




Integrating hazards for forest management and planning in Norway


Olalla Díaz-Yáñez,

Blas Mola-Yudego, Jose Ramón González-Olabarria, Timo Pukkala

olalladiaz@uef.fi / olalladiaz.net / @olalla



You are here



Forest ecology

Economy

Natural
disturbances

Characterization



Damage occurrence



Damage



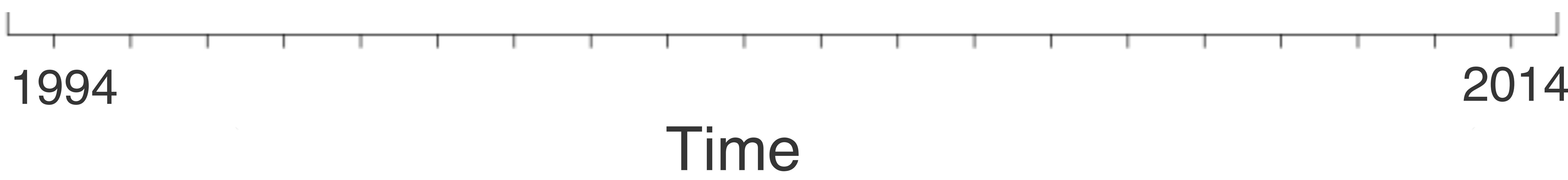
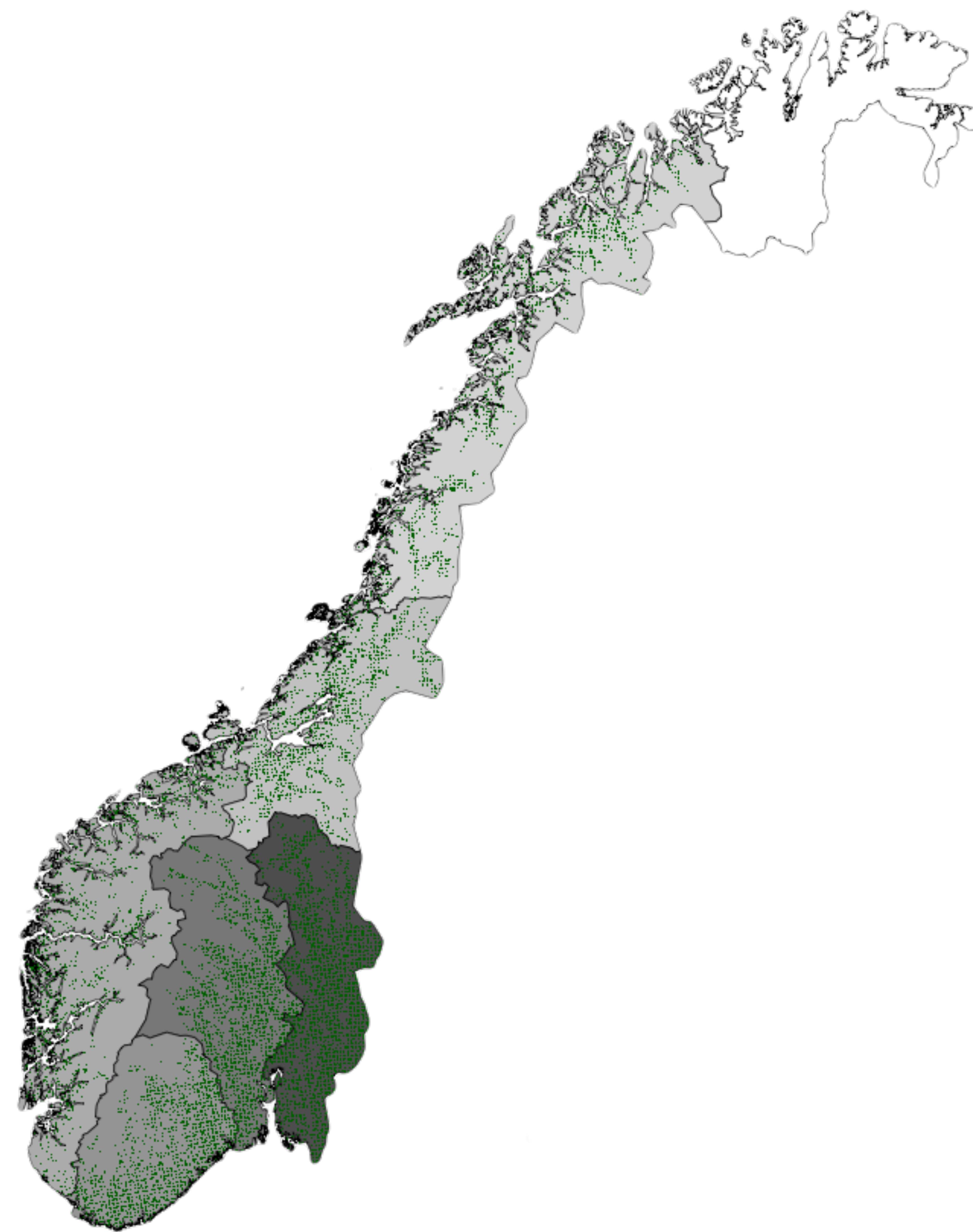
Optimization



