Luke
NATURAL RESOURCES
INSTITUTE FINLAND

ECODIVE
KARELIA
CBC // Project

ECODIVE

Diverse and clean forests – successful bioeconomy

Päivi Merilä

Why ECODIVE project?

- Managed forests dominate the Karelia CBC Programme area
- Forestry and forest industries important sources of income
- **Forests provide also many other products and services than timber**, such as
  - Biodiversity reservoir; ecosystem health; resistance and resilience to environmental change
  - Berry yields, other nature products; health benefits recognized (e.g. superfood berries bilberry and lingonberry)
  - New business opportunities

Problem: the effect of environmental factors on the abundance of non-timber-forest products and their health-promoting compounds are still poorly known and measured

Large dataset available to tackle this problem

ECODIVE target

Improved living and working environment **(overall objective)**.

Our specific objective

Increased knowledge and awareness on the **environmental factors controlling yields and health-promoting compounds** of non-wood forest products (berries and other valuable plant species) during the life cycle of managed forests.

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Overview of the study themes

1. The response of understorey vegetation to site and tree stand characteristics (edible plants and species richness)
2. Using remote sensing to map bilberry and lingonberry yields and their hot spots
3. Could we characterize the forest environments providing high quality bilberries?

Open access audiovisual information package also provided

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Managed forests in Finland provide at least 68 edible "wild" plant species

- **Study material**: national systematic monitoring network, including 1271 plots on mineral soil forests and 507 plots on peatlands

Information on abundance and diversity of edible plants:

- 68 edible plant species found (medicinal plants not included)
- 5 edible species / 300 m^2
- The most common and abundant species were bilberry and lingonberry.
- Fertile and open sites were richest in edible plant species.
- The effect of forest cuttings varies between the species

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Abundance and diversity of edible wild plants in managed boreal forests

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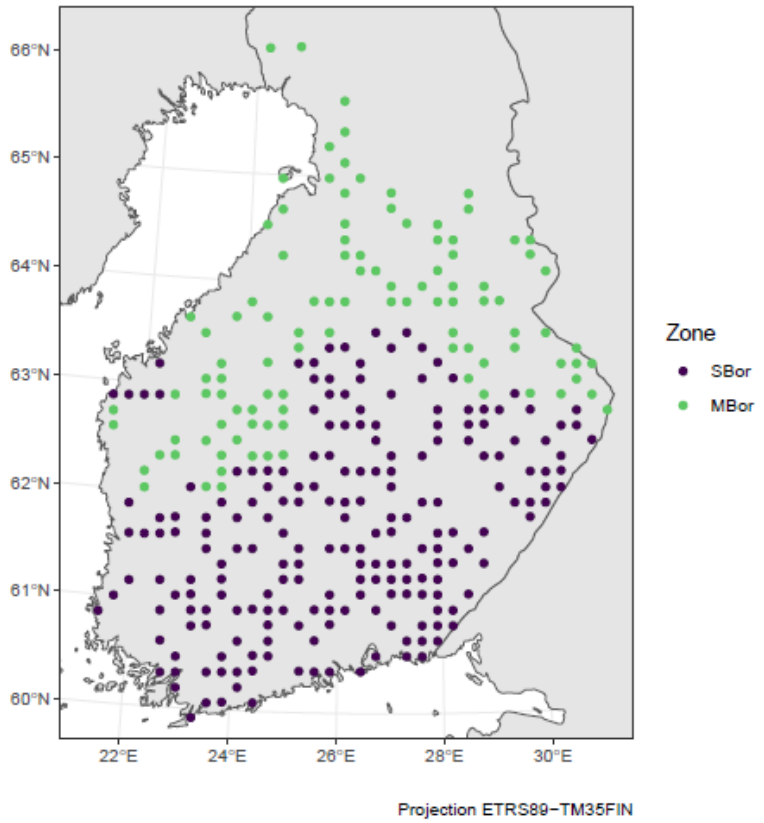
Juniper /Kataja
Fireweed /Maitohorsma
Crowberry /Variksenmarja
Heather /Kanerva
Bog bilberry /Juolukka
Stone bramble /Lillukka
Wood sorrel /Käenkaali
Raspberry /Vadelma
Wild strawberry / Ahomansikka

Study on the effect of mixed-species stands on the species richness of the understorey vegetation



- **Motivation:** Mixed forests may be better than monocultures with respect to
  - **Biodiversity: vegetation plays a major role**
  - Risk management
  - Recreational value

