Tools and techniques to enhance forest development on industrial disturbances

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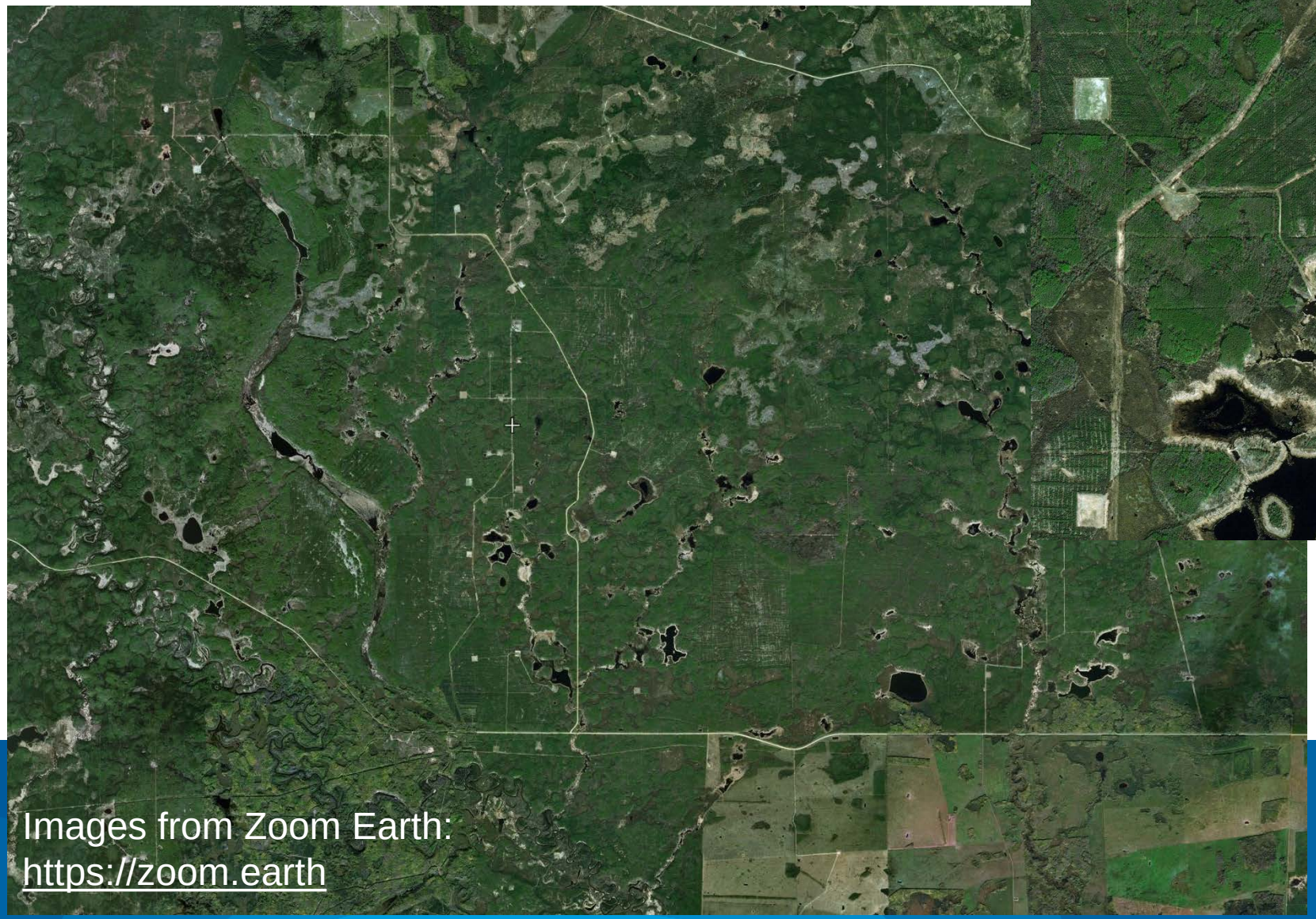
Context for today's presentation

- Industrial disturbances in NW Alberta have been present in this landscape for decades.
- In recent years, operators have been working towards the reclamation and ultimately certification of these legacy sites.
- Due to age of these disturbances, there are immense variations in site conditions and some real challenges towards successful reclamation and reforestation of these sites.
- Today we will discuss two legacy challenges: agronomic vegetation and mulching winter access sites