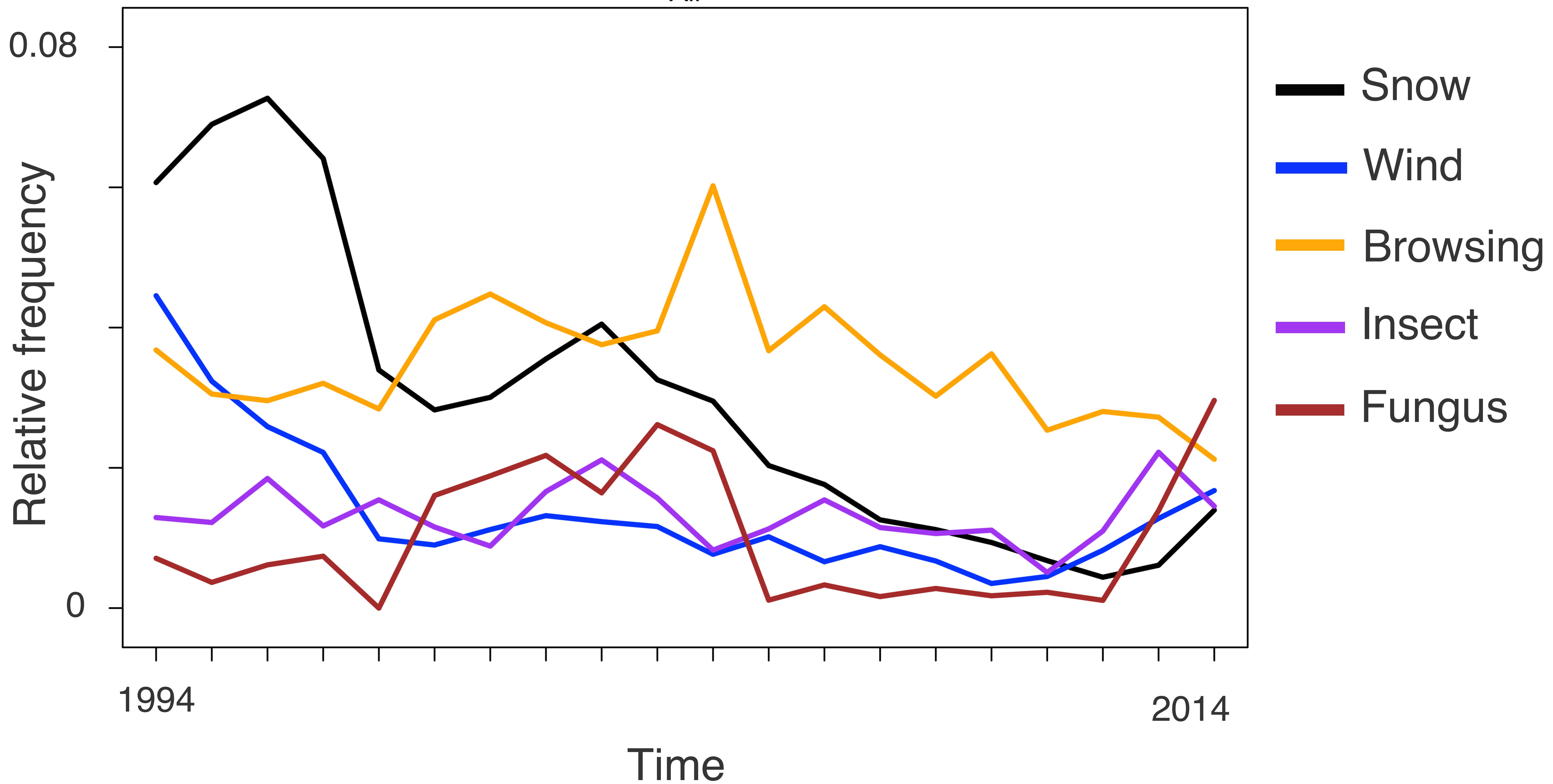
Other on-going work





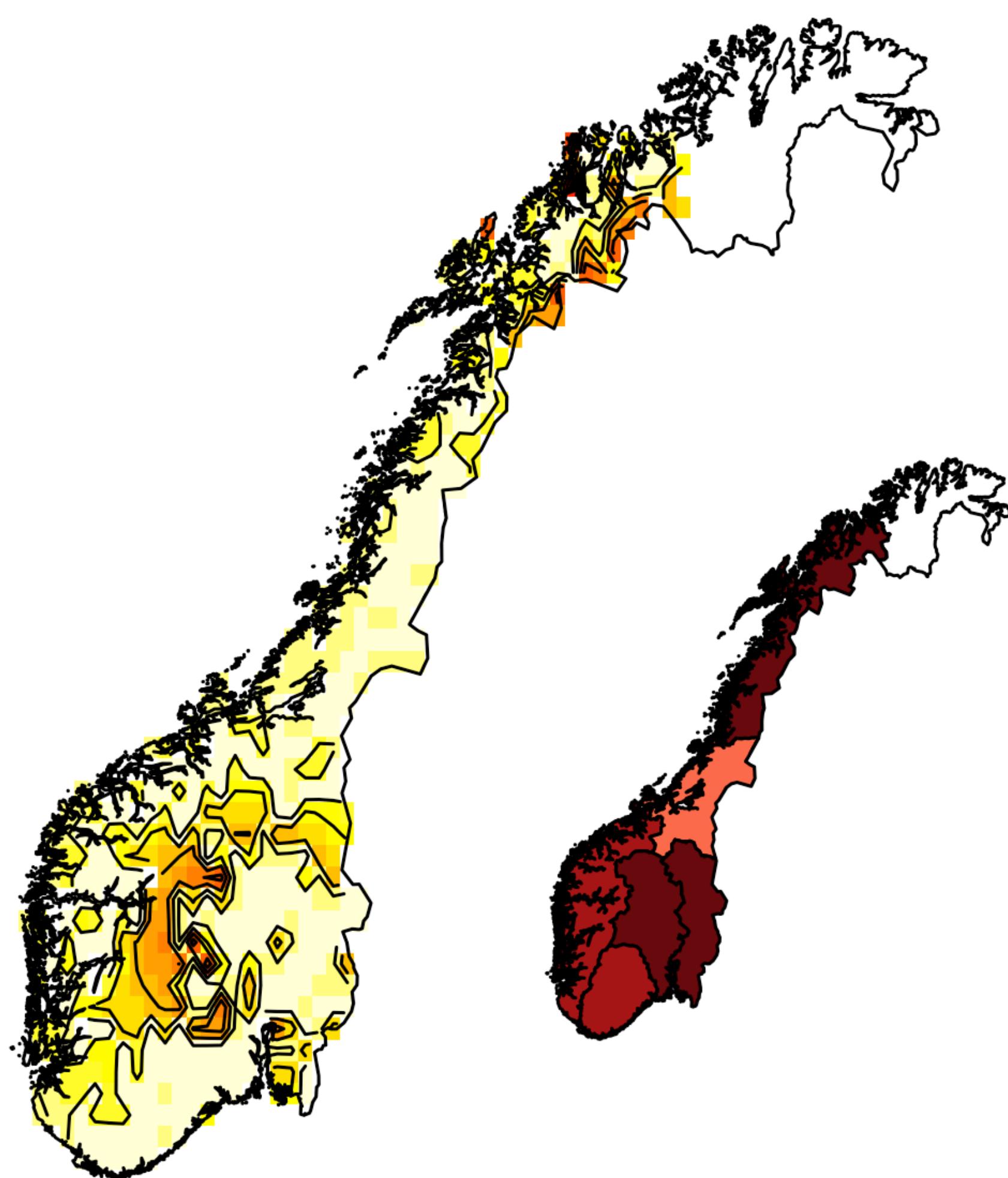


Snow and wind present a decreasing pattern

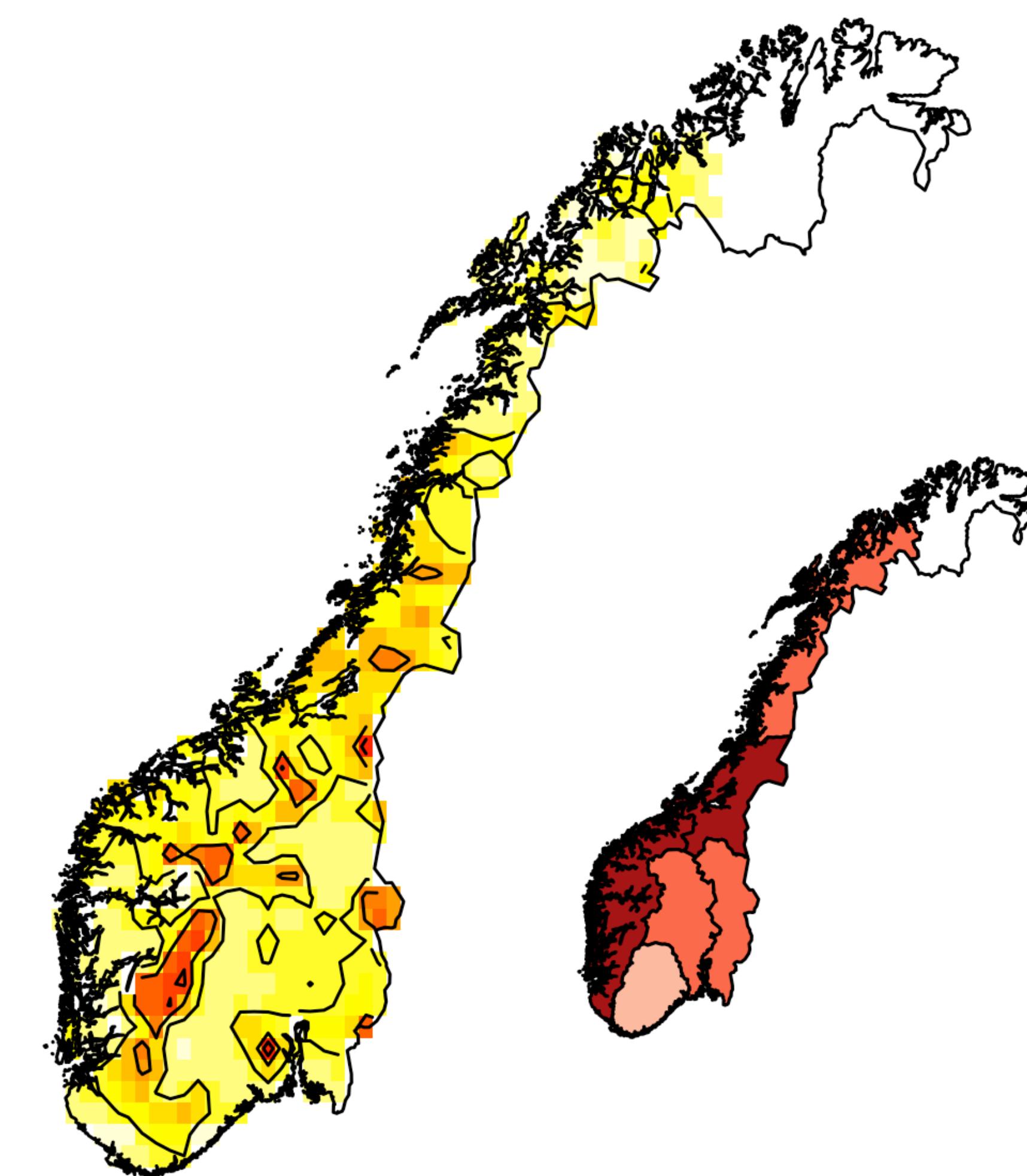




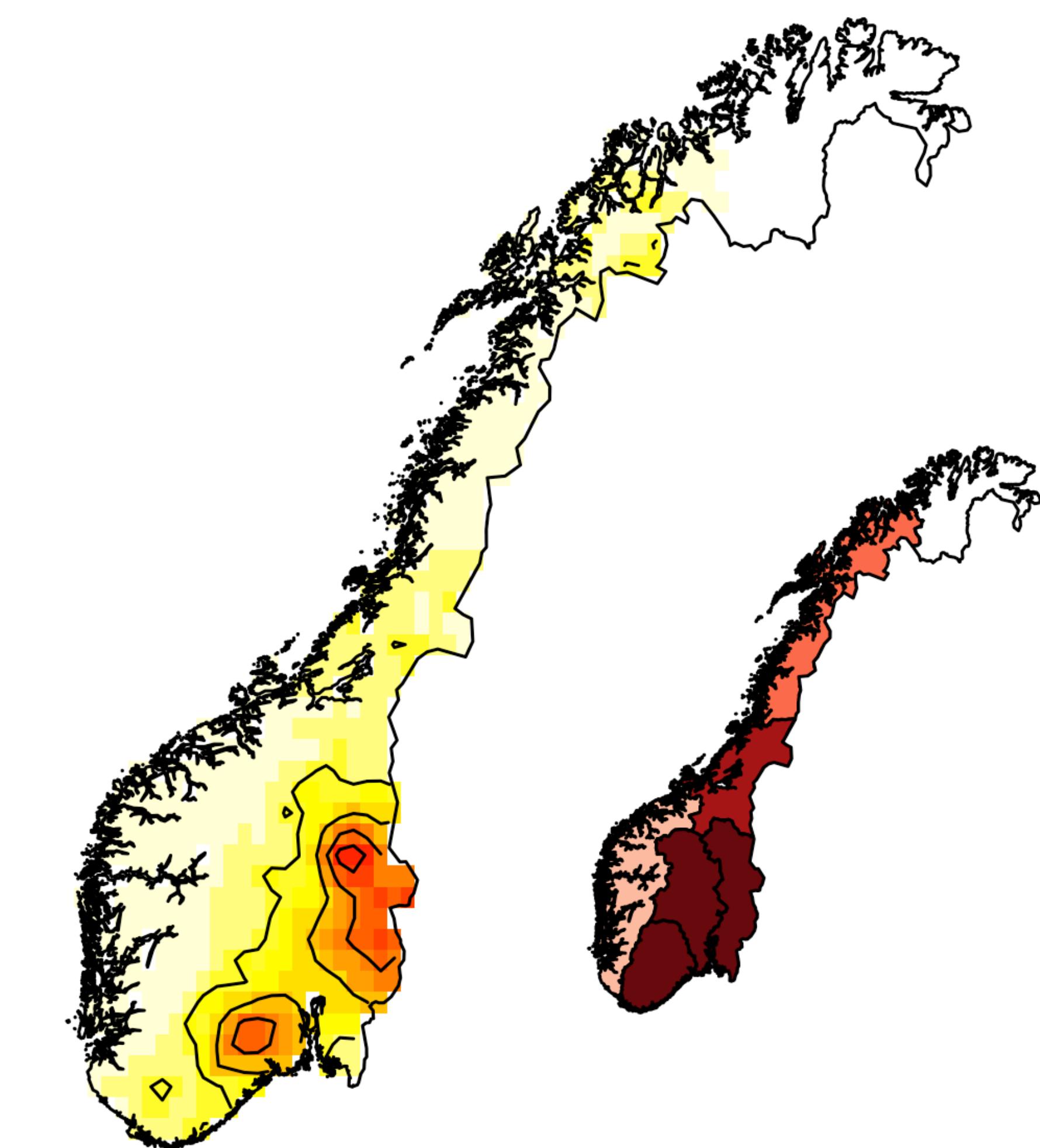
Snow



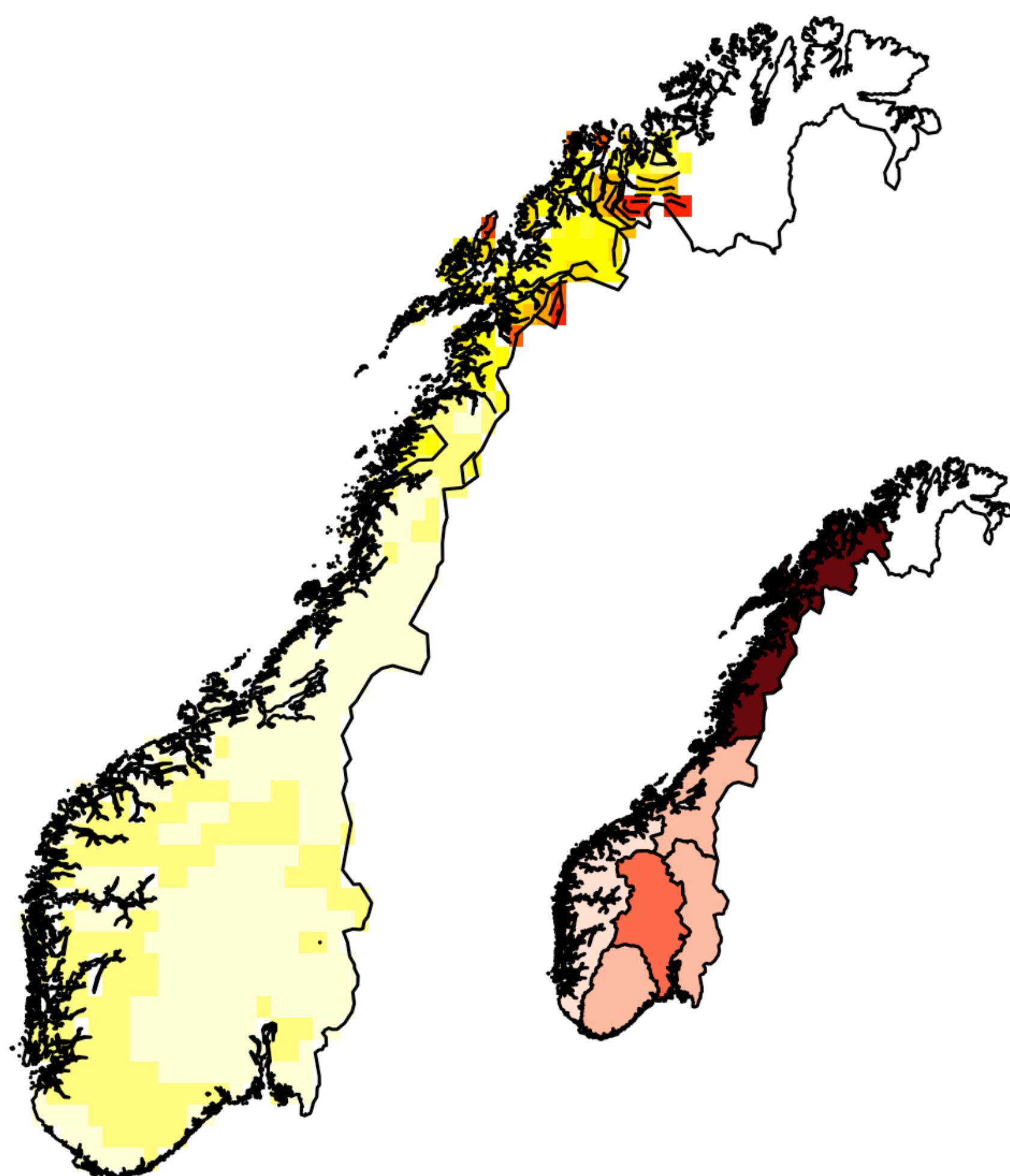
Wind



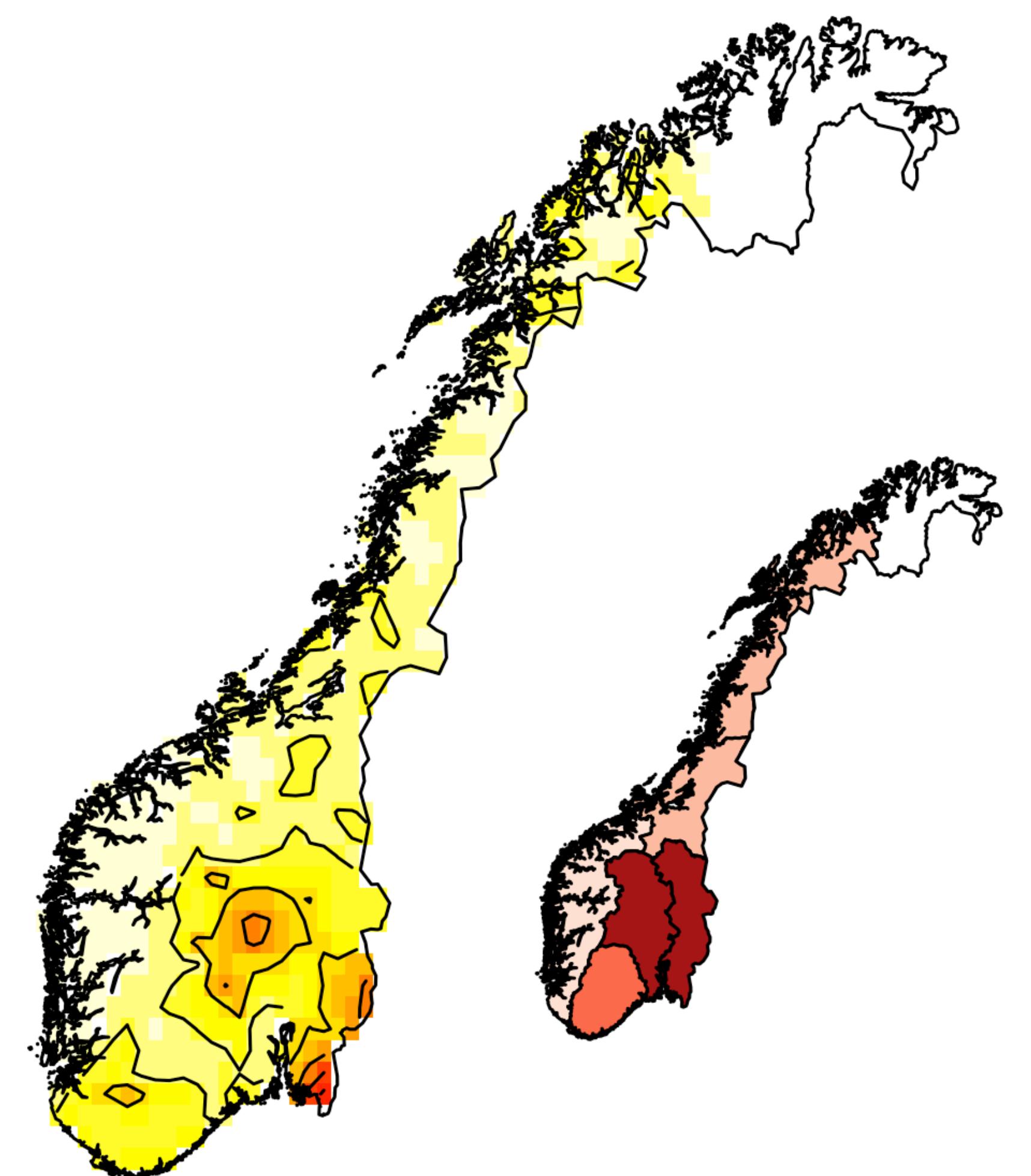
Browsing



Insect

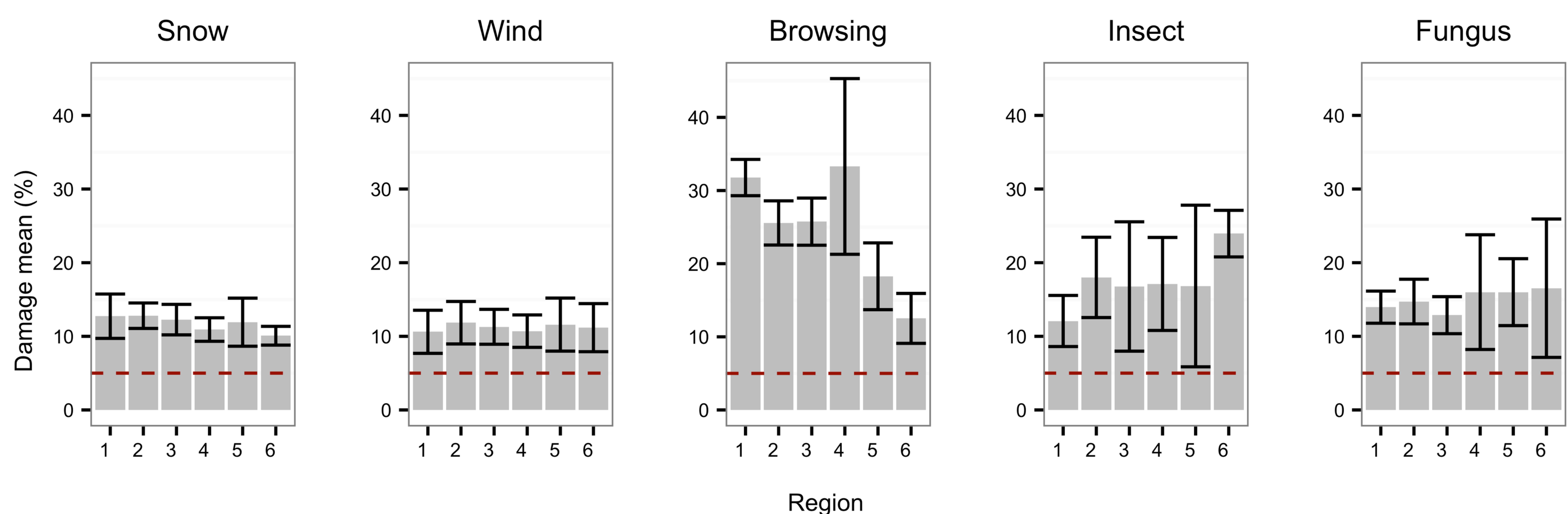


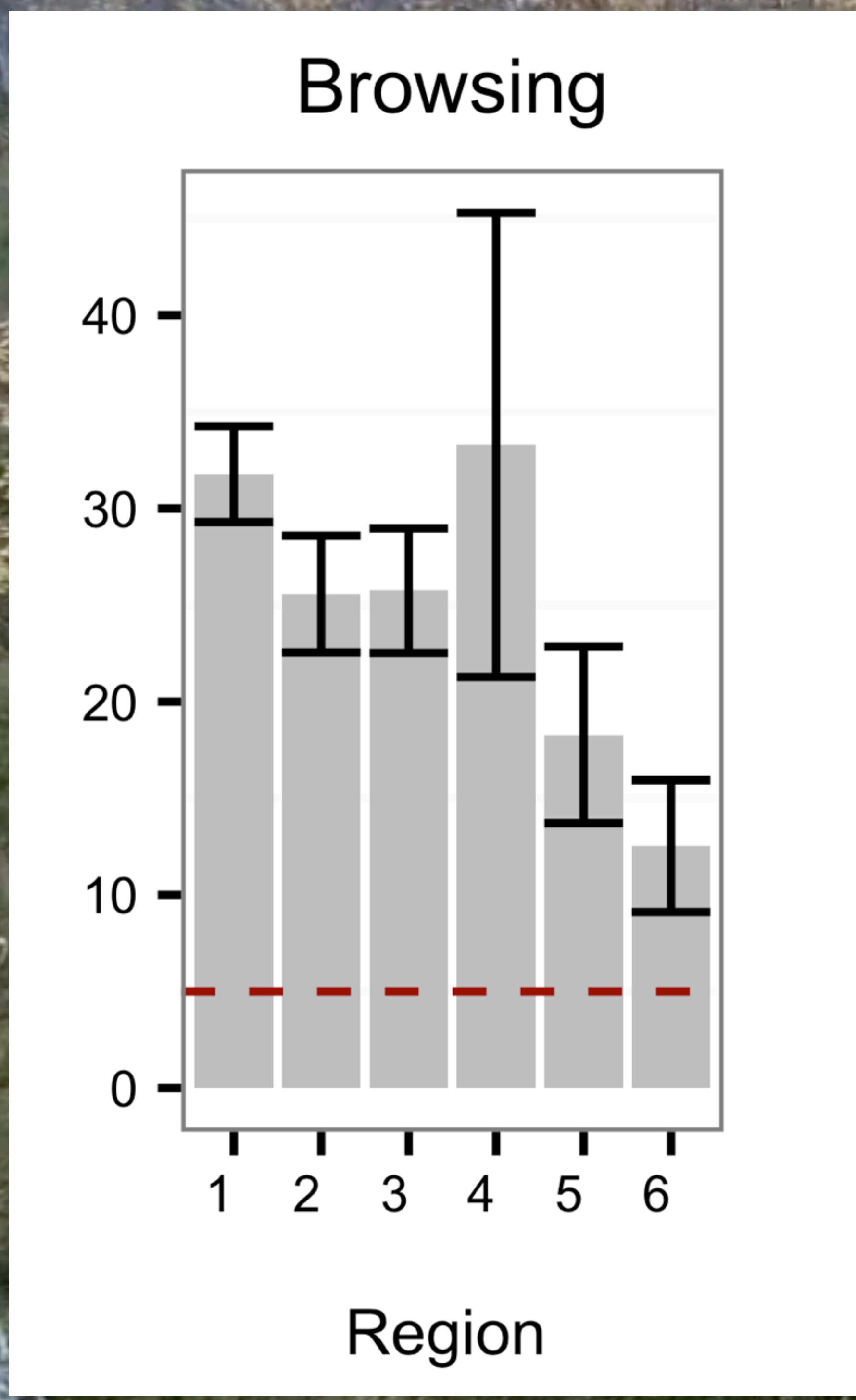
Fungus



- n.d.
- under 0,05 %
- 0,05-0,15%
- 0,15-0,26 %
- 0,26-0,34 %
- 0,34-1,5 %

Stands with ungulate browsing have higher damage mean



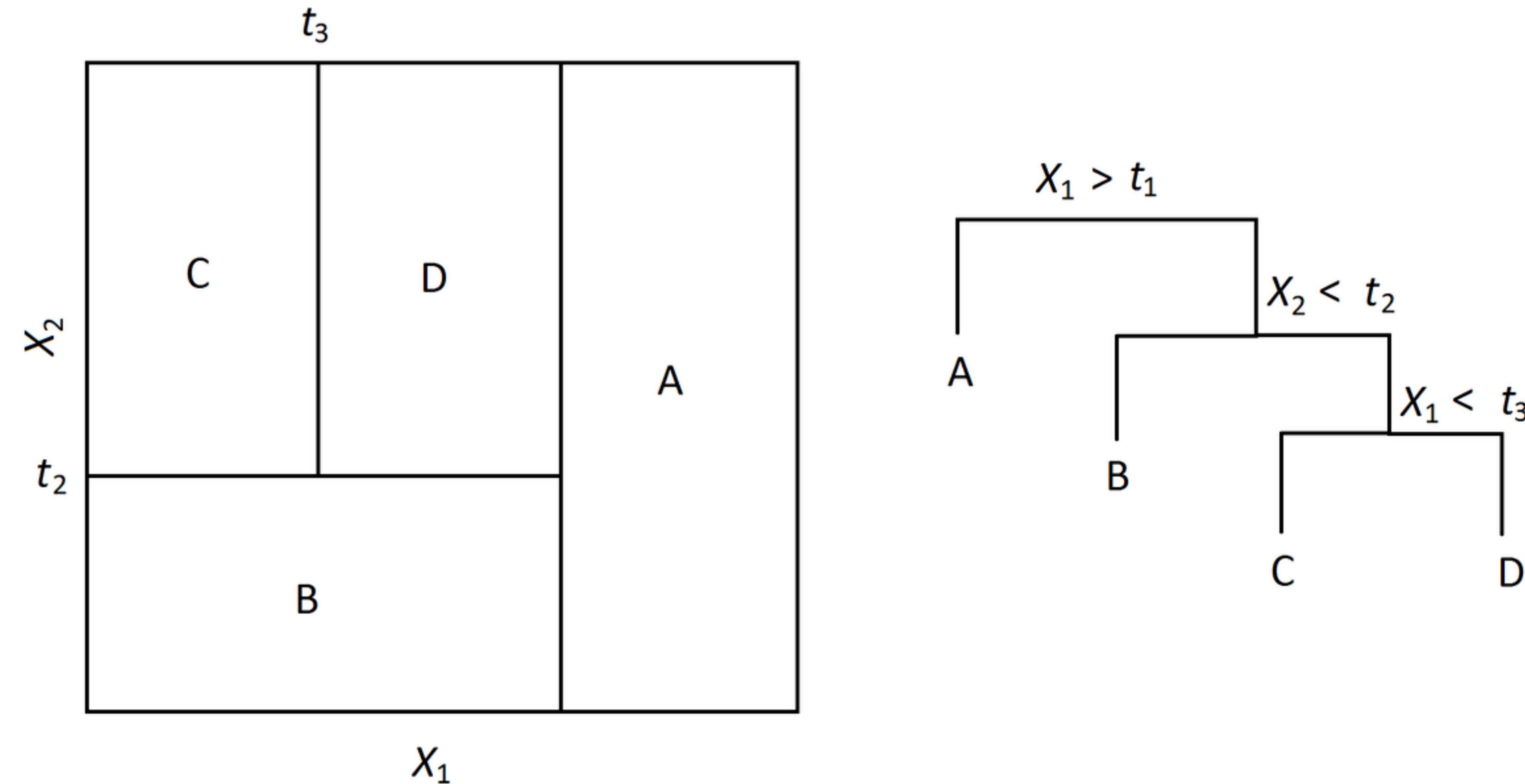




Stand vulnerability to browsing damage: Method

Under-sampling of the majority class

Classification trees

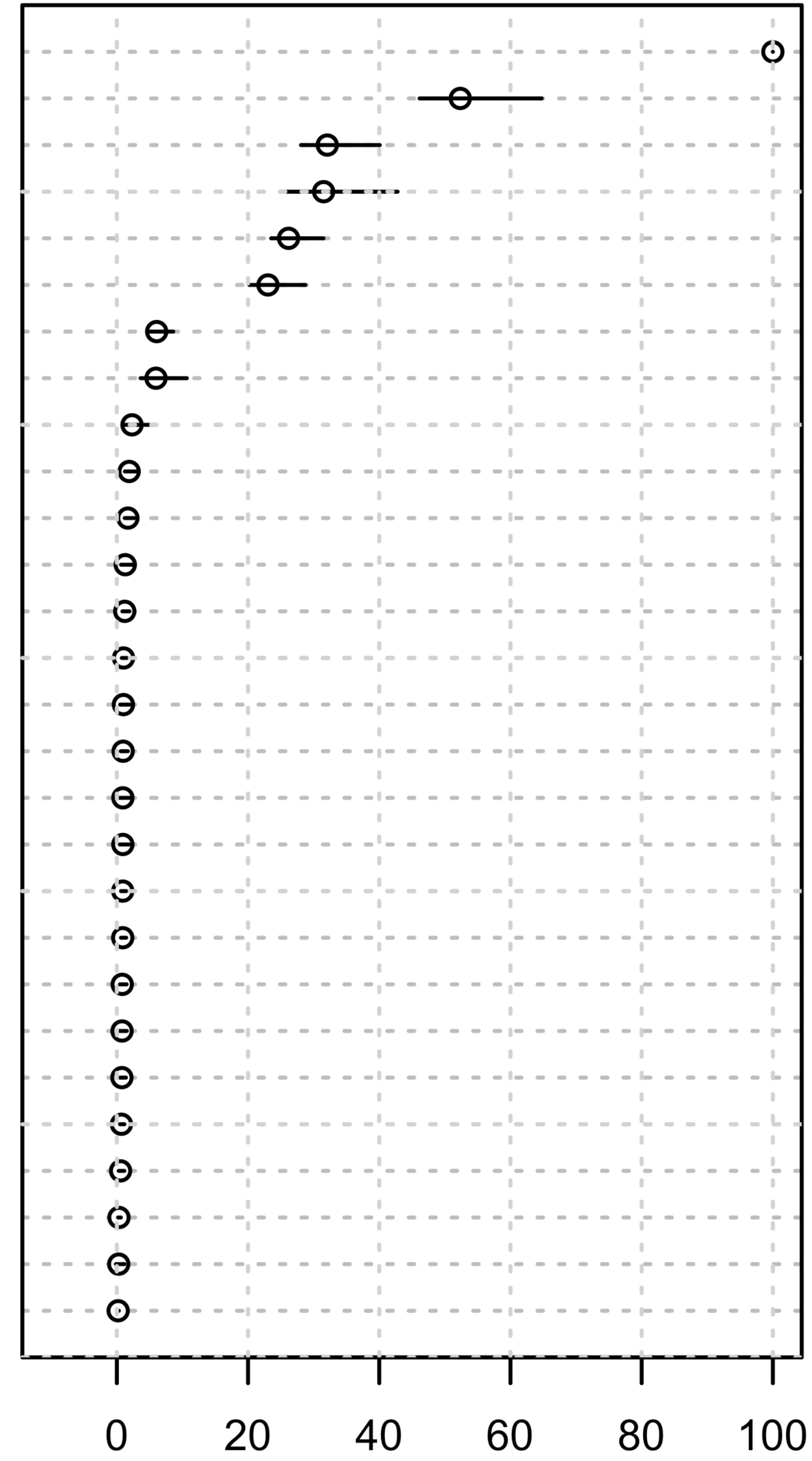




Mean estimated variable importance

50 models

Age
Development class
Basal area
Stand size
Density
Diameter
Altitude
Previous treatment
Gini
Pine percentage
Slope
Height
Site index
Dominant specie
Population on stand edge
Crown cover
Soil depth
Slope orientation
Spruce percentage
Steepness
Shannon
Deciduous percentage
Distance to stand edge
Birch percentage
Slope longitude
Relief
Conifer percentage
Soil type





