Ungulate impact on height growth of forest regeneration in Germany

BIOWILD-PROJECT

Content

https://is.gd7KOXFd7

Impact of browsing

- Browsing = Biomass Withdrawal = Nutrient Removal
  - Vitality reduction

- Impact of heavy browsing pressure:
  - Reduced height growth
  - Reduced competitive strength } Mortality

- Selective browsing -> Reduction of species mixture

- Economical damages:
  - Loss of regeneration and reduced timber quality
  - Reduced tree species portfolio -> Risks
  - Slower growth -> opportunity costs
  - Costs for browsing prevention

http://bit.ly/2tXau8S

BioWild-Project

- Goal:
  - Evaluating the condition of the forest vegetation
  - ...

- 5 project regions in Germany

- Different ownership structures

- Variate growth conditions
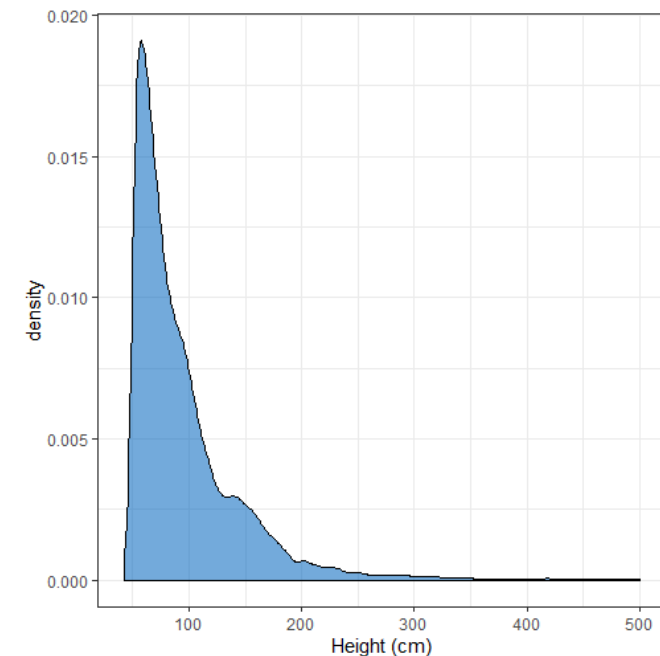
- 248 sampling areas

Data acquisition

- Annual vegetation survey (since 2016)

- 100 m² fenced and unfenced plots
  - No ungulate vs. "given" ungulate influence

- Main variables of the woody regeneration
  - Species [factor]
  - Height [numerical] (50:500 cm)
  - Browsing [binary]
  - Quantities per plot [numerical]

- Site variables
  - Light
  - Hunting bags -> Roe deer
  - Hunting regime (factor)
  - (Site mapping variables)
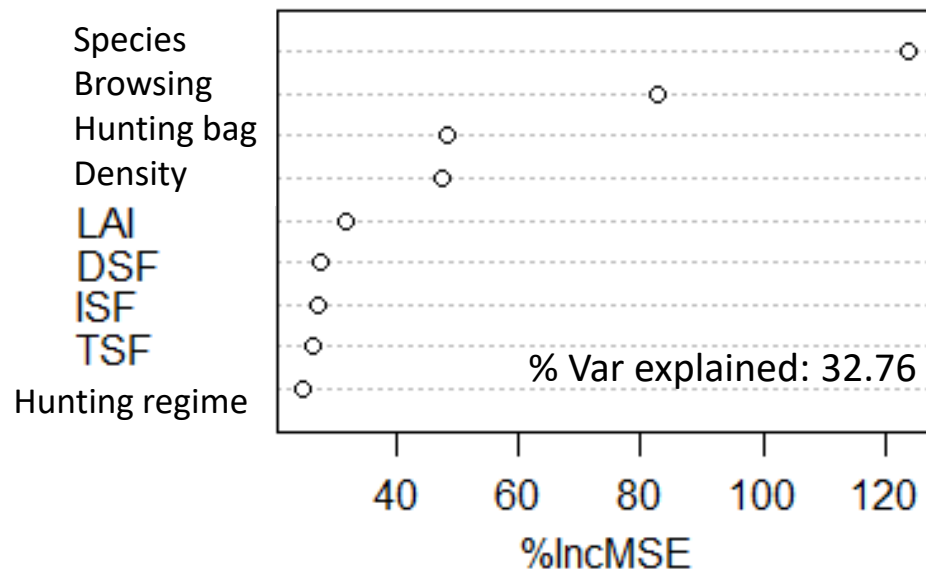

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Two-Sample tests

- Significant differences fenced and unfenced plots?

