

# Effect of Applying Fertilizer to Facilitate the Recovery of Newly Restored Seismic Lines in a Boreal Alberta Fen

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I would like to acknowledge the land in which  
this study was conducted on is within Treaty  
6 and Métis Nation of Alberta Region 4







Source: Cenovus



Upland Seismic Line



Lowland Seismic Line





Photo Credit: [hww.ca](http://hww.ca)

# Seismic Lines Threaten Woodland Caribou

↓ Safe habitat:

↑ Predator's visibility

↓ Blockages in the pathway for predator's chasing their prey

↓ Secure food source:

↓ Environmental conditions that support food growth (lichen)





Natural Peatland

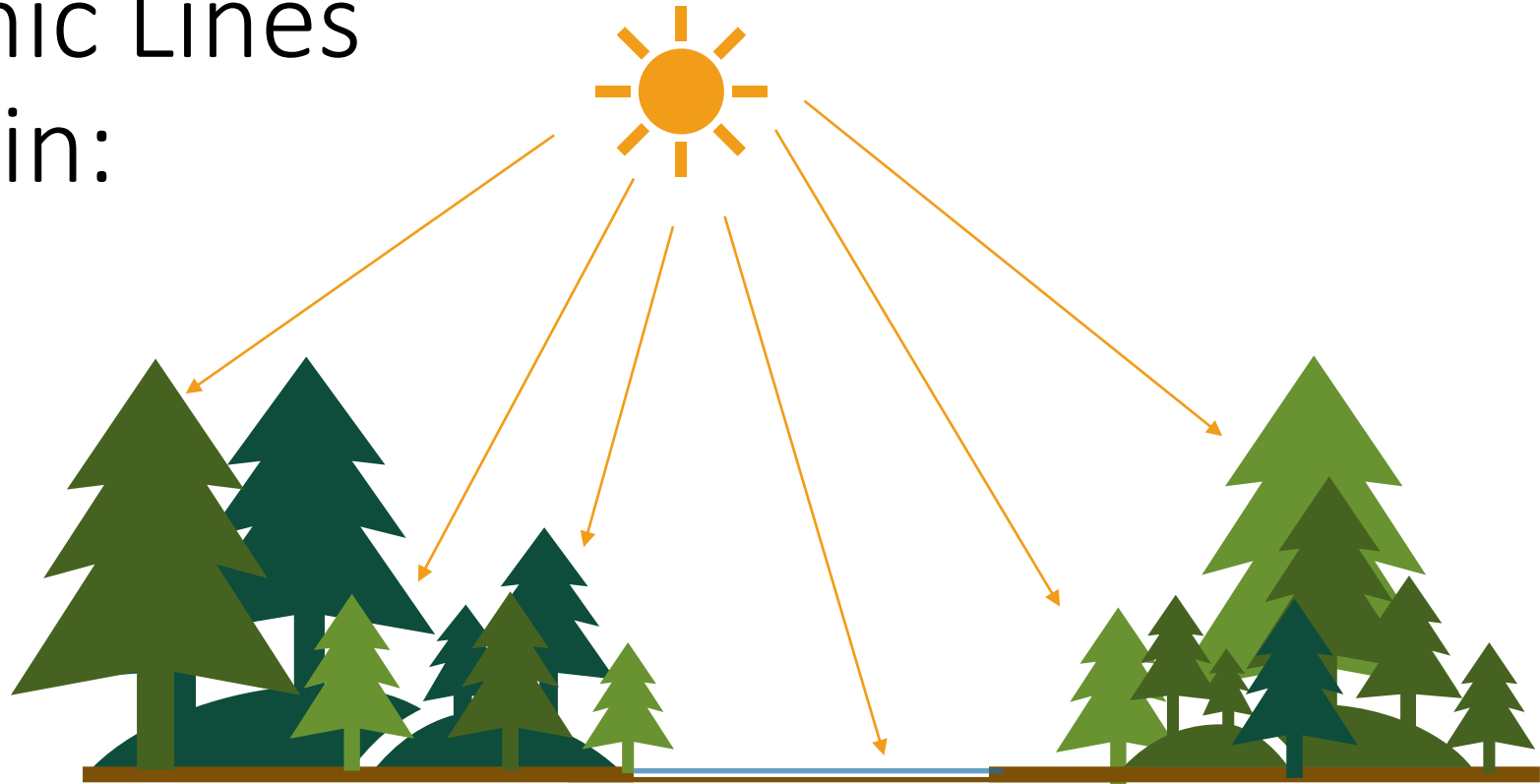


Seismic Line Peatland



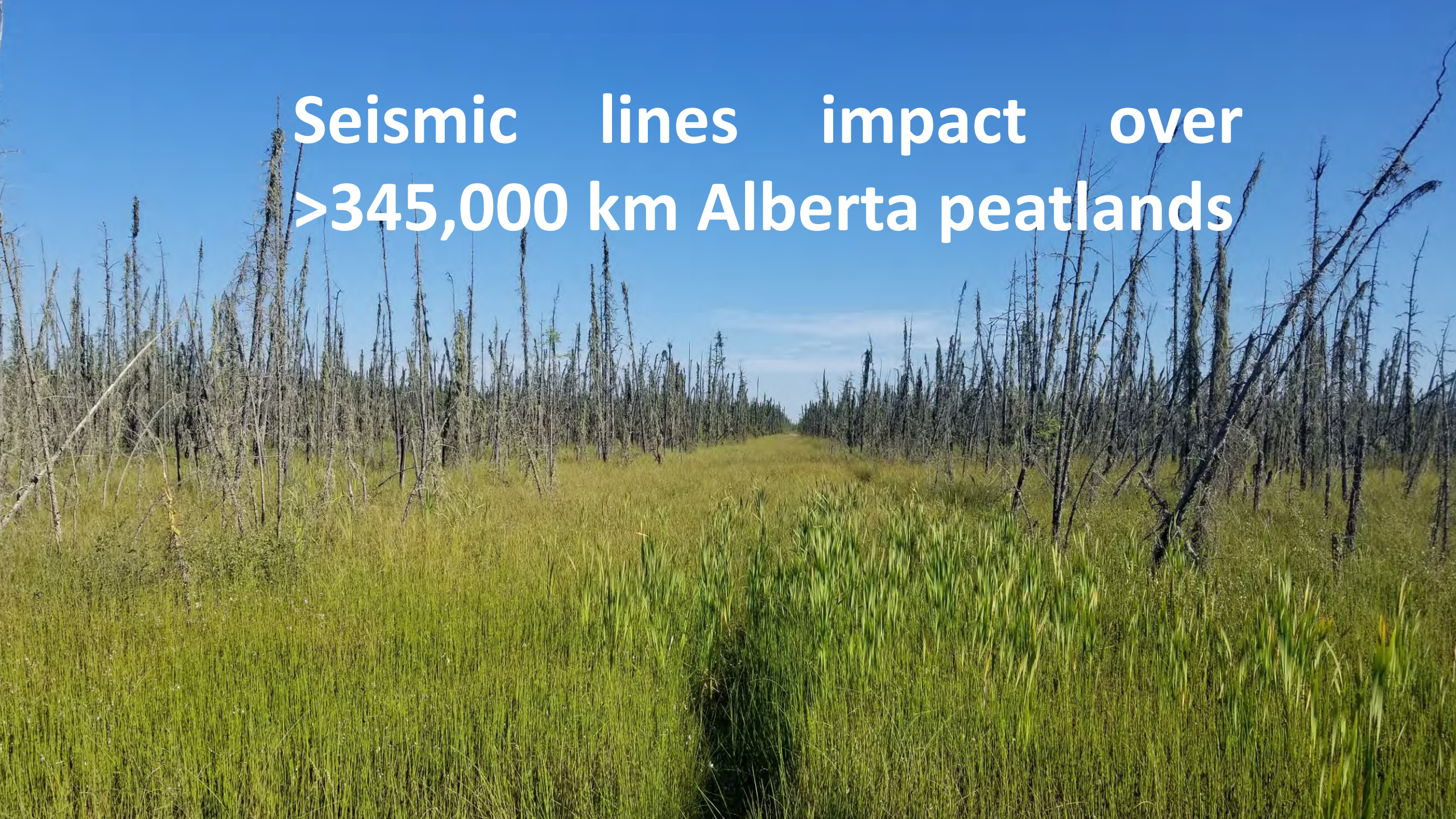
# Creation of Seismic Lines Lead to Changes in:

