# Regeneration dynamics of seedling origin aspen: Managing for resiliency in forest restoration

American Society of Mining and Reclamation

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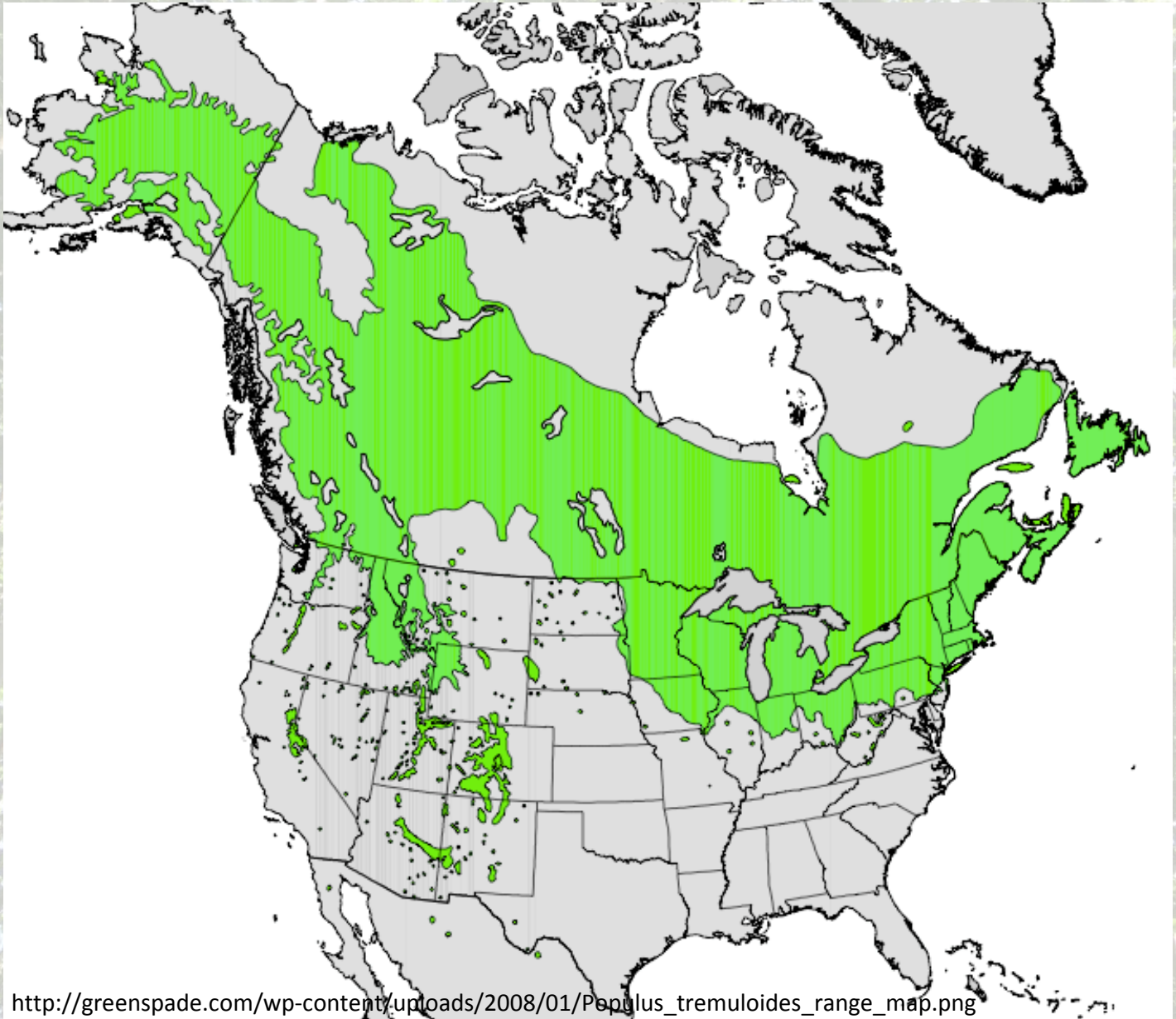
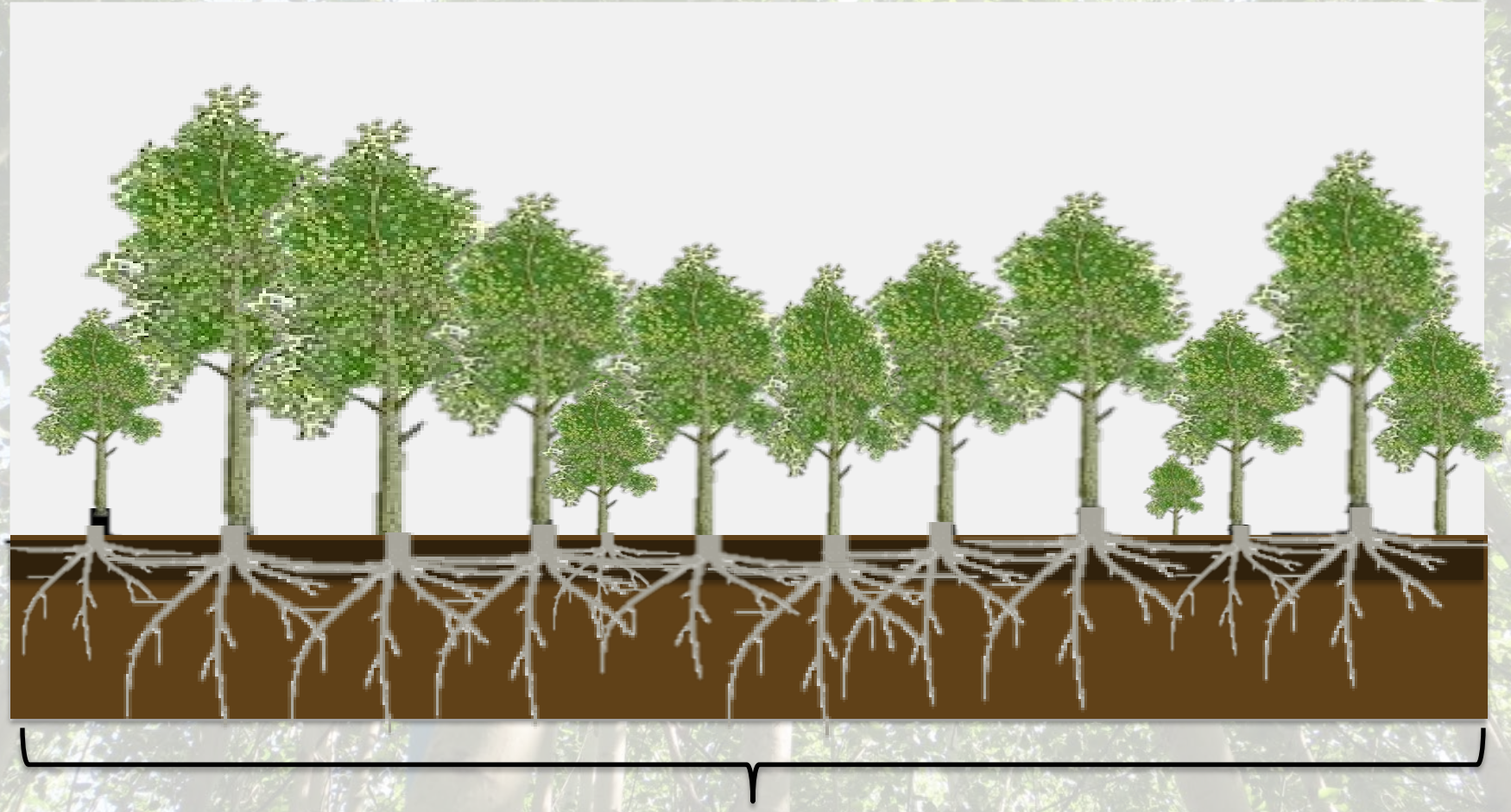
# Range of *Populus tremuloides* Michx.