- Probability distributions:
  - Count-Data/Densities -> Poisson
  - Height -> Poisson

➢ Nonparametric statistics
  - Wilcoxon rank-sum test for densities and height
  - $H_0 = \tilde{x}_A \leq \tilde{x}_B \ vs. \ H_1 = \tilde{x}_A > \tilde{x}_B$
    - 95 % confidence interval -> α = 0.05

- Median of Densities
  - Significant difference since 2017
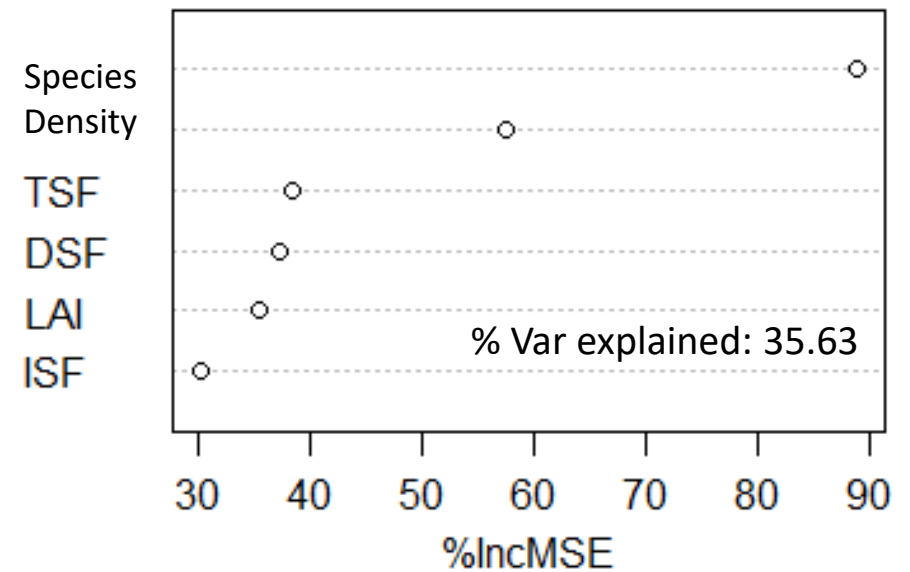
- Median of Heights
  - Significant difference since 2017