- Vegetation
- Compaction
- Temperature
- Habitat and Use





**Seismic lines impact over  
>345,000 km Alberta peatlands**





# Site

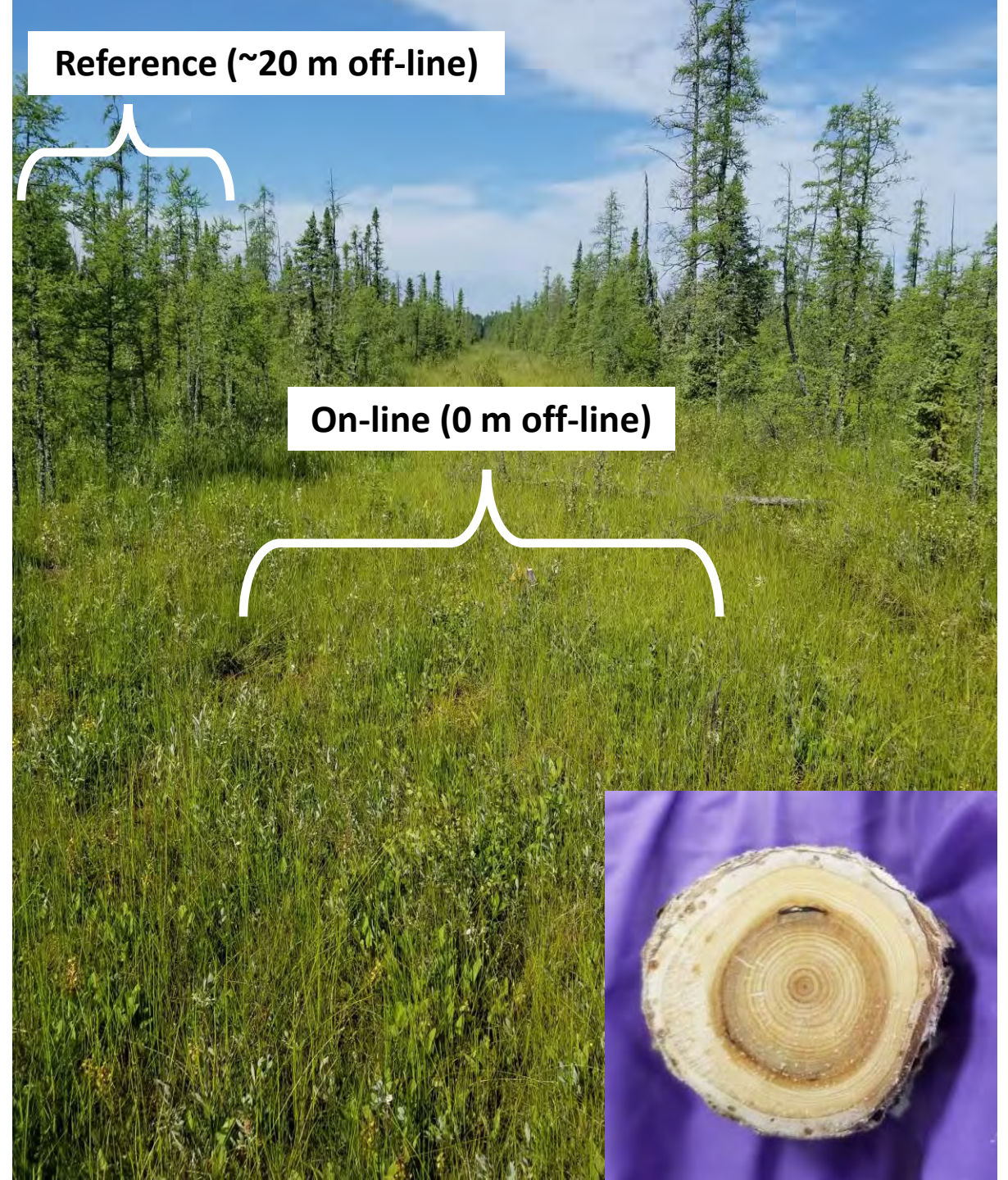
- Location:
  - Fen (peatland)
  - Brazeau County, Alberta
  - Boreal forest
- Features:
  - Two intersecting seismic lines





# Dendrochronology

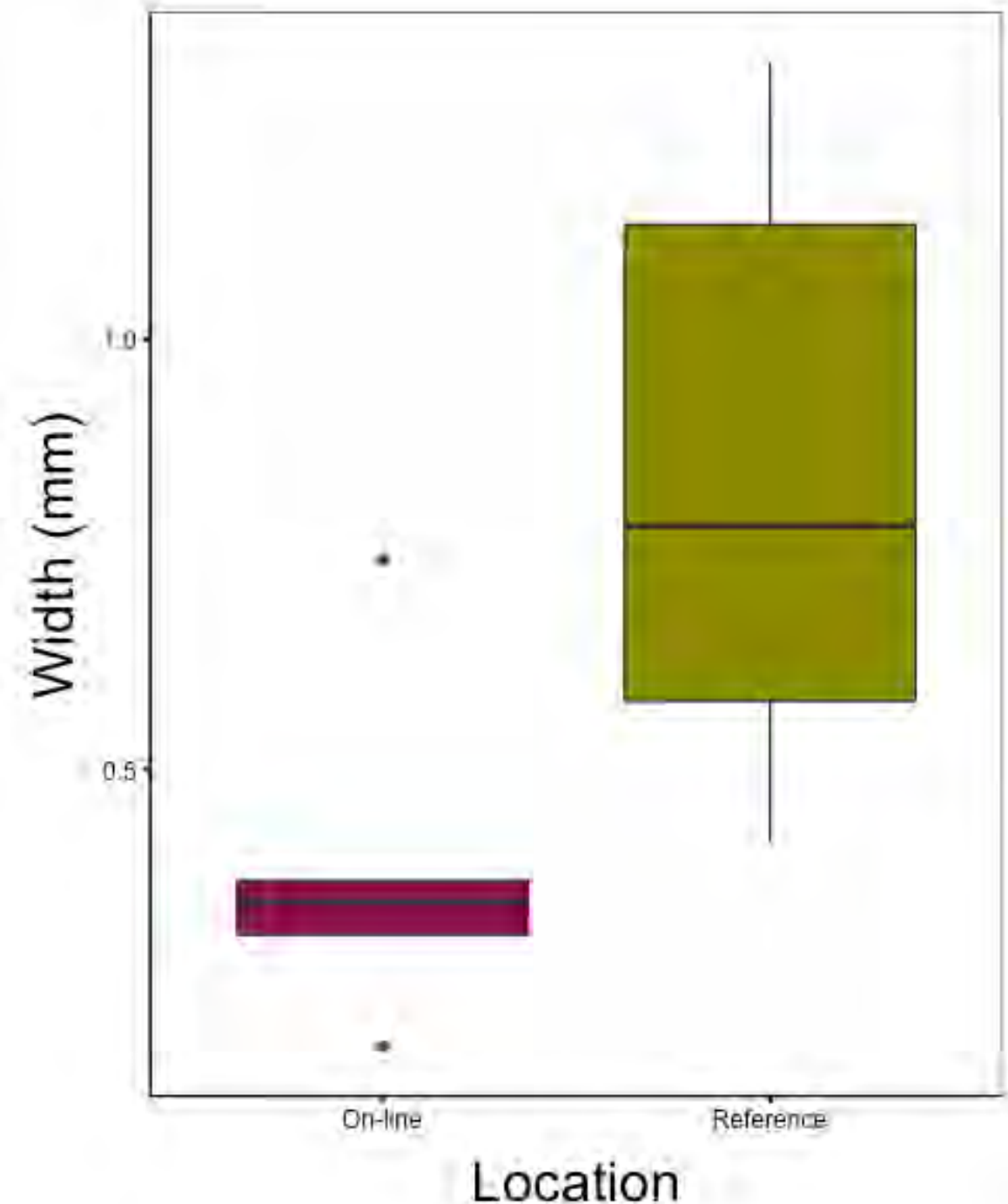
- Primarily black spruce (*Picea mariana*) and larch (*Larix laricina*) grow on this peatland
- Sampled 2 cores from 8 trees on the line and 8 trees in the reference area
- Reference trees measured approximately 20 meters from the edge of the seismic line
- Tree ring widths were analyzed to compare growth rates





# Dendrochronology

- Average ring width over 8-years
- Tree growth rates stunted on-line compared to reference area
- Trees on the seismic line had significantly lower growth rates than in the reference area ( $P=0.0251$ )
- Trees growing on seismic lines, where the water table was higher, grew an average of 57% of the width of trees in the reference site
- Average yearly tree ring growth for the on-line and reference sites were  $0.452\text{ mm}$  and  $0.842\text{ mm}$  respectively.





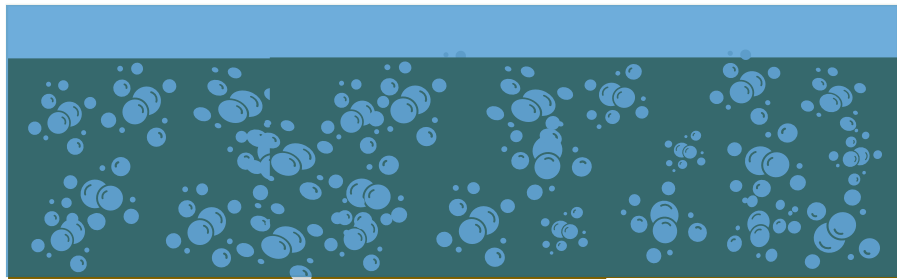


Why are trees having  
a hard time growing  
back?

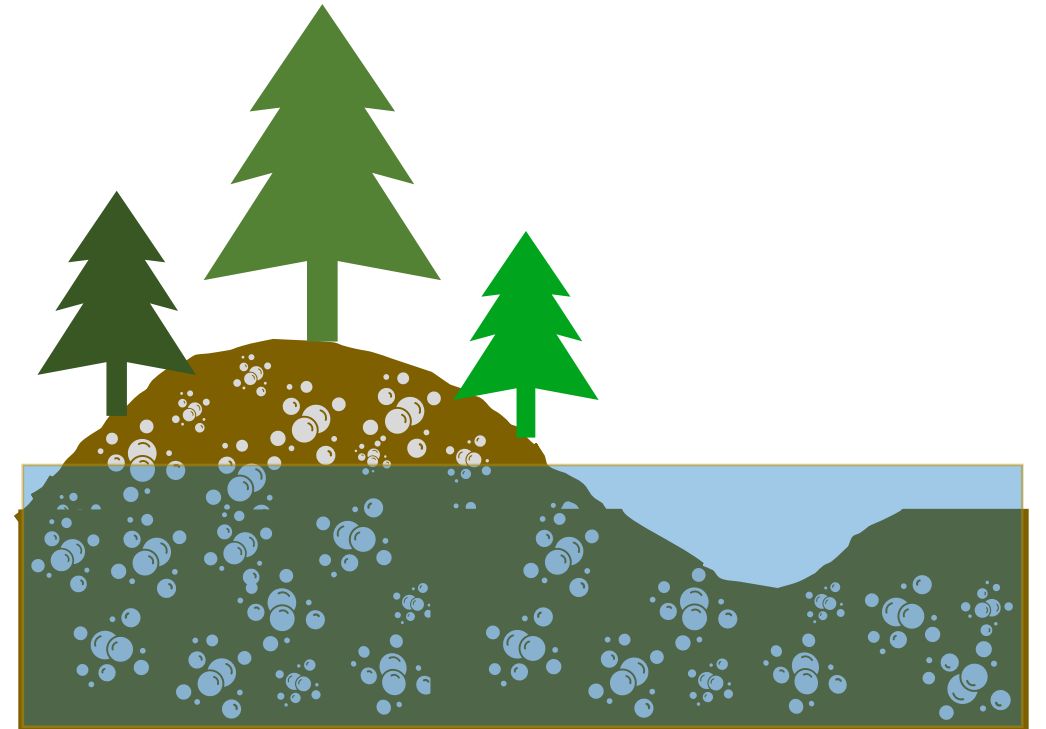
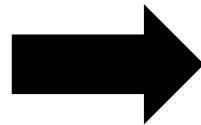
Is it the lack of  
microtopography?