- **Study material:** Biosoil data gathered in v. 2006
  - 307 sample plots, < 21y. and >150 v. stands omitted
  - Vegetation, soil chemistry and stand characteristics measured
  - Southern and Middle boreal zones included
  - Two fertility levels; mesic and xeric

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Focus in vascular plants which include dwarf shrubs, grasses and graminoids

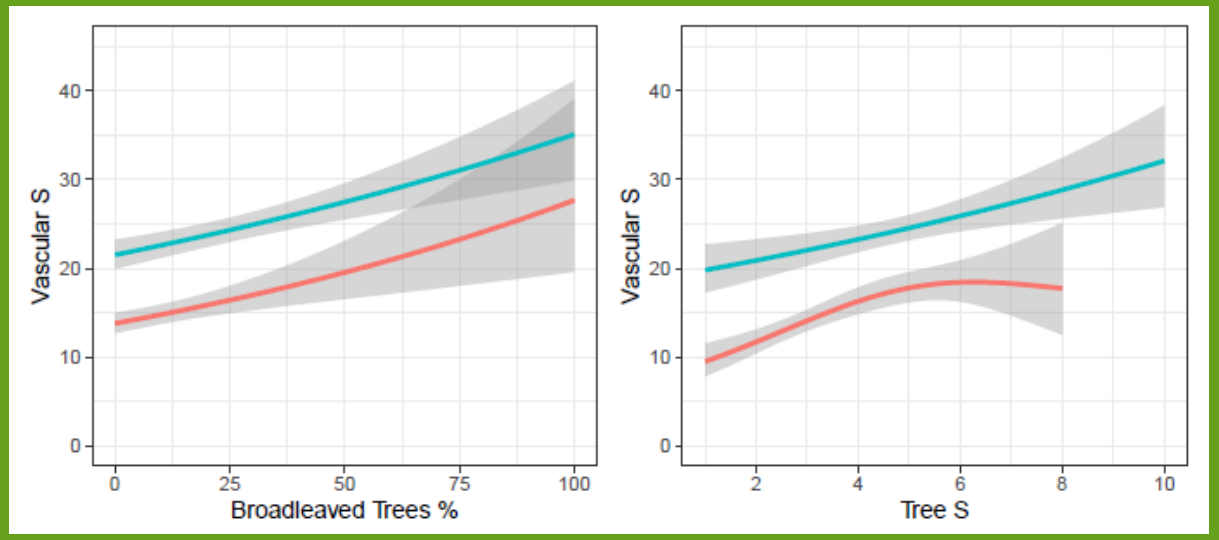


Photos: Hannu Nousiainen

Increasing proportion of broadleaved trees enhances the species richness of the understorey

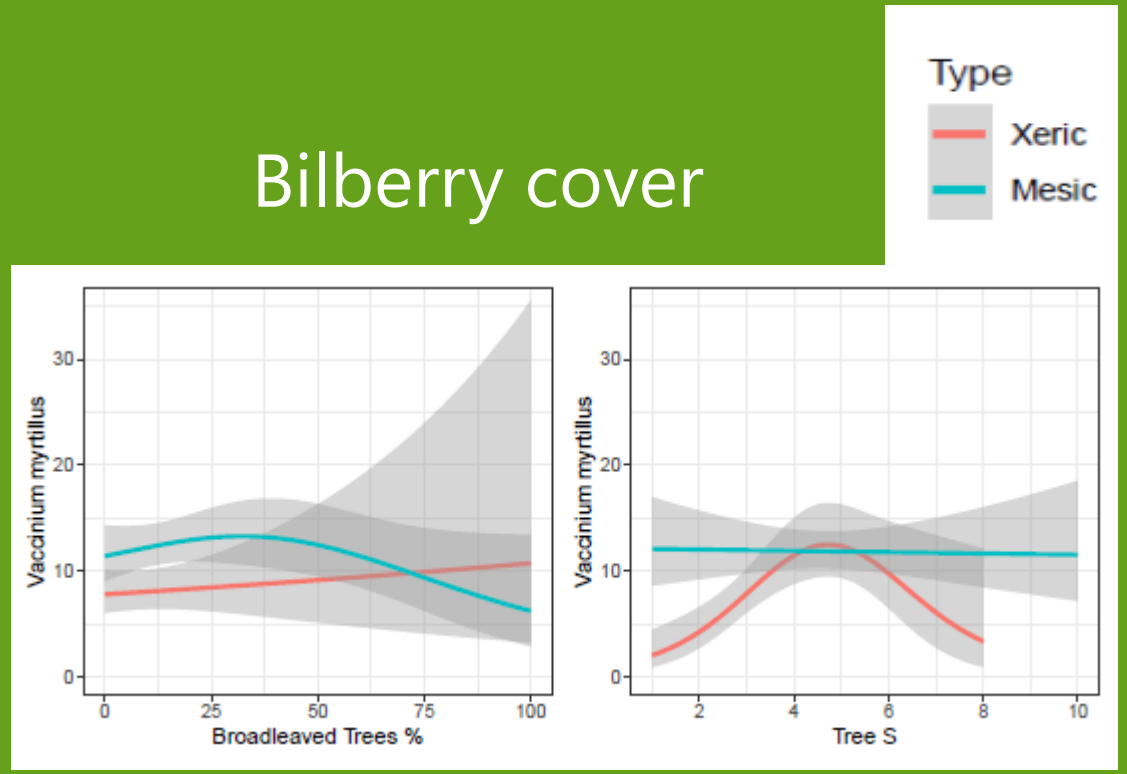
For bilberry only moderate amount of broadleaved trees seems beneficial