Images near Sulfur Lake, AB



Images from Zoom Earth:
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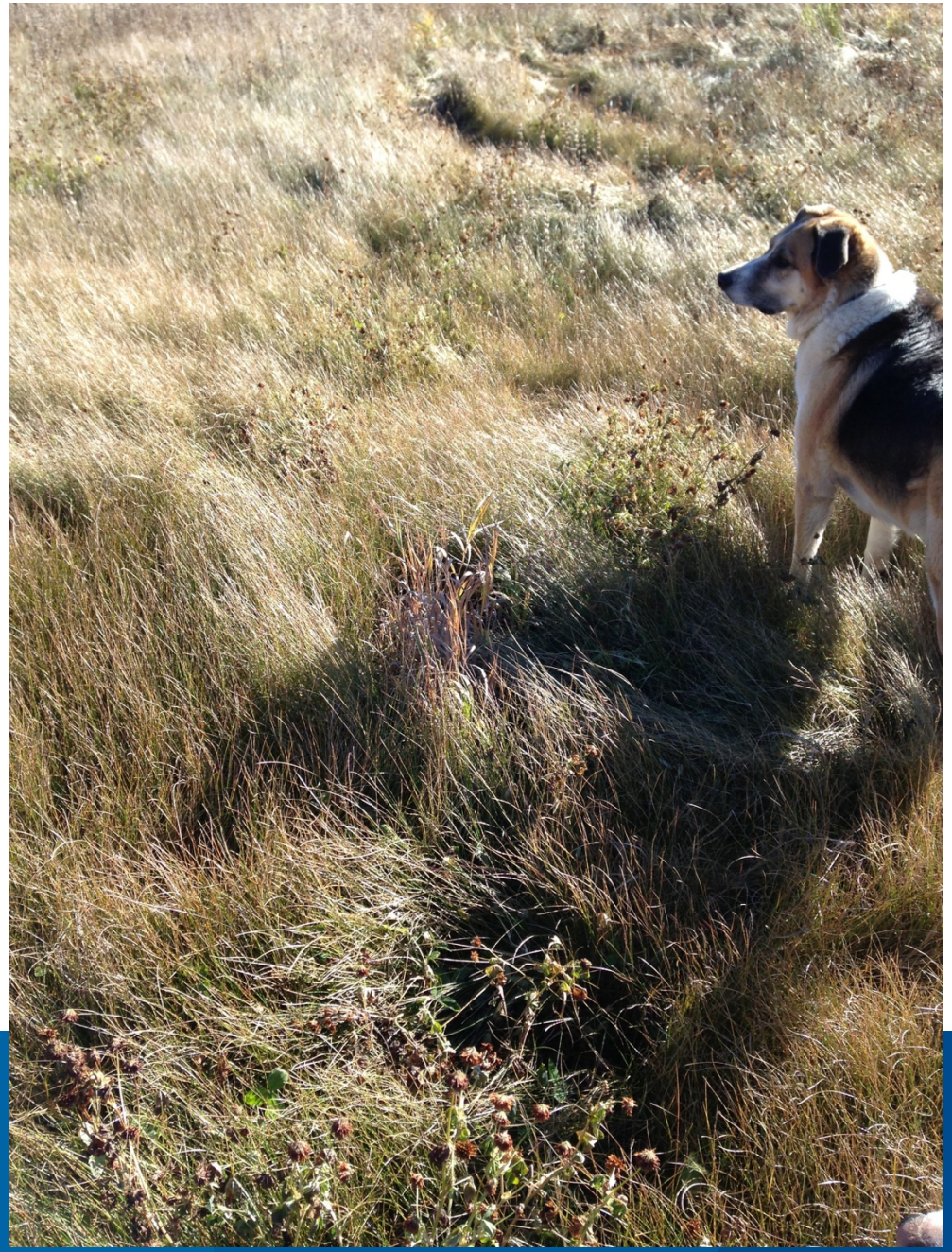