# Addition of Microforms



Seismic line



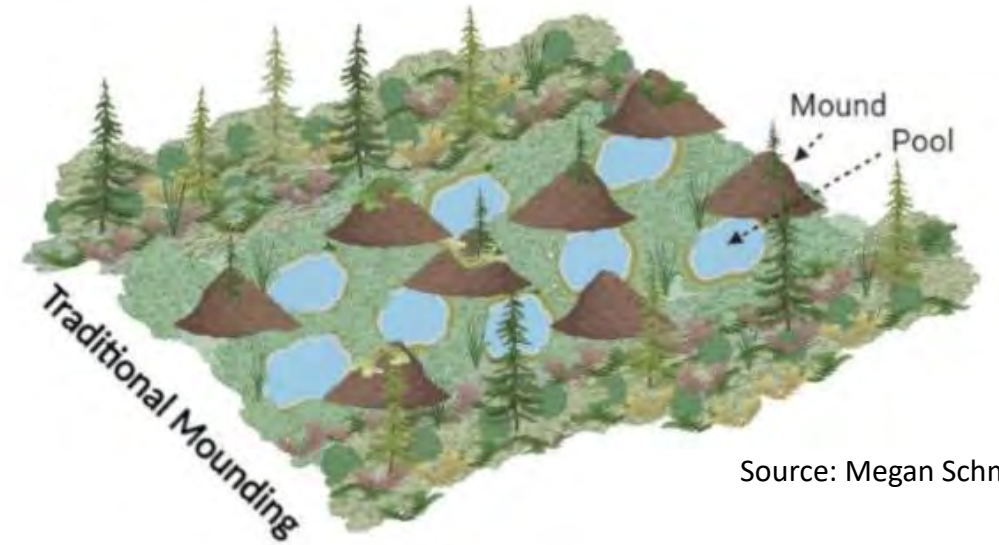
Restored



# Traditional Mounding



Source: COSIA



Source: Megan Schmidt





Mounding  
Technique  
(Hummock  
Transfer)





Ripping  
Technique  
(Rip and Lift)





Untreated  
(no mechanical  
restoration)





Why are trees having  
a hard time growing  
back?

Is it the lack of  
microtopography?  
OR

Could it be a lack of  
nutrients?





## Addition of NPK fertilizer

### **Slow release RTI Fertilizer:**

**17.64% nitrogen (N)**

**10% phosphorous (P)**

**8% potassium (K)**





Addition of  
Seedlings



# Objective

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Evaluating the Impact of Fertilizer on the Biogeochemical Processes and Vegetation Dynamics of a Peatland One to Two Years Post Restoration on Legacy Seismic lines in Canada's Boreal Forest Region





# Measured Biometrics

Biometric	Fertilizer Effect
Decomposition Rate	?
NH <sub>4</sub> <sup>+</sup> -N Net Mineralization Rate	?
NO <sub>3</sub> <sup>-</sup> -N Net Mineralization Rate	?
Nutrients Supply Rate (NH <sub>4</sub> <sup>+</sup> -N, NO <sub>3</sub> <sup>-</sup> -N, & P)	?
Larch Foliar Nutrients (TN & P)	?
Leader Length	?
Shrub Vegetation Cover (Treated)	?
Graminoid Vegetation Cover (Treated)	?





Source: TeaTime4Science



# Decomposition Rates

Tea Bag Index (TBI)

*Importance: indicator of biological activity and nutrient release.*

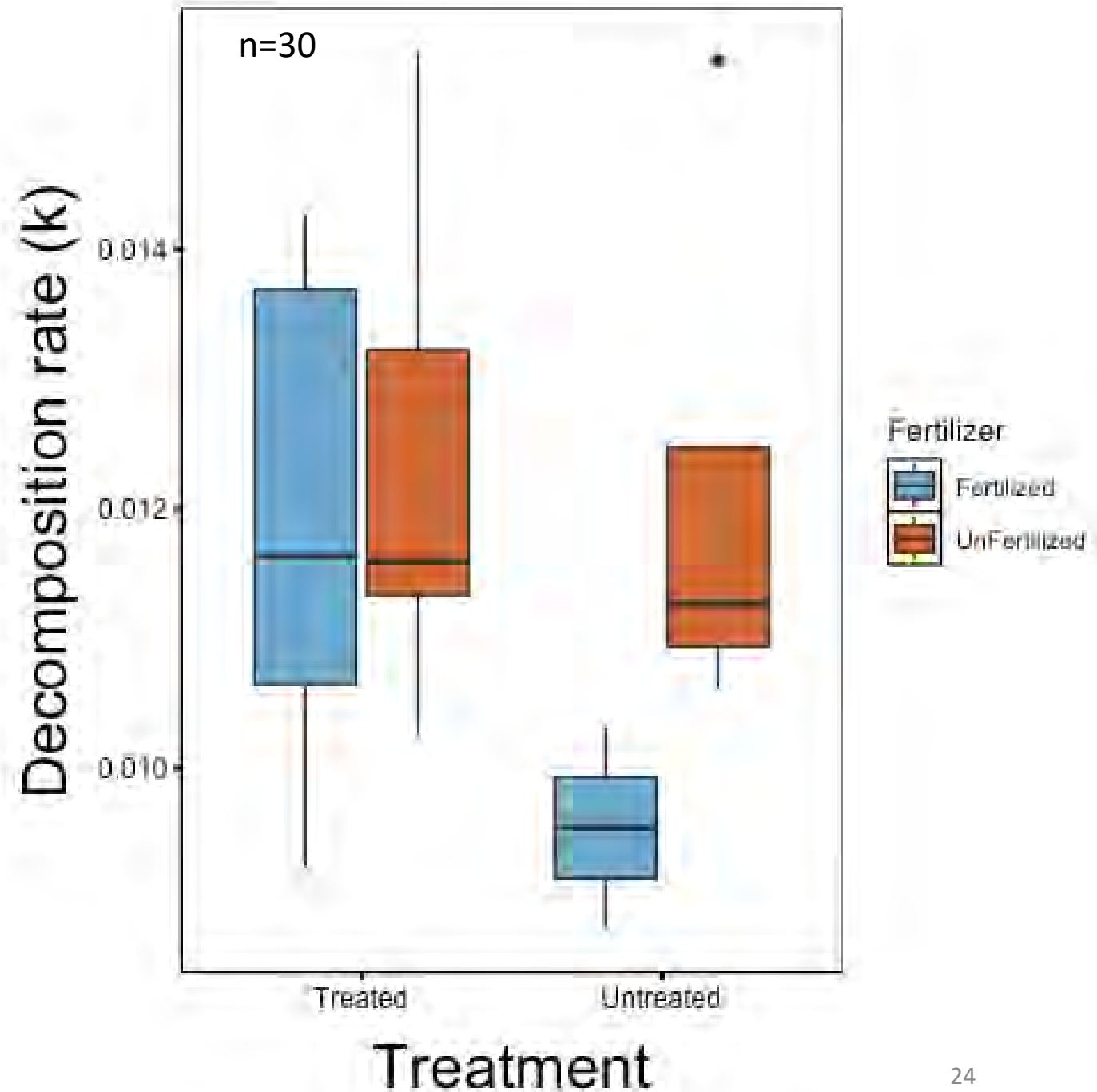


# Field Decomposition

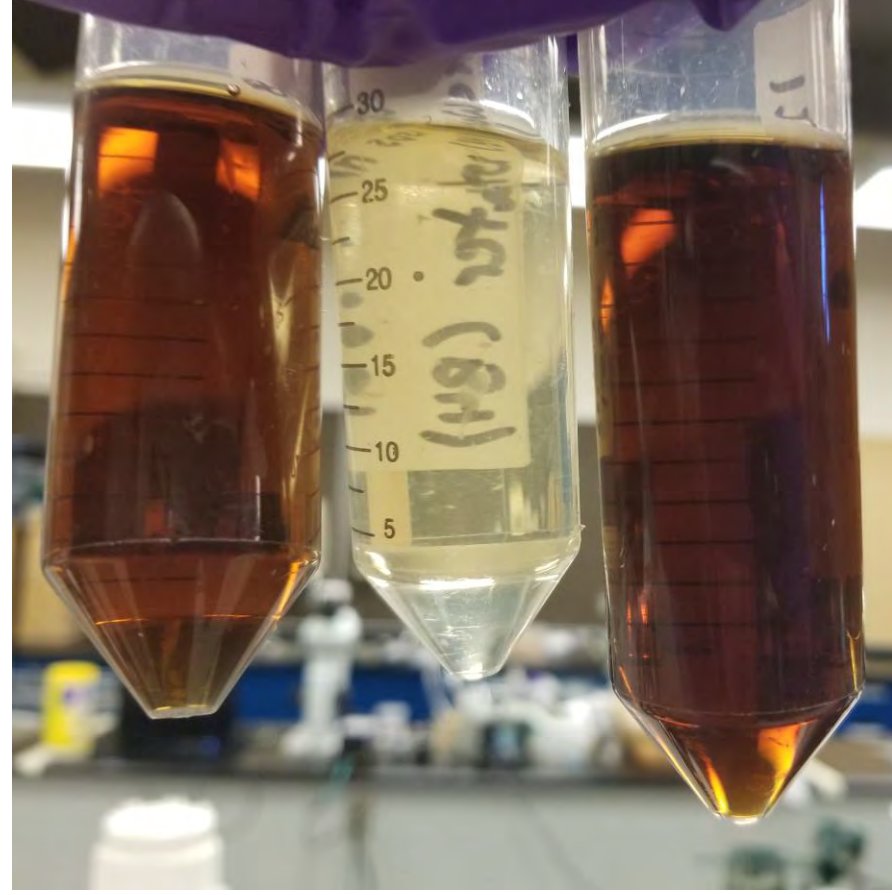
↓ Untreated area compared to treated areas.

