



UNIVERSITY OF  
EASTERN FINLAND

# **Soratiien laadun ennustus olemassa olevan paikkatiedon avulla**

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**Eesityksen kieli englanti**



# Forest roads in Finland

- Finland has approximately 160,000 kilometers of forest roads.
- The majority of this forest road network was constructed between the 1960s and 1990s, with a planned technical life of 30 years. The roads built during that period were not designed to accommodate the heavy trucks (81 tons) commonly used today.
- Many of these roads represent bottlenecks in the transportation network and require extensive rehabilitation.





# Conducted research



Falling-weight deflectometer

Handheld gamma spectrometer

## Objectives

- Assess which road parameters could be used to predict the bearing capacity of forest roads.
  - Create a bearing capacity model
- Which road properties could be determined from laser scanning data
  - Road width, surface quality, ditch depth

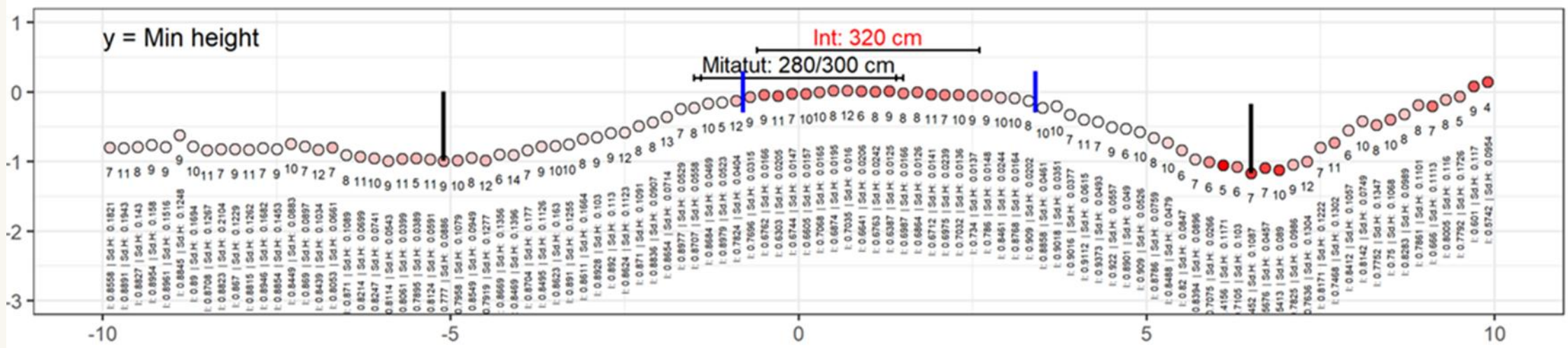
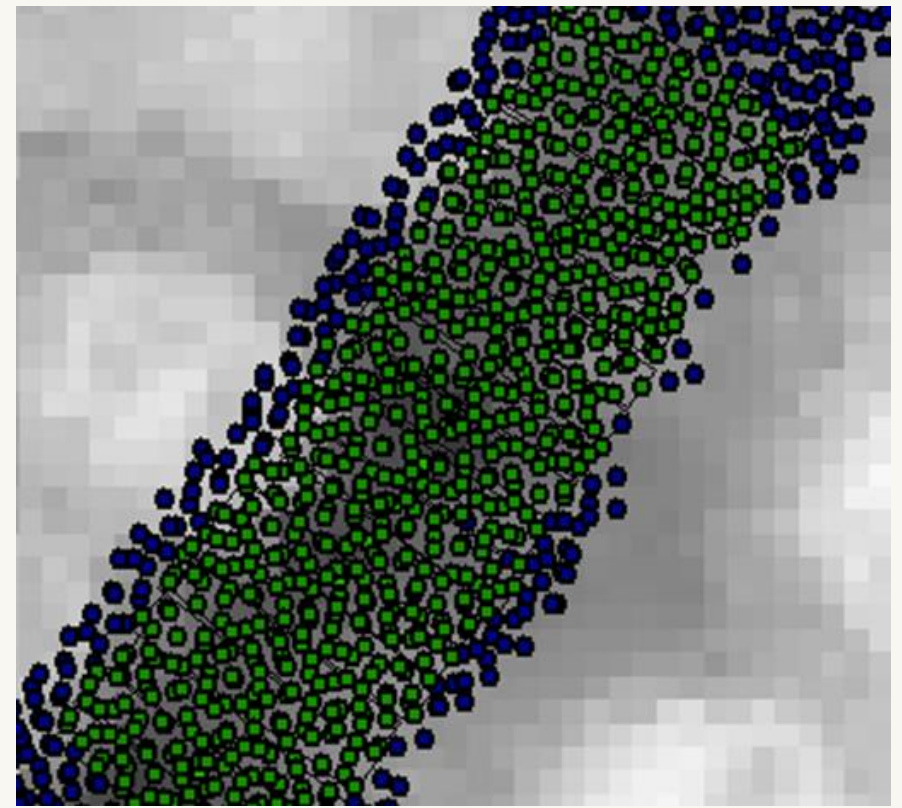
## Utilized data

