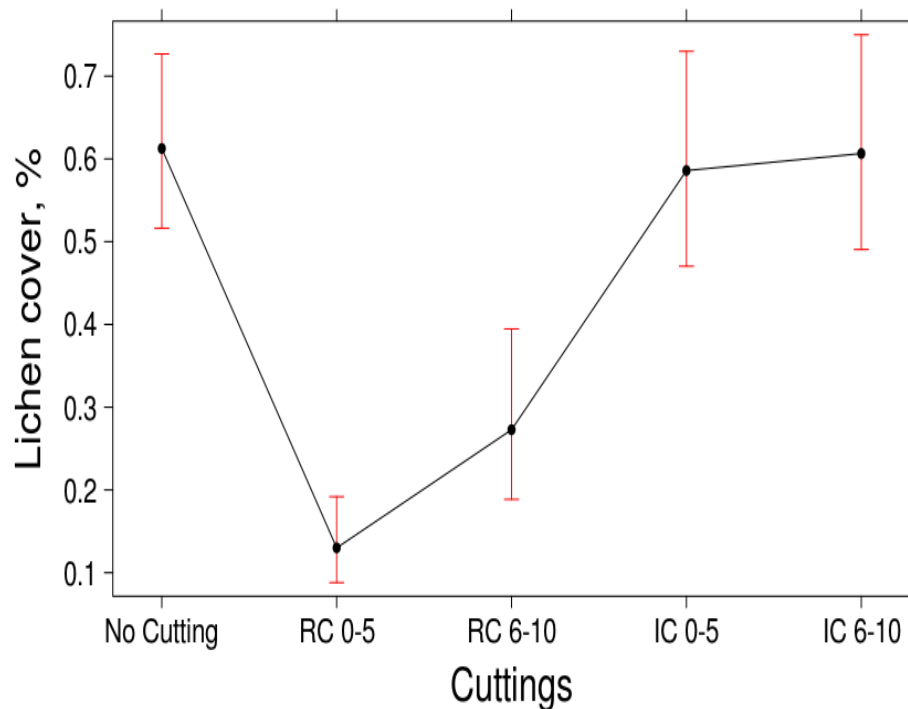
Significant interactions: Subzone:Site type and Subzone:Dwarf shrubs