↓ Untreated fertilized area compared to untreated unfertilized ( $P=0.5589$ )

■ Fertilized treated compared to the unfertilized areas.





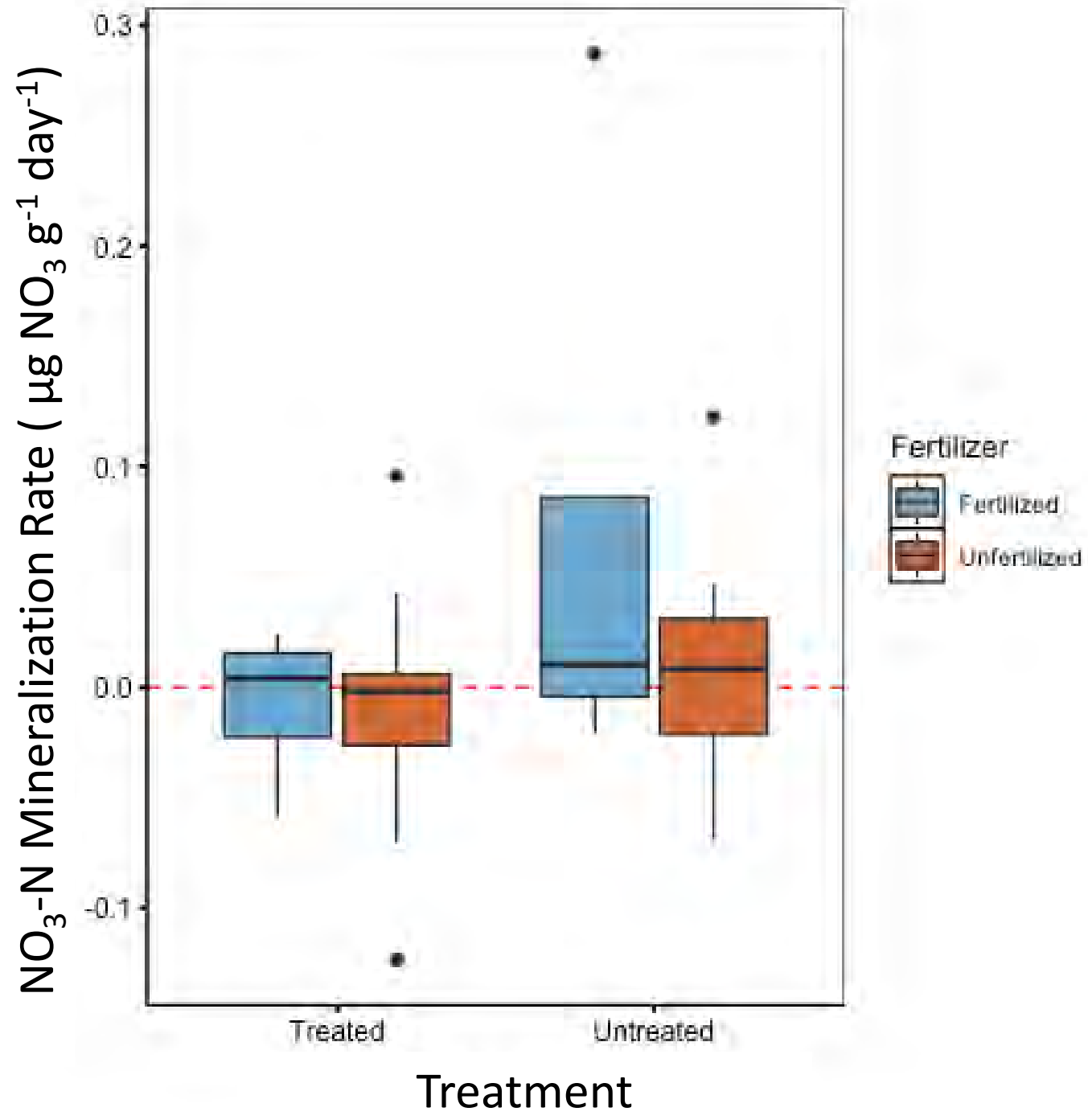
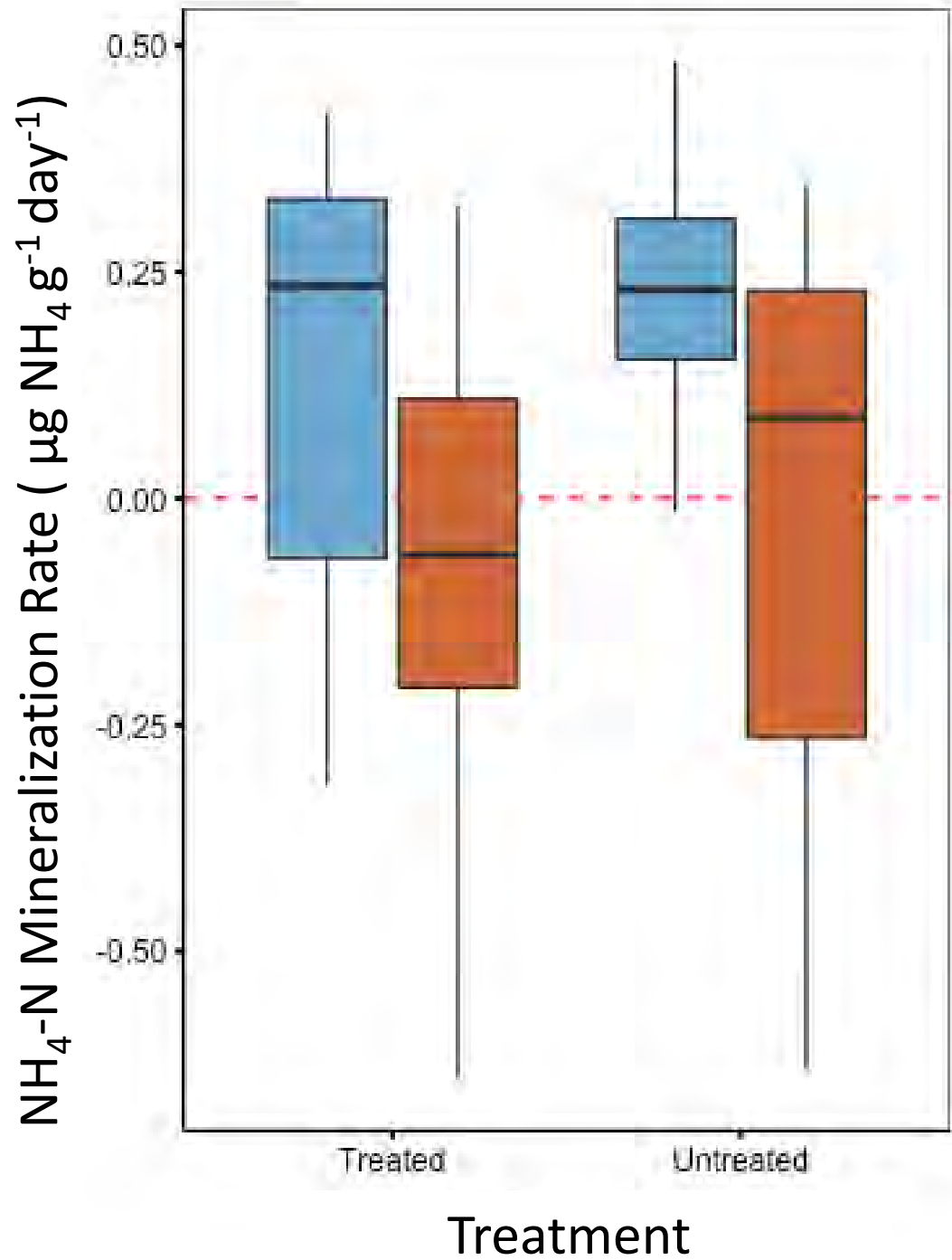


# Net Mineralization Rates

Buried bag method

*Importance: determine if fertilizer effects the net mineralization rate*









### Anion PRS Probe

adsorbs:

$\text{NO}_3^-$ ,  $\text{PO}_4^-$ ,  $\text{SO}_4^-$ ,  
micros, etc.

Anion Resin  
quaternary  $\text{R-NH}_4^+$



### Cation PRS Probe

adsorbs:

$\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  
 $\text{Mg}^{2+}$ , etc.