- ALS (5p/m<sup>2</sup>)
- Falling weight deflectometer measurements
- Field measurements of road parameters
  - Road width, ditch depth, rut depth, surface quality



# Road width

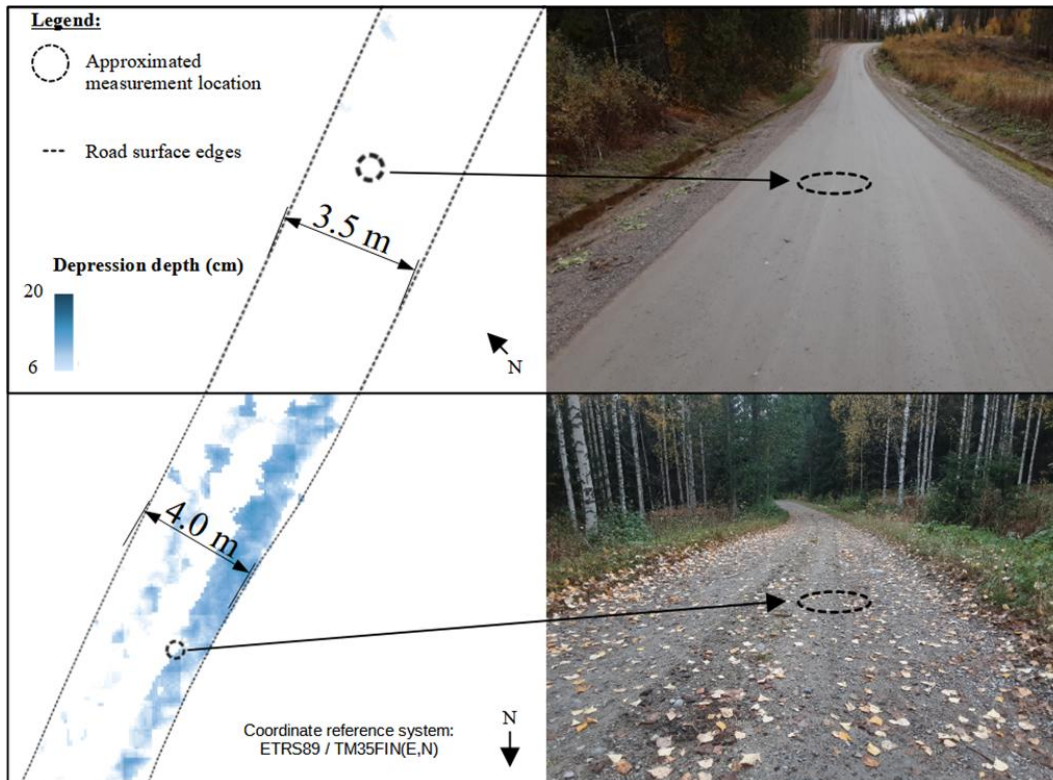
- When assessing the roads width, three algorithms were created, which use the intensity of the laser scanning data in the modeling.
- The best algorithm was able to predict the road width with an accuracy of 22.4 cm (RMSE% 8.2 % / 22.4 cm)