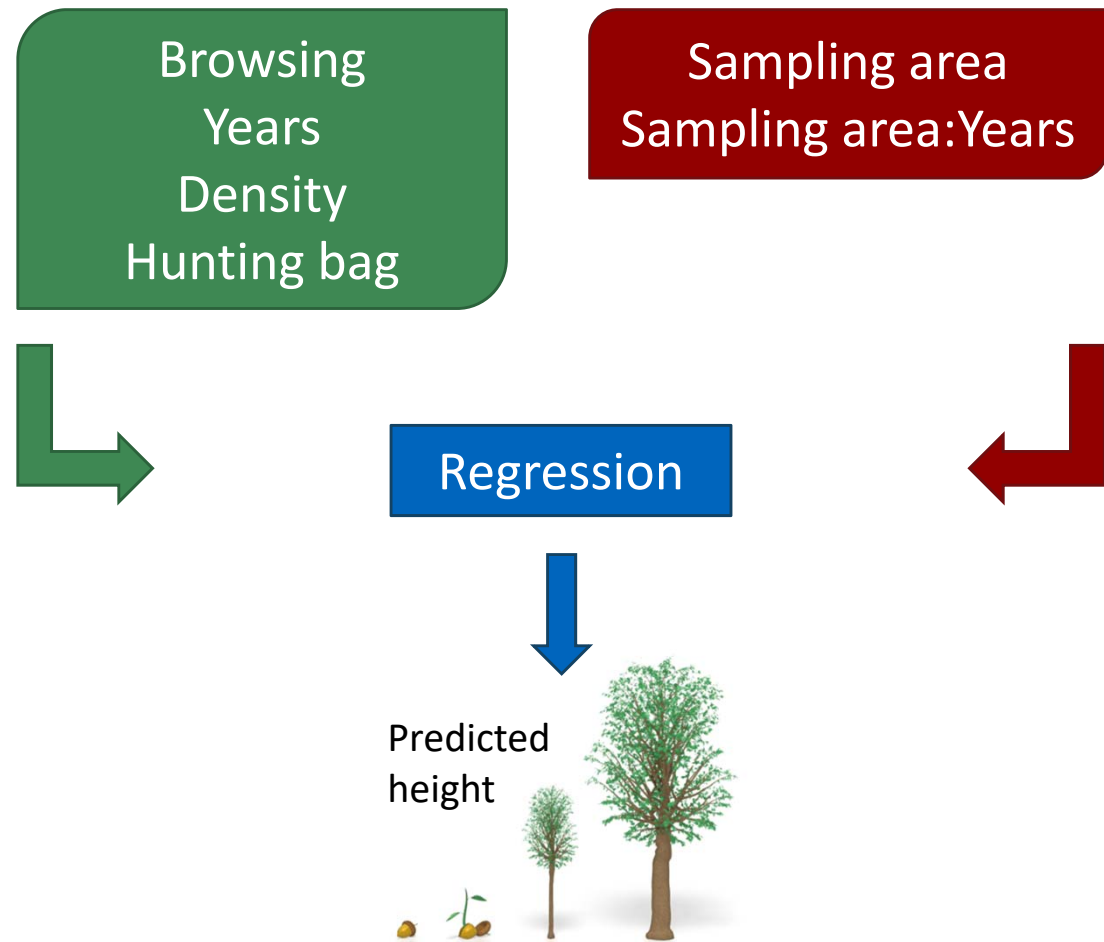# Variable Selection –> Random Forest

HEIGHT, UNFENCED, 2018

Species
Browsing
Hunting bag
Density
LAI
DSF
ISF
TSF
Hunting regime

% Var explained: 32.76

%IncMSE

HEIGHT, FENCED, 2018