Cation Resin  
sulfonic acid  $\text{R-SO}_3^-$



Source: Western Ag

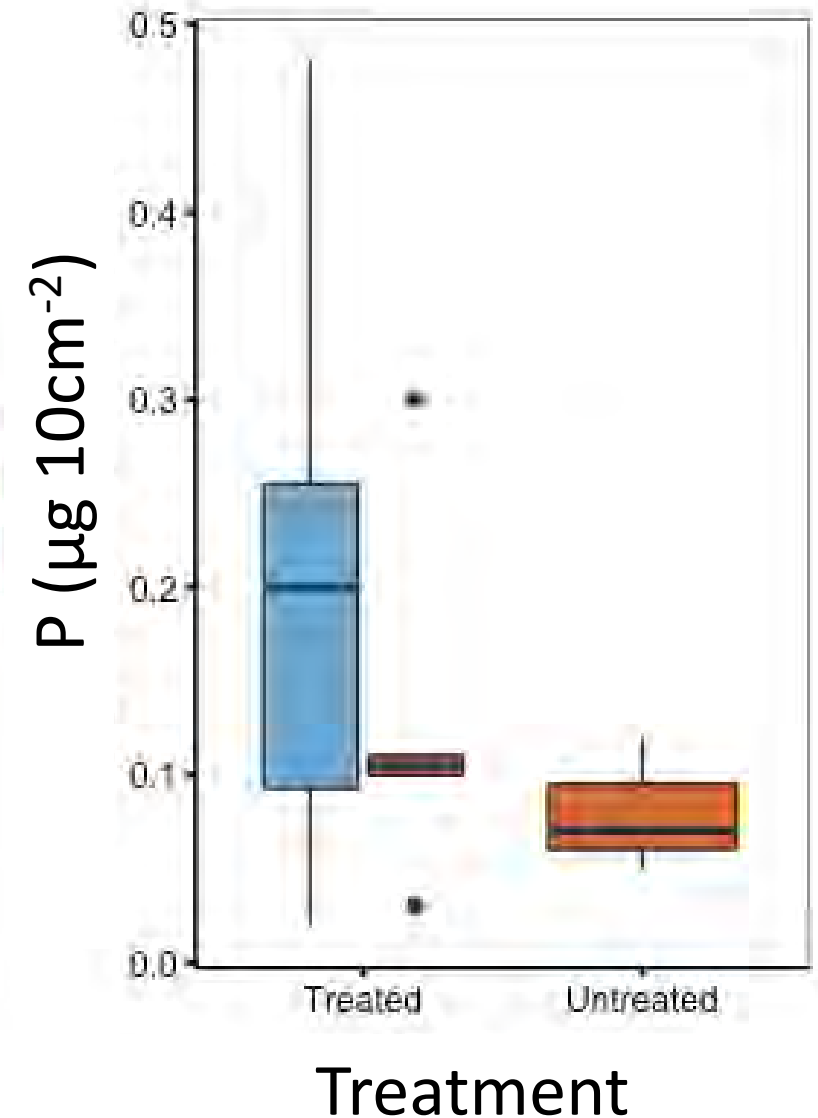
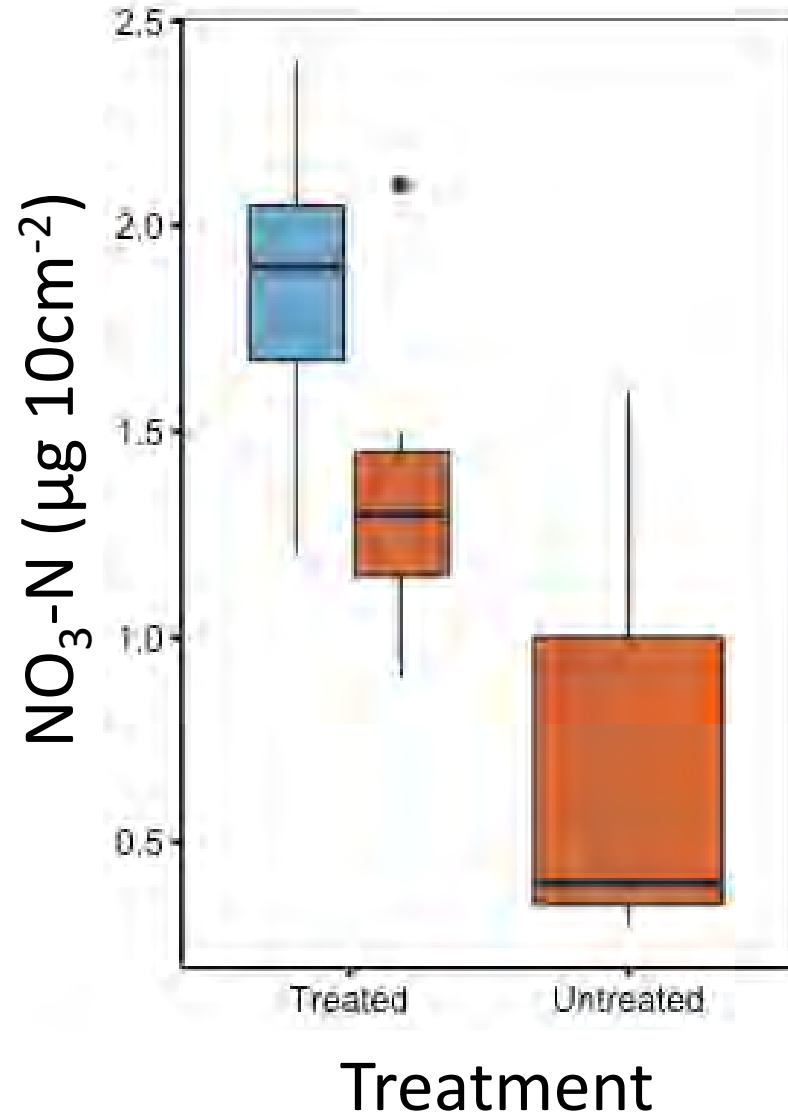
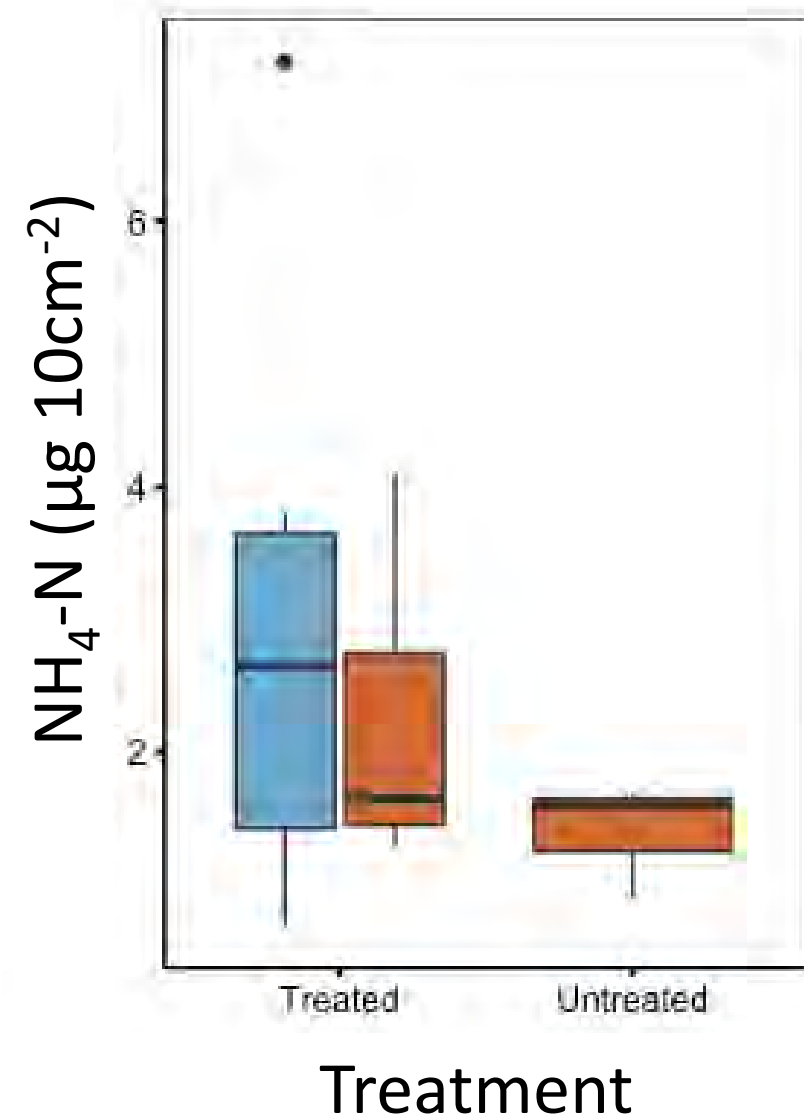
# Nutrient Supply Rates

## PRS Probes

*Importance: determine the availability of nutrients that is accessible to the vegetations roots*