Species richness of the vegetation



Response of vascular plant richness (S) to the proportion of broadleaved trees and number of tree species (S).

Bilberry cover

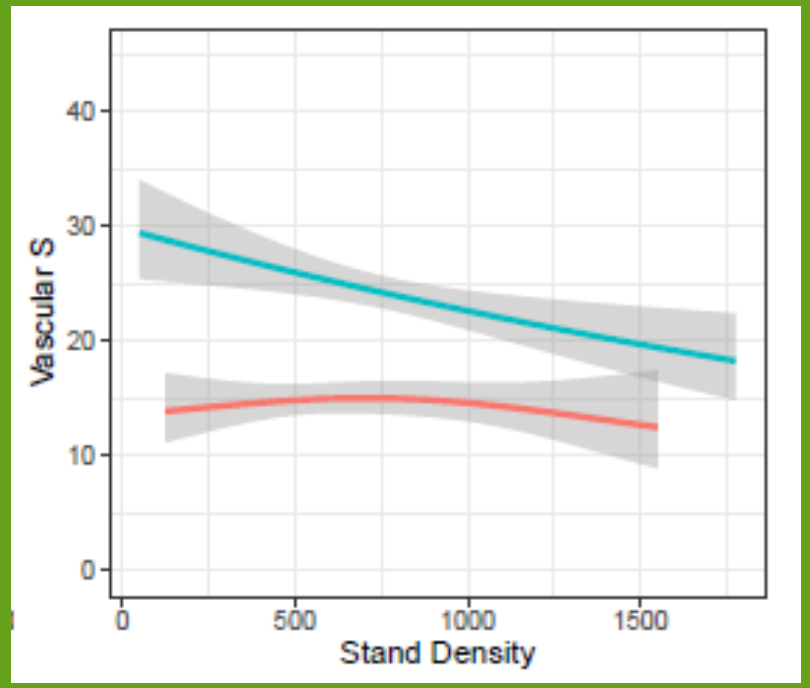


Response of bilberry cover to the proportion of broadleaved trees and number of tree species (S).

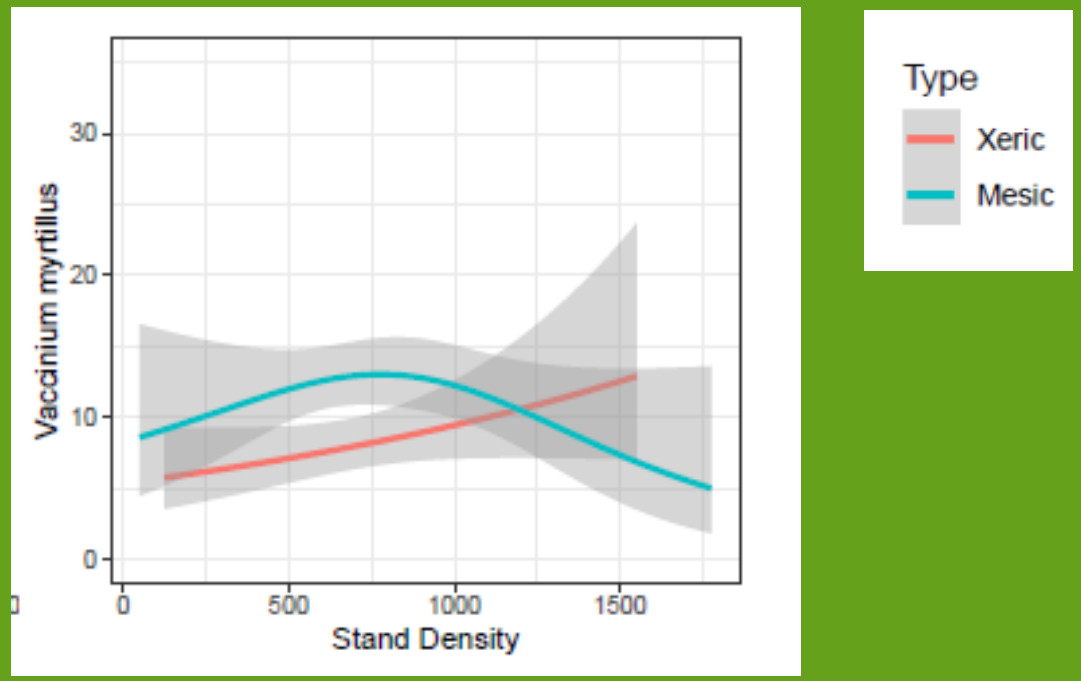
Maija Salemaa et al. 2023 In revision.