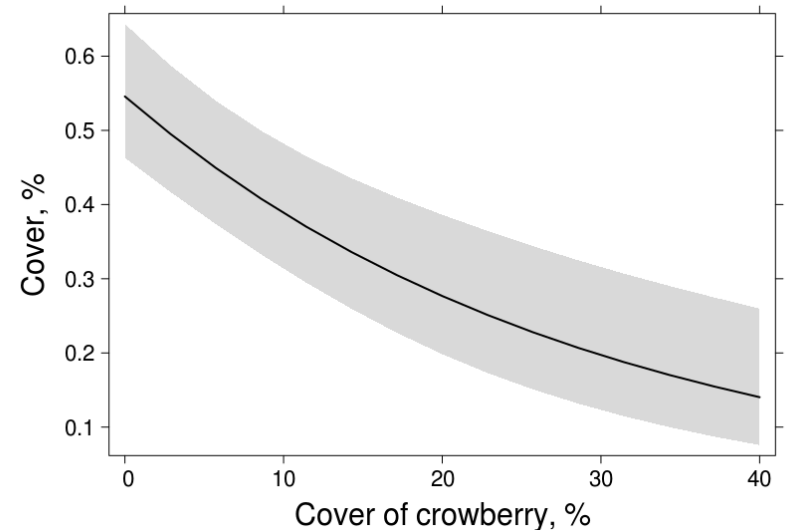
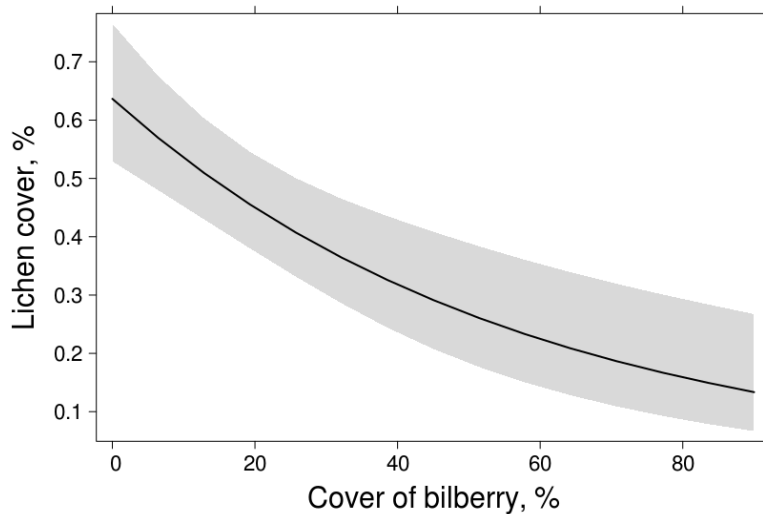
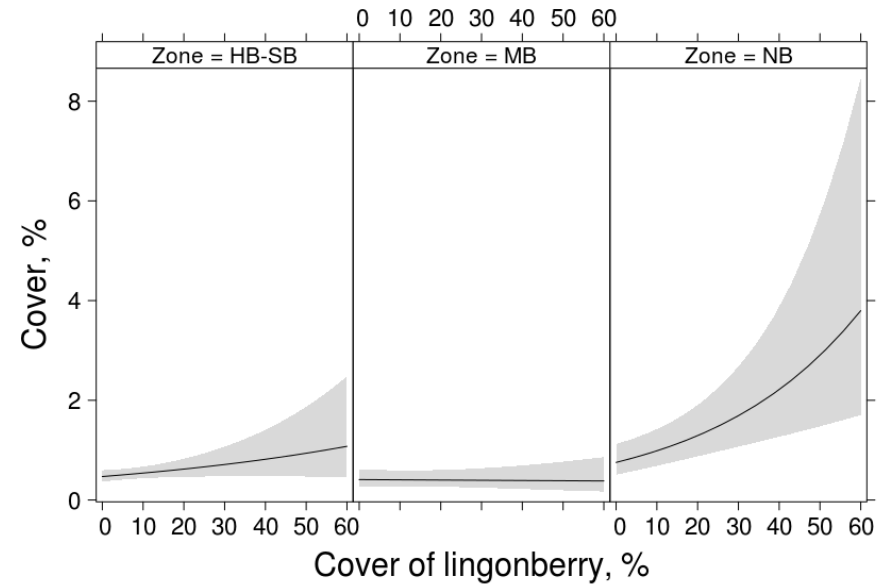
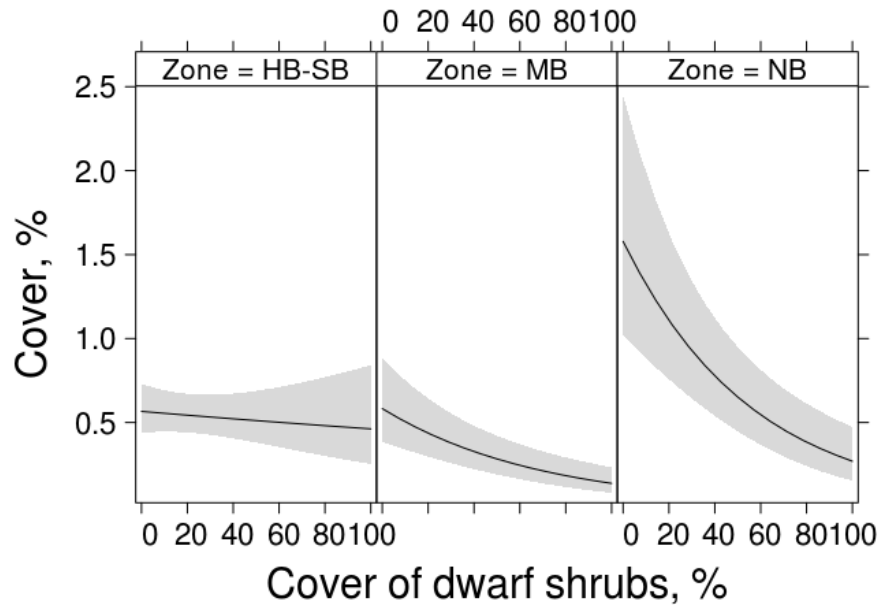
The results confirm that lichens (and reindeer lichens) thrive in old, sparse Scots pine forests on xeric sites



**Hypothesis 1** Forest cuttings and soil preparation decrease the cover of lichens – the stronger the treatment the heavier the impact. Regeneration cutting (RC), ploughing and ditching affect lichens (and reindeer lichens) negatively (but see the milder treatments)



## Hypothesis 2: Cover of dwarf shrubs, bilberry and crowberry have a negative association with lichens



# Interrelationships between species?





# Conclusions: possible factors behind the decline of lichens

- **Reindeer herding** in the Northern boreal subzone
- **Changes in forest structure** since the 1950s:
  - The area of old, sparse pine forests ↓
  - The area of younger closed, more shaded forests ↑
  - decline of lichens and reindeer lichens
- **Changes in forest management** after 1950s
  - decline of lichens and reindeer lichens.
- The role of these factors remains unknown:
  - eutrophication
  - climate change
  - nitrogen deposition
  - lack of forest fires
  - recovery of soil from slash-and-burn cultivation era

# Thank you!



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