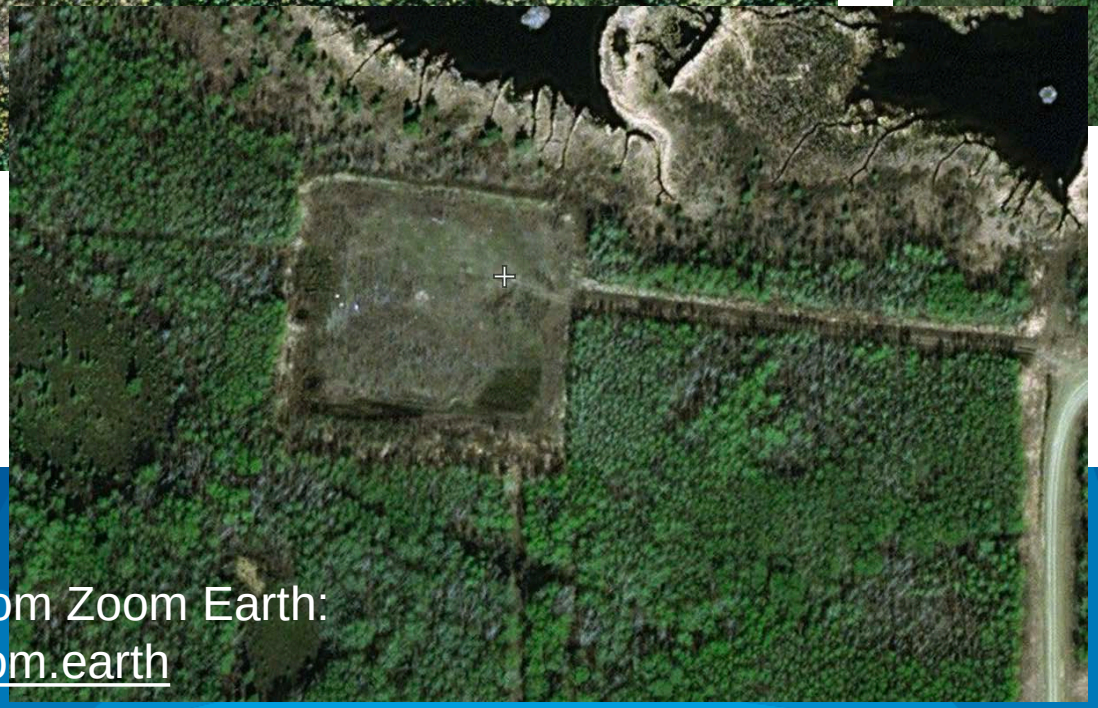
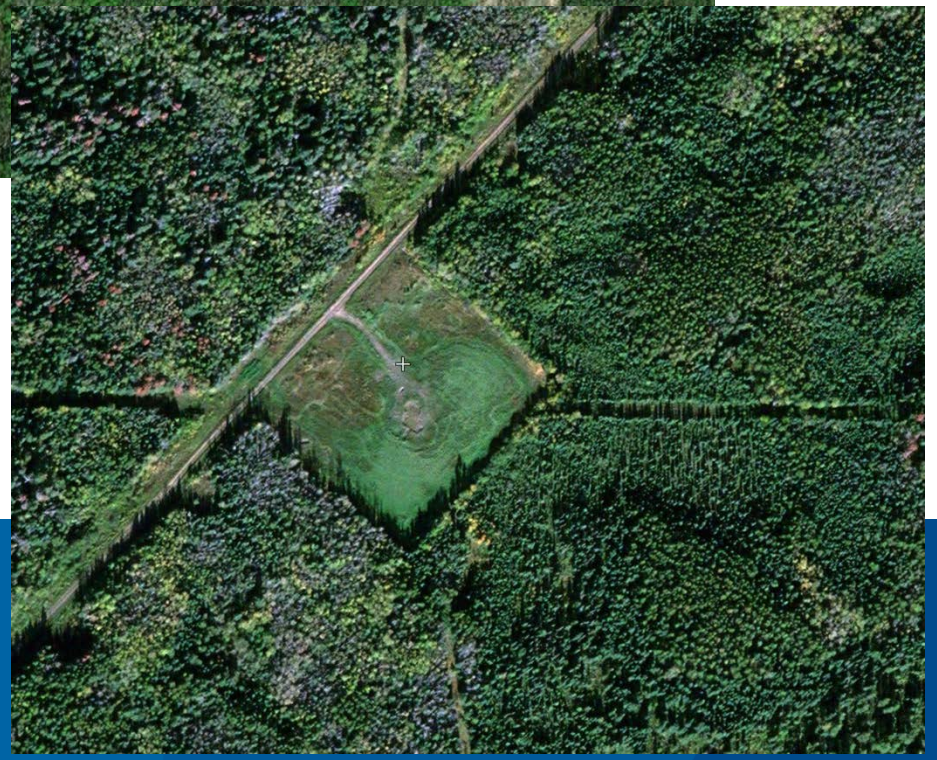
Challenge #1: competition from agronomic species