Species richness and bilberry cover decreases in dense forests, may suppress the positive biodiversity effects of mixed stands

Species richness of the vegetation



Bilberry cover



Response of vascular plant species richness (S; left) and bilberry cover (right) to the density of the tree stand (Includes tree stems with diameter >10 cm per hectare).

Maija Salemaa et al. 2023. In revision

Why does increasing number of tree species increase diversity of understorey vegetation?

- Tree diversity creates **different microhabitats on the forest floor**, which facilitates development of species-rich plant communities

- **Conclusion:** more attention and methodological development on the silvicultural practices suited for mixed boreal forests
- Increasing forest biodiversity is in line with EU Biodiversity strategy 2030

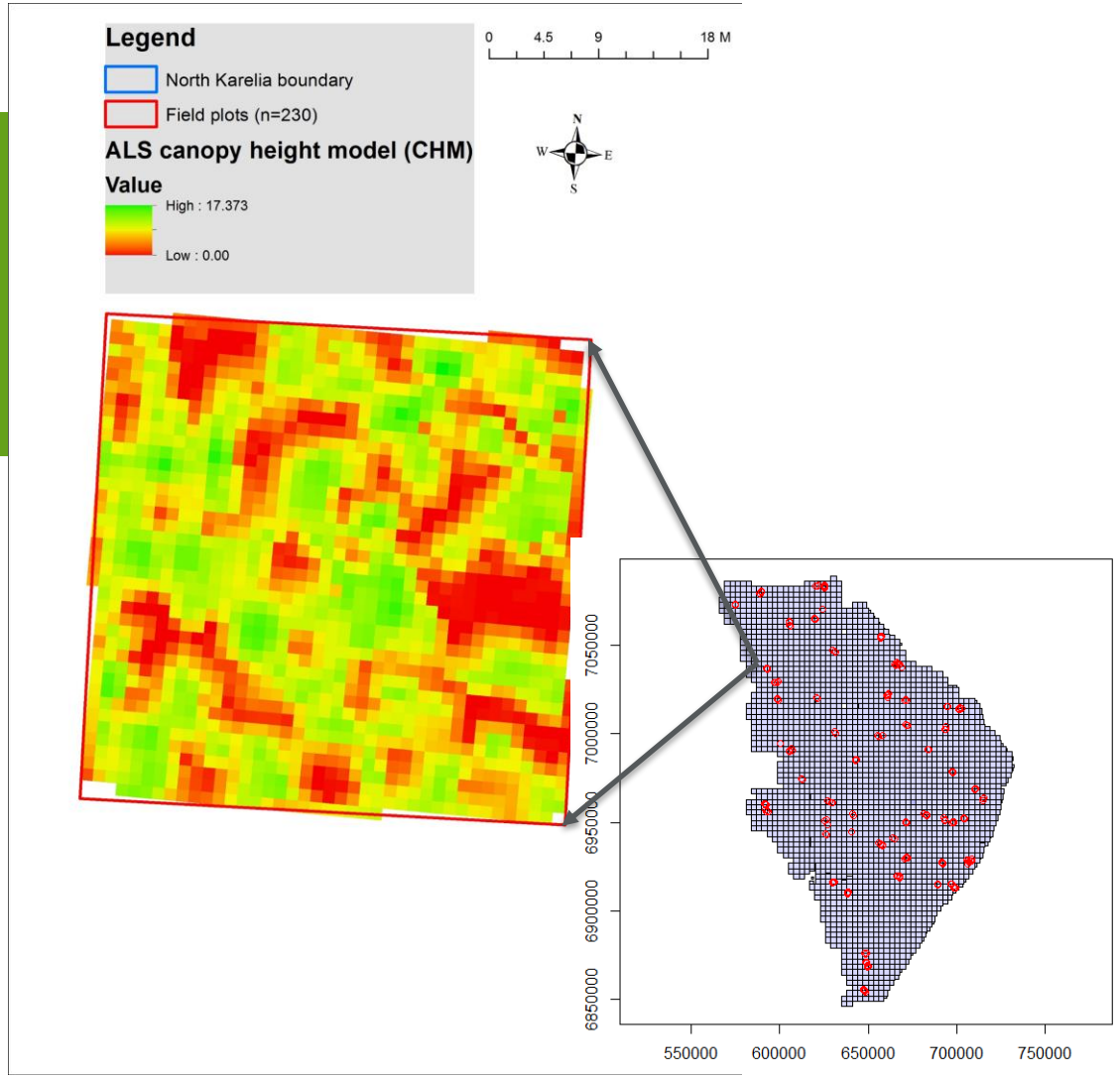
- **Benefit: Diverse forests are more resistant, resilient and adaptable to changes in the environment including climate change**