# Nutrient Supply Rates PRS Probes (2021)





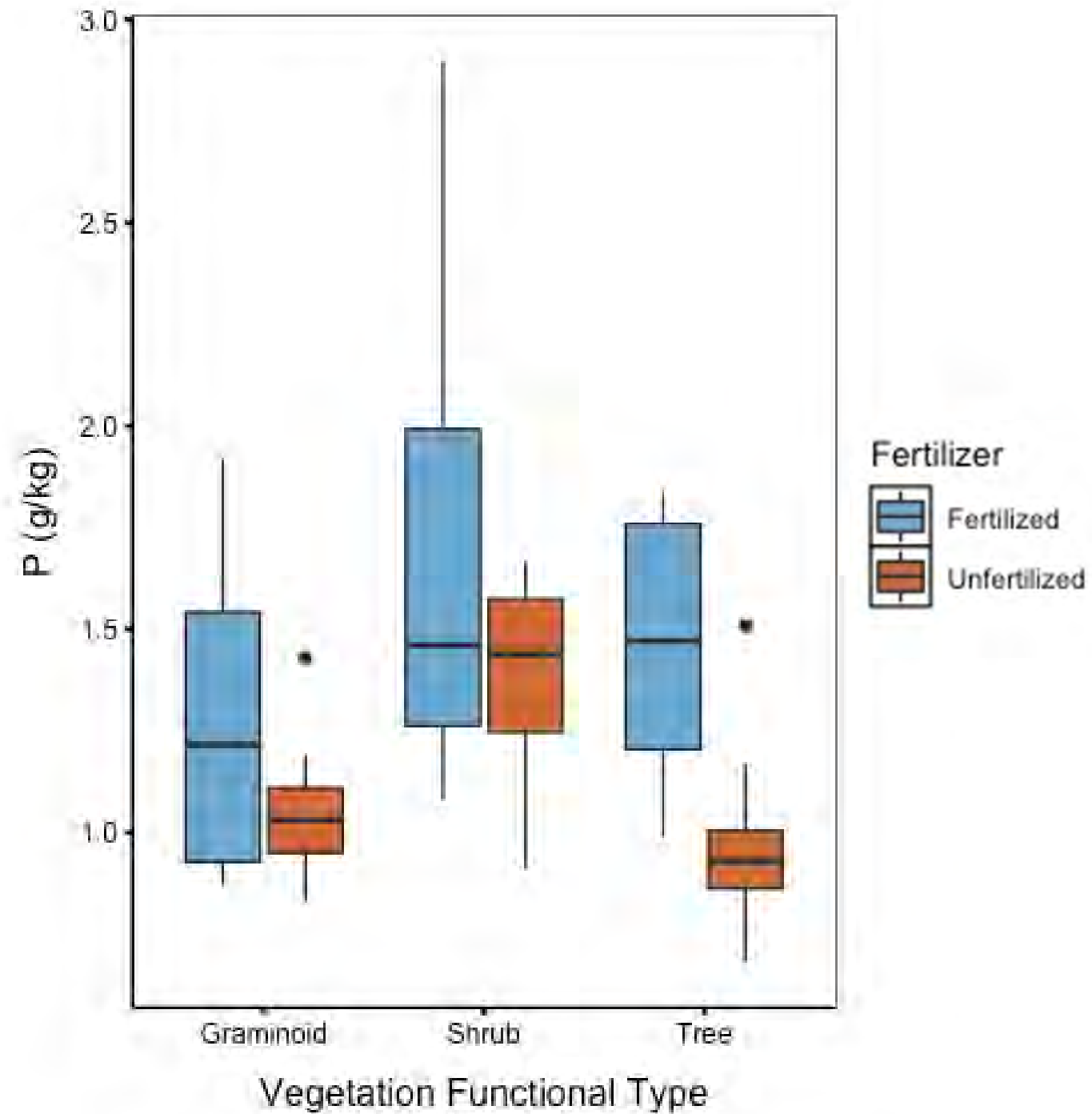
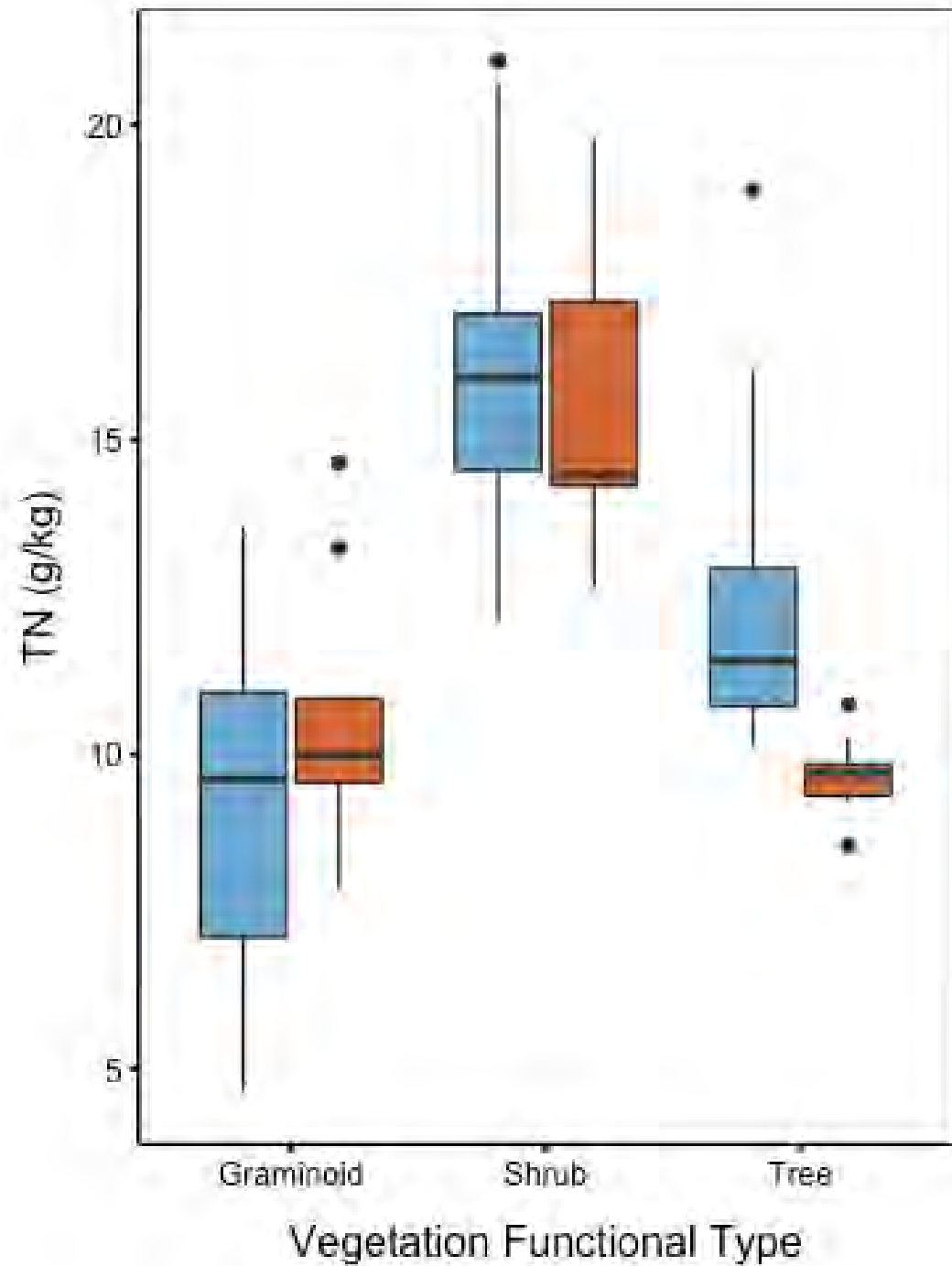


# Foliar Nutrients

## Vegetation leaves

*Importance: demonstrates the nutrients stored in the leaves of the vegetation. It shows if the addition of nutrients through fertilizer targeted the desired vegetation (trees).*



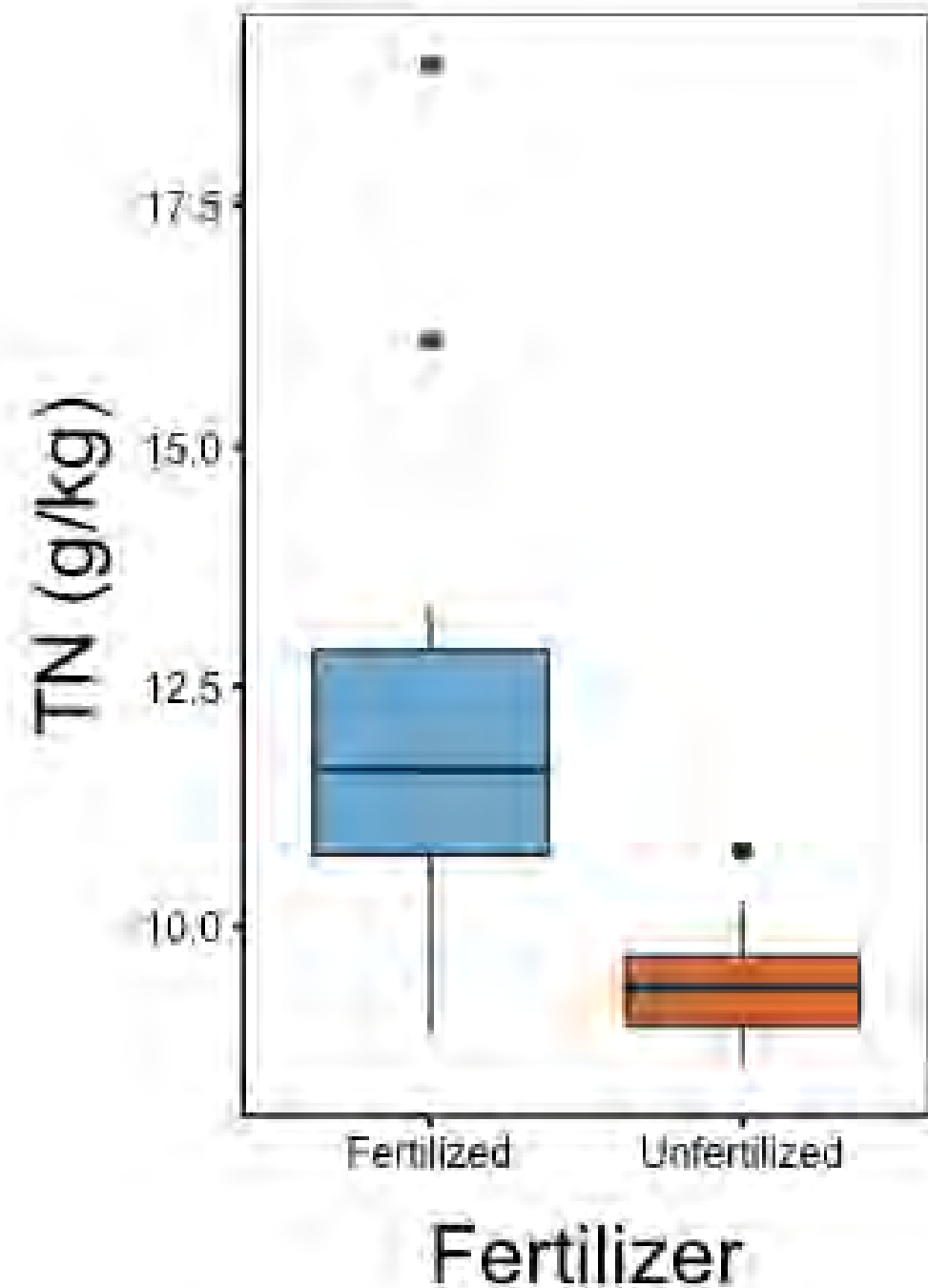




# Foliar Nutrients *for Larch Trees*

↑ Fertilized trees have a significantly higher total nitrogen concentration than unfertilized trees ( $P=0.0534$ )

↑ Fertilized trees have a higher phosphorus concentration than unfertilized trees ( $P=0.0798$ )