Variables describing composition, site or management
are helpful to evaluate vulnerability to browsing damage

Age

Development class

Basal area

Stand size

Density



Variables describing composition, site or management
are helpful to evaluate vulnerability to browsing damage

Age

Development class

Basal area

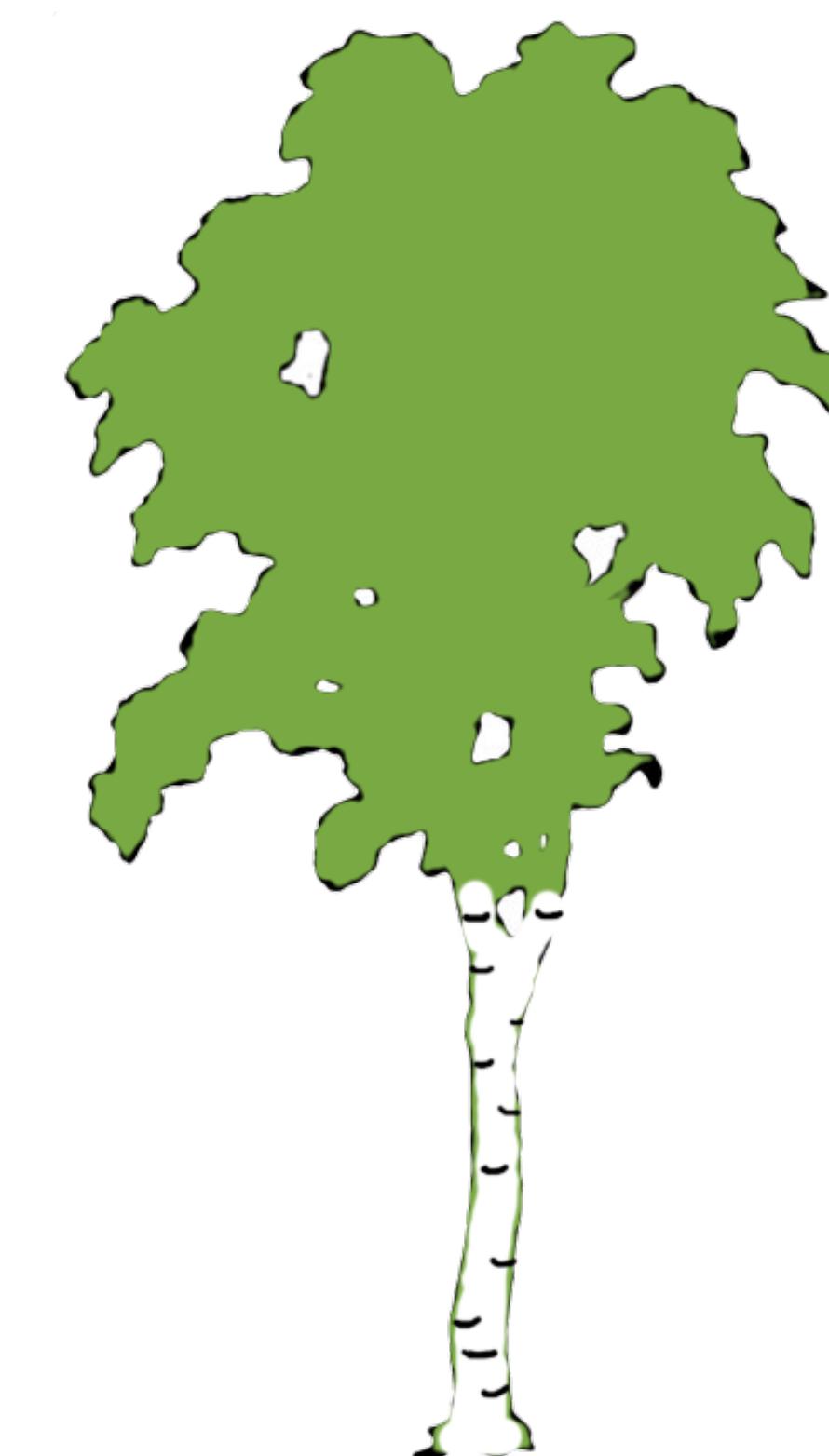
Stand size

Density

Young



Spruce



Birch



Pine



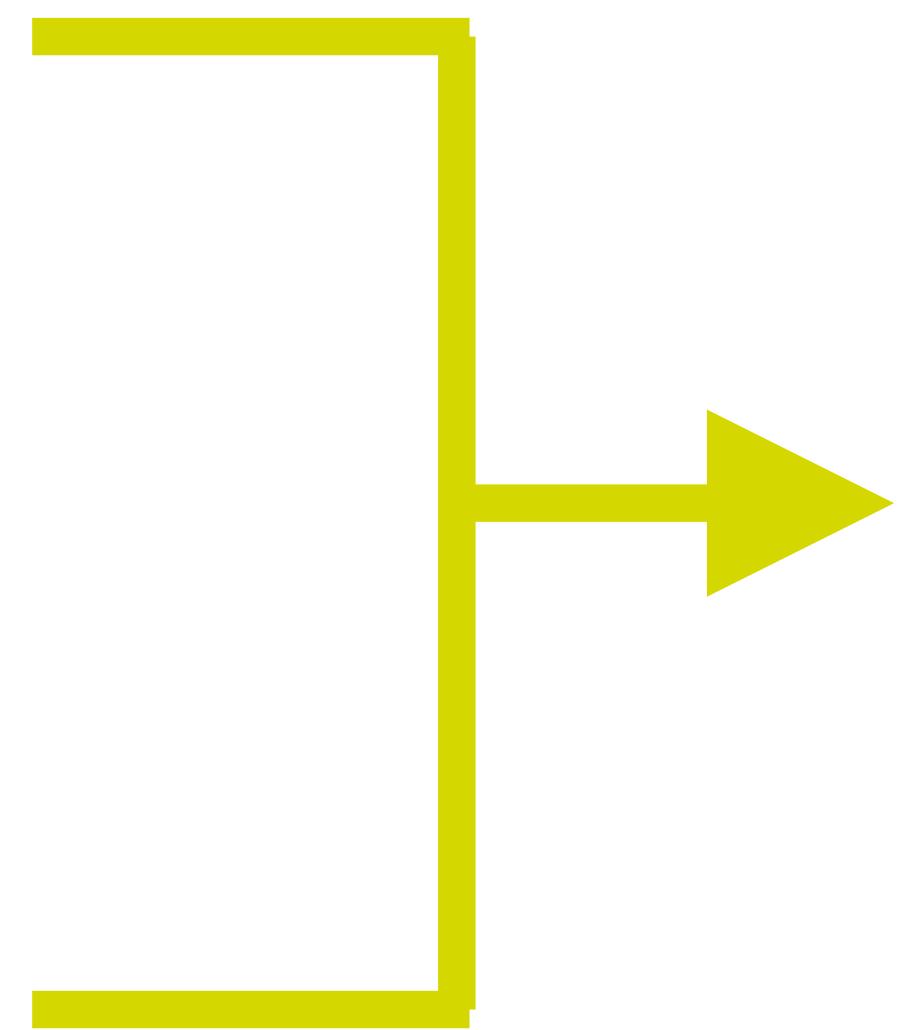
Mixed



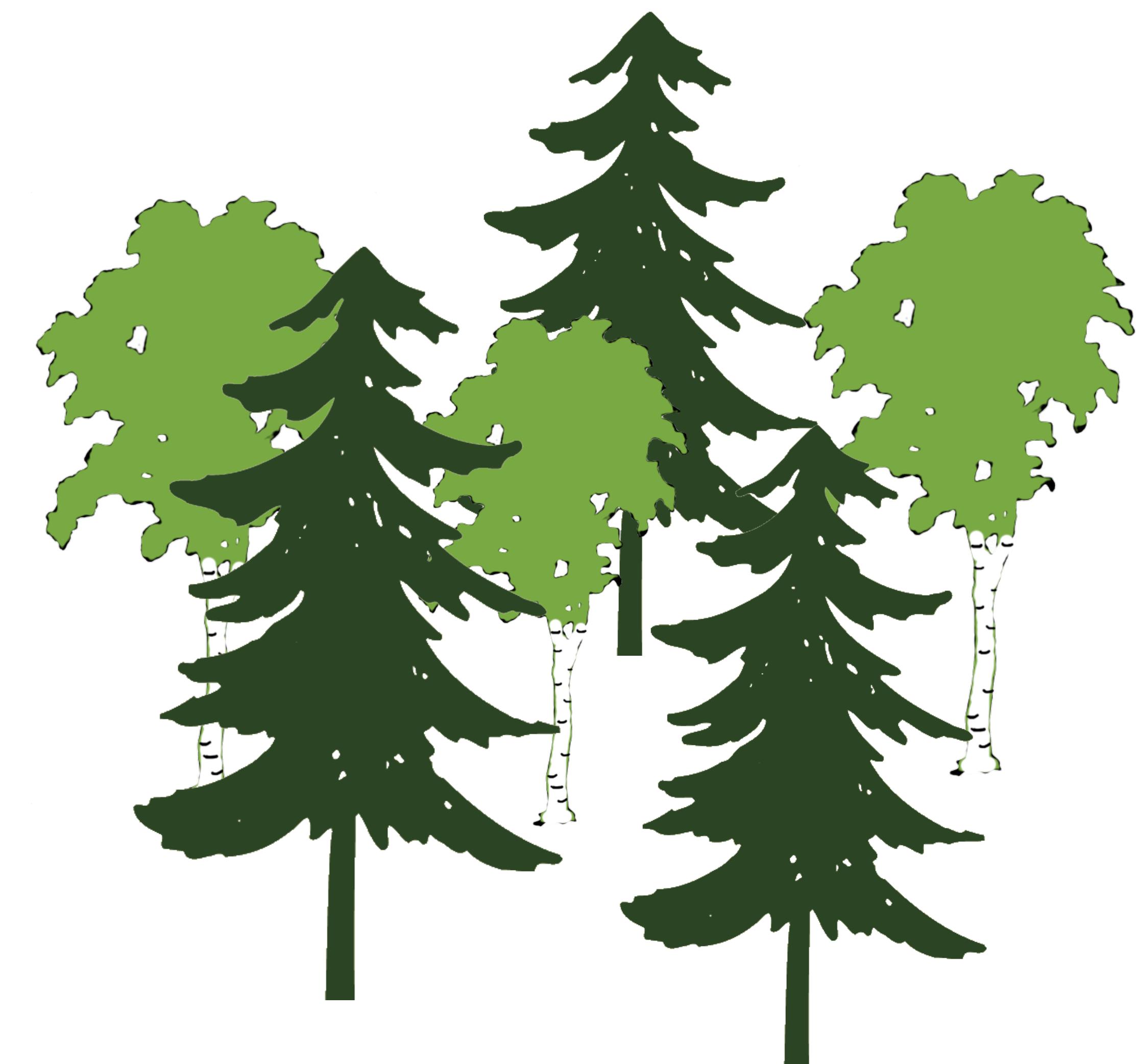
High tree density decreases the probability of browsing damage occurrence