Using remote sensing to map berry yields and to identify berry hot spots

- Remote sensing datasets & accurate berry yield observations gathered in the field combined

  → high-resolution mapping of berry yield at a larger scale

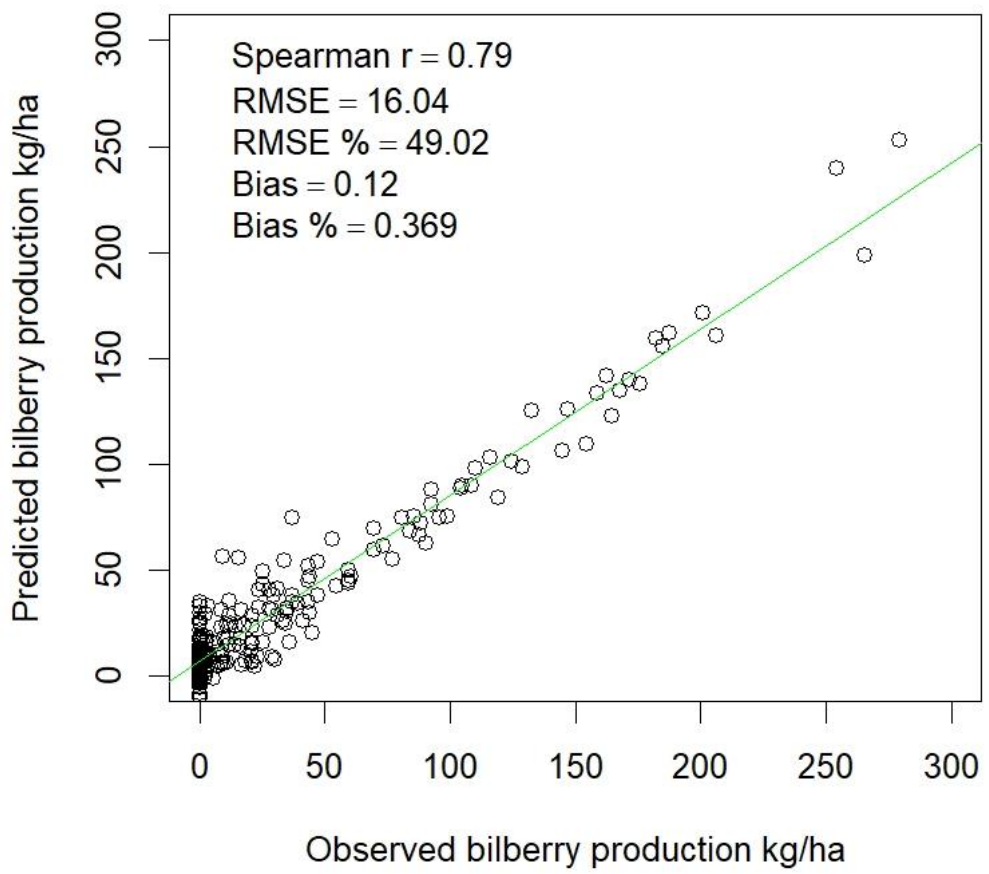
- **Basis of the habitat modeling method**:
  - Identification and modelling the characteristics describing the forests producing high berry yields
  - Modelling enables generalization and generation of high-resolution maps of berry yields and identification of berry hotspots