Sod removal study

- This study evaluated a reclamation practice involving soil stripping of sod material surrounding well sites.







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Methodology

- Sod removal was tested on 5 recently reclaimed well sites: all were located NW of Dixonville, AB
- Earthworks activities through Fall 2013:
  - The existing grass sod which surrounded the well centers were stripped (2-3”) and piled
  - Sites were recontoured and de-compacted (straight rippers)
  - Subsoil and topsoil were placed; grass sod was spread on 1/3 of site
  - Final ripping with straight shanks
- White spruce (*Picea glauca*) seedlings were planted summer 2014
- Vegetation monitoring occurred in 2014 and 2015.
  - Four 3.98 m radius circular plots were conducted in each soil treatment where stem count by species was determined as well as total height.
  - Three random 0.5 x 0.5 m quadrats were used to determine % vegetation cover by species

Sod placement vs removal

With sod

Without sod

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Sod present

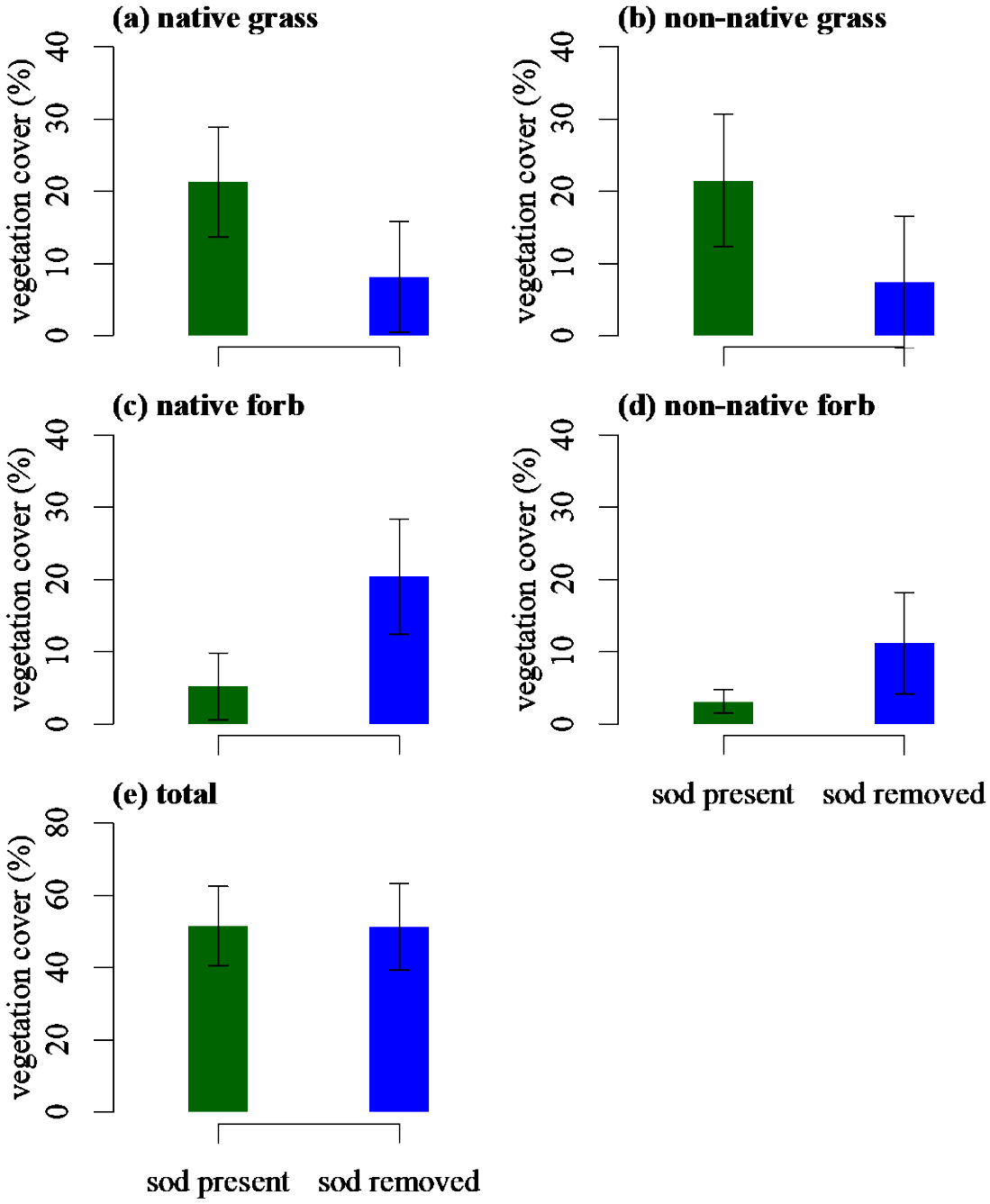
Sod removed

Sod present

Sod removed

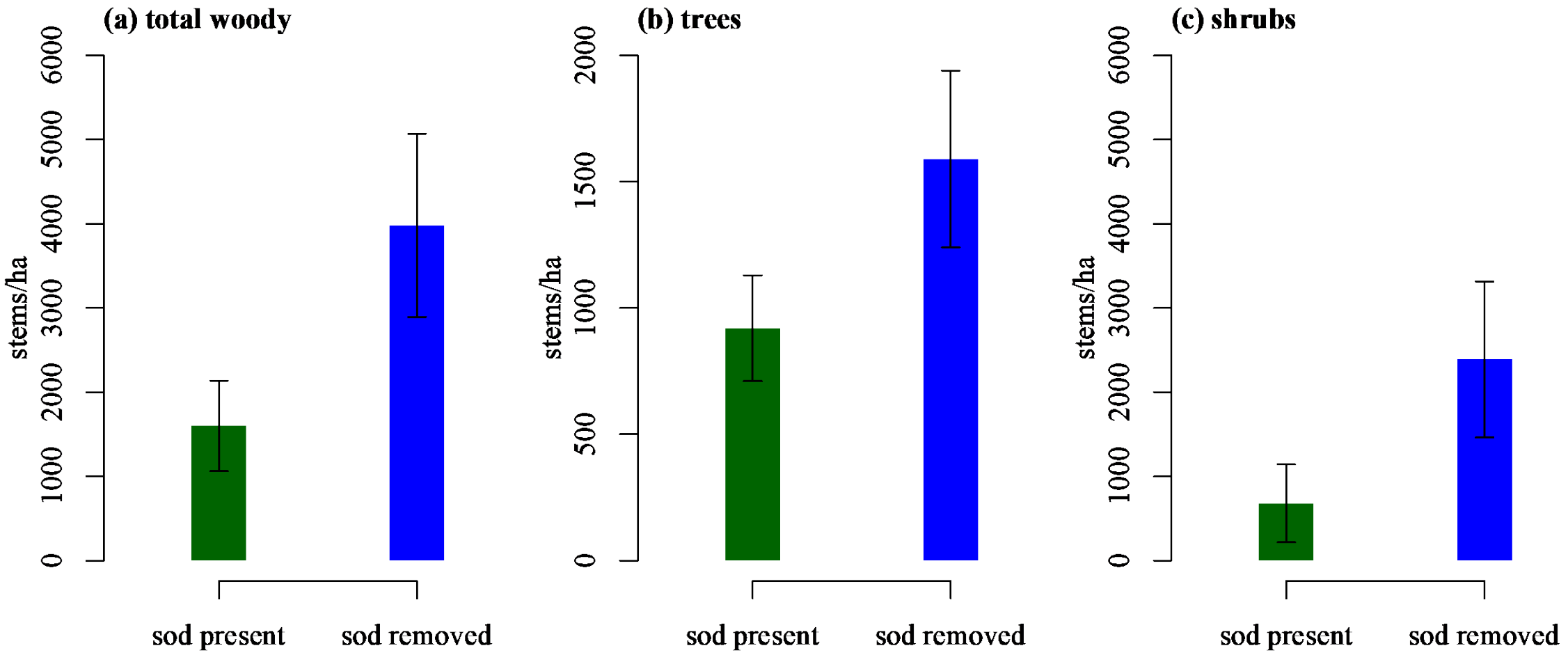
Effect on vegetation cover (2 growing seasons later)