http://greenspade.com/wp-content/uploads/2008/01/Populus_tremuloides_range_map.png

# Clonal dynamics

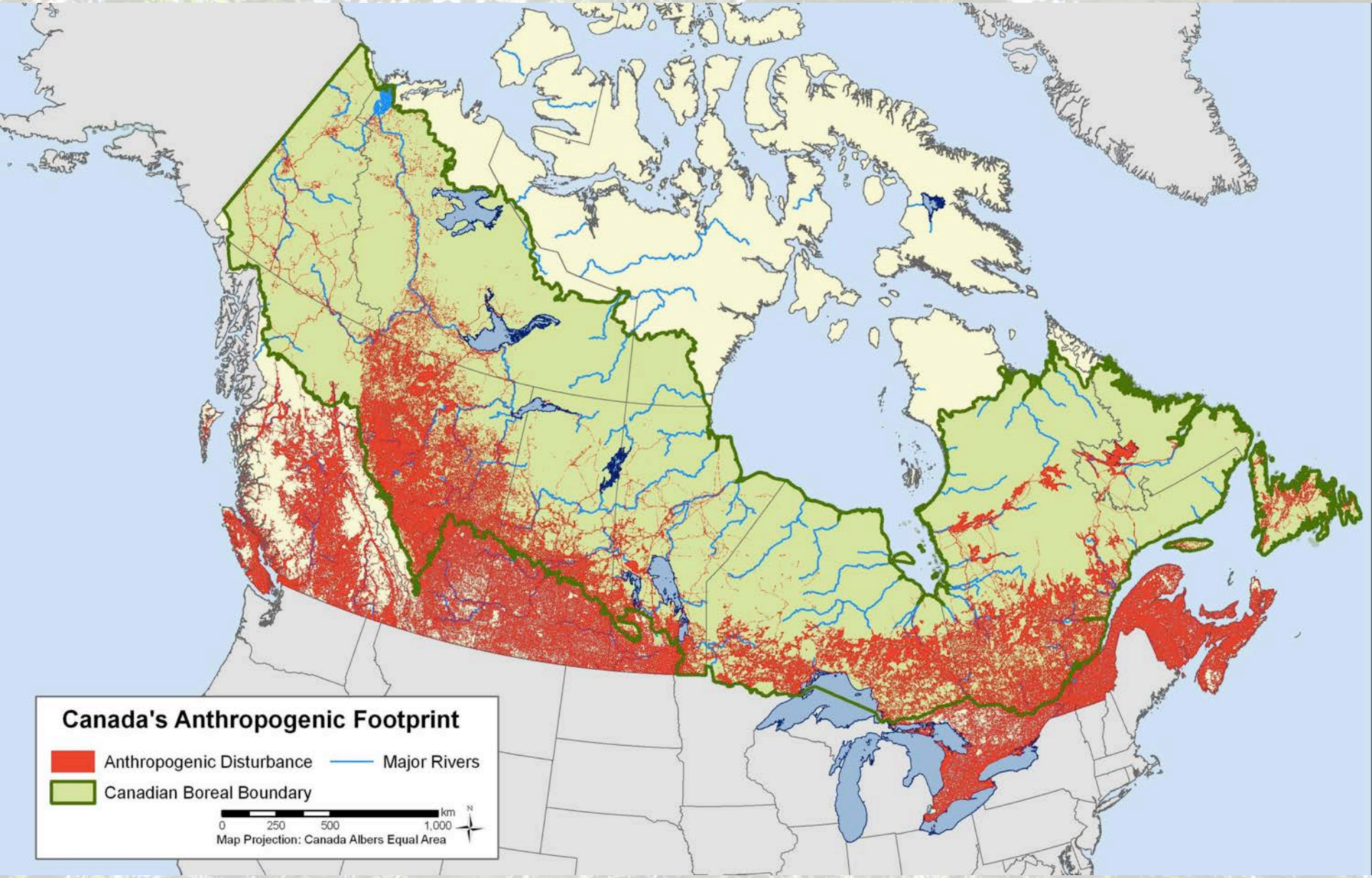


Shared root systems – one genetic individual

# Clonal origin

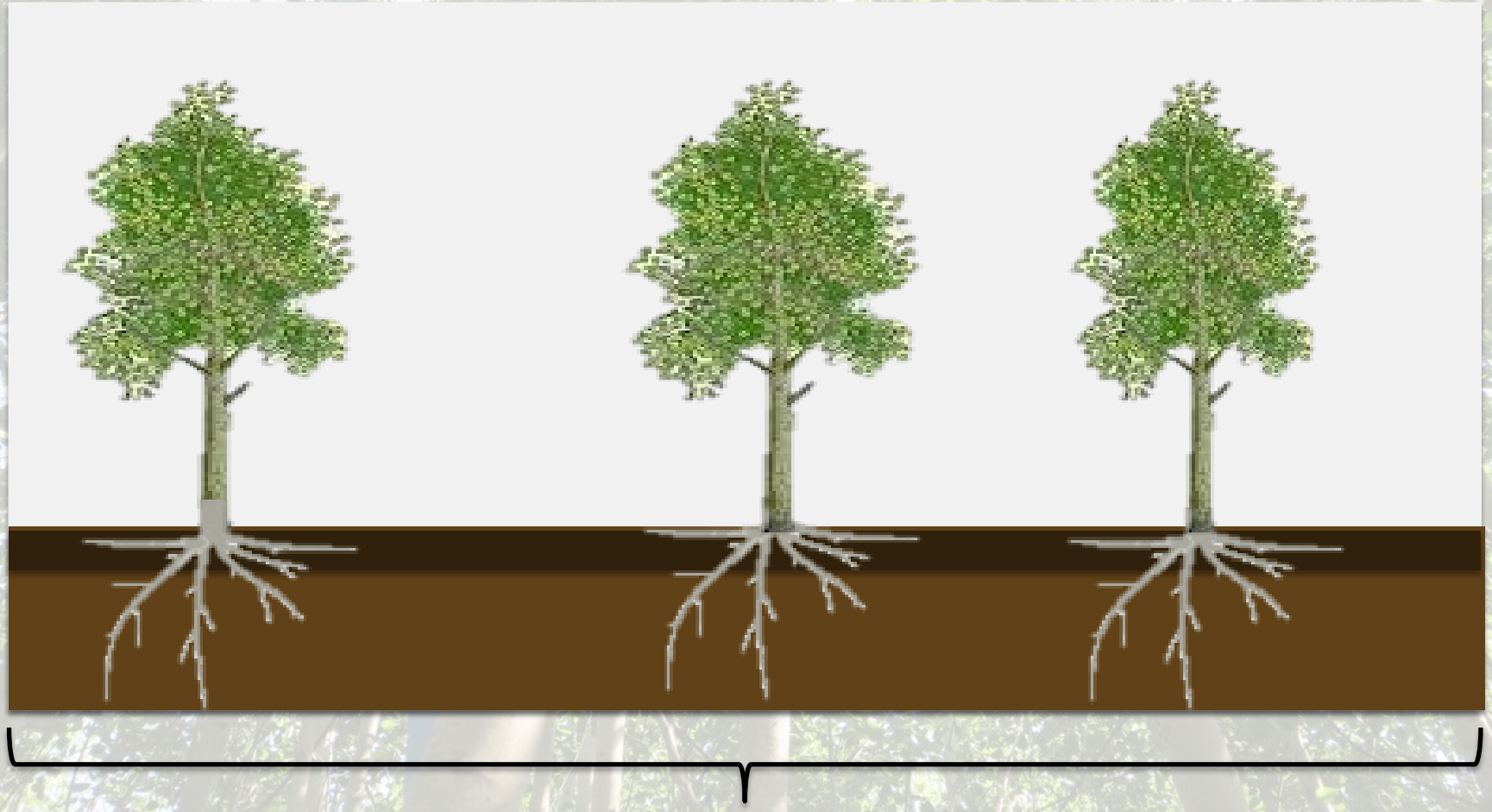

Bell et al 1999; Mulak et al 2006

# Introduction



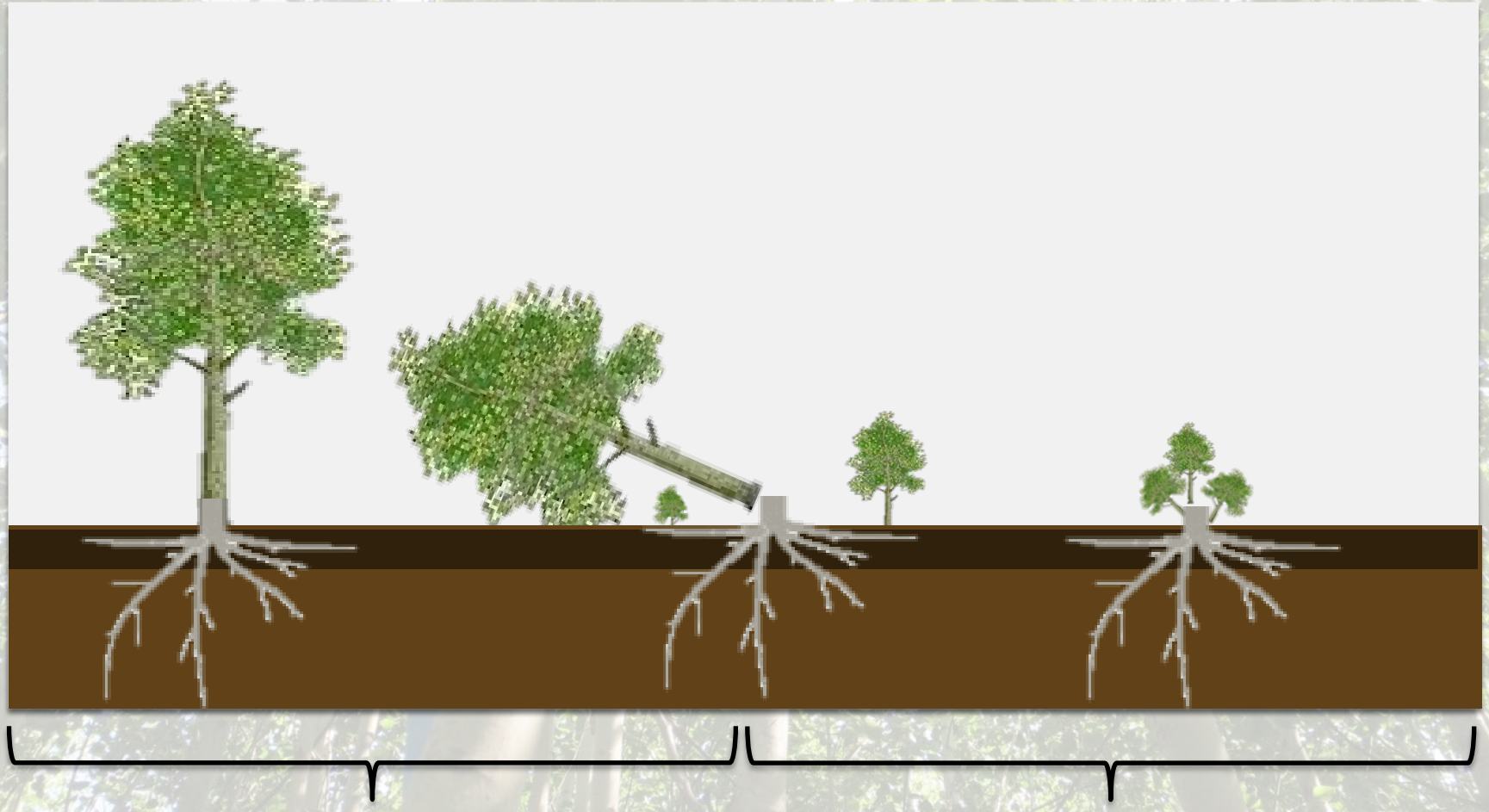

http://www.borealscience.org/wp-content/uploads/2012/06/map-boreal-disturbances1.jpg

# Seedling origin



# Canopy conditions

# Seedling origin



# Research Site


https://www.thoughtco.com/blank-us-maps-and-other-countries-4070241

# Research Site

Ellerslie Research Station, planted aspen sites

# Research Site

**Large Diameter (LD)**
**10,000 stems ha$^{-1}$**

**Small Diameter (SD)**
**29,000 stems ha$^{-1}$**

# Research Questions

1. Does height at which a tree is cut affect the number of suckers and stump sprouts produced?
   - Does the planting density of a stand have a further effect on this?