Rana and Merilä 2022

- ✓ Field data were collected during June-August 2014
- ✓ 230 field sample plots (20*20m)
- ✓ Each sample consisted of five 1 m^2 quadrates subplots

Bilberry model performance

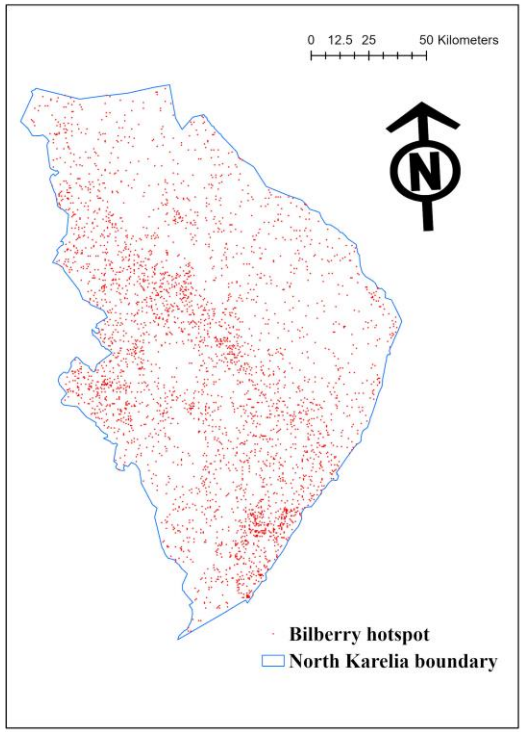


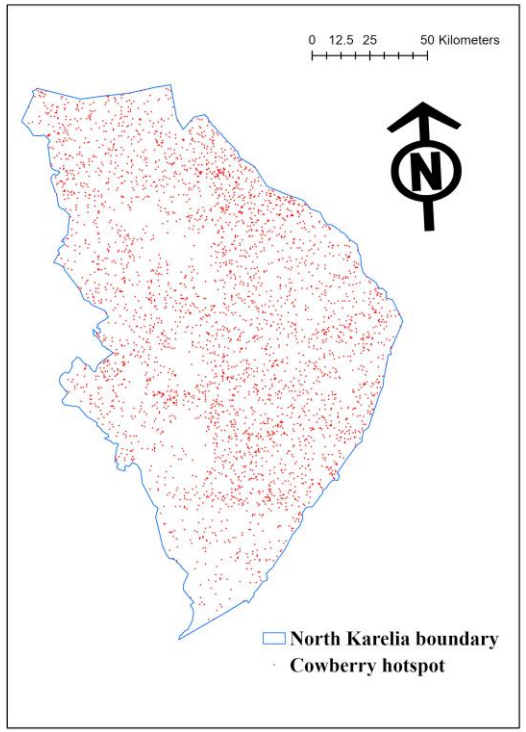
Rana and Merilä 2022

We used 15 variables selected from

- ✓ ALS (n=11; The most common variables are related to height and density percentiles)
- ✓ ALS-derived forest characteristics (n=2; Basal area, volume)
- ✓ Landsat (n=1; NDVI: green vegetation indicator)
- ✓ Other auxiliary variable (n=1;GDD, growing degree days)