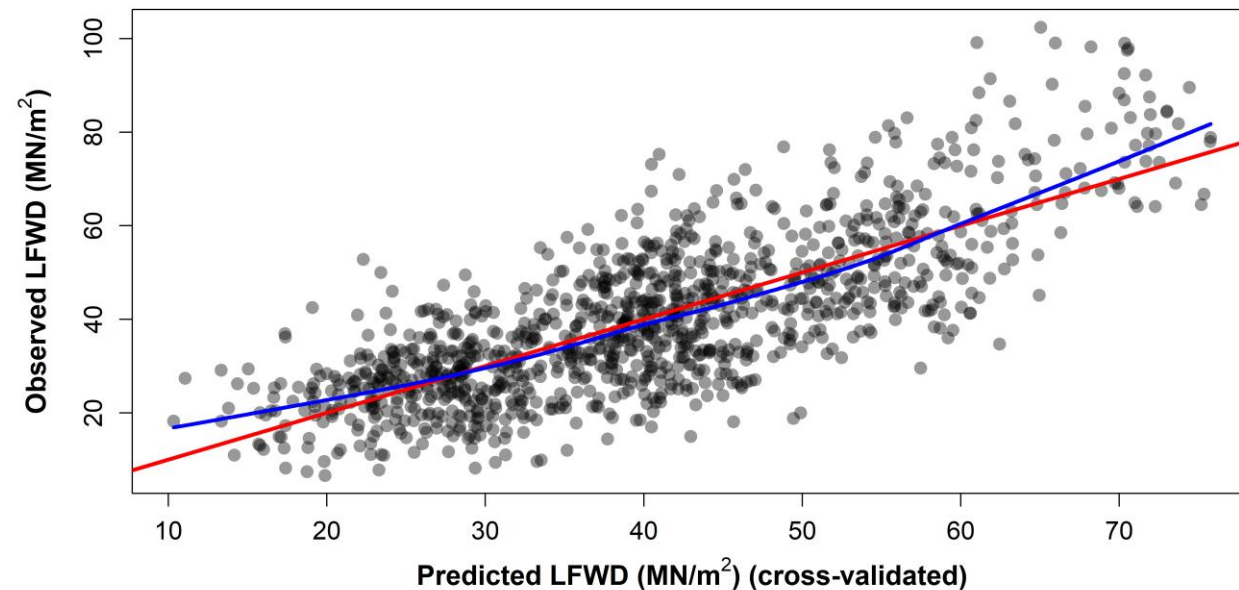


# Rut depth and bearing capacity

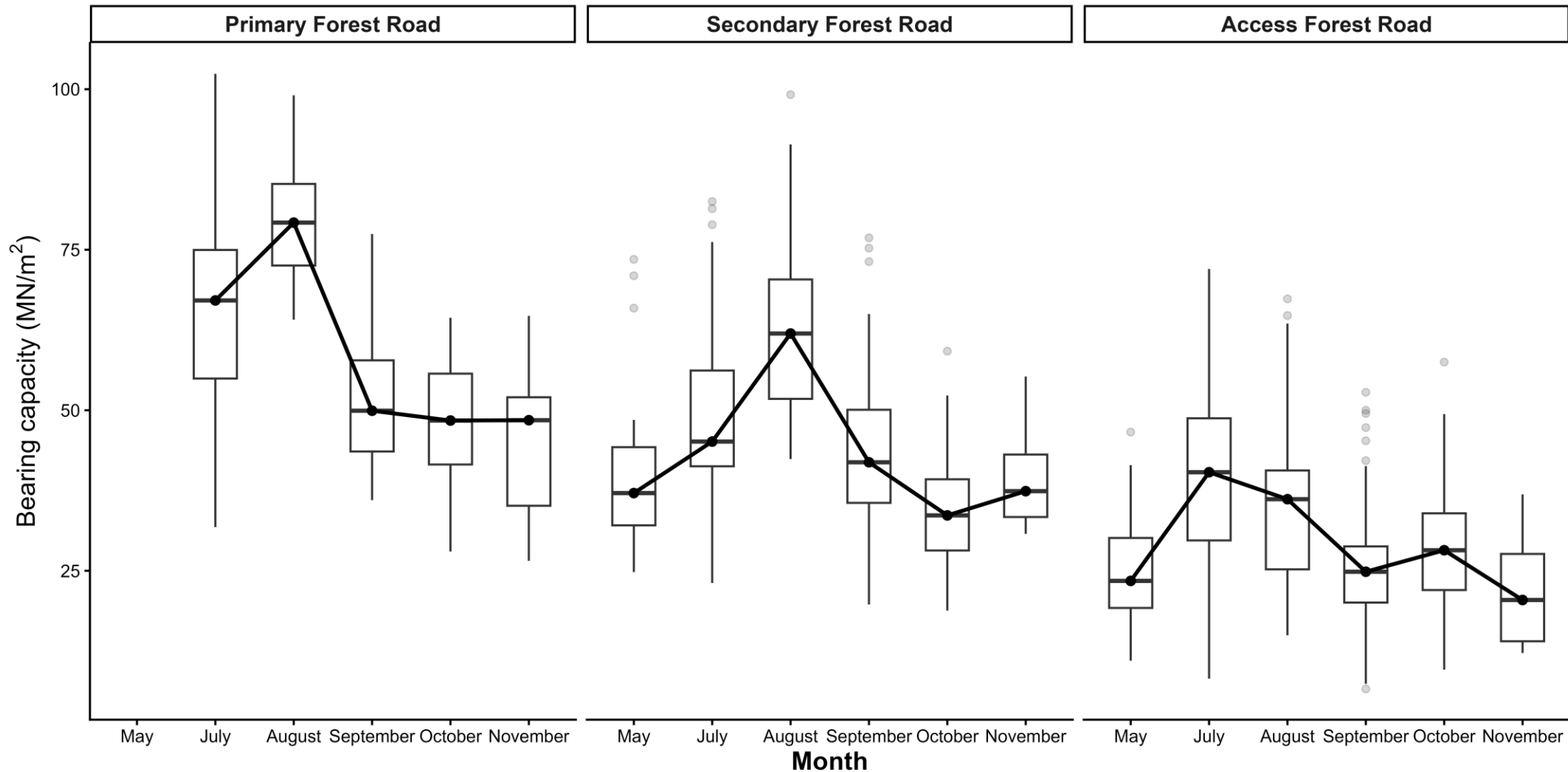
- The rutting of the road was assessed based on laser scanning data. The method estimates the rut depth from the differences in echo heights, creating a prediction of the rut depth.
- The model was able to predict the rut depth with 47% accuracy. (RMSE 2.5 cm)