Age
Development class
Basal area
Stand size
Density



High density



Low density



$<1400 \text{ trees ha}^{-1}$



Stand size did not indicate a clear predictive effect

Age

Development class

Large stands

Small stands

Basal area

>1 ha, 1-2 ha, 2-5 ha, >5 ha

<0.2 ha, 0.2-0.5 ha, 0.5-1 ha

Stand size



Density

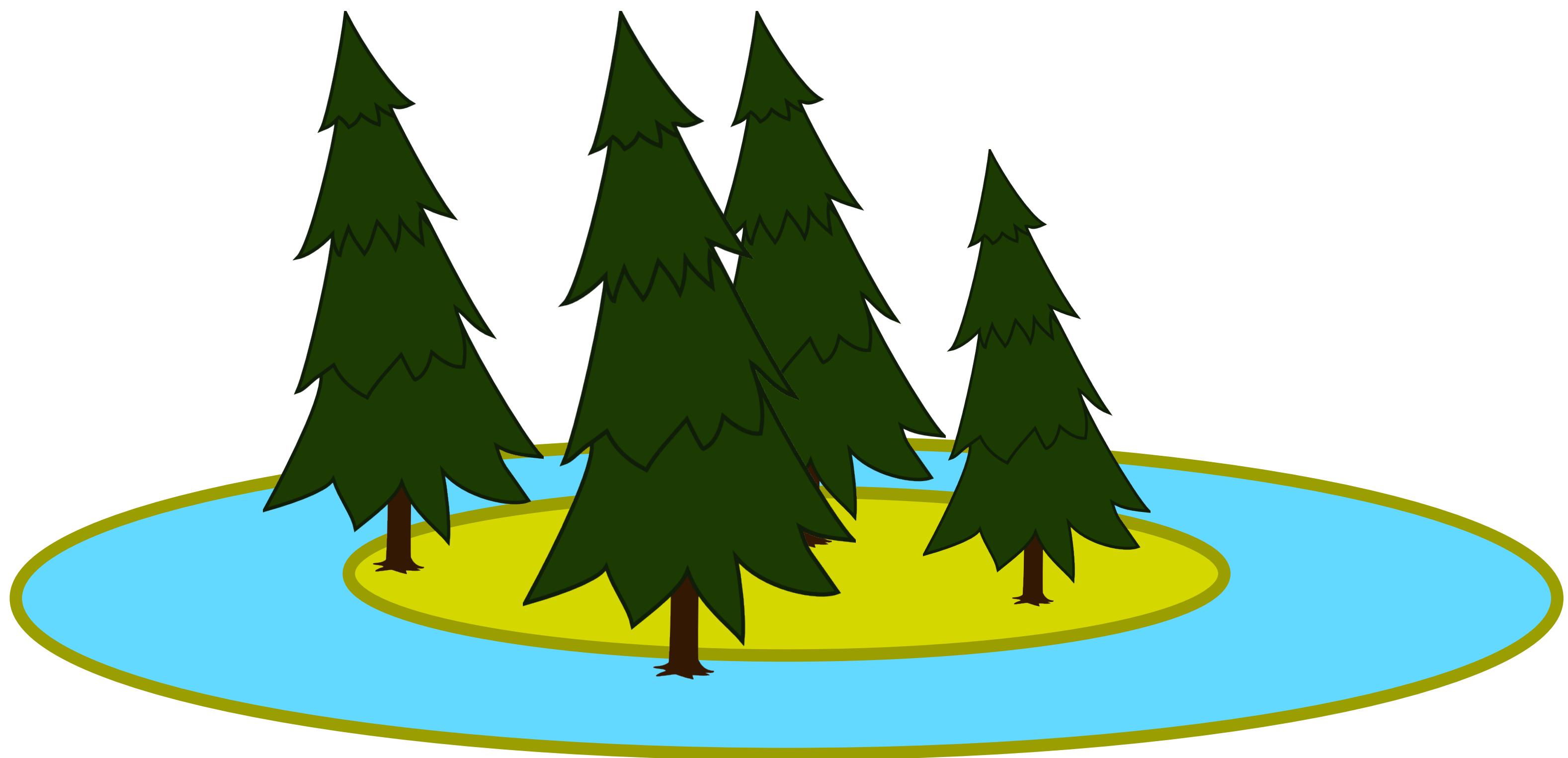




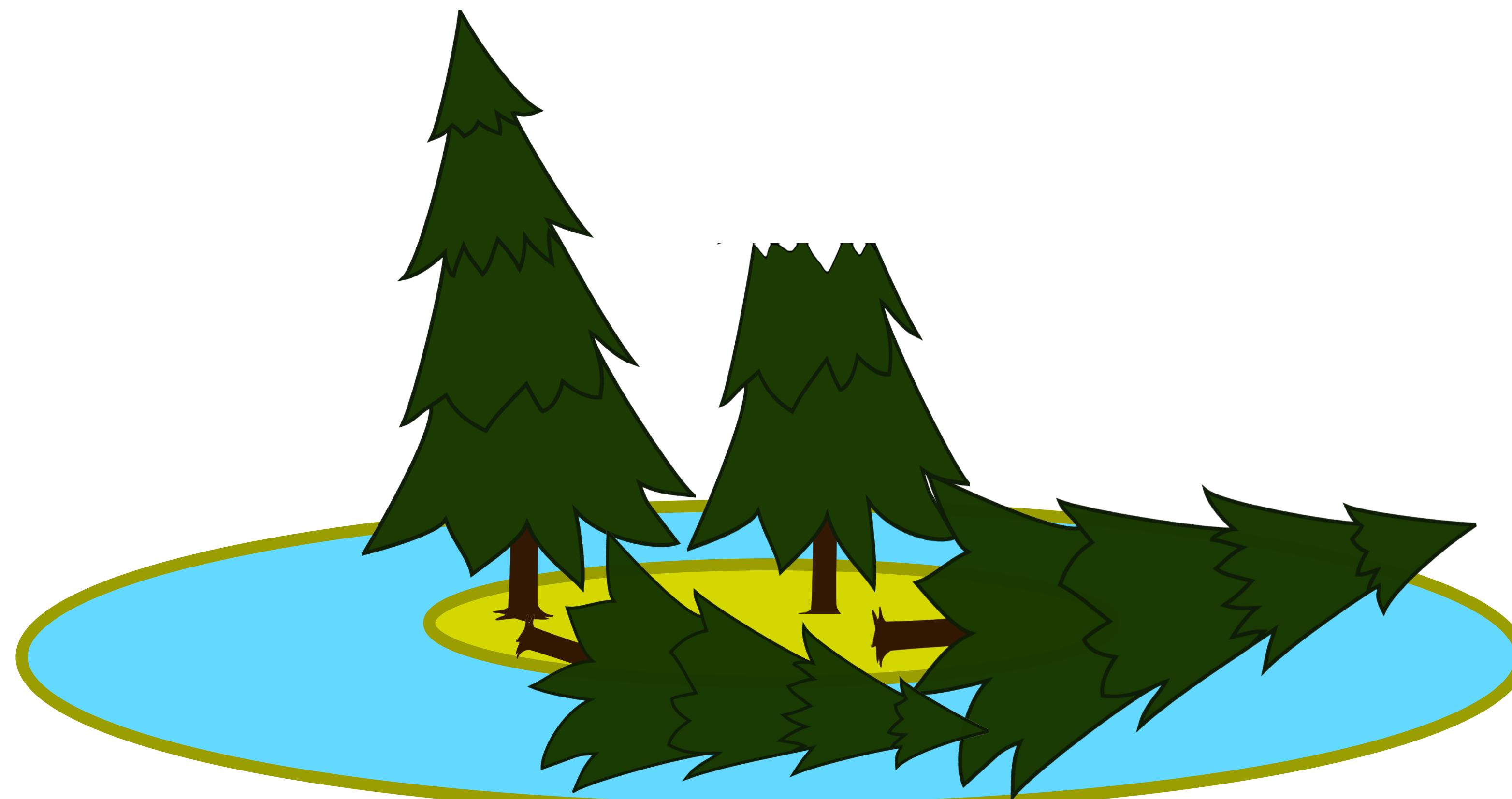


Snow and wind damage occurrence: Methods

No damaged



Damaged





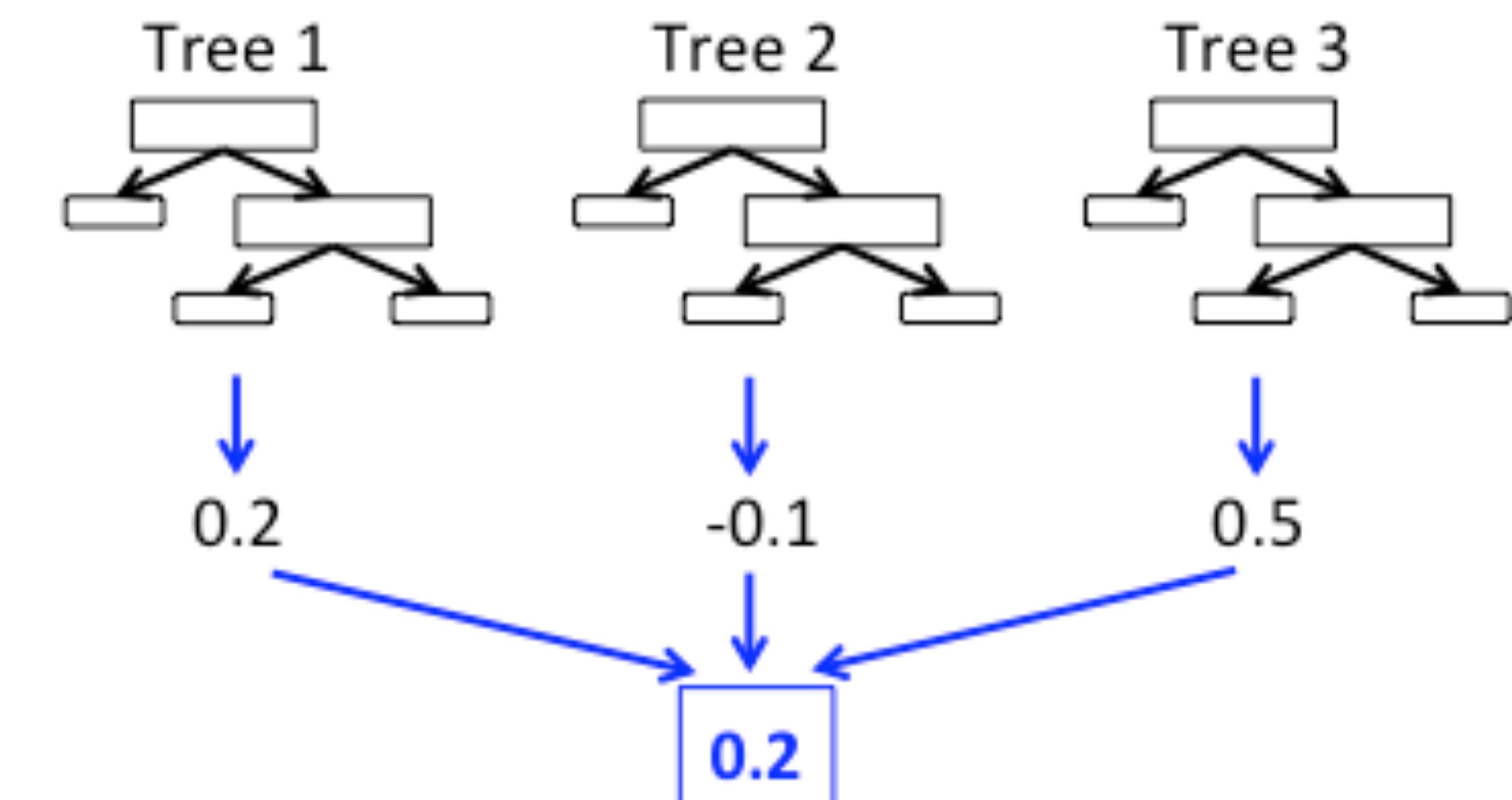
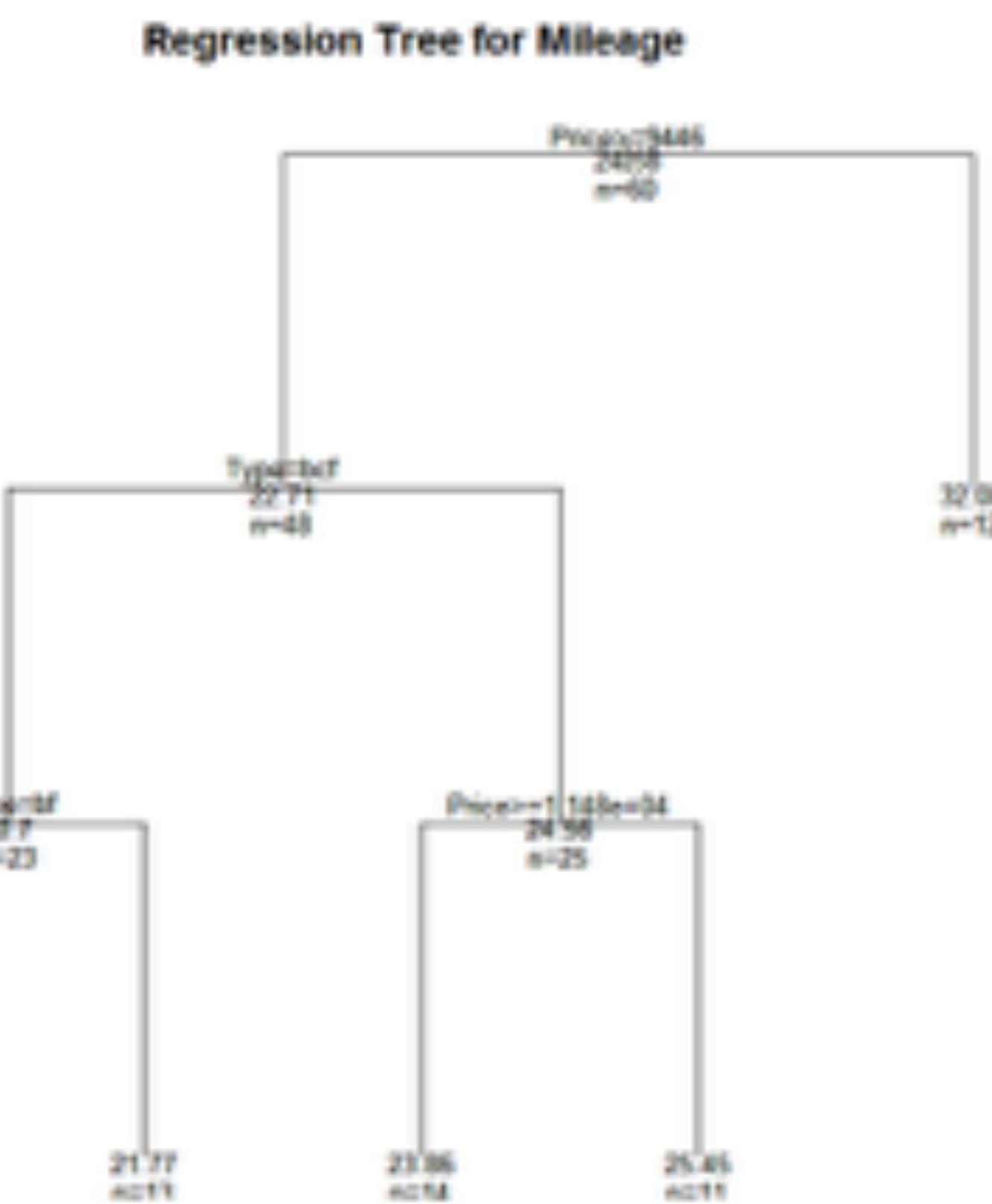
Snow and wind damage occurrence: Methods

Boosted Regression Trees (BRT)

Regression tree

+

Boosting method

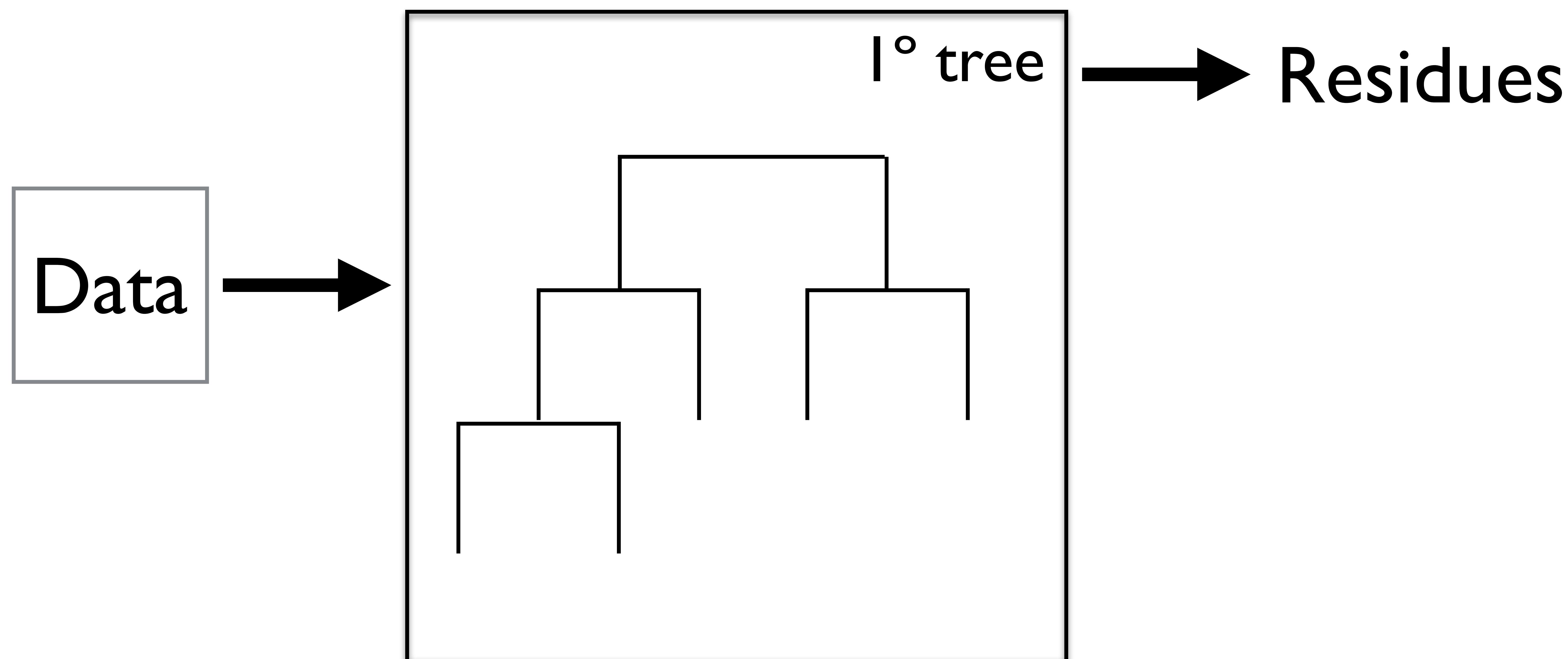




Snow and wind damage occurrence: Methods

Boosted Regression Trees (BRT)

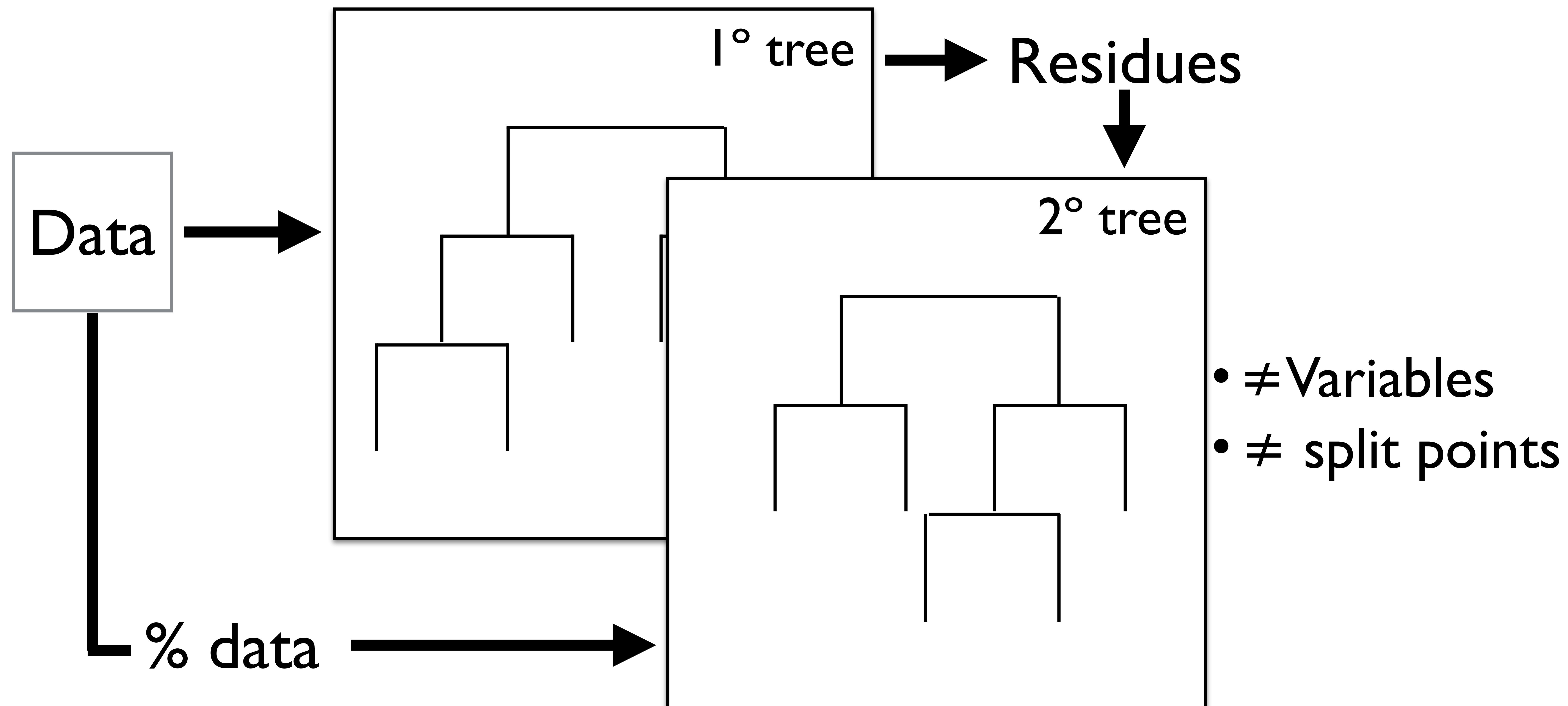
1-The tree that best reduces the loss function





Snow and wind damage occurrence: Methods

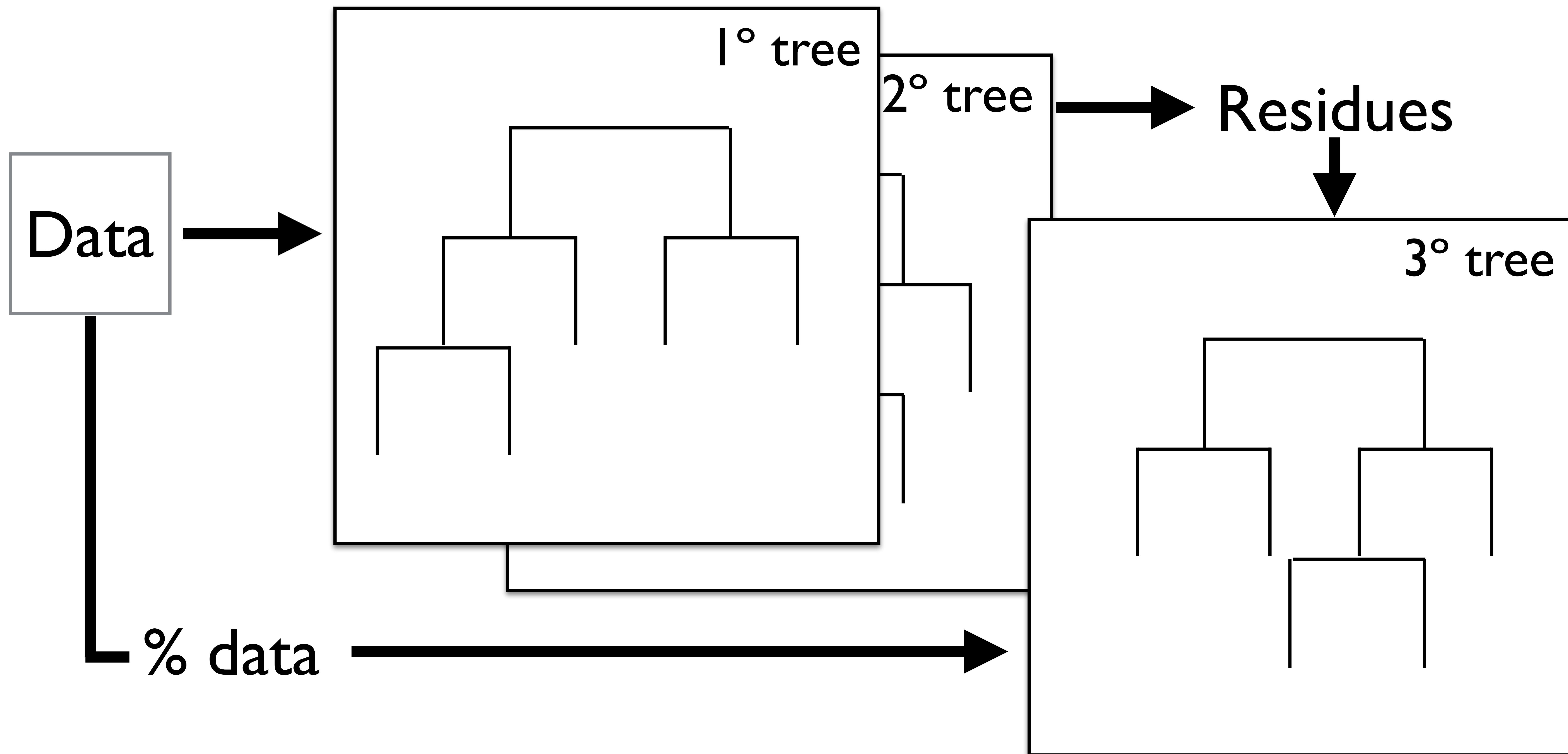
Boosted Regression Trees (BRT)



Snow and wind damage occurrence: Methods



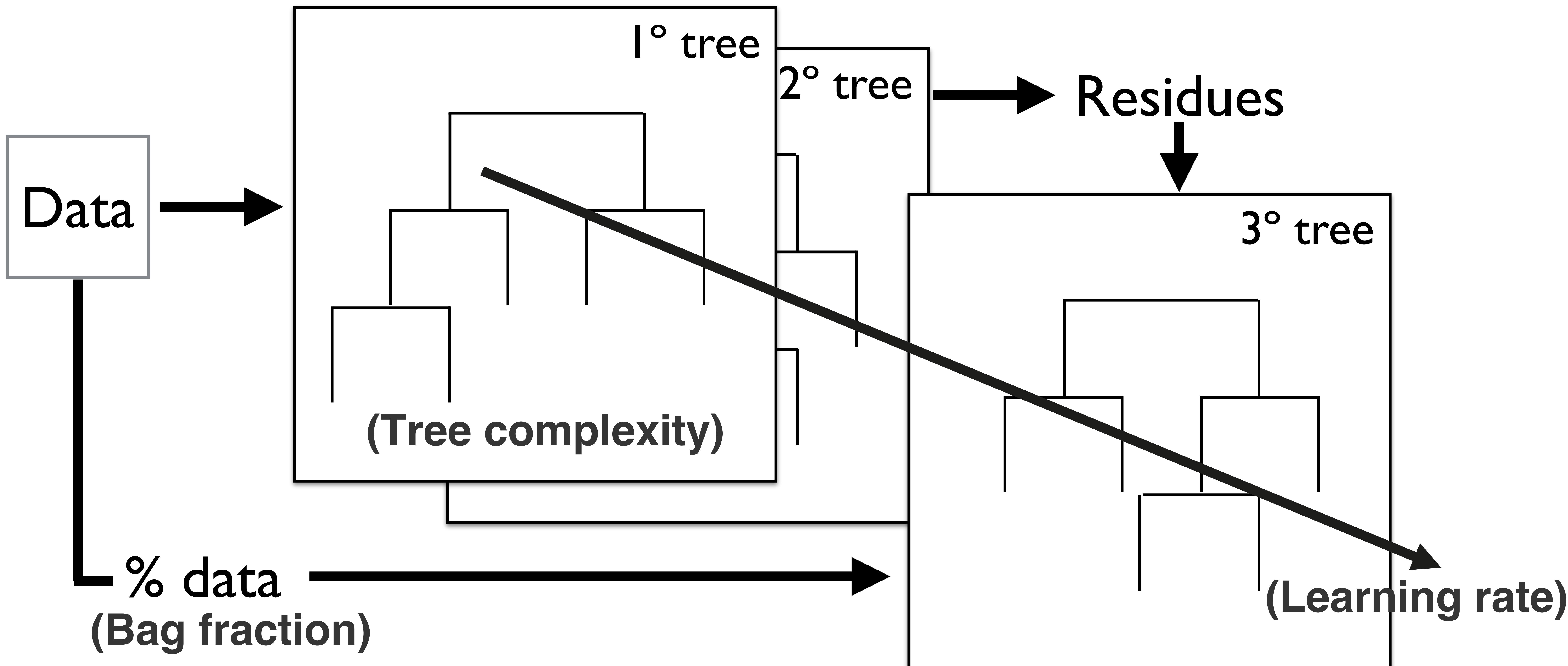
Boosted Regression Trees (BRT)



Snow and wind damage occurrence: Methods



Boosted Regression Trees (BRT)