Hotspot maps for bilberry and lingonberry yields provided





- Covers North Karelia
- Based on 2014 data

© Parvez Rana

© Parvez Rana

Further development ideas

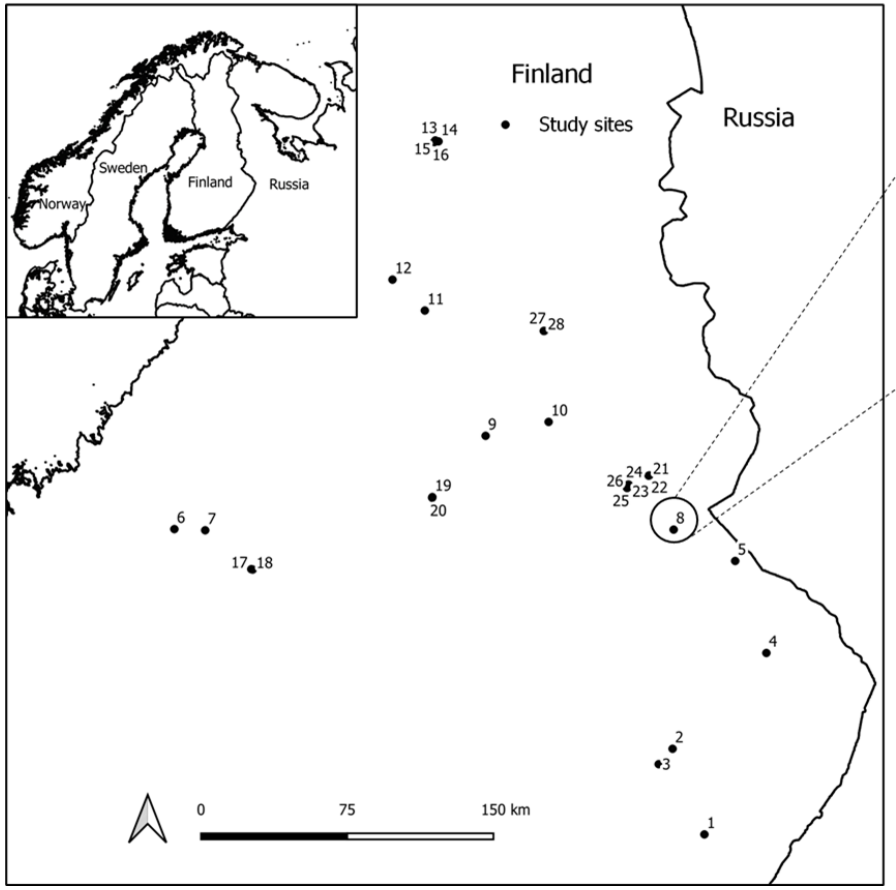
- Remote sensing data is nowadays widely used in estimation of timber volume in forests
- By integrating berry yields into forest planning systems forest owners could evaluate trade-offs in different decision-making situations
- Would facilitate multiple use of forests
- Is this of interest e.g. for Metsäkeskus?

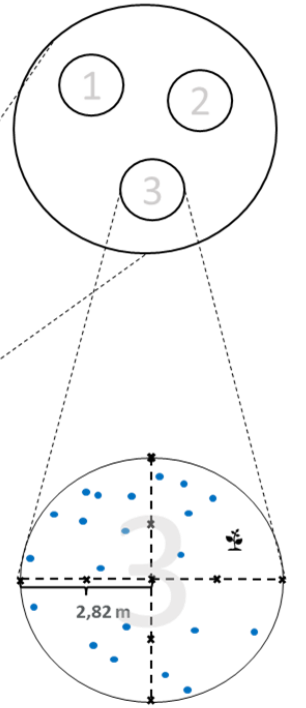
What are the forest environments providing the best quality bilberries?

- Bilberry is a high-polyphenol plant
- Anthocyanins characteristic to bilberry
- Bilberry contains at least 5 times more anthocyanins than highbush blueberry (pensasmustikka)
- Polyphenol concentration in bilberry is influenced e.g. by temperature and availability of light, nutrients and water
- Could we characterize the forest environments providing high anthocyanin bilberries?

Sampling

Merja Uutela & Jaakko Miettinen
In field work.





Region
- LAI canopy cover
- Basal are
- Stem density
- Vplume
- Height
- Age
- Temperature

Sample plot
Berry samples
- Total phenolics
- Anthocyanins
- Flavonols
- etc.

Soil samples
- pH
- C, N, K, Ca, P, Mg,
- OM, moisture

TE FINLAND

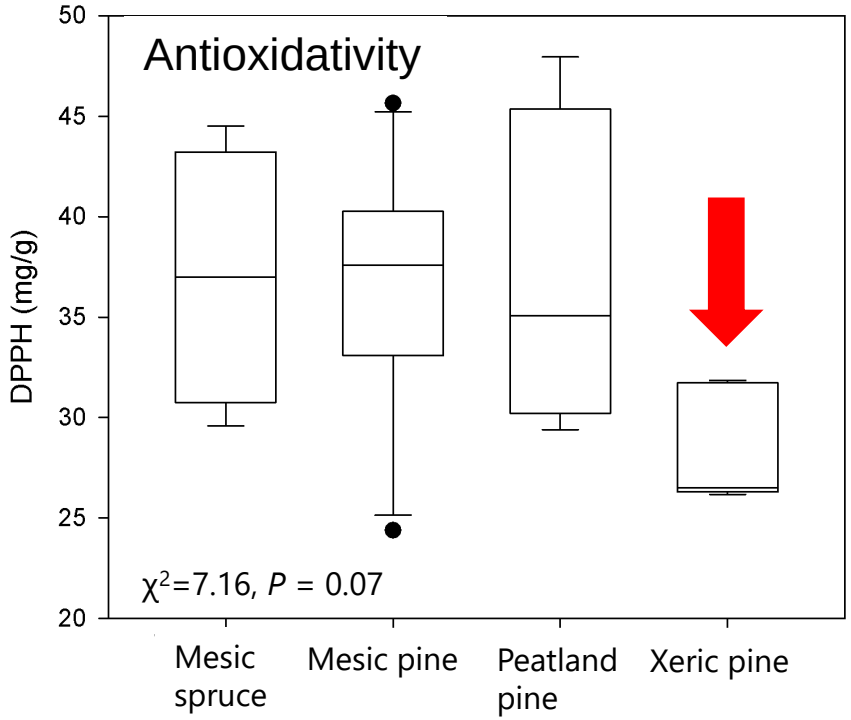
Manninen et al. 2023 manuscript.