2. Does the production of stump sprouts inhibit the production of suckers?

3. How does a seedling origin stand respond to clear-cutting?

4. How do root characteristics differ between planted stands, and how do they influence suckering?

# Treatments (2015, RQ 1,2)

Control – Severed Roots – High cut (25cm) – Low cut (0 cm)

(10 trees per treatment per stand = 80 trees)


# August 2015

- Roots from treatment trees excavated and collected
- Suckers and stump sprouts collected if attached to excavated roots


April 13, 2016


April 18, 2016


April 20, 2016


June 24, 2016


June 30, 2016


July 8, 2016

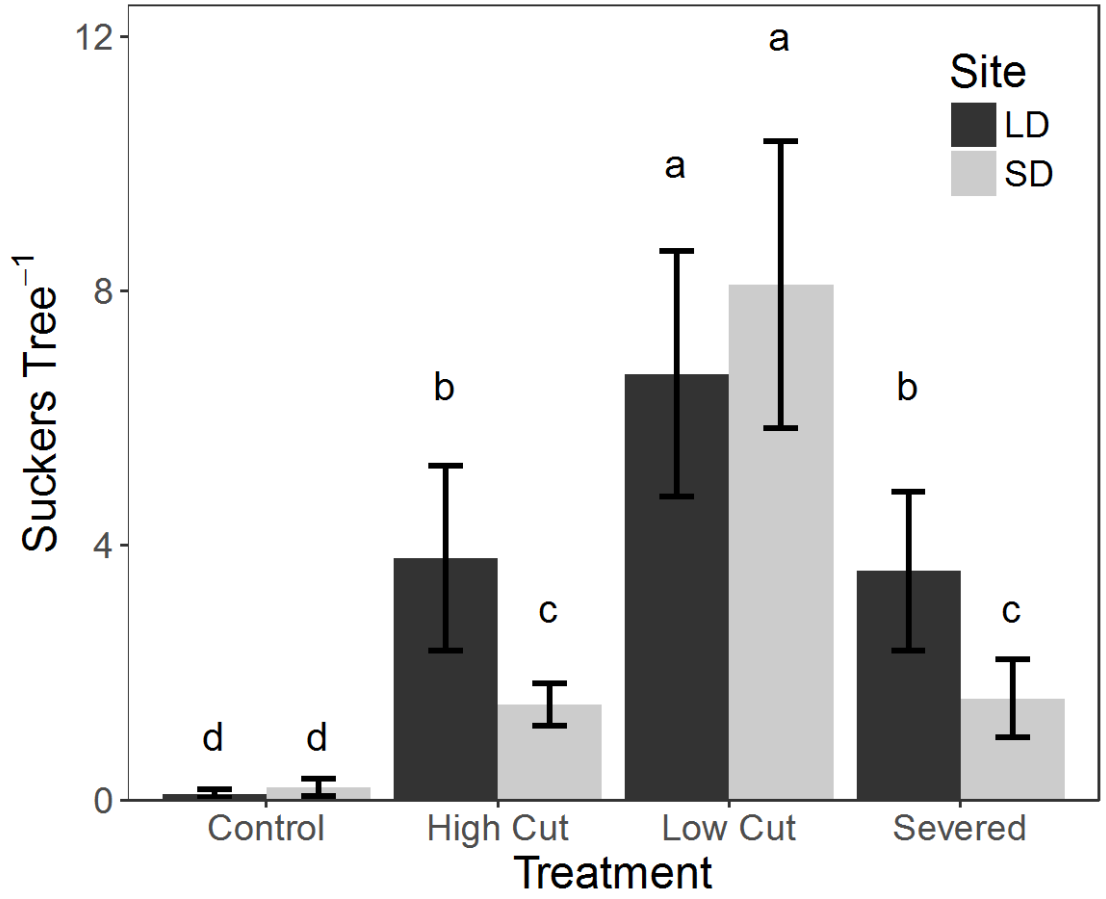

July 25, 2016


July 25, 2016


August 18, 2016

# Results

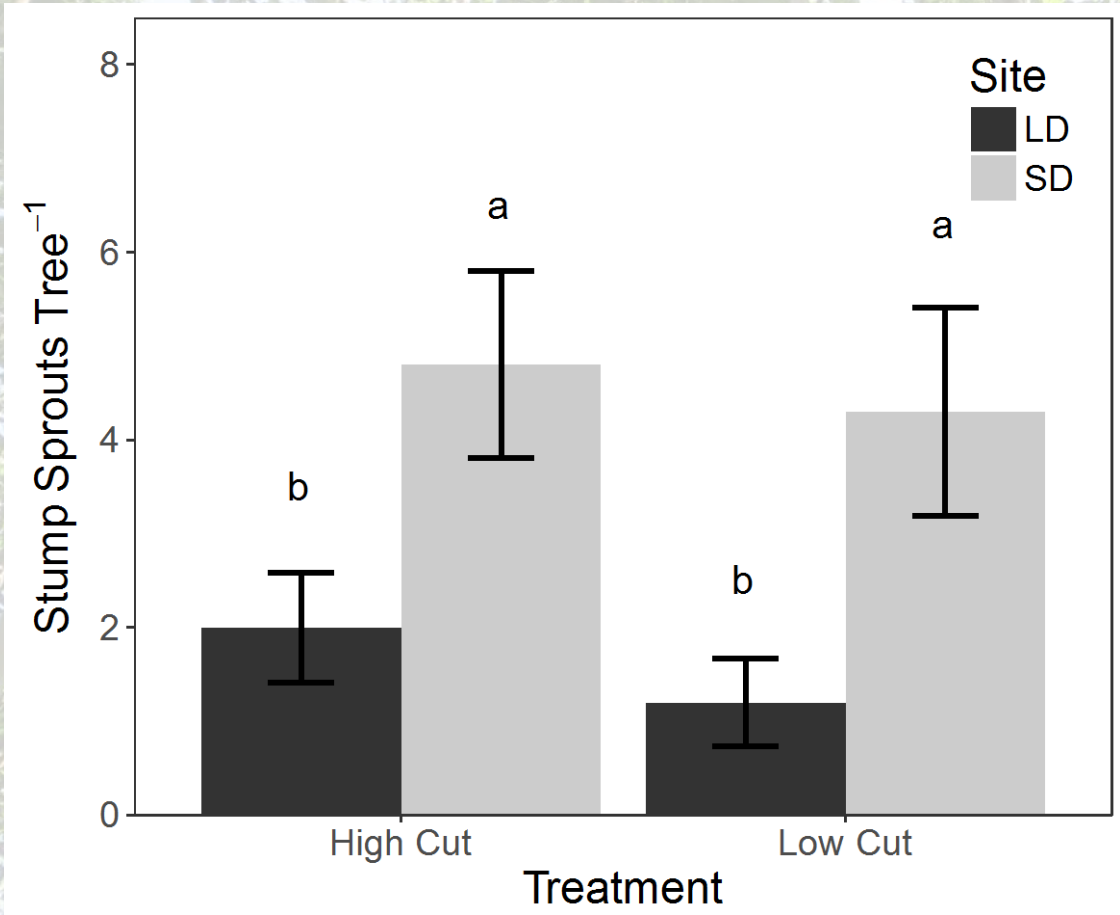
# RQ1a. Does cut height affect the number of suckers produced? Does stand diameter affect this?