- Sod present: more grass, both native and non-native
- Sod removed: less grass, more forbs both native and non-native
- Overall coverage similar between treatments



*Error bars = 1 standard error of the mean

Effect on observed density (2 growing seasons later)



*Error bars = 1 standard error of the mean

Summary learnings

- Removing the sod material is a recommended best-practice to favor establishment of native forest species.
- Likely driven by lower overall grass coverage as the sod-removal treatment favored native forb over non-native forb cover.
- Summary recommendations:
  - Pay attention to soil stockpile stripping, if you believe there will be substantive grass sod, consider isolating heavily infested material for special management.
  - Though high grass coverage was likely somewhat detrimental, this effect does also illustrate how well grasses can manage down non-native forb cover. Future work could include further examining appropriate coverage of grasses that can maintain this effect but not hinder native forest species to the same degree.

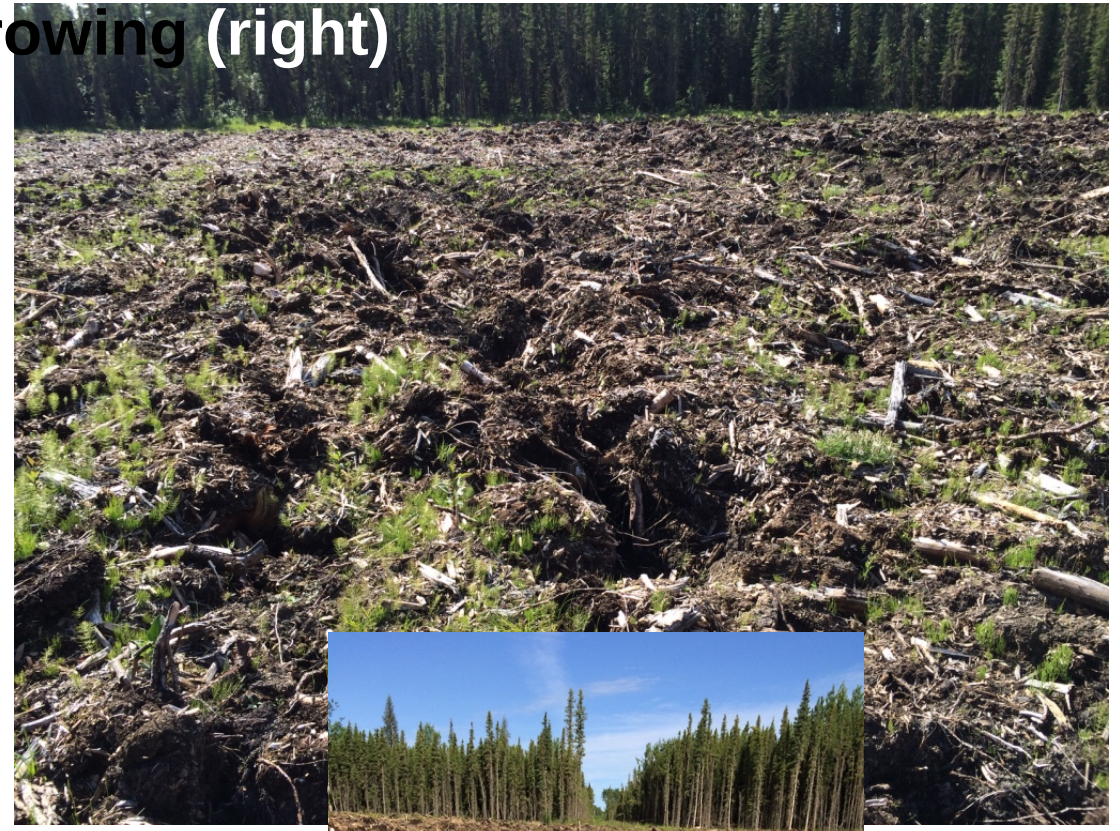
Challenge #2: wood mulching

Methodology

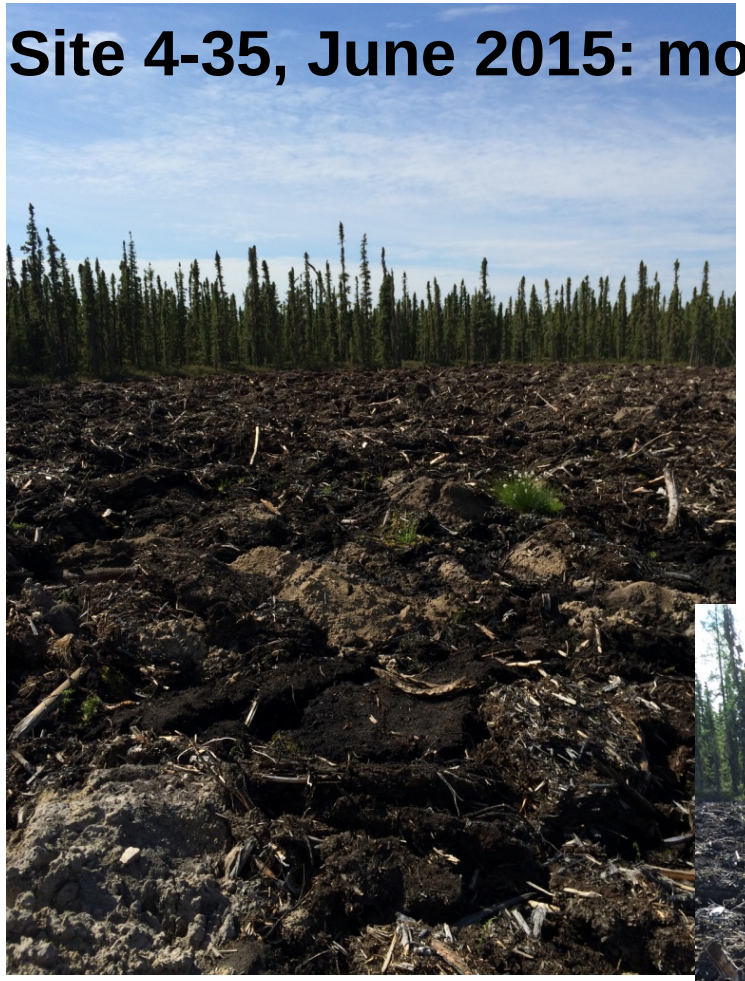
- Oil-sands exploration sites that were supposed to be minimal disturbance, winter access drilling
- As sites were transitional (lots of skinny black spruce), they were mulched to facilitate access and protect ground surface
- Following drilling, natural recovery was poor due to cyclic effect of mulch (too wet or too dry)
- This experiment evaluated two mechanical approaches to displace mulch: furrowing with RipPlows or rough/loose mounding with an excavator

Entire site was disturbed in December 2014 – purpose being to displace mulch

Site 7-31, June 2015: mounding (left) and furrowing (right)



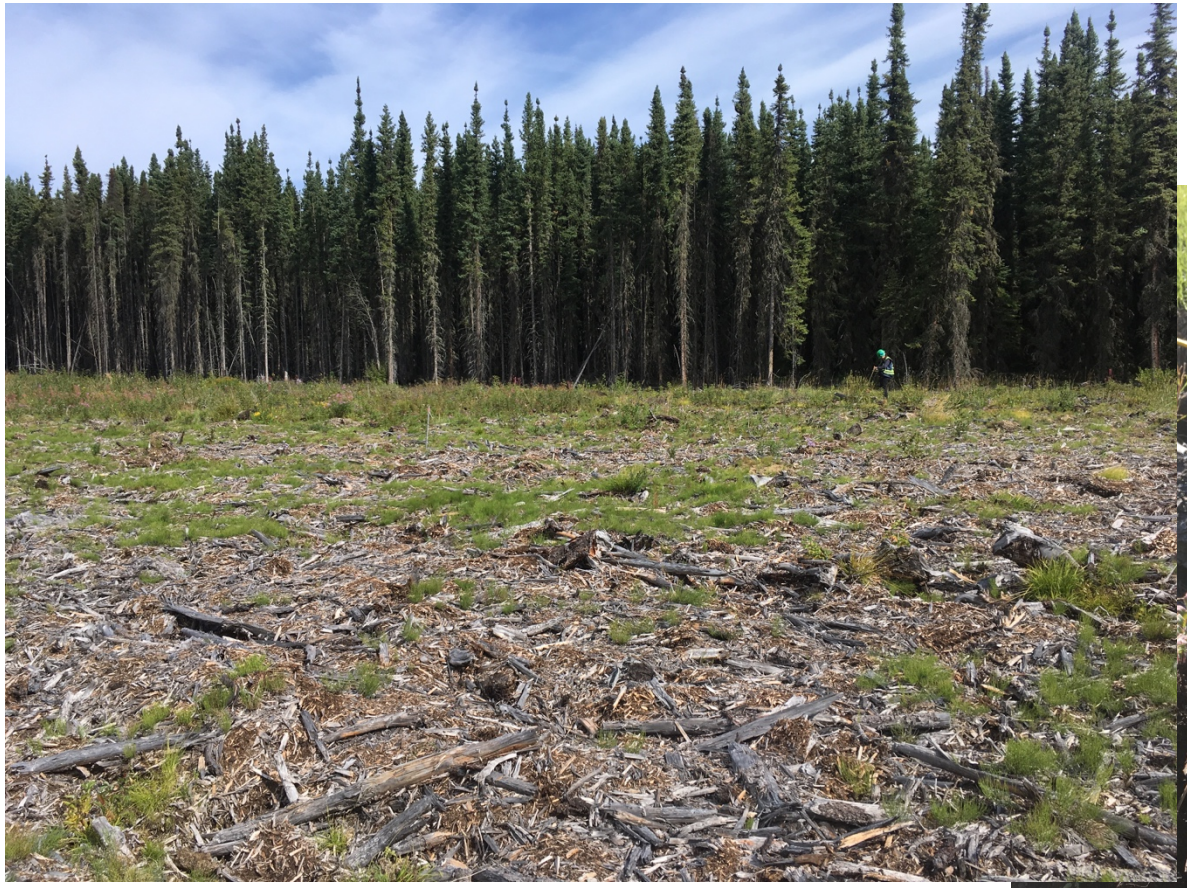
Site 4-35, June 2015: mounding (left) and furrowing (right)