Species
Density
TSF
DSF
LAI
ISF

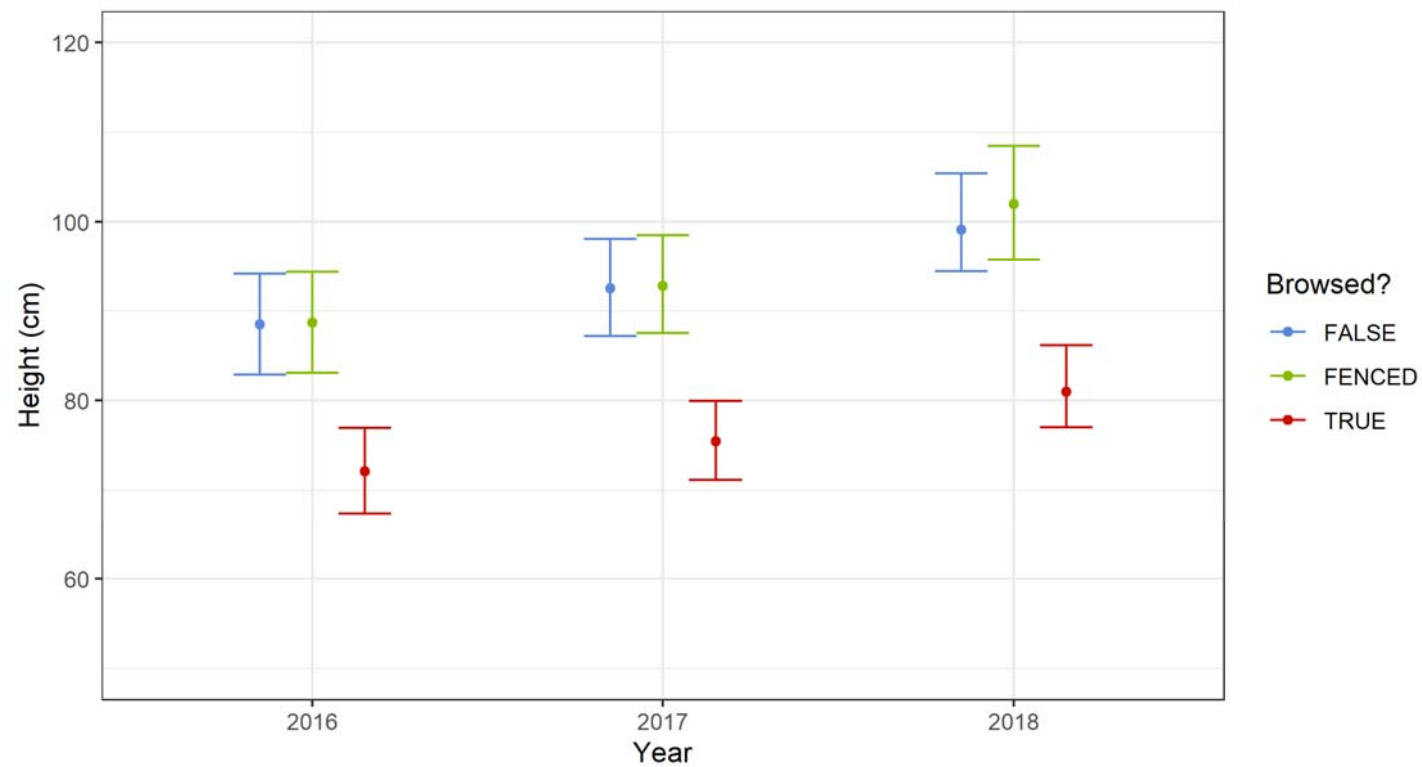% Var explained: 35.63

%IncMSE

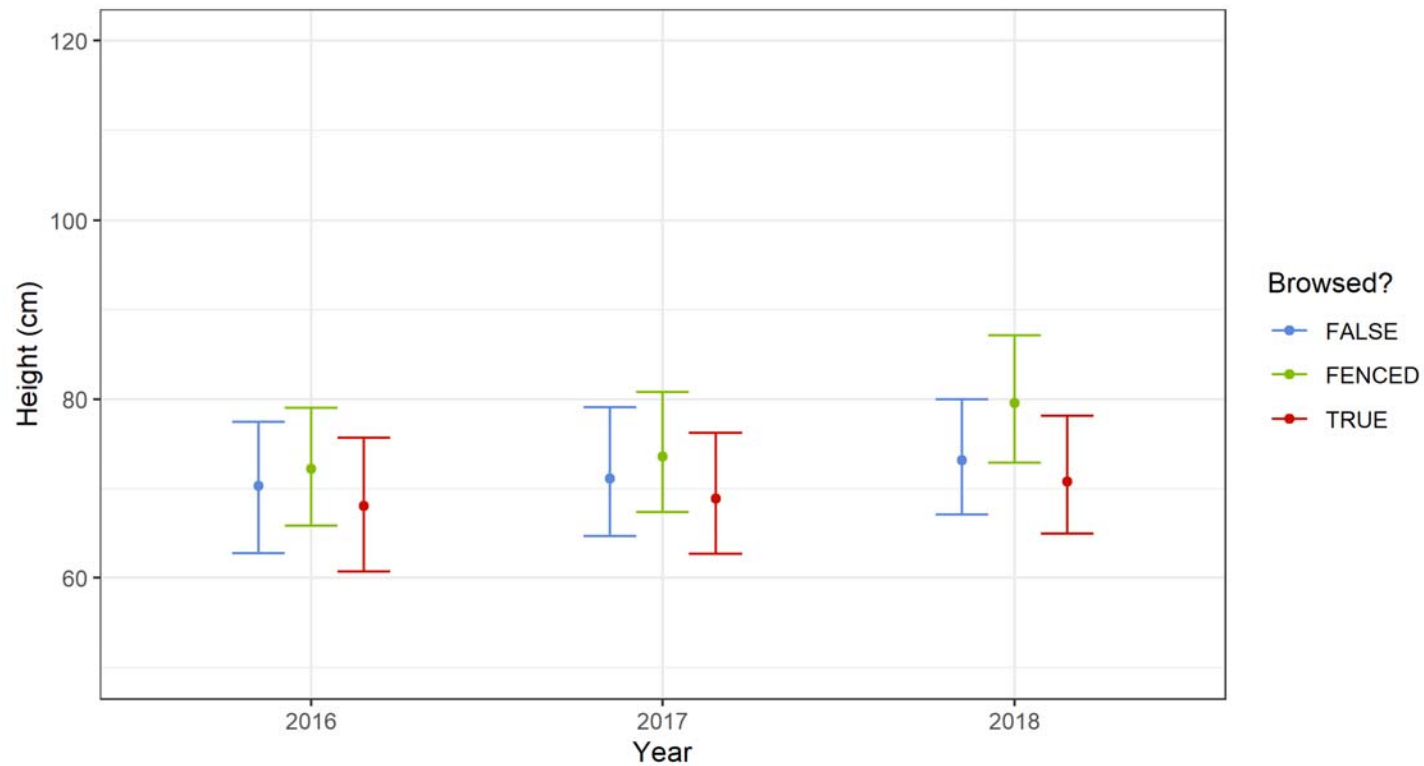# Generalized mixed effect model

- Dependent variable: Height