| | |
|---|---|
| **Treatment** | **<0.001 **** |
| Stand | 0.079 ‘ |
| **Treatment x Stand** | **<0.001 **** |

Error Bars represent standard deviation

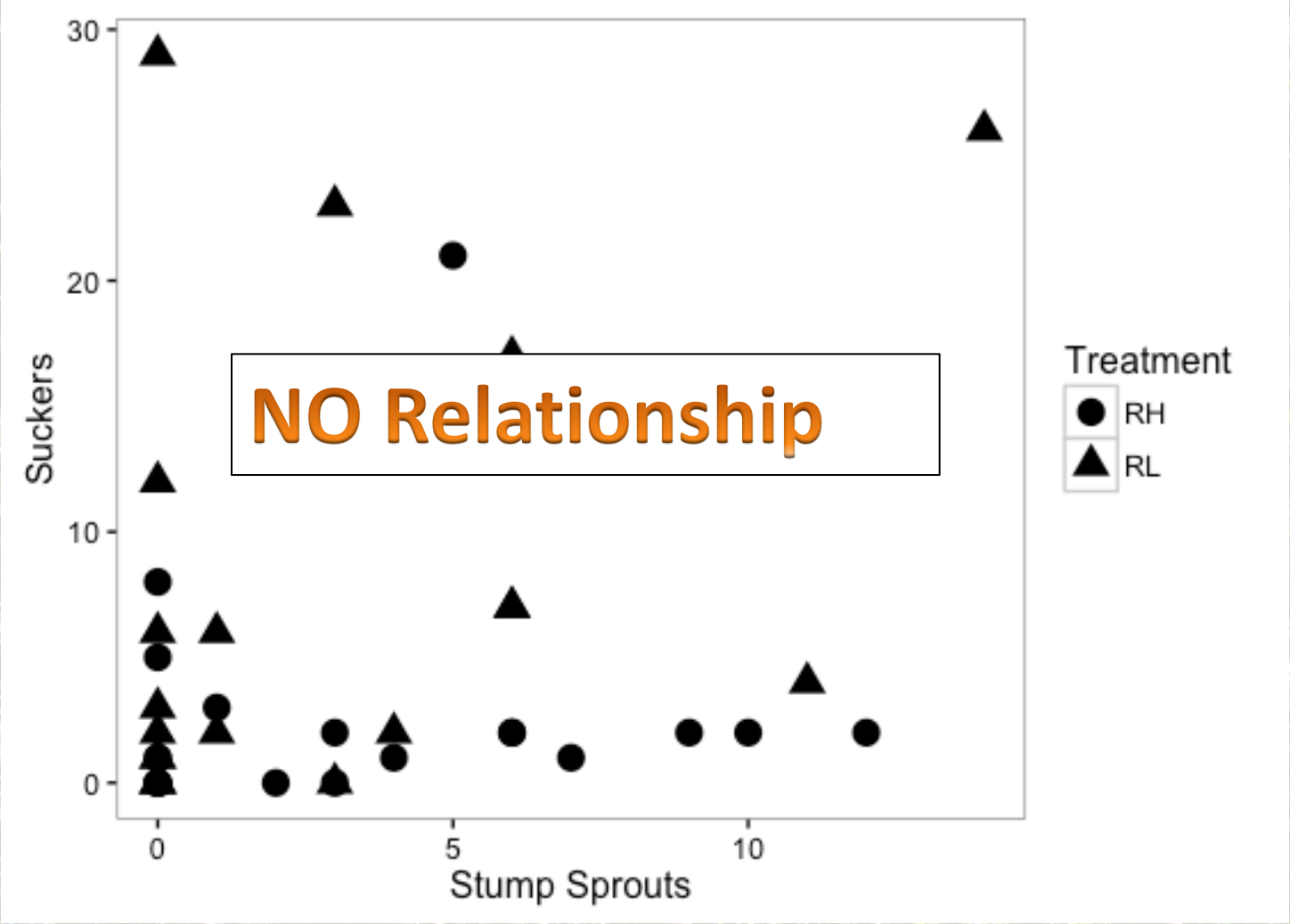
# RQ1b. Does cut height affect the number of stump sprouts produced? Does stand diameter affect this?




| | P-value |
|---|---|
| Treatment | 0.58 |
| **Stand** | **0.01** * |
| Treatment x Stand | 0.89 |