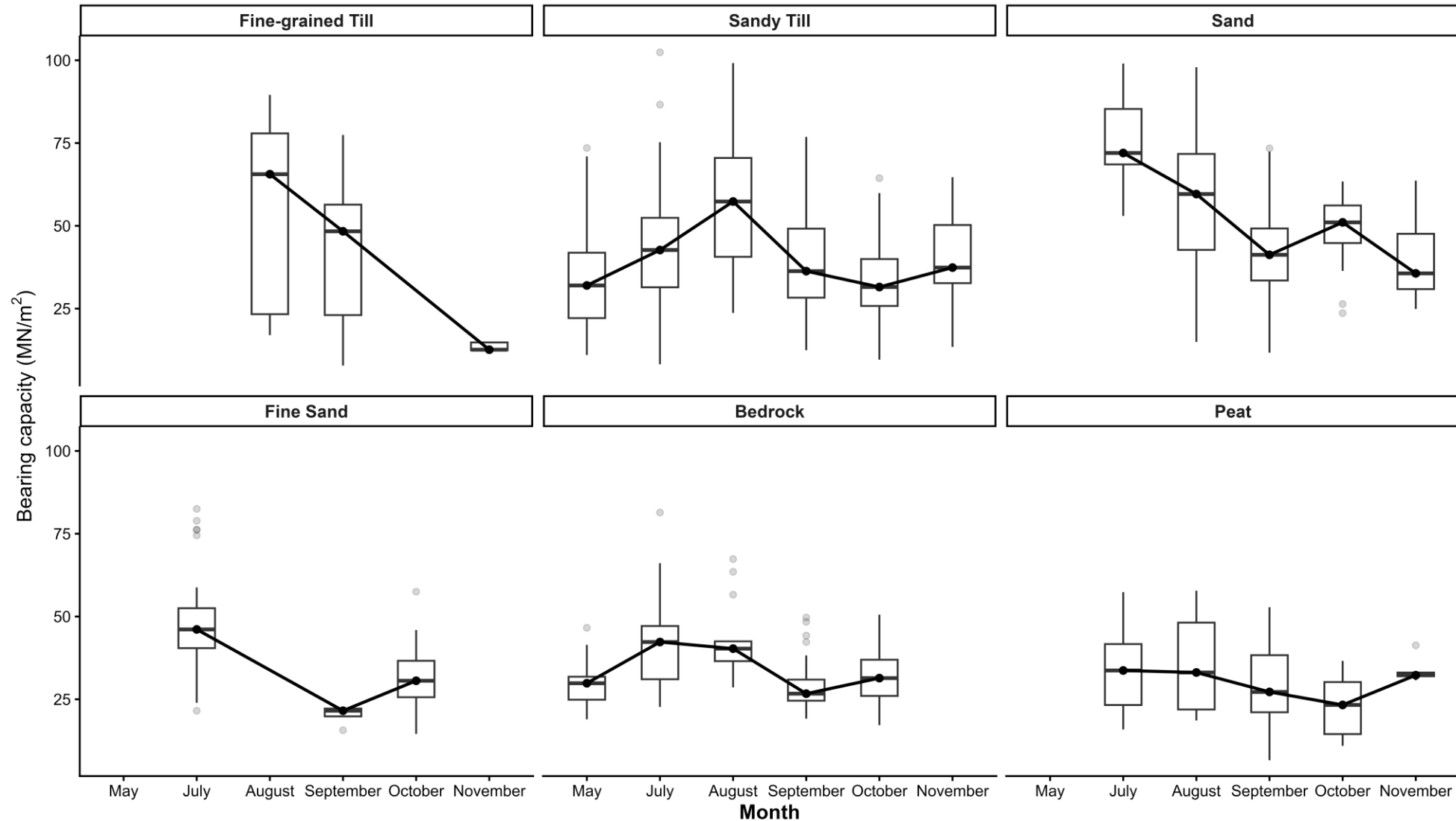
- The road's bearing capacity was predicted using mixed models that used the characteristics of the road and the surrounding terrain along with weather variables (road width, ditch depth, soil type, terrain moisture, rainsum, avg. temperature).
- The models achieved a 60% prediction accuracy for the bearing capacity.



# Change in bearing capacities on different road classes on varying seasons



# Change in bearing capacities on different soil types on varying seasons





# Plans for field measurements in June 2025

- The prediction of road network bearing capacity still requires a lot of work
  - The load capacity of roads is strongly correlated with the road width
  - Need to produce our own bearing capacity models for different sized roads?
- Aim to measure minimum of 300 new plots (3-5 per selected road segment)
  - The parameters to be measured: Road width, roadway width, ditch depths, rut depth
- Balanced data in terms of:
  - Surrounding soil types
  - Different sized roads
- Field measurements located in Heinävesi
  - Close to other study areas
  - 20 p/m<sup>2</sup> ALS data available
  - Some possibility for additional study site
- Bearing capacity measurements conducted in the end of June or start of July for all measured roads (~250 plots + new measurements)
  - Bearing capacity value when the roads are dry (assumed maximum bearing capacity)
  - Same roads measured again in autumn when there is moisture in the road structure (decreased bearing capacity)

# References

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**Thank you!**