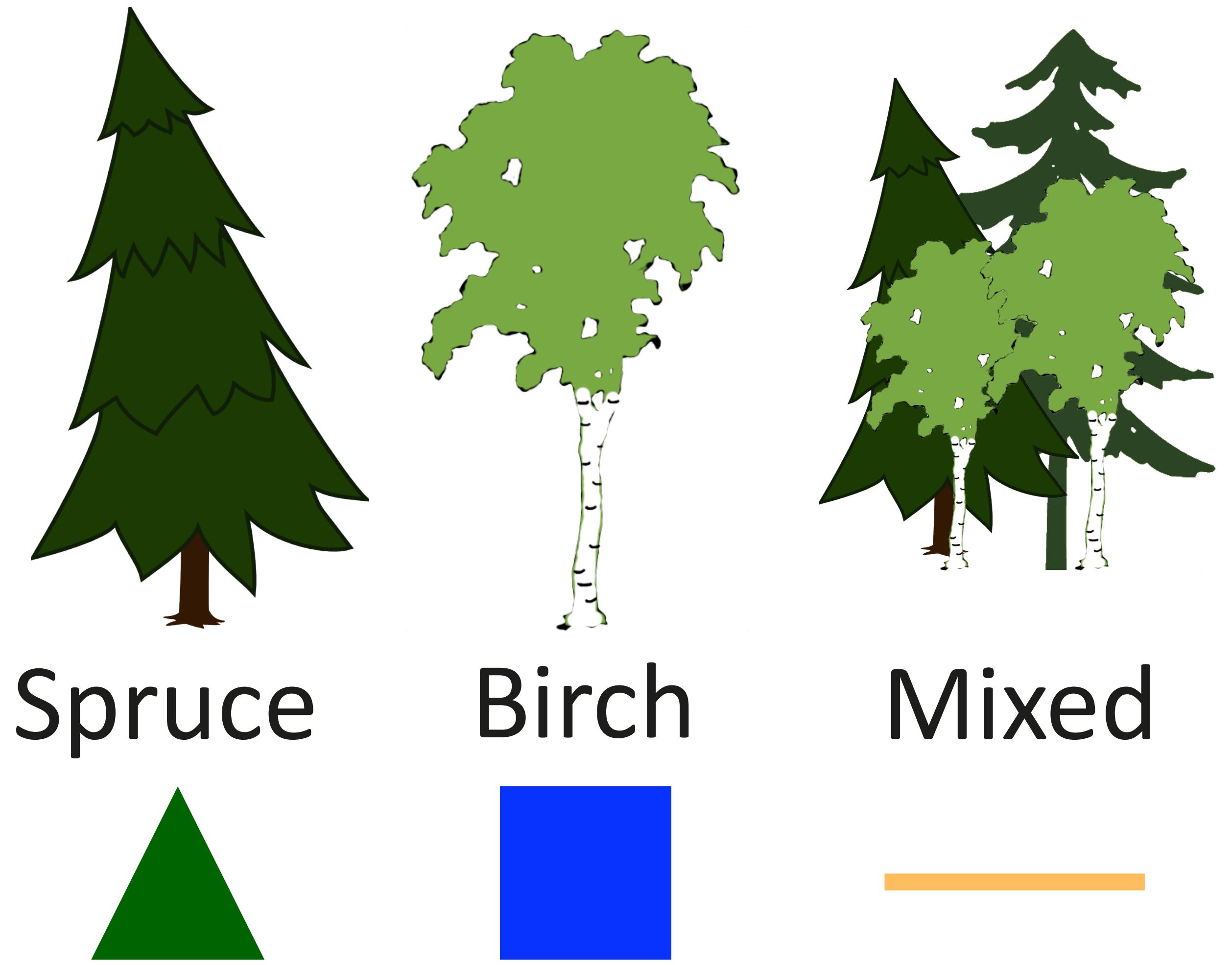


Snow and wind damage occurrence: Methods

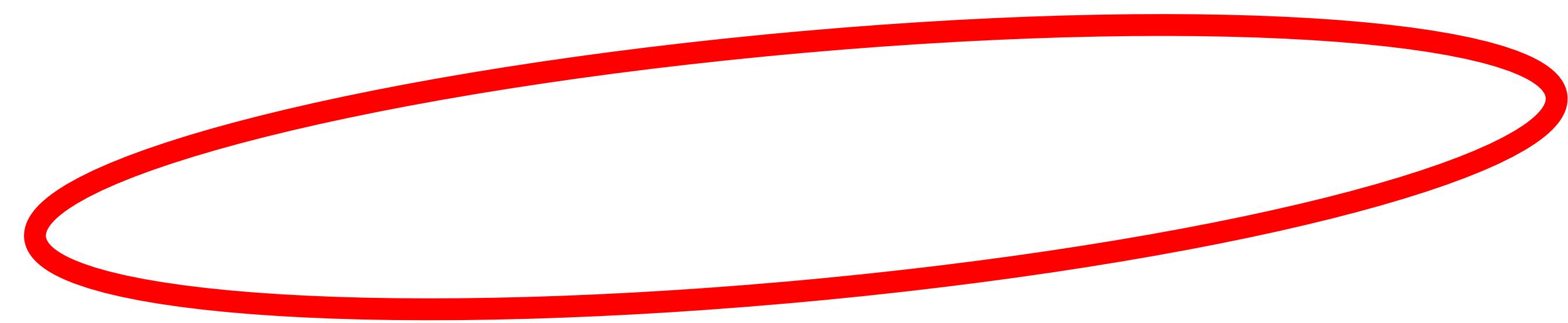
92 models
(750 models)



The main variables associated to damage occurrence
are consistent across all the models

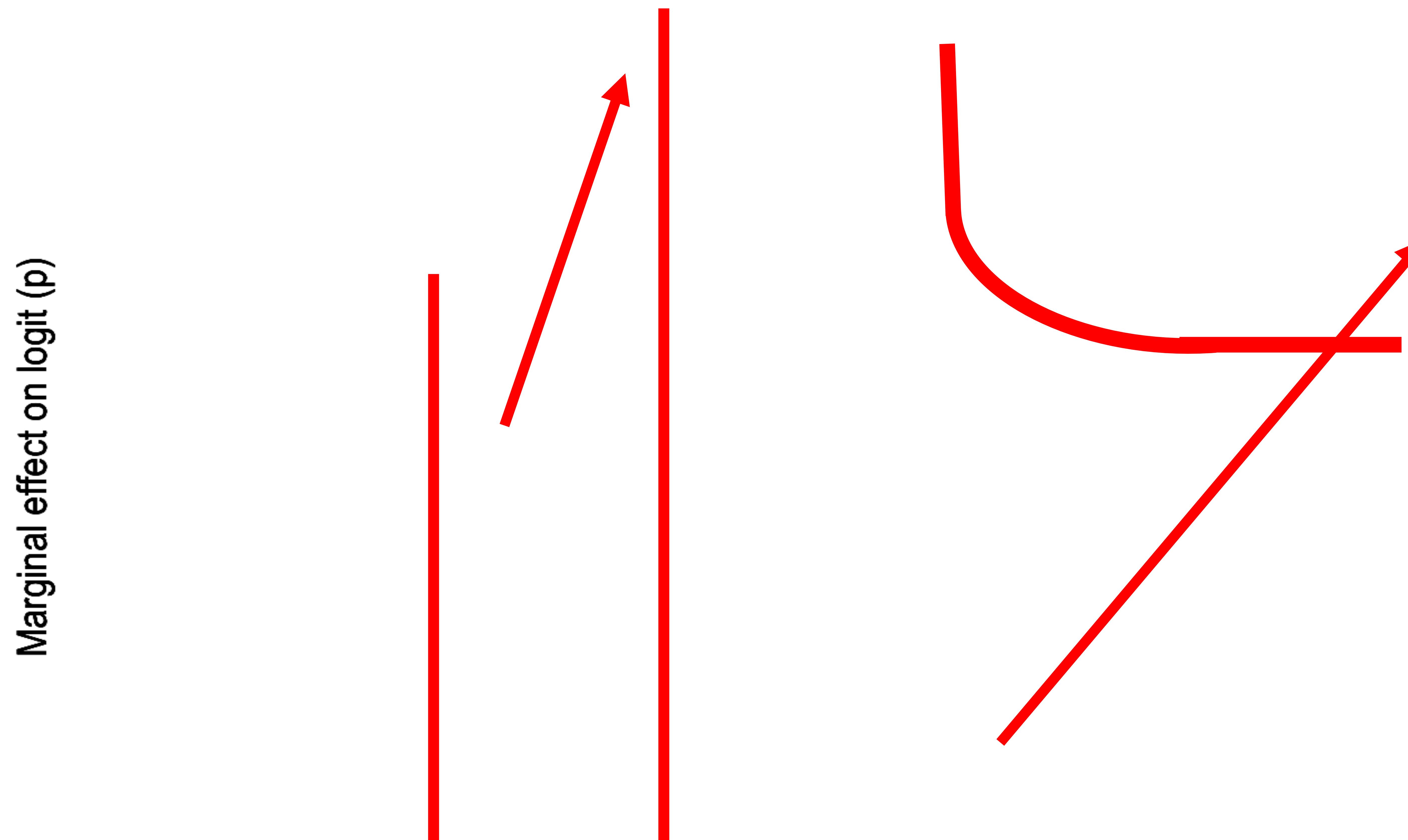


Altitude and latitude did not affect equally all the species



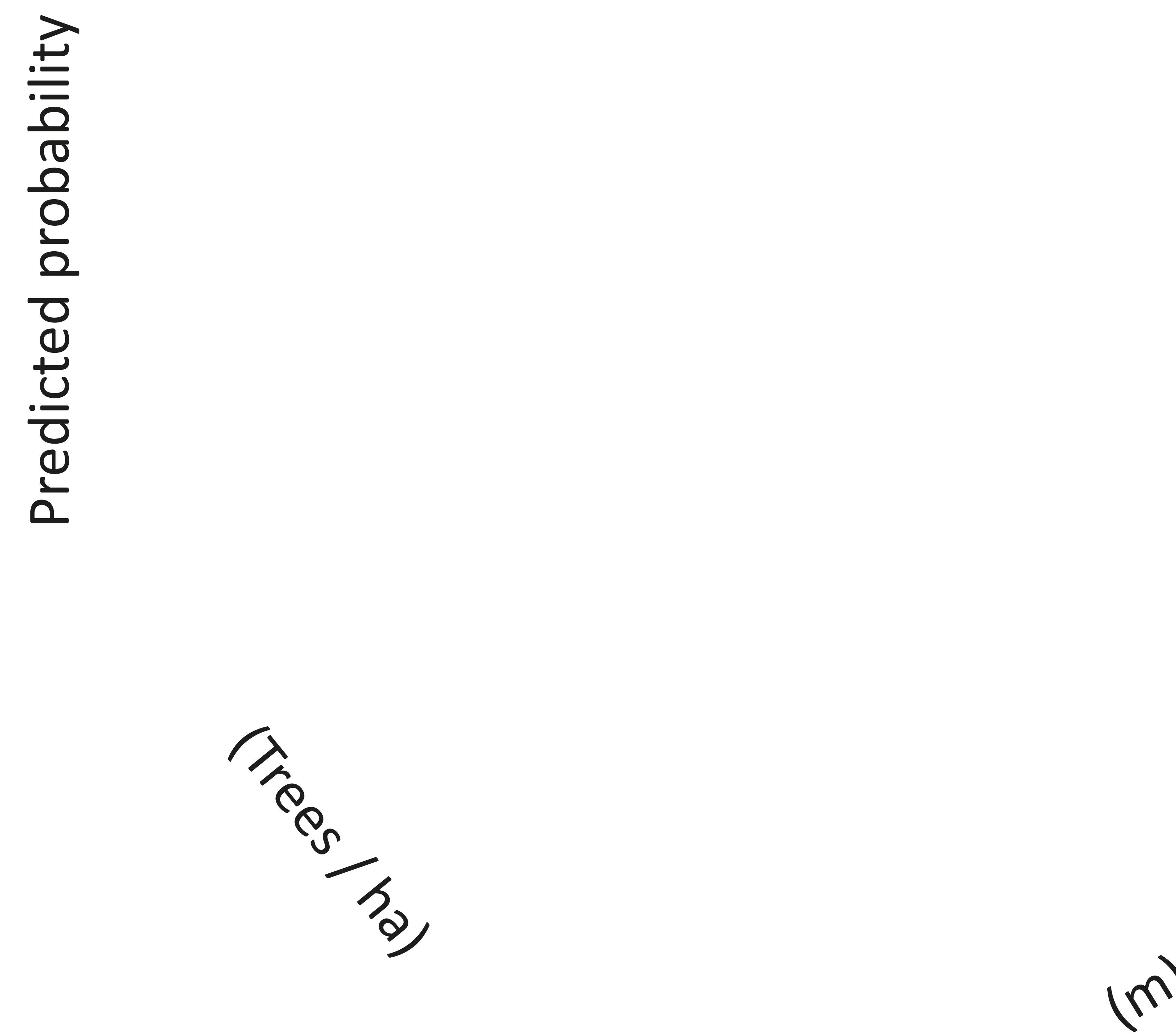


Height and diameter are the most important forest condition variables in all the occurrence models



Height and diameter are the most important forest condition variables in all the occurrence models

Spruce





Increasing slenderness
did not influence the damage occurrence probability

Marginal effect on logit (p)



Increasing the stand structure heterogeneity, above 0.5,
had a negative impact on the damage occurrence probability

Marginal effect on logit (p)

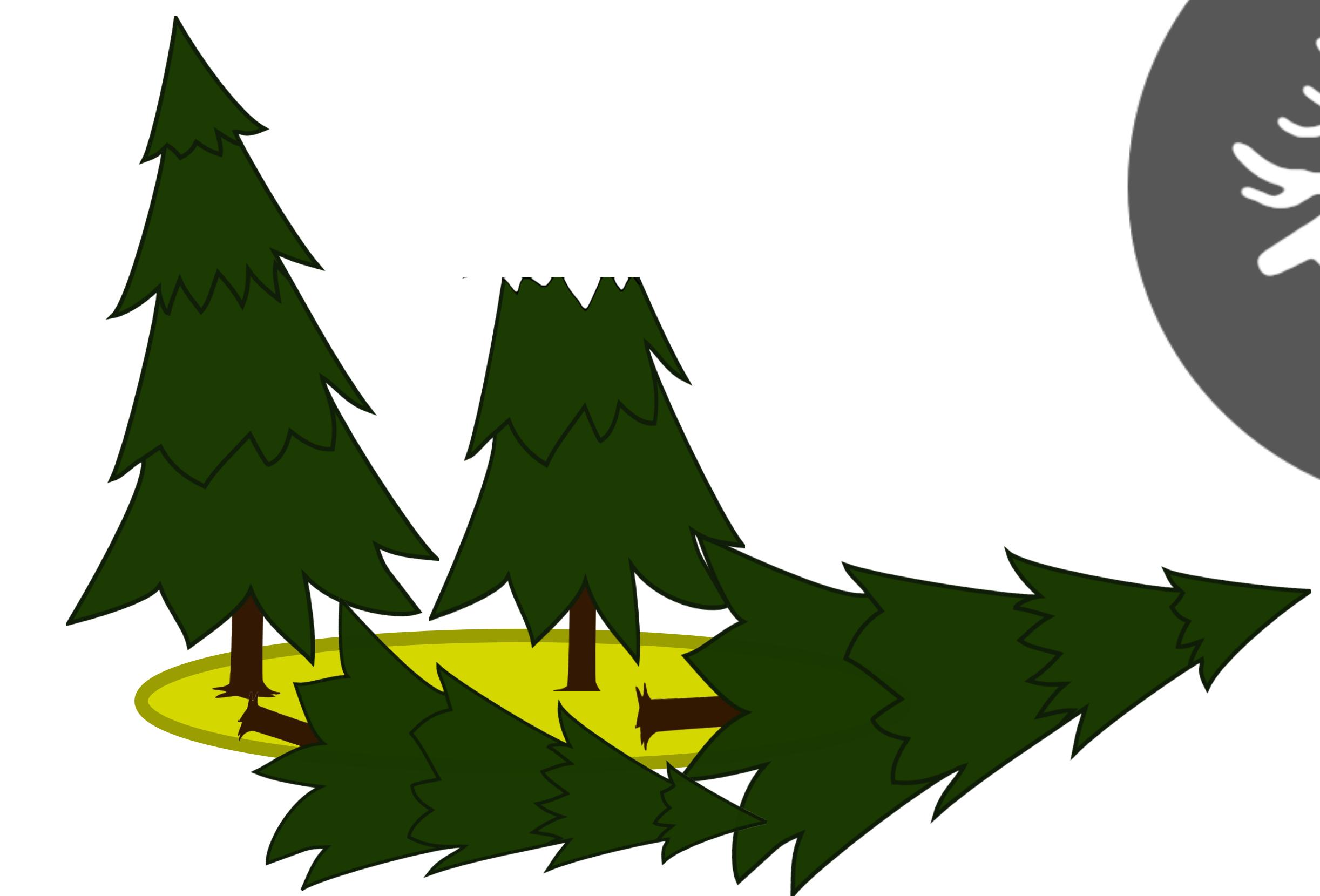


Step 1:

Damage occurrence



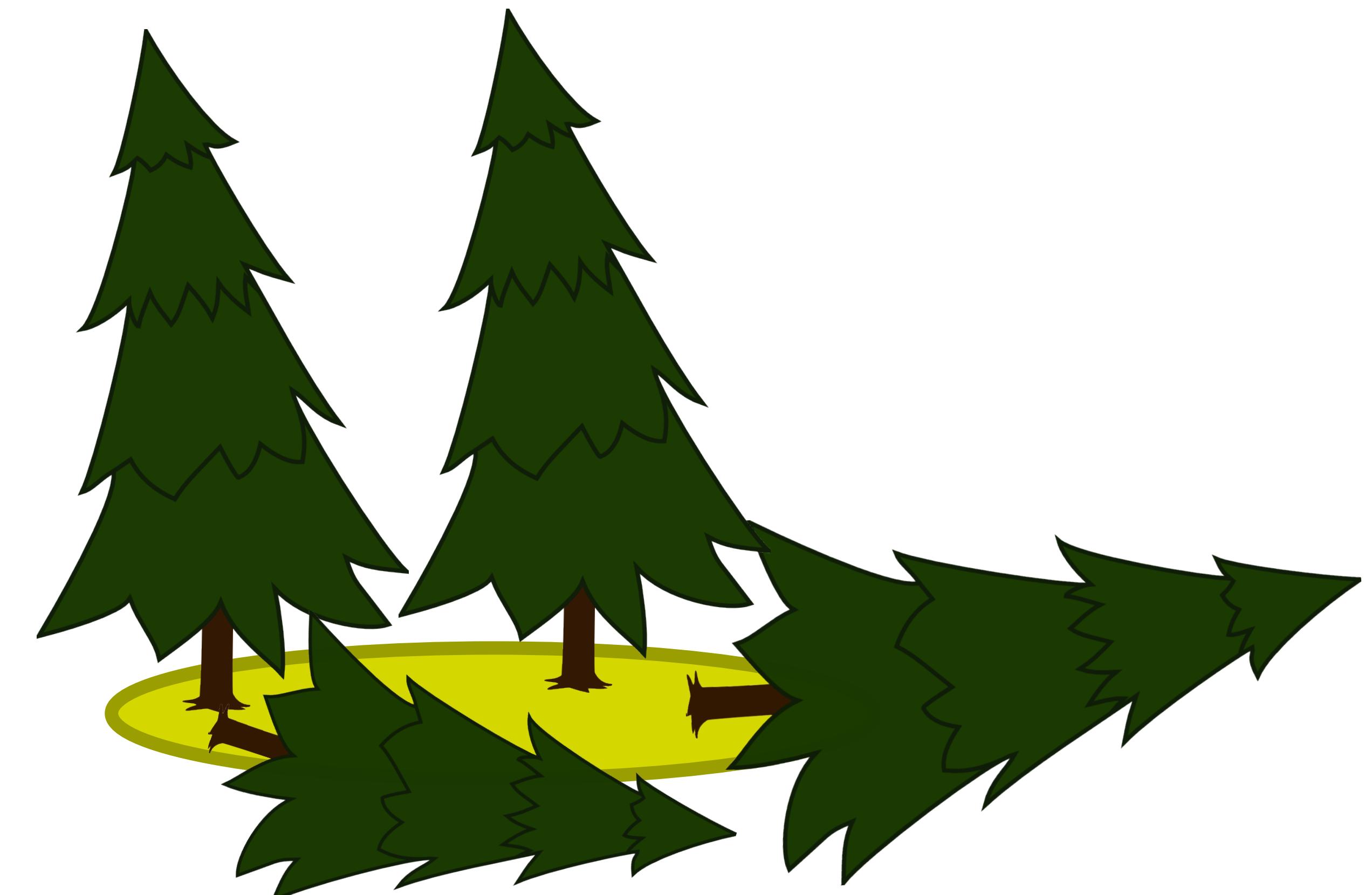
Undamaged



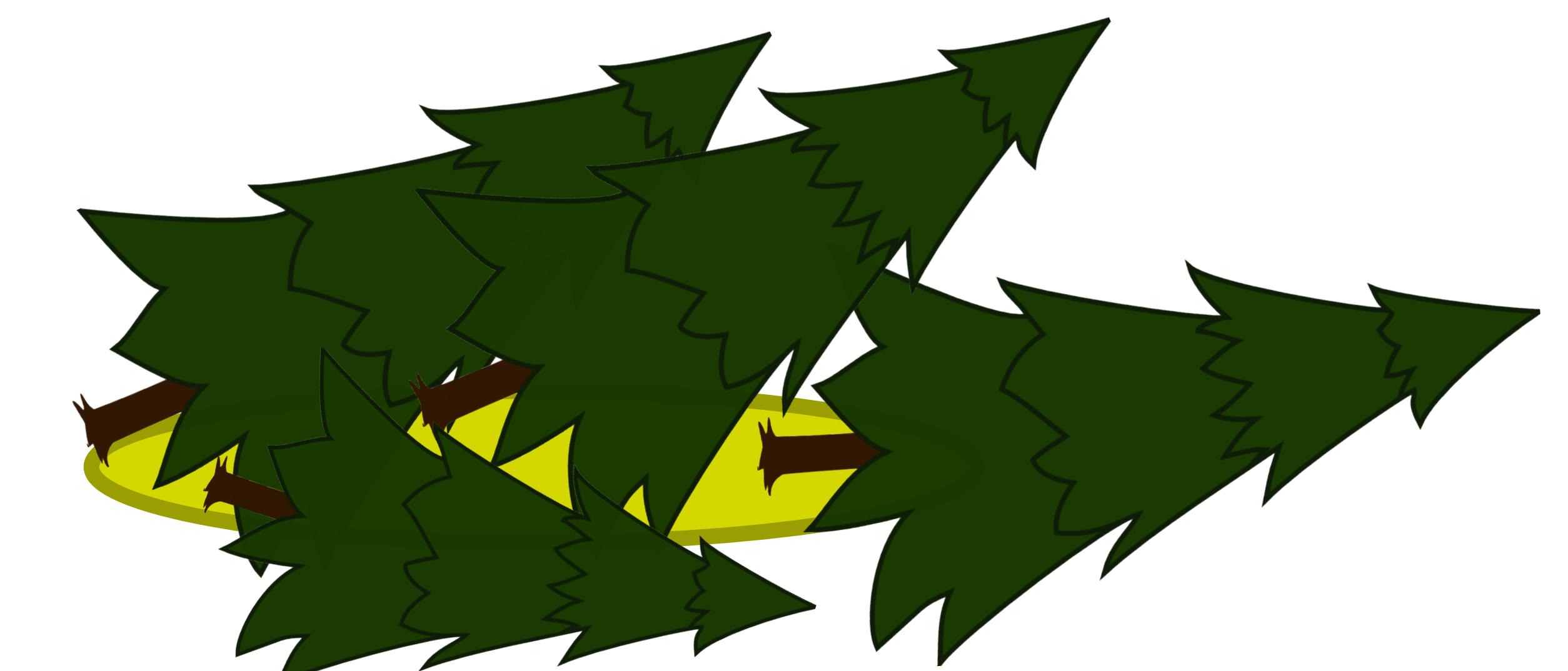
Damaged

Step 2:

Damage level



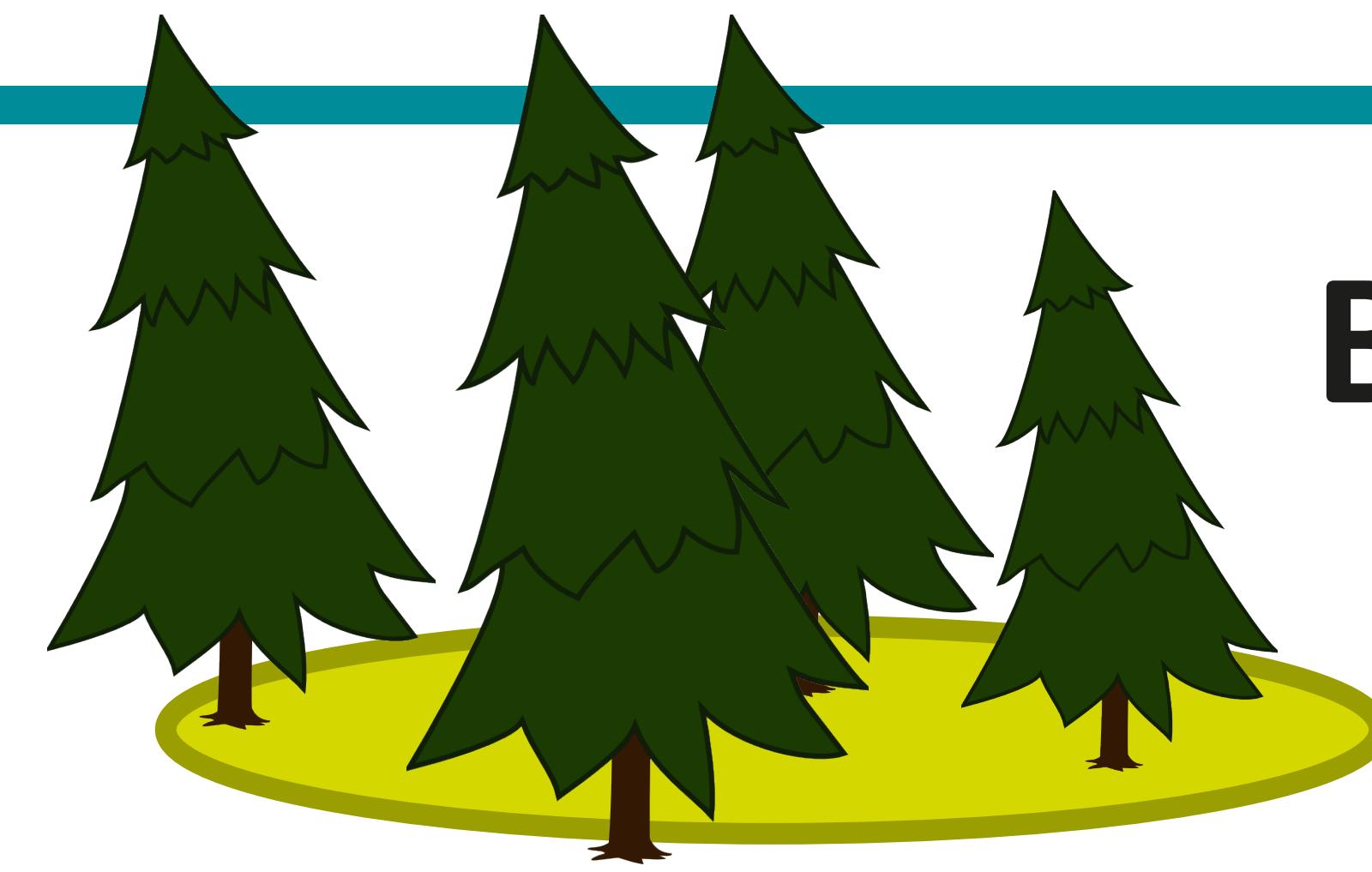
Lower damage level



Higher damage level

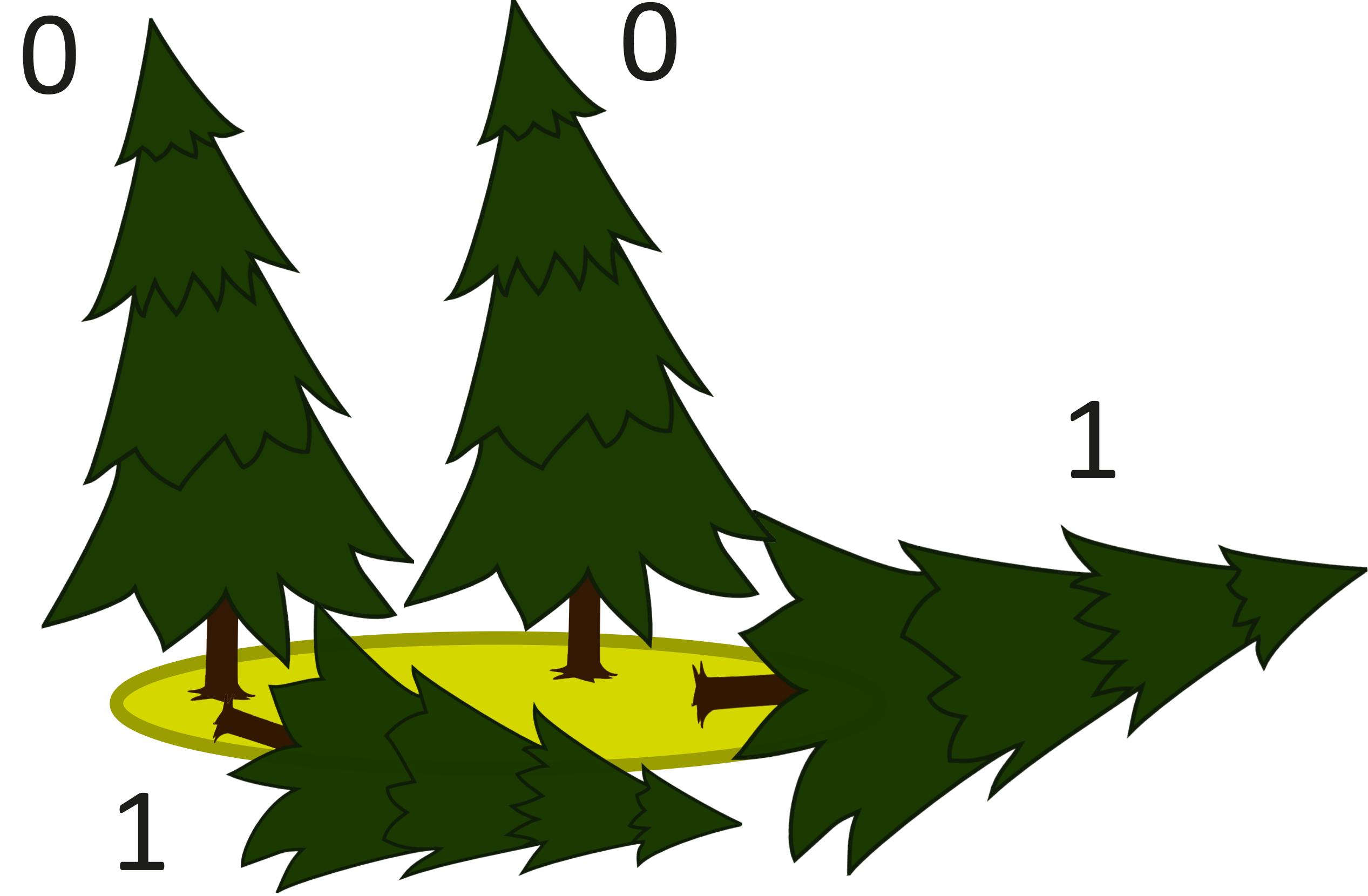


Snow and wind damage: methods

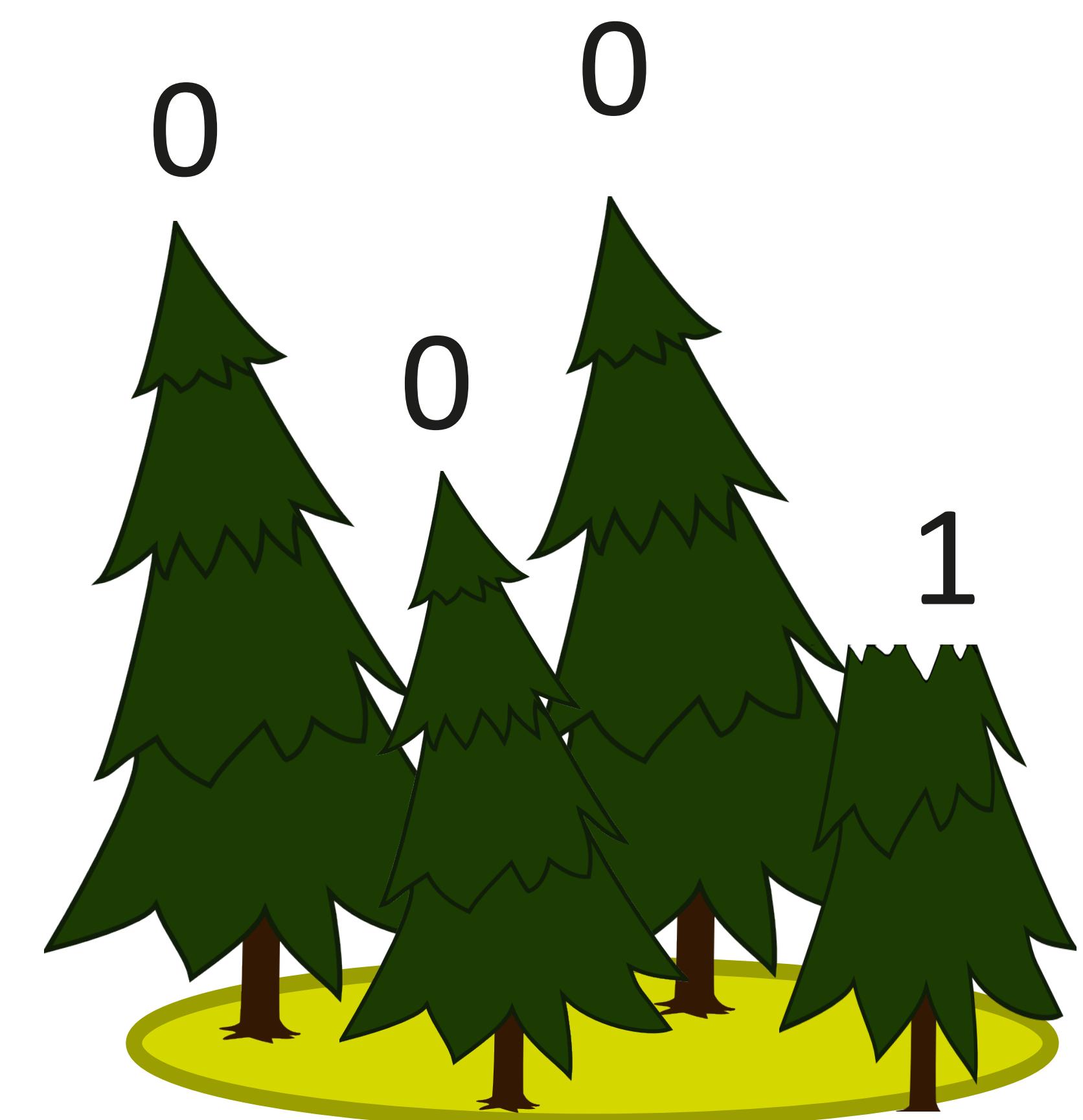


Before damage (reference)