Error bars represent standard deviation

# RQ2. Does the production of stump sprouts inhibit the production of suckers?



# RQ3. How does a seedling origin stand respond to clear-cutting? (second growing season)

**Large Diameter (LD)**

**10,000 stem ha$^{-1}$ → 40,000 suckers**

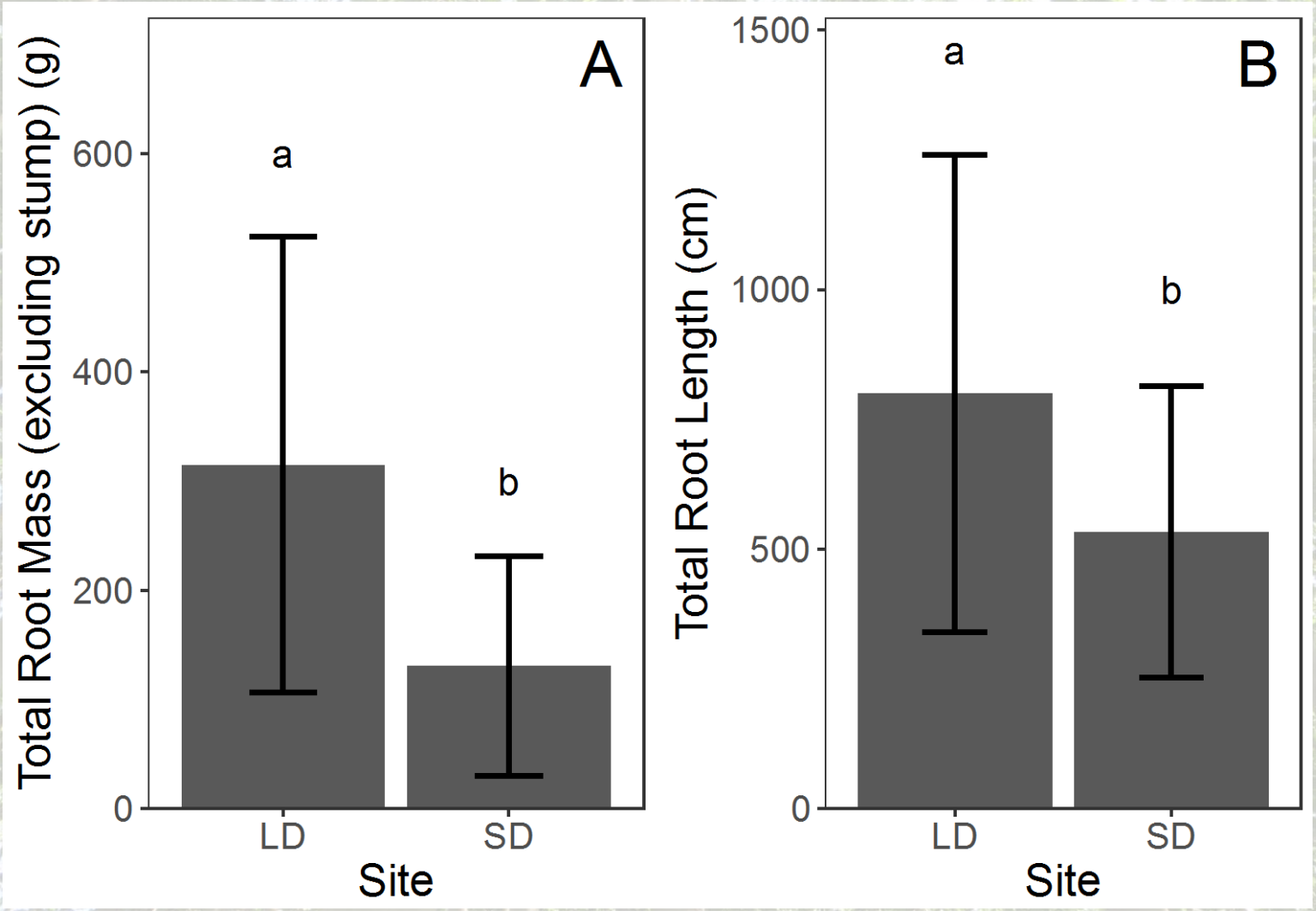
**→ 3000 stump sprouts ha$^{-1}$**

**Small Diameter (LD)**

**29,000 stems ha$^{-1}$ → 26,000 suckers**

**→ 15,225 stump sprouts ha$^{-1}$**

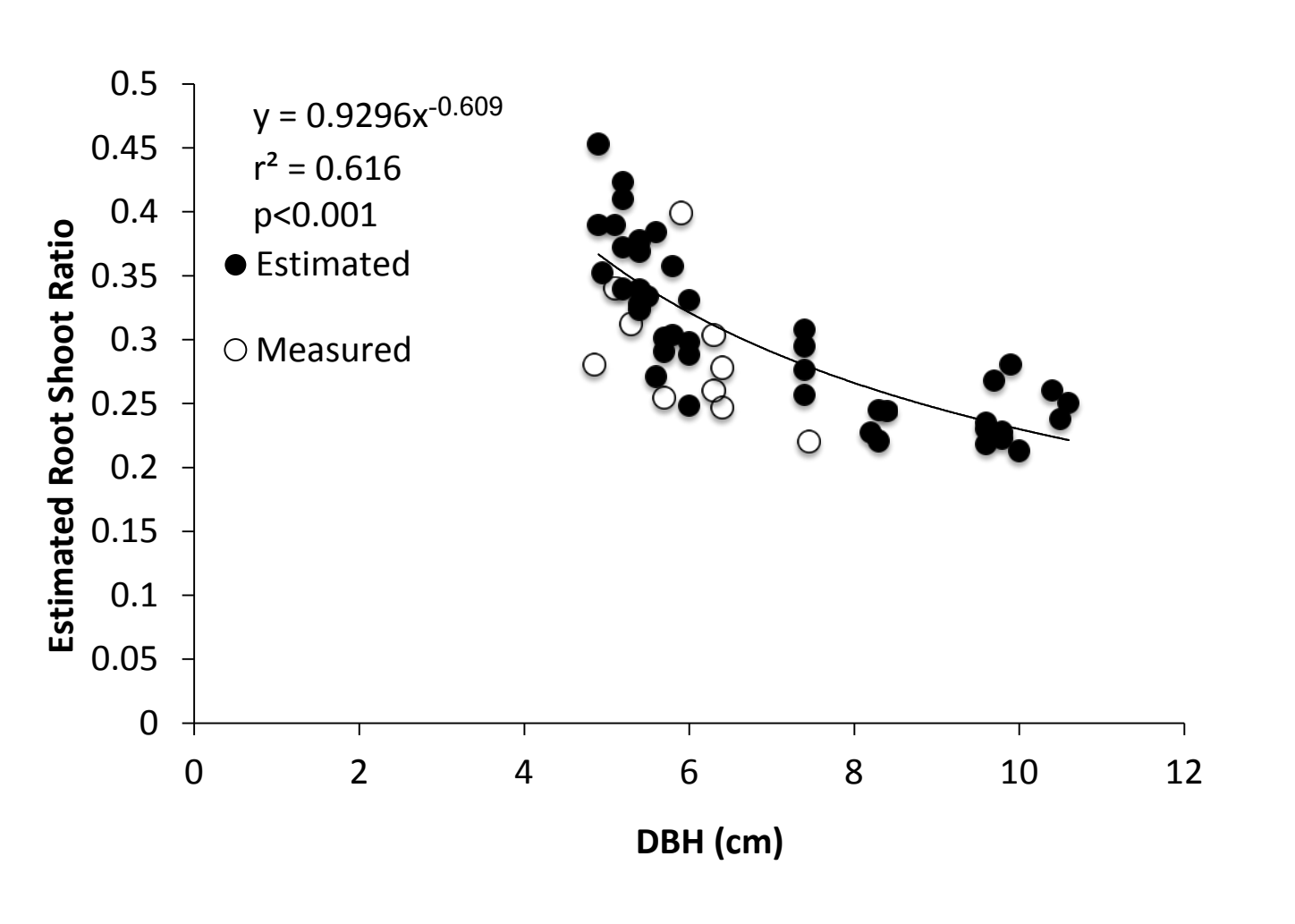
# RQ4. Do root characteristics differ between stands of different densities?