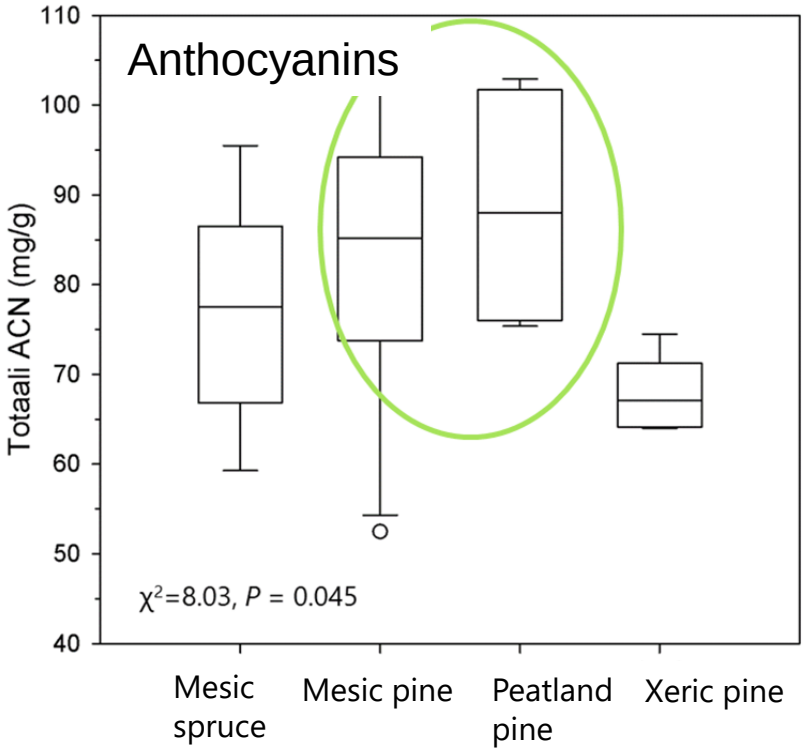
Highest anthocyanin contents in mesic pine sites

- Anthocyanins: Somewhat higher contents in pine dominated stands

  Exception: **lowest contents on xeric pine sites!**

- Antioxidative activity also lowest on xeric pine sites





Manninen et al. 2023. Manuscript

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Favourable sites for picking anthocyanin-rich bilberries


Mesic light spruce stand


Mesic pine site

Information package published in metsabiotalous.fi

Infocards:

https://www.metsabiotalous.fi/muut/ecodive-informaatiopaketti-metsamarjoista/

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Youtube videos

Blueberry animation for children: Let's enjoy and take care of blueberry! 2 min 56 s

Distributed also via **Mappa.fi**, a platform for material distribution for nature and environment education professionals maintained by Suomen luonto- ja ympäristökoulujen liitto ry and supported e.g. by the Ministry of Education and Culture and the Ministry of Environment

Two videos

1. Forest site types on mineral soil in a nutshell. 6min 28 s
2. Site type classification system in Finland and their identification in field. 21min 38 s

Educational material for students, forest enhusiasts and professionals

Three videos

1. How to establish a wild berry test plot. 6 min 8 s
2. Hot to count berry flowers in a test plot 4 min 44 s.
3. Enhancing pollination services for wild berries. 4 min 56 s.

Educational material e.g. for 4H youth, facilitates international cooperation

Thank you!

ECODIVE Research group getting ready for the final seminar: J-P Hotanen, Marika Laurila, Francoise Martz, Päivi Merilä, Parvez Rana, Maija Salemaa. Outside the photo: Outi Manninen, Jari Miina, Jari Oksanen, Rainer Peltola, Tähti Pohjanmies

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