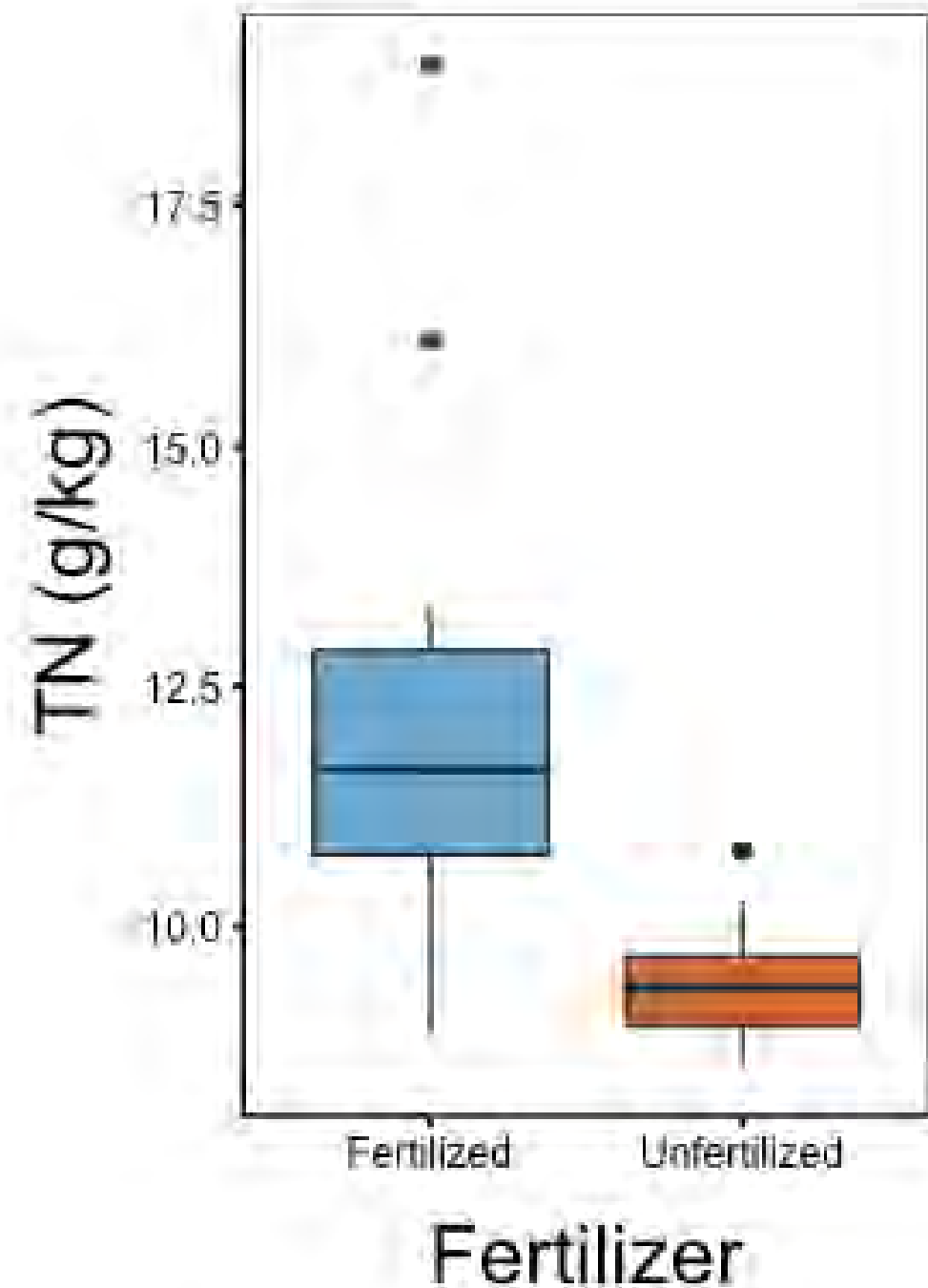


# Foliar Nutrients *for Larch Trees*

↑ Fertilized trees have a significantly higher total nitrogen concentration than unfertilized trees ( $P=0.0534$ )

↑ Fertilized trees have a higher phosphorus concentration than unfertilized trees ( $P=0.0798$ )

*Did the increased foliar nutrients correspond to increased growth in the fertilized area?*





# Leader Length

Tree growth

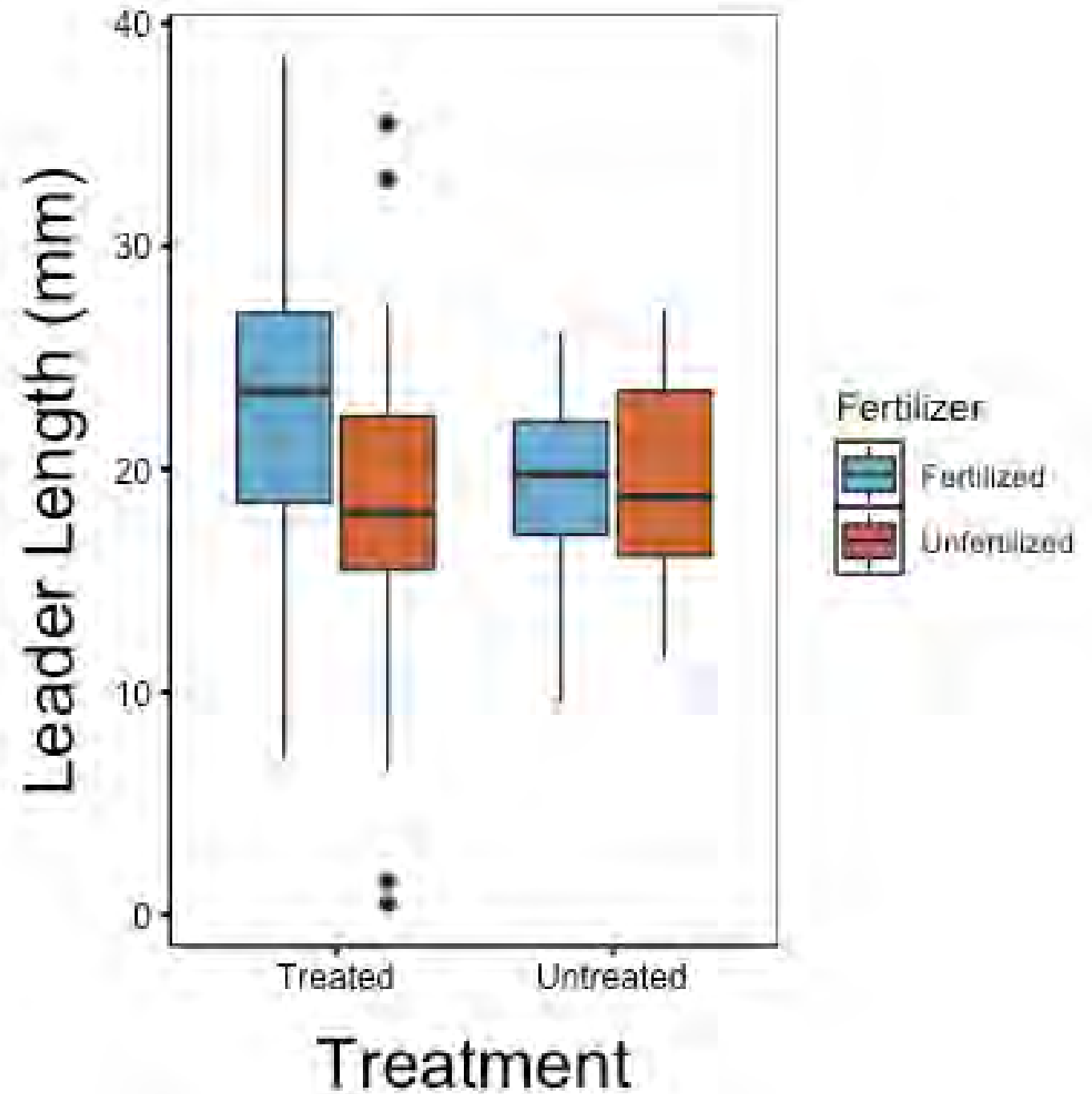
*Importance: indicates the growth of the trees.*





# Larch Leader Length

↑ Fertilized trees (P=0.04)

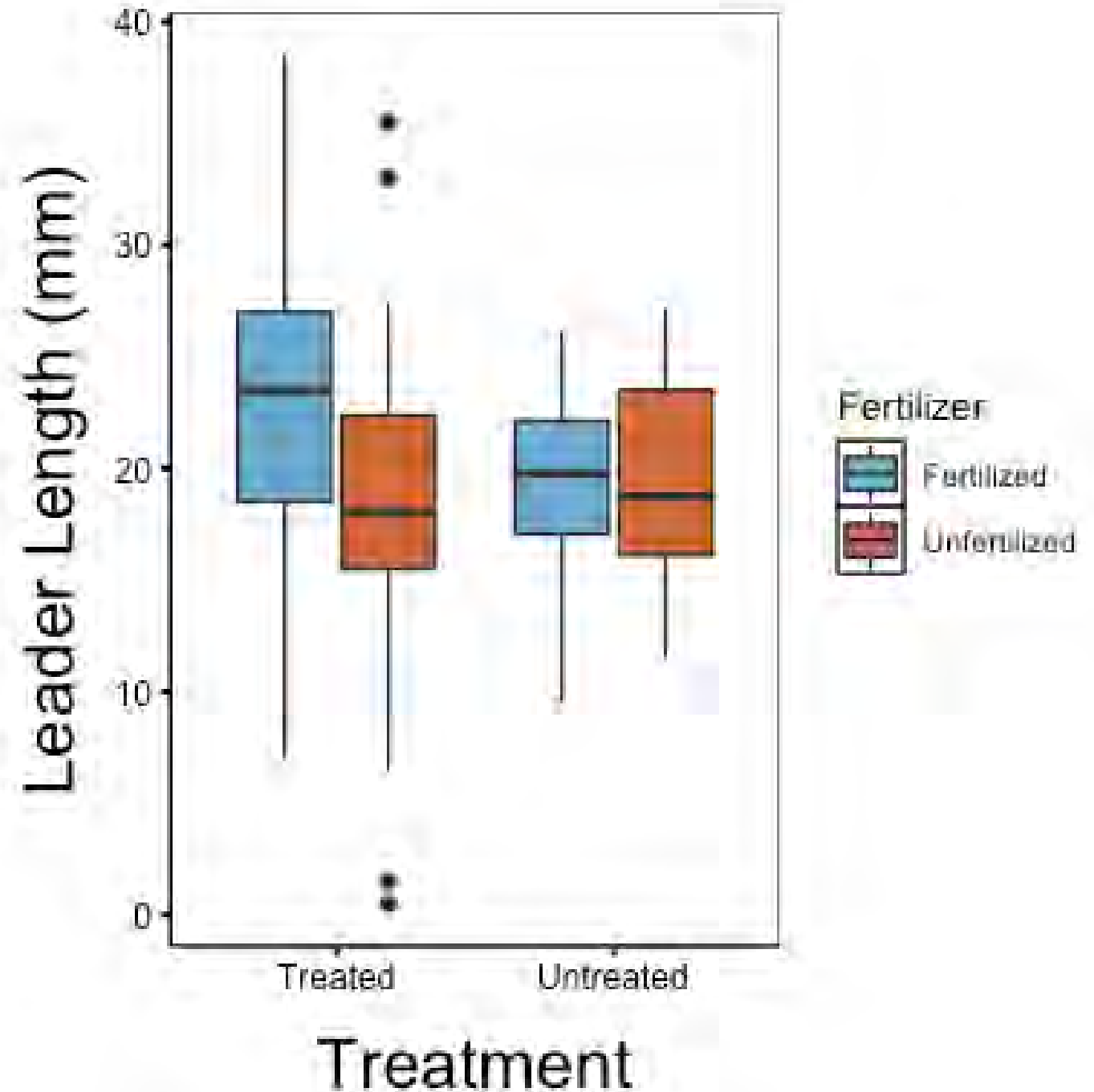




# Larch Leader Length

↑ Fertilized trees (P=0.04)