# RQ4. Do root characteristics differ between stands of different densities?

| | Root system weight kg $ha^{-1}$ | Root system length m $ha^{-1}$ |
|---|---|---|
| Large Diameter Stand | 5700 | 81856 |
| Small Diameter Stand | 3639 | 130743 |

# RQ4. How do root characteristics change with tree DBH?



# Conclusions

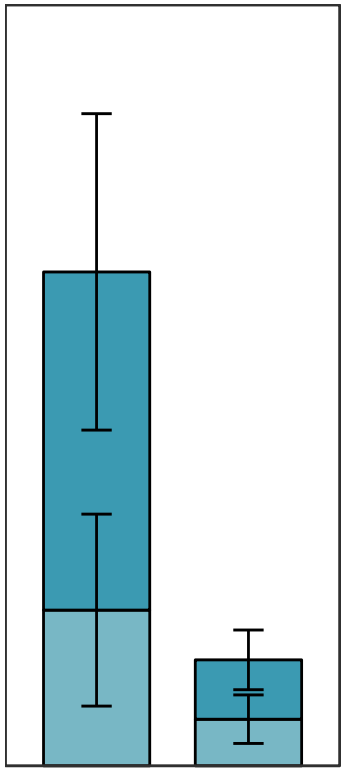
# Conclusions

- Juvenile aspen from seedling origin do produce suckers
  - 4 suckers / tree as an overall average, up to an average of 8 suckers per tree in the low cut treatments
- Cut height affects sucker production
  - Low cuts produce more suckers than control and severed root treatments
- Severing roots has a comparable effect to high cut treatments
- Smaller diameter stands produce more stump sprouts
  - Stump sprout production does not inhibit sucker production

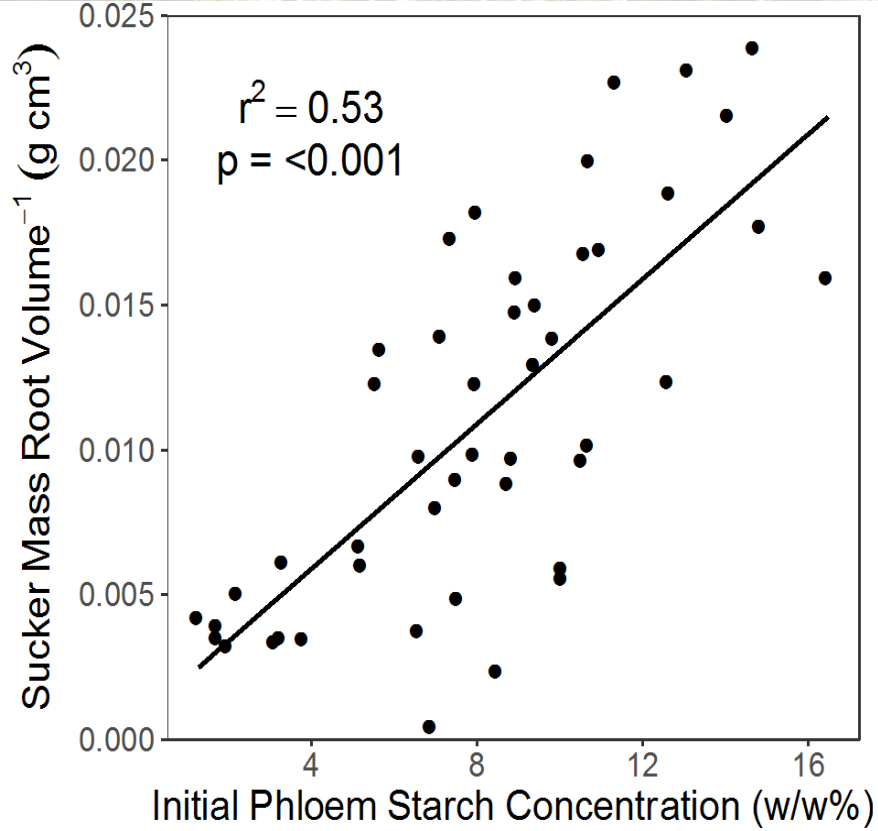
# Implications

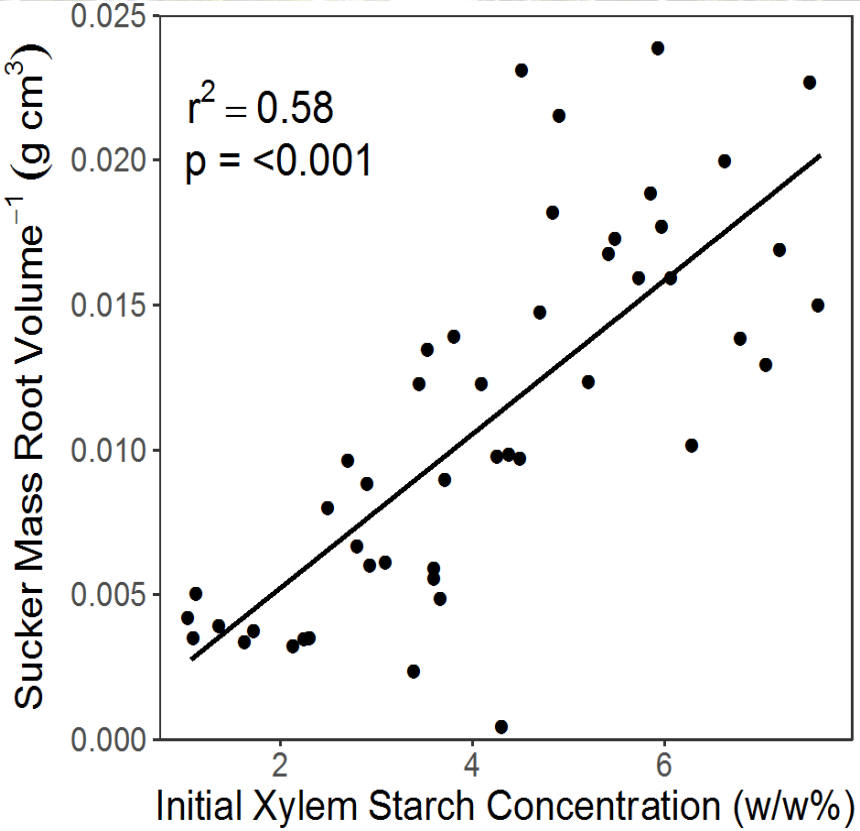
- Stem density can be increased in planted stands by low-severity disturbance (root severing) or canopy removal
  - BUT Suckering was highly variable in our study
  - 0 – 28 suckers per cut tree (2015), average of 4/tree (2016)
- Intra-species root competition likely has an impact on regeneration (Bockstette et al. In Press)
  - A stand with 81 km of roots $ha^{-1}$ was able to produce 40,000 stems $ha^{-1}$ compared to 130 km of roots $ha^{-1}$ producing 26,000 stems $ha^{-1}$
- More research into rooting behavior is needed
- Suckering also likely driven by storage