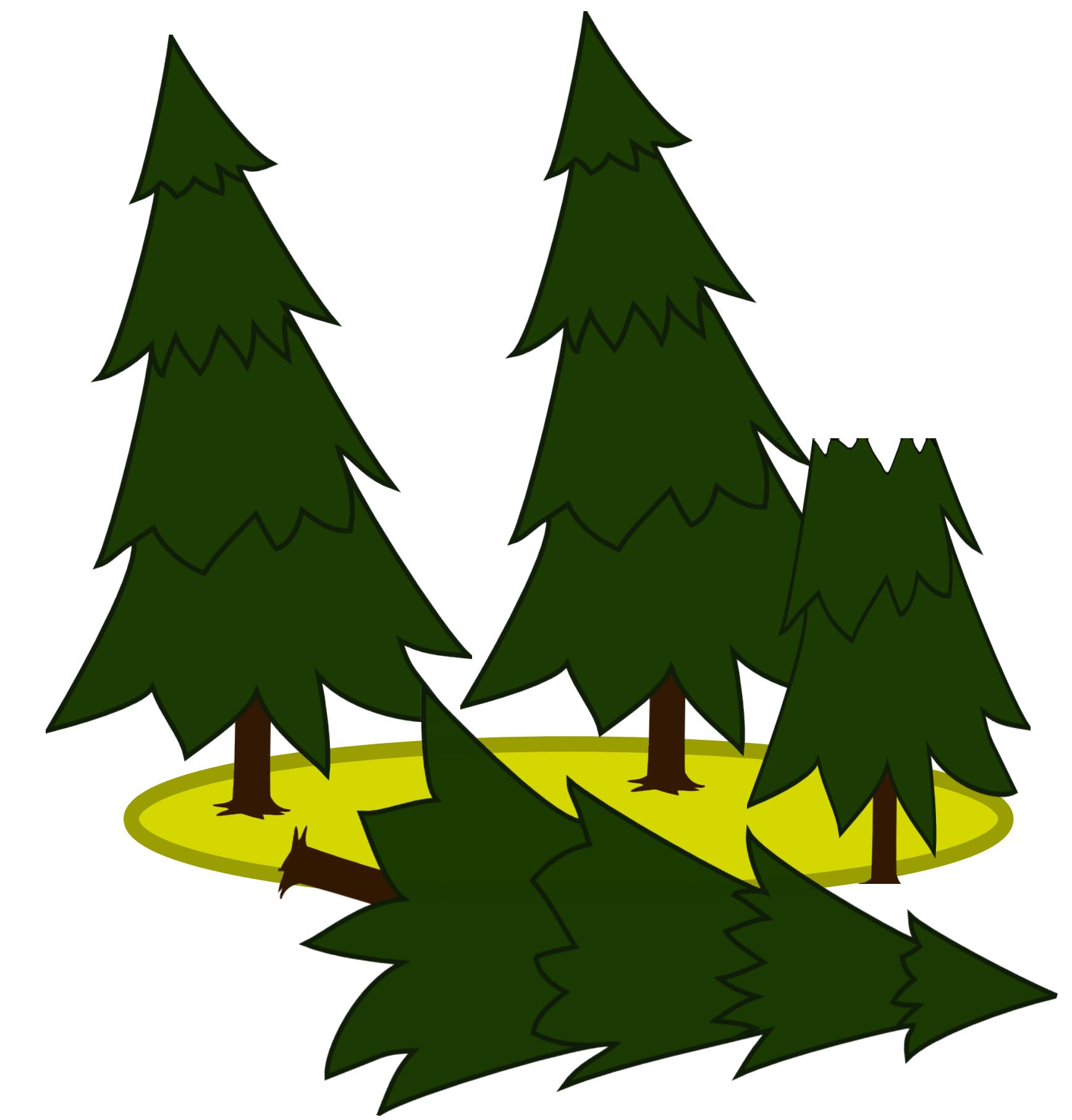
Uprooted trees



Broken trees

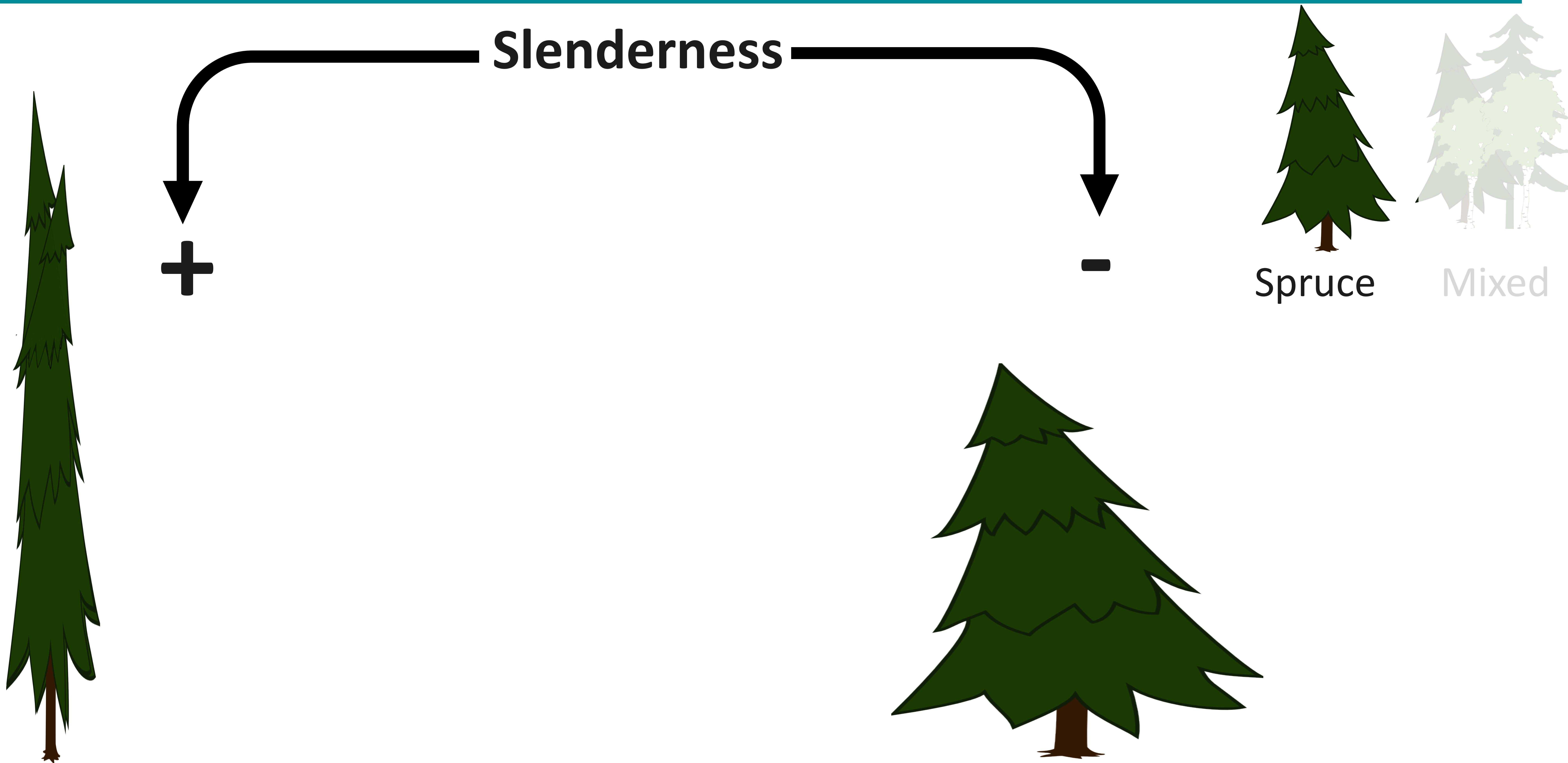


Broken / Uprooted trees

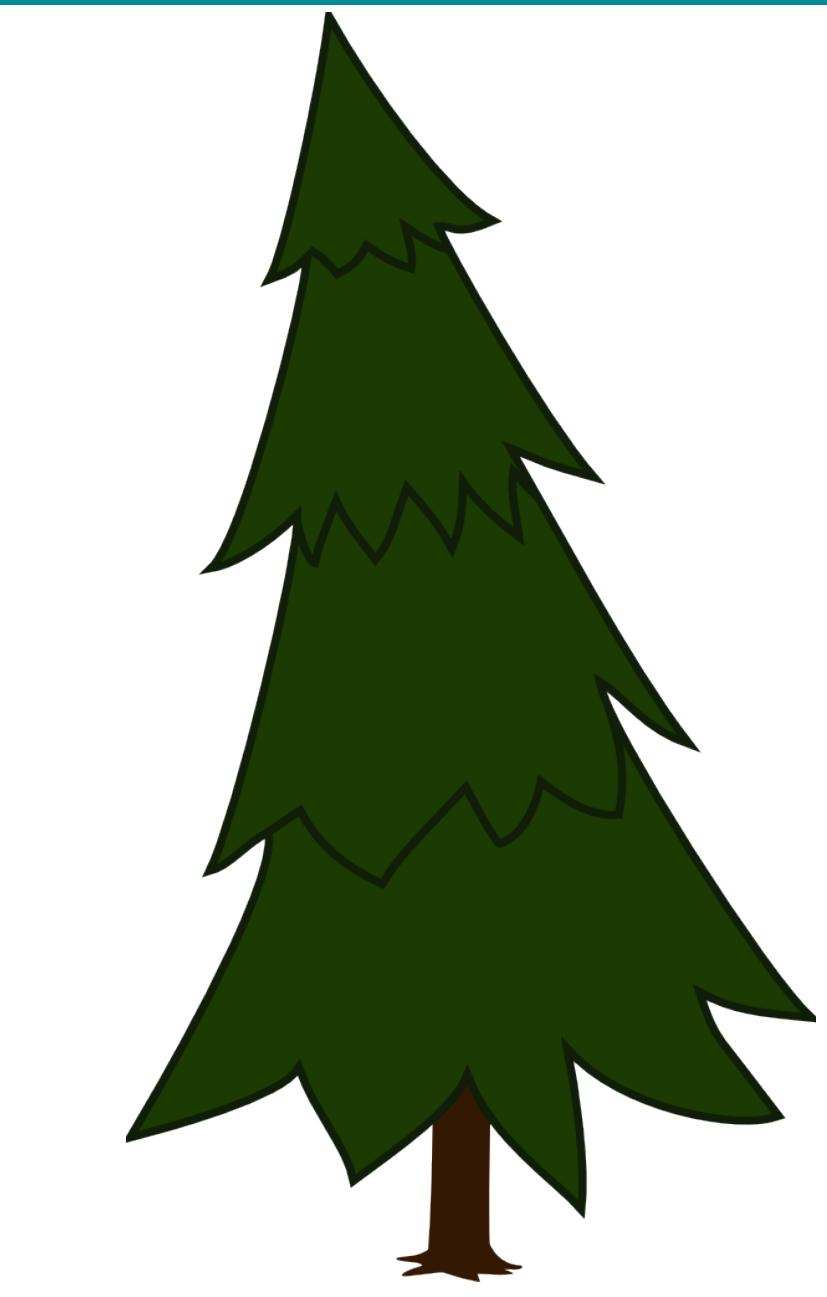
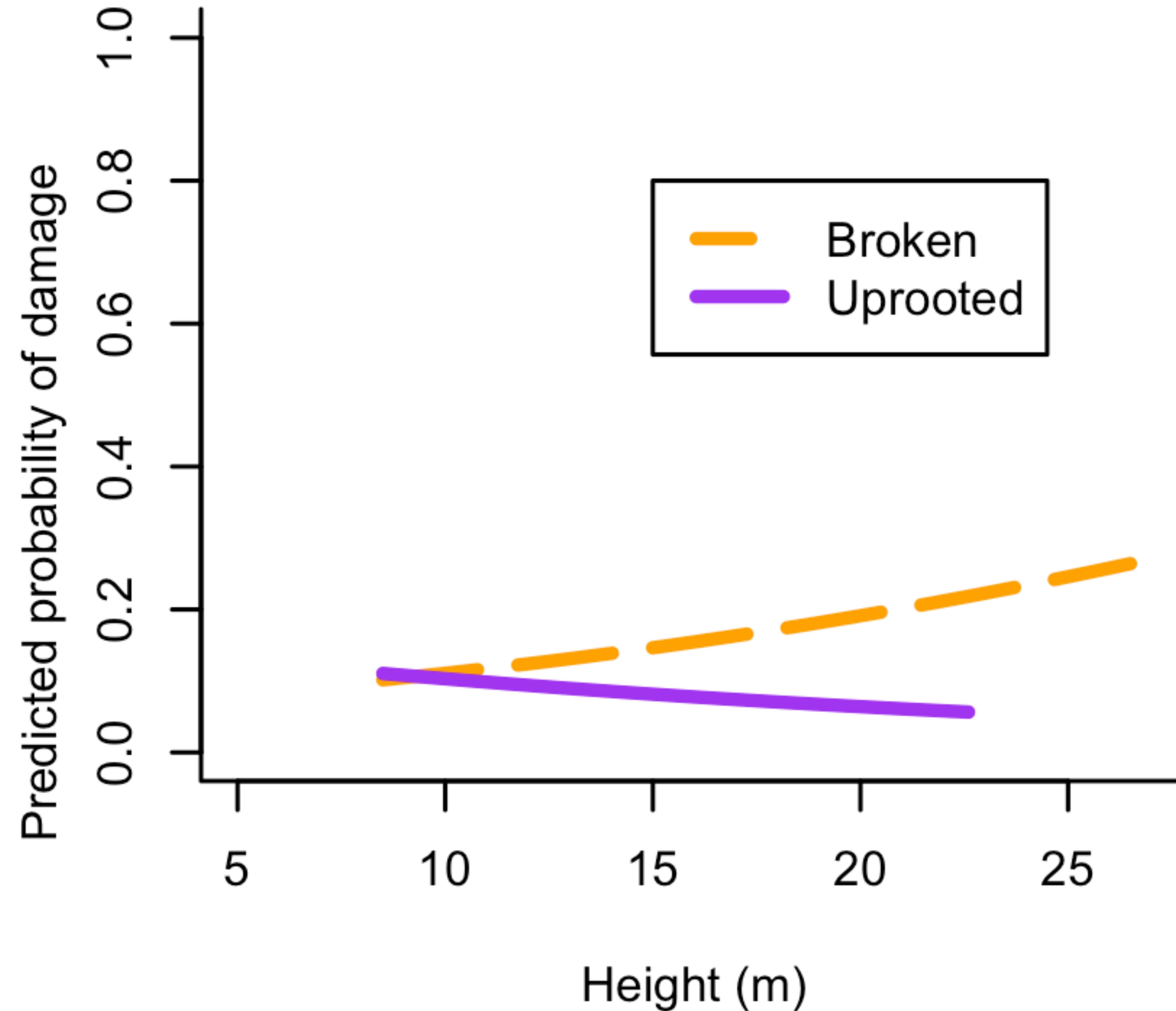




Slender trees are more prone to break than uproot



Increasing height is associated with increasing probability for a tree to be broken

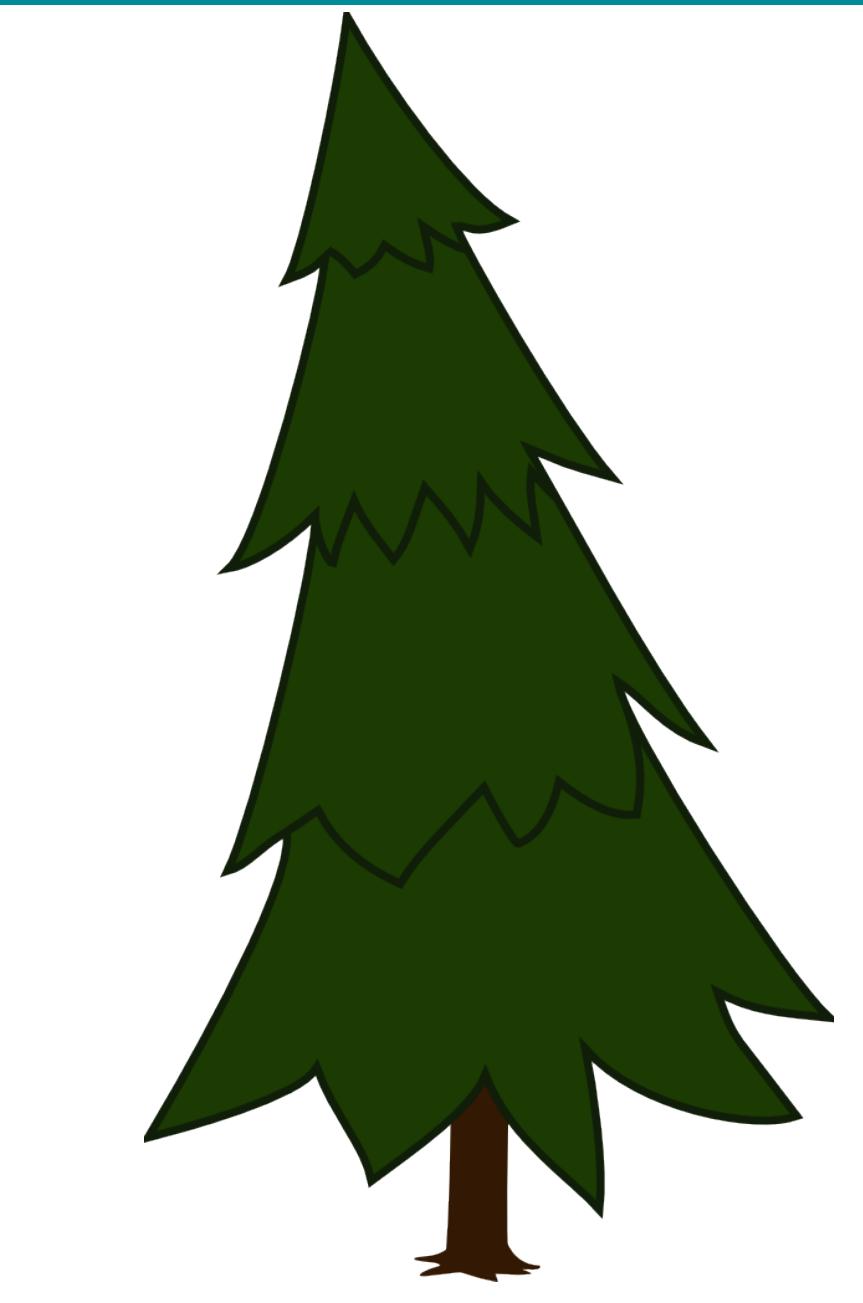
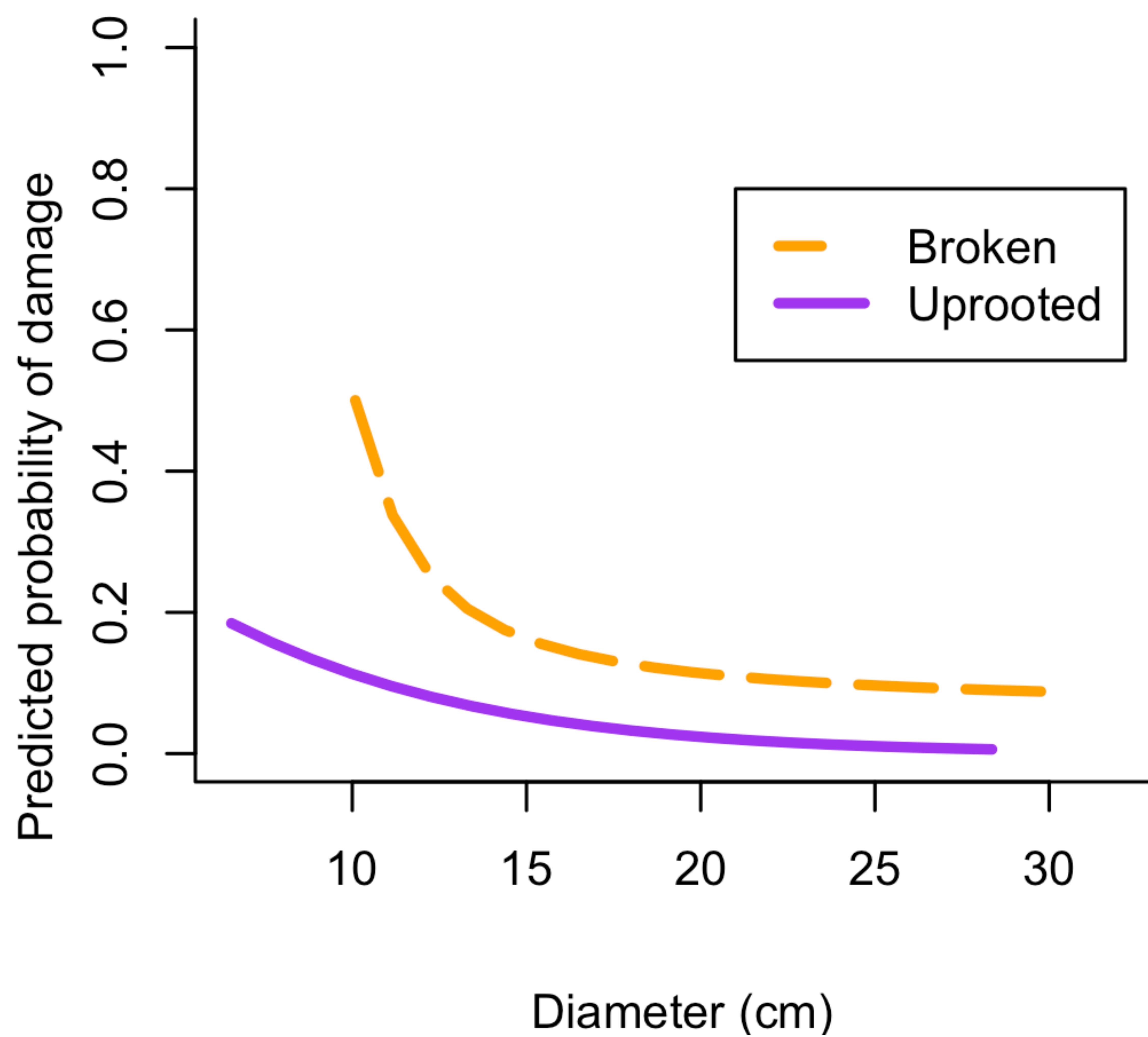