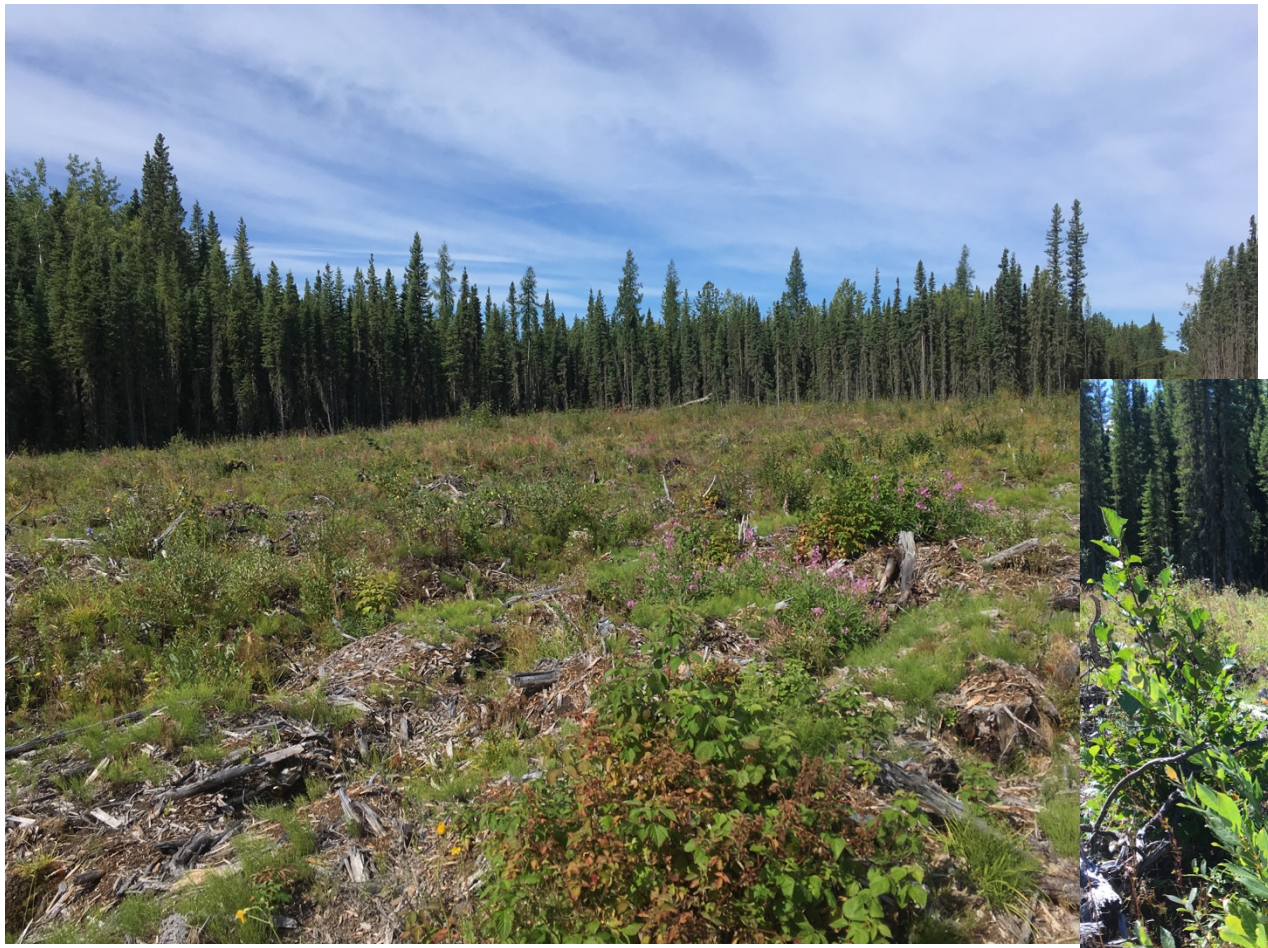
Site 7-31: Summer 2014

Site 7-31: Summer 2017

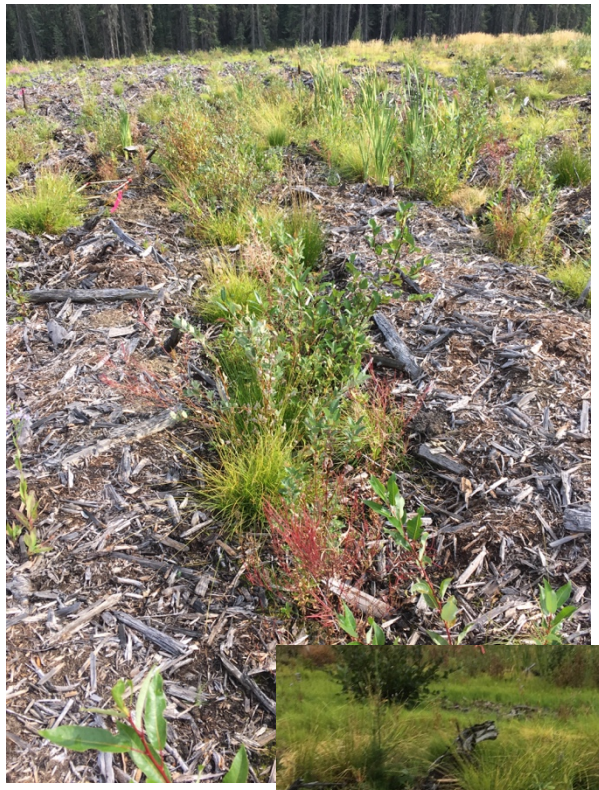
Site 7-31: Furrowing with RipPlows

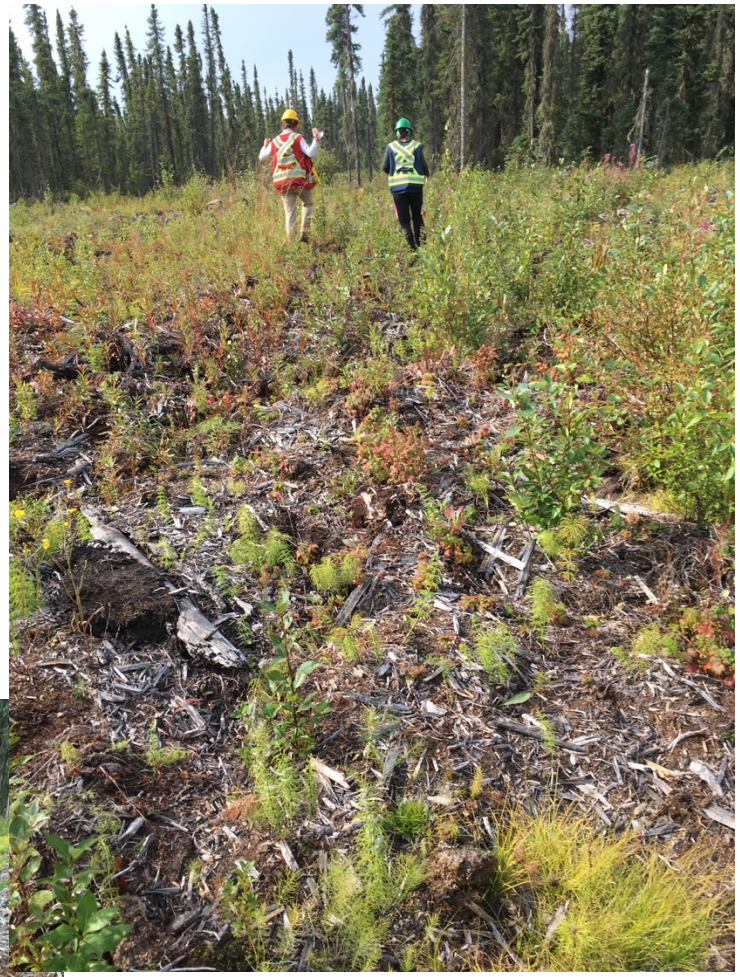