# Total Storage Dynamics



# Storage drives suckering



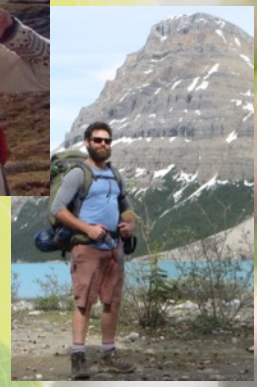



# Thank You

Thank you to Erin Wiley, Fran Leishman, Pak Chow, and the rest of the Landhäusser Research Group for your help in the field and the lab





References:
Bell F.W., D.G. Pitt, A.E. Morneault, S.W. Pickering. 1999. Response of immature trembling aspen to season and height of cut. N J Appl For 16:108–14.
Mulak T, S.M. Landhäusser, V.J. Lieffers. 2006. Effects of timing of cleaning and residual density on regeneration of juvenile aspen stands. For Ecol Manage 232:198–204
Bockstette, S.W., B.D. Pinno, M.F. Dyck, S.M. Landhäusser. In Press. Root competition, not soil compaction, restricts access to soil resources for aspen on a reclaimed mine soil. J Bot

Landhäusser Research Group

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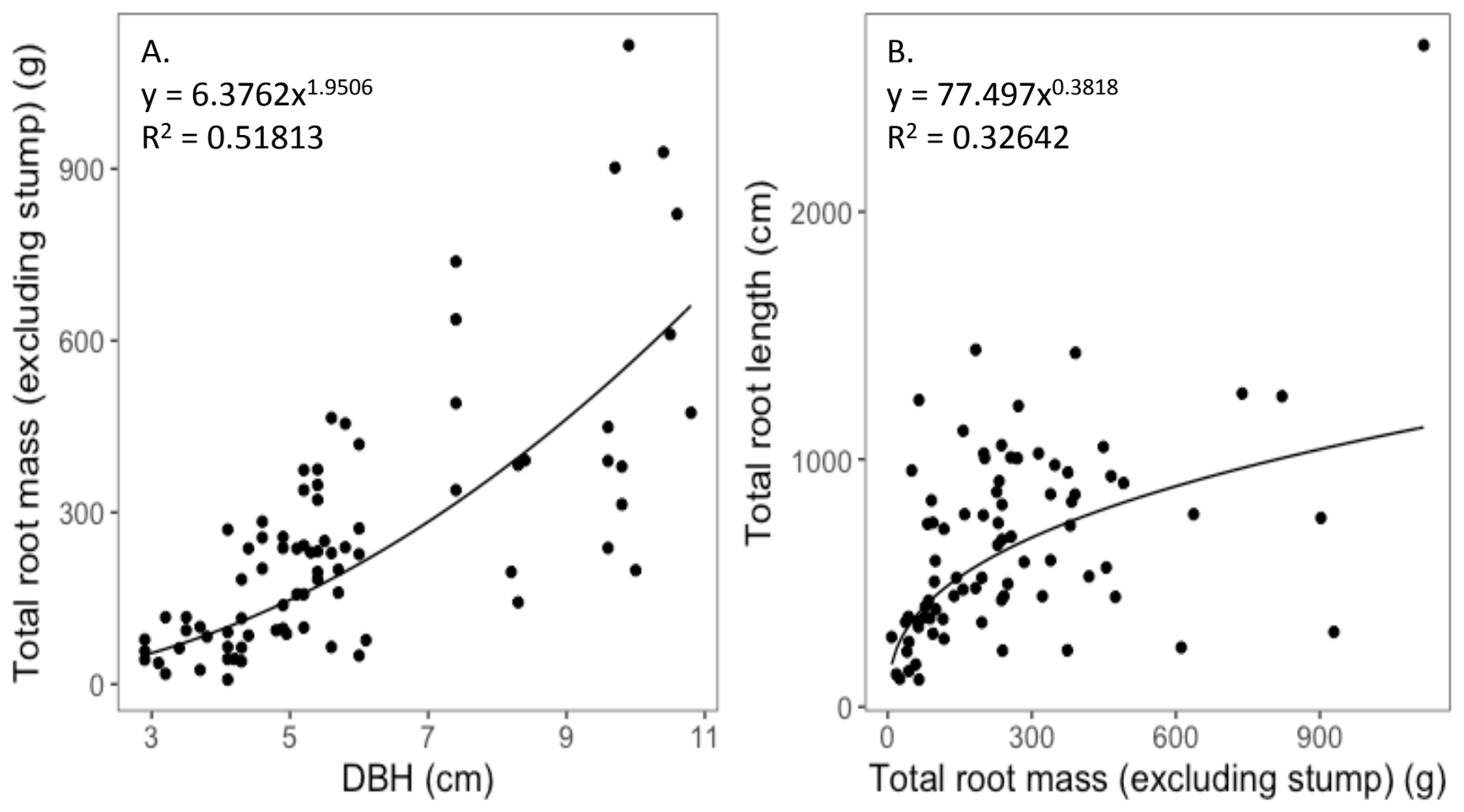
CANADA'S OIL SANDS INNOVATION ALLIANCE

# Cutting vs. Trenching

## Severed root trees survived!

# Root relationships



# Root relationships

| Site | Site Characteristics | | 2016 Sucker Characteristics | | 2016 Stump Sprout Characteristics | |
|---|---|---|---|---|---|---|
| | Density (stems $ha^{-1}$) | Basal Area ($m^2$ $ha^{-1}$) | Regeneration (stems $ha^{-1}$) | Average Height (cm) | Regeneration (stems $ha^{-1}$) | Average Height (cm) |
| Large diameter | 10000 | 79 | 40380 ± 6264 a | 59 ± 44 a | 3000 ± 1811 a | 67 ± 43 a |
| Small diameter | 29000 | 49 | 26025 ± 665 b | 48 ± 37 b | 15225 ± 2212 b | 64 ± 45 a |