  - Poisson distributed

- Coefficient (green box)
  - Fixed effects

- Statistical dependence of the observations
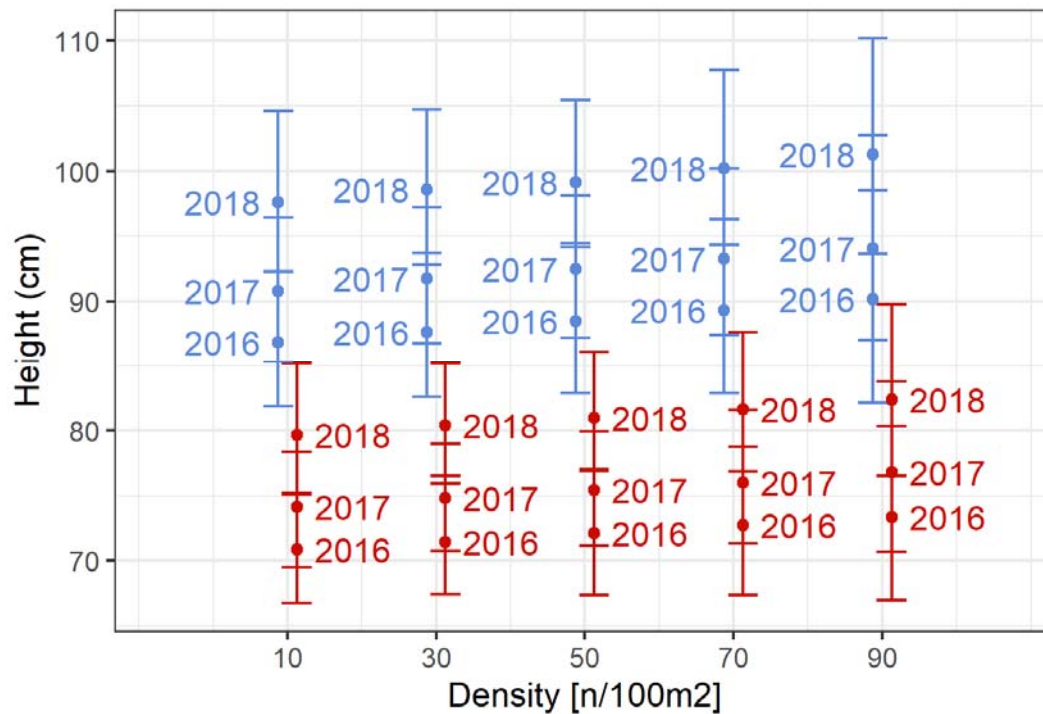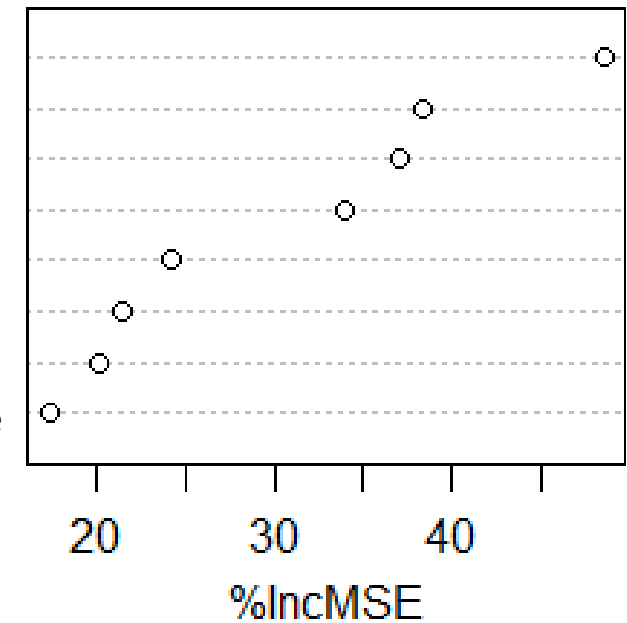 - Random effects (red box)