*Could other vegetation functional types be benefitting from the addition of NPK fertilizer?*







# Vegetation Cover

Quadrat method

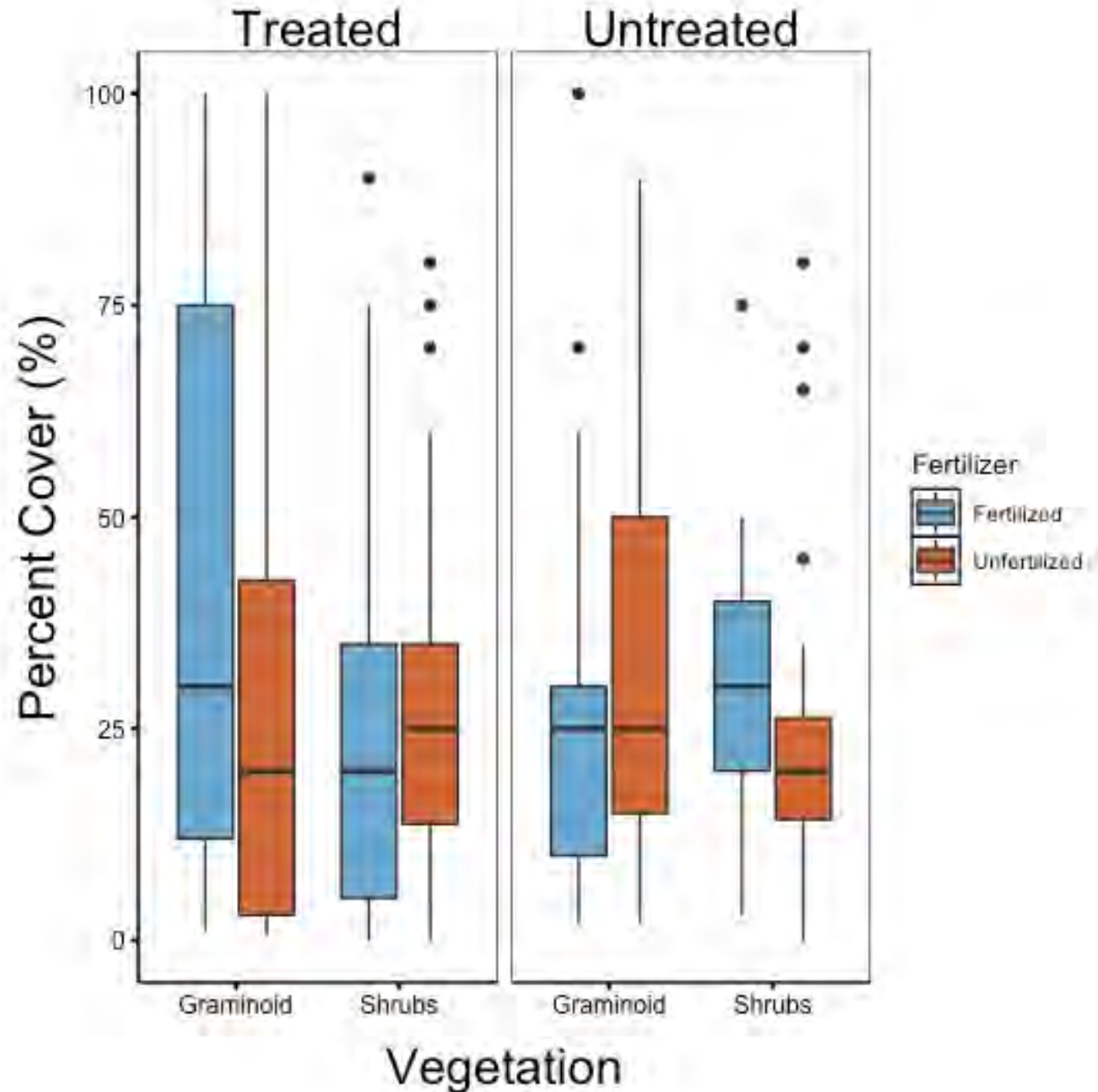
*Importance: determine if there may be composition between different functional groups*



# Vegetation Cover



Treated graminoids cover is significantly higher in the fertilized compared to the unfertilized ( $P=0.016$ )





# Vegetation Cover



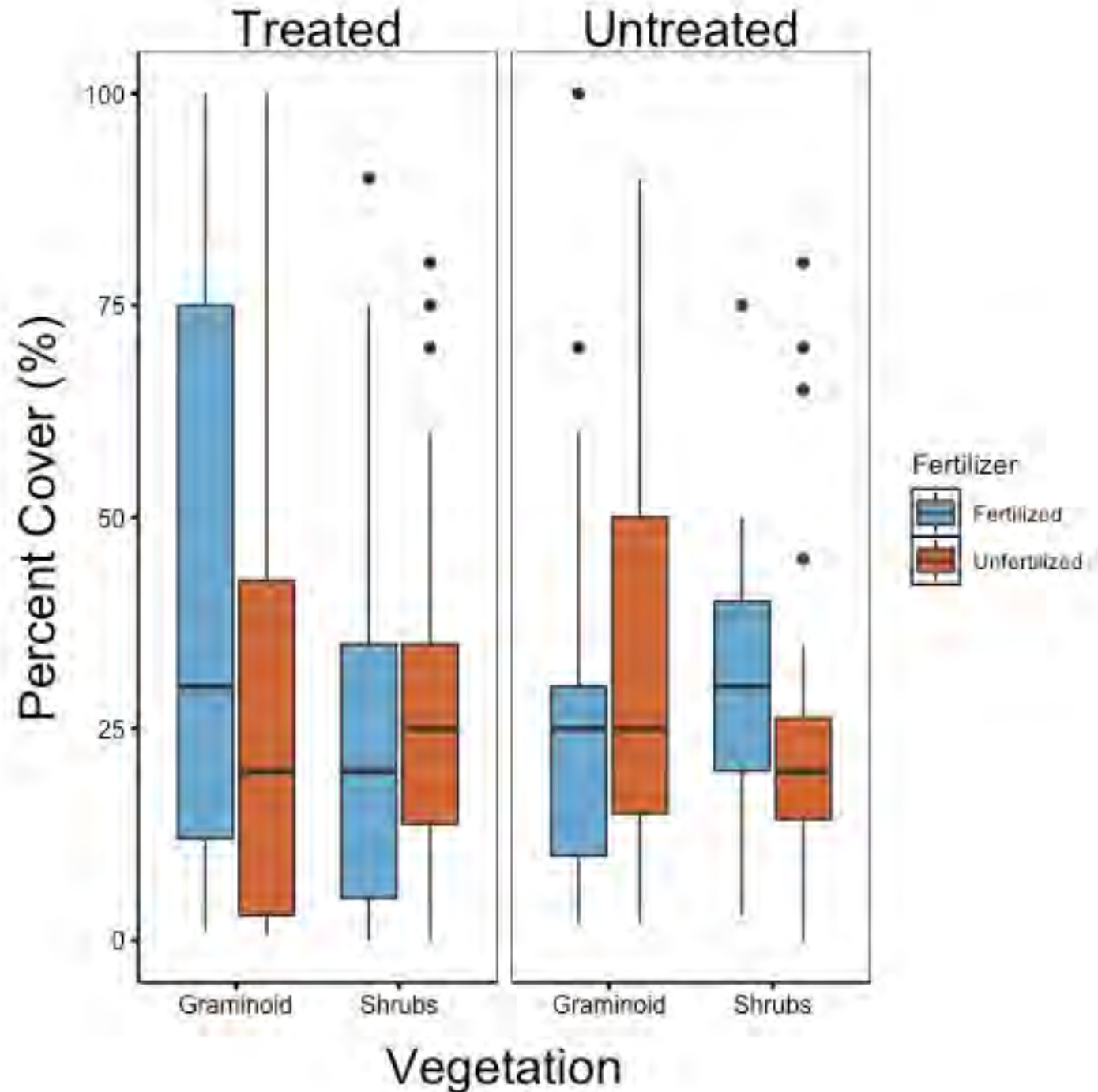


# Vegetation Cover



Treated graminoids cover is significantly higher in the fertilized compared to the unfertilized ( $P=0.016$ )

*This increased graminoid growth could create competition for the trees?*







Biometric	Fertilizer Effect
Decomposition Rate	
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NO <sub>3</sub> <sup>-</sup> -N Net Mineralization Rate	
Nutrients Supply Rate (NH <sub>4</sub> <sup>+</sup> -N, NO <sub>3</sub> <sup>-</sup> -N, & P)	
Larch Foliar Nutrients (TN & P)	
Leader Length	
Shrub Vegetation Cover (Treated)	
Graminoid Vegetation Cover (Treated)	

*Major Findings*



# Thank you

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## Collaborators

Dr. Maria Strack

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Thank You!

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