Spruce



Mixed

Increasing diameter is related with decreasing damage



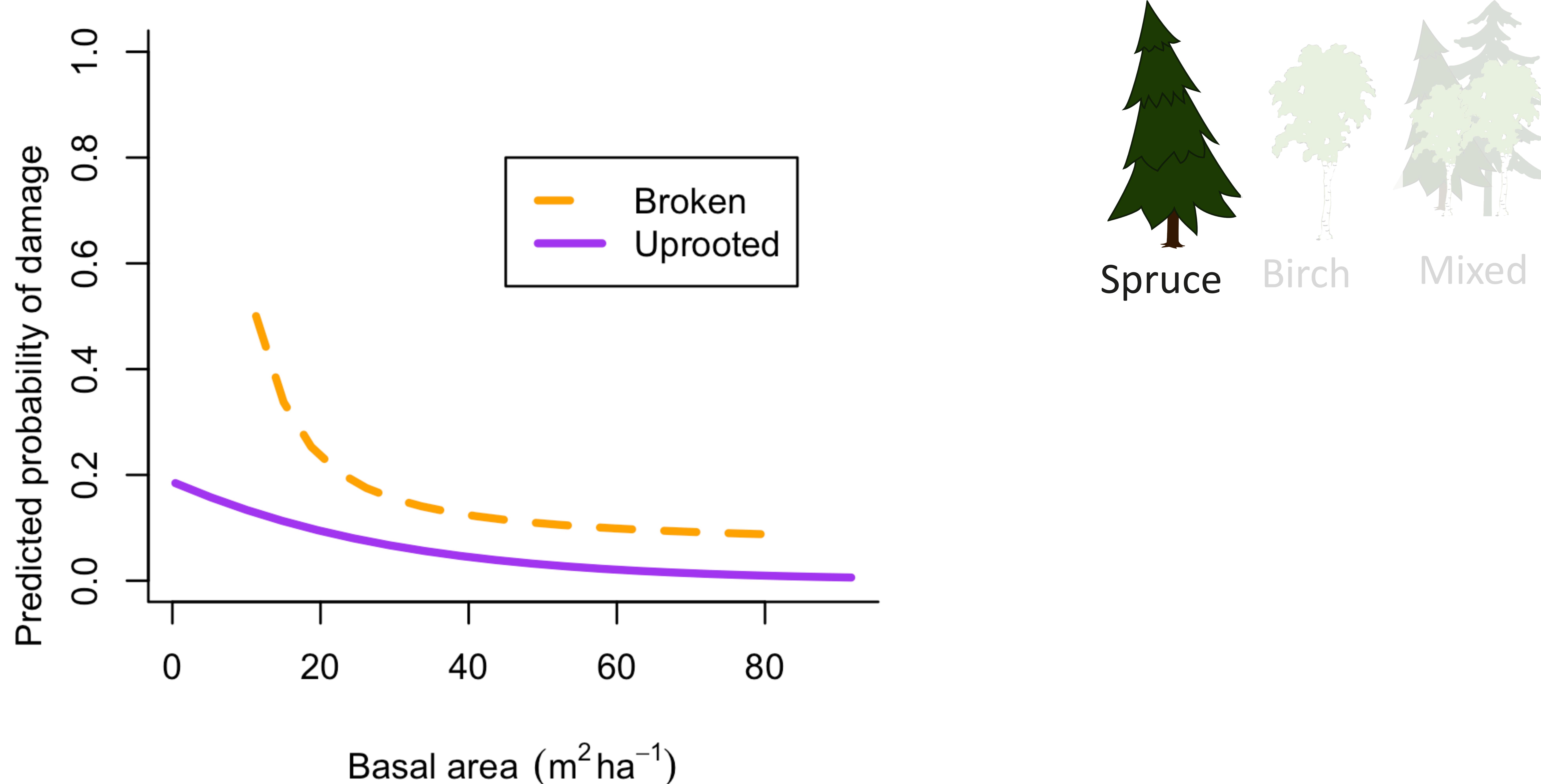
Spruce

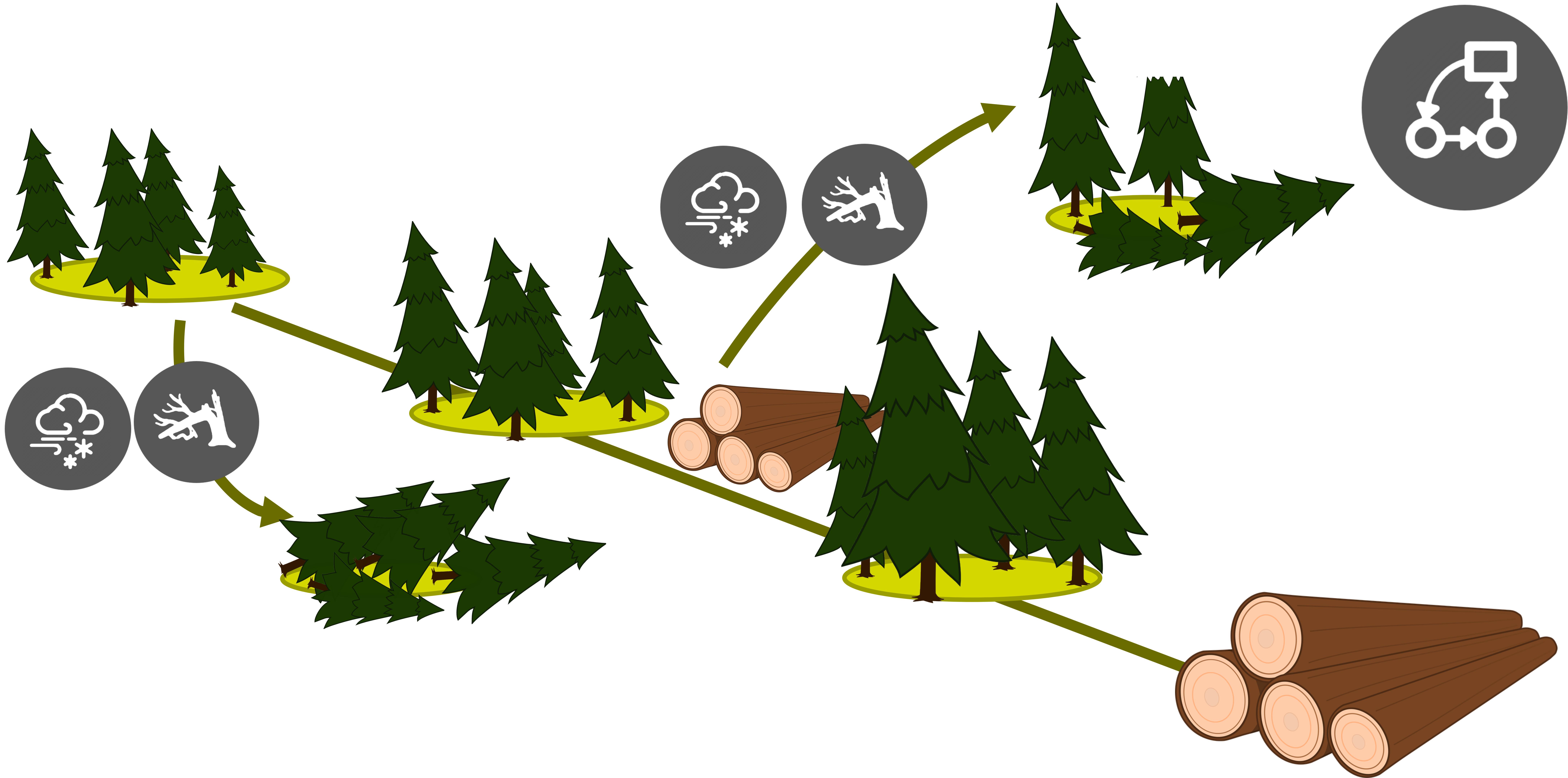


Mixed

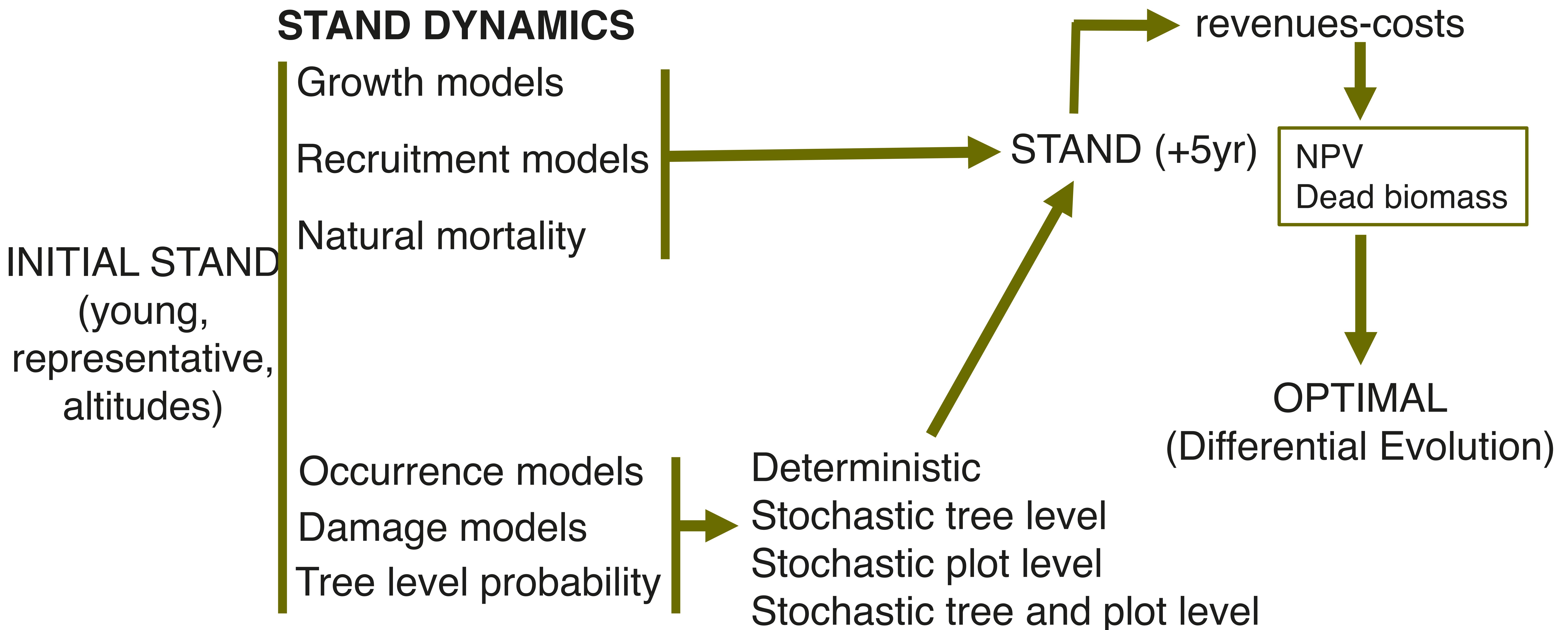
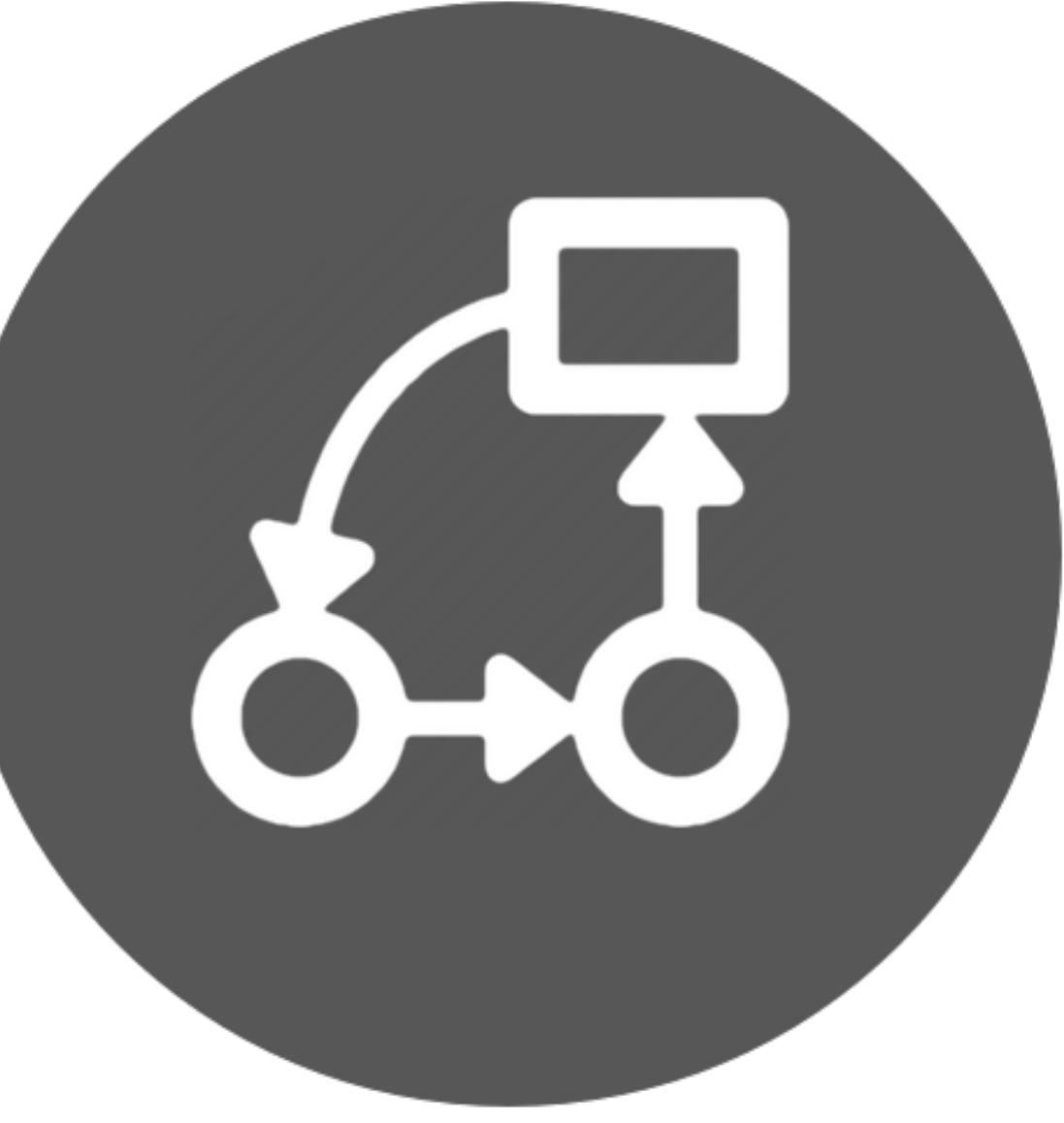


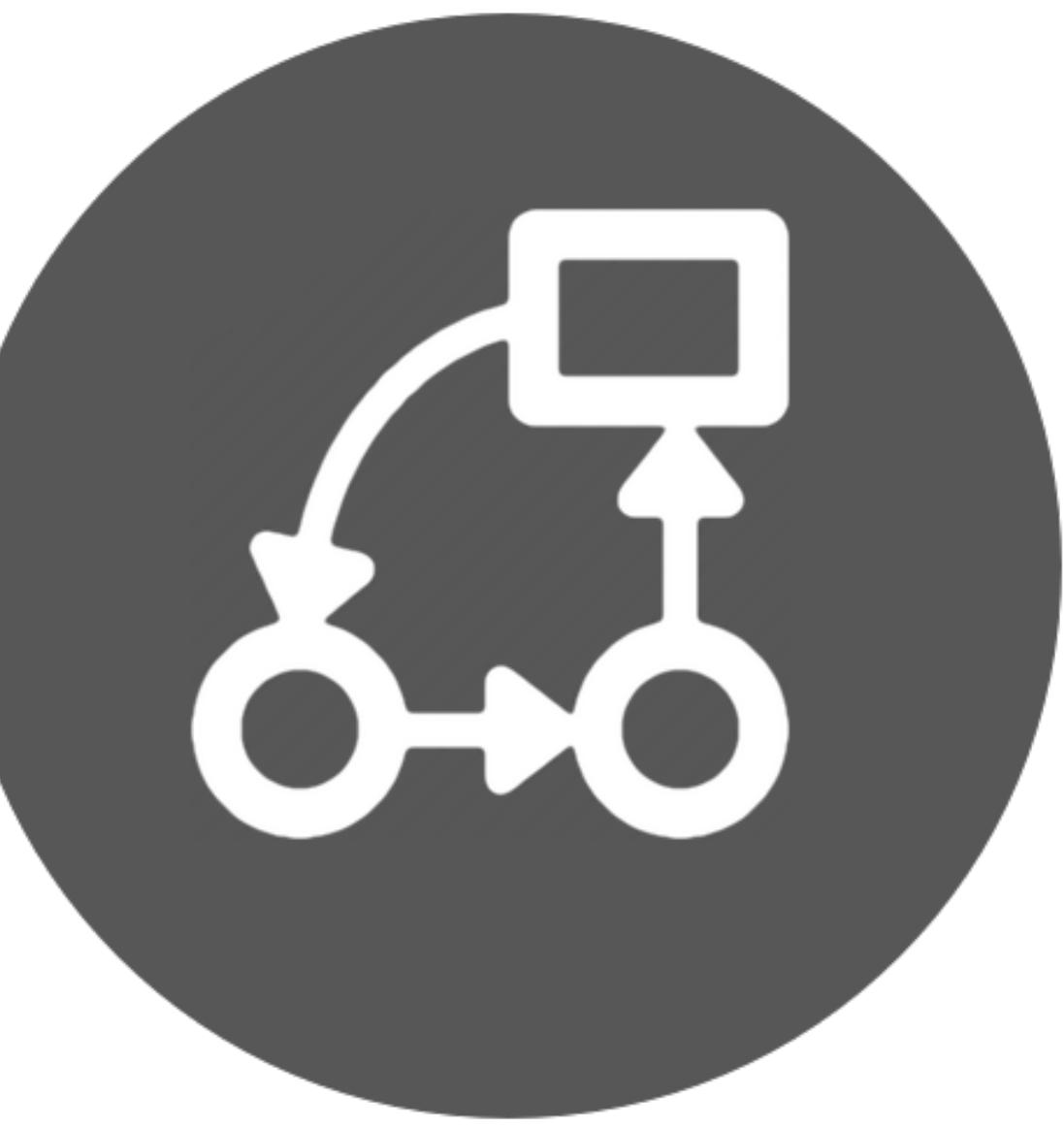
Increasing basal area is associated with
a reduction in the tree vulnerability to be damaged





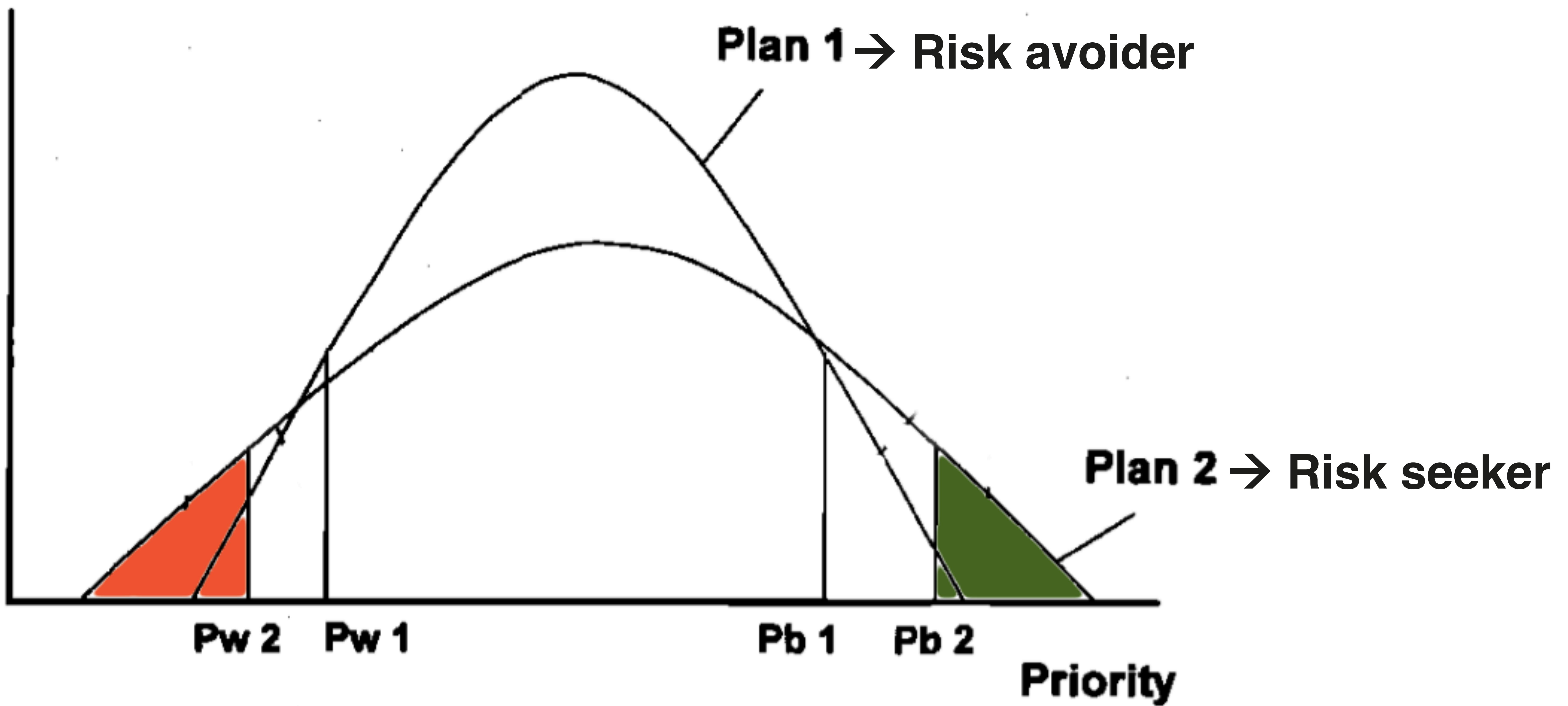
Optimization: methods





Optimization: methods

Frequency







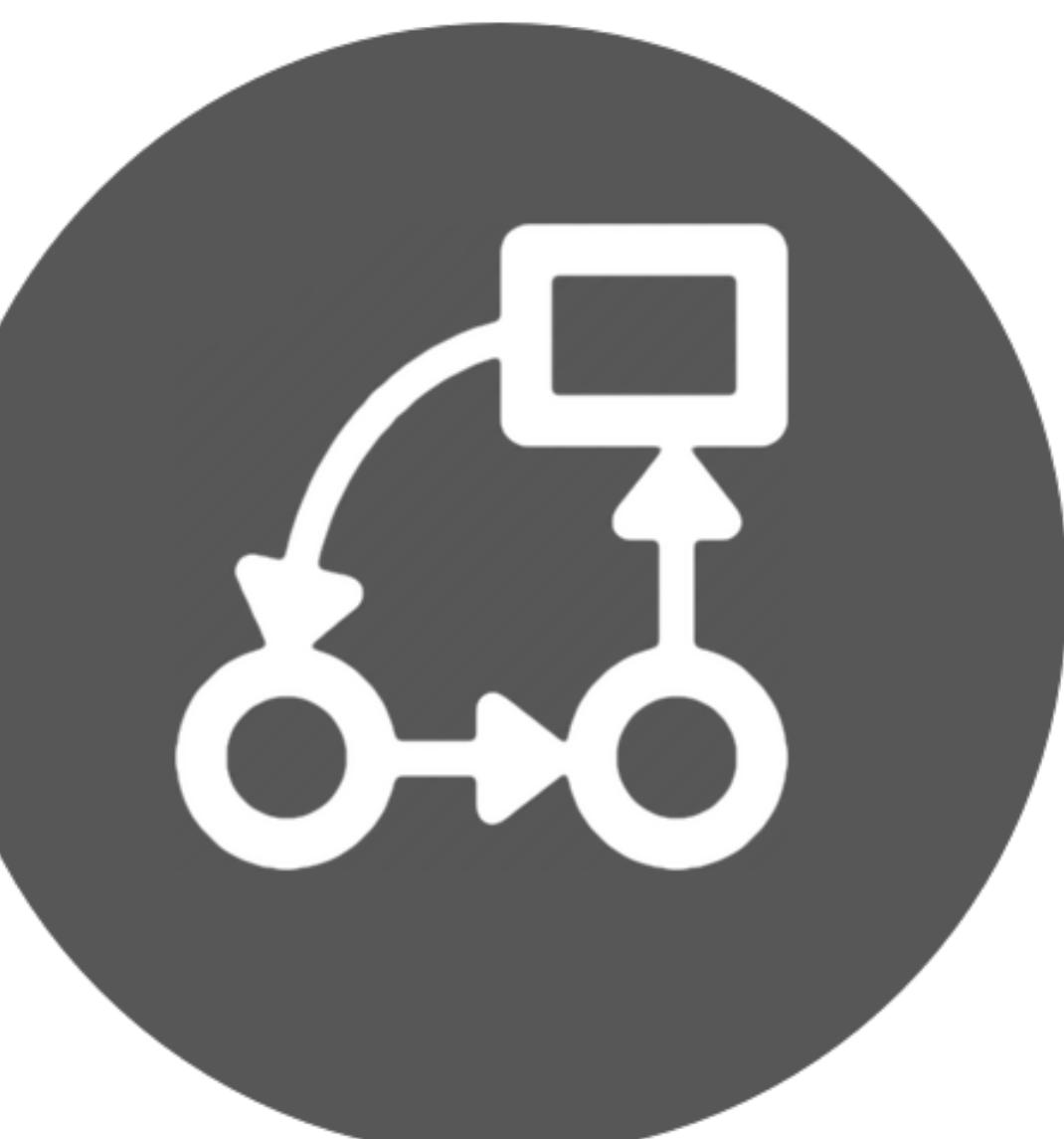
Younger stands with lower densities are more vulnerable to browsing damage. The **stand size** could represent an interesting variable to determine vulnerability



Height and diameter are the most important forest condition variables in all the models predicting damage occurrence and **latitude and altitude** describing the stand location



Increasing **slender** and tree **height** is associated with increasing probability for spruce trees to be **broken** in a damaged stand and increasing **basal area** reduces the damage probability.



The developed models can be used to **simulate and optimize** management approaches that consider the risk of wind and snow damage

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