Browsing
Years
Density
Hunting bag

Sampling area
Sampling area:Years

Regression

Predicted height

Prediction – Beech

Prediction – Norway spruce

Prediction – Beech with density gradient

Probability being browsed again
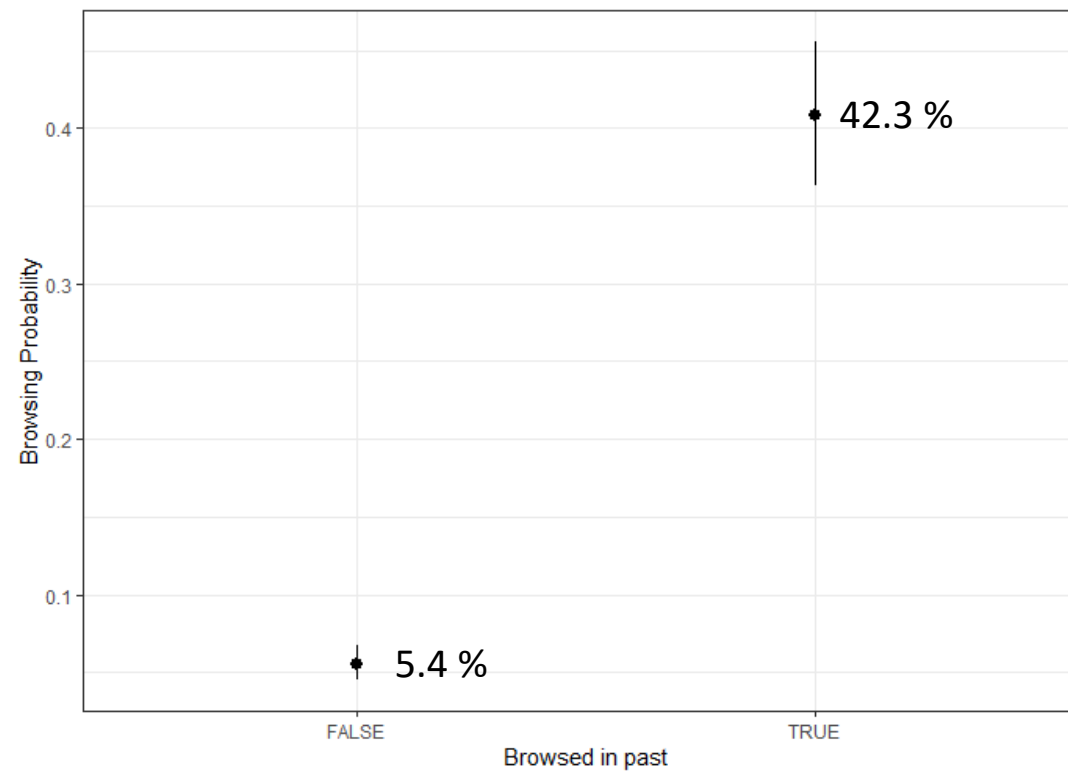
First conclusions

- Ungulate browsing has a significant impact on the height and density of regeneration (larger 50 cm)
  - Impact differs between tree species
  - Height growth -> sensitive browsing indicator

- Generalized mixed effect model -> suitable for predicting the development of height growth

- Plants that have been browsed in the past are more likely to be browsed again

Outlook

- Include more explanatory variables
  - Site information (Cation-exchange capacity)

- Include competition
  - Intra- and interspecific competition

➤ Use loss of height growth by ungulate browsing in forest economic models

- Why did density and hunting bag seem important in the Random Forest, but weren't in the mixed effect regression?

https://is.gd/9NQmnL

Many thanks for your attention!