Site 7-31: Rough/loose mounding with excavator



Site 4-35: Furrowing with RipPlows





Site 4-35: Rough/loose mounding with excavator

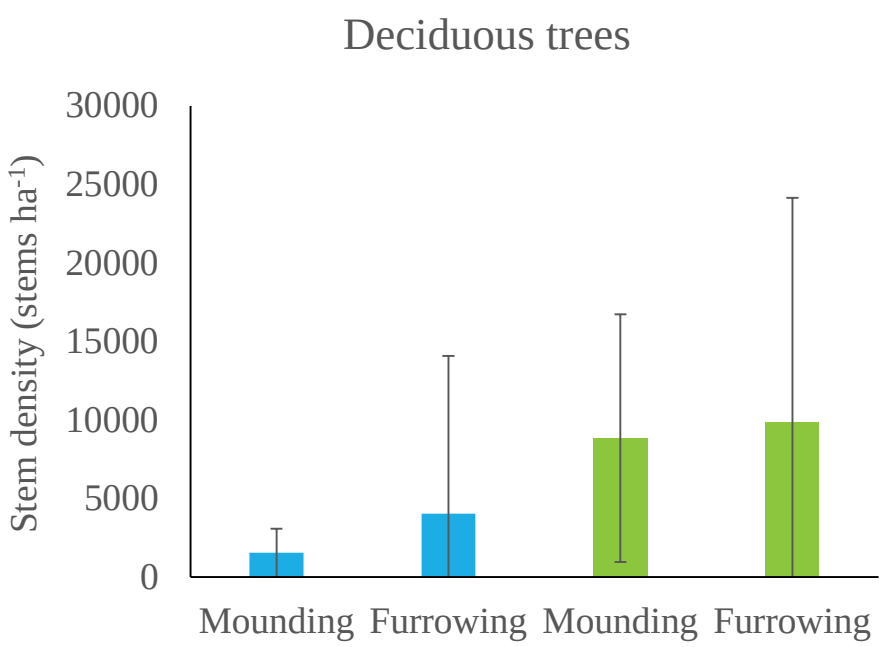
A quick side-bar on some interesting plant stuff (for the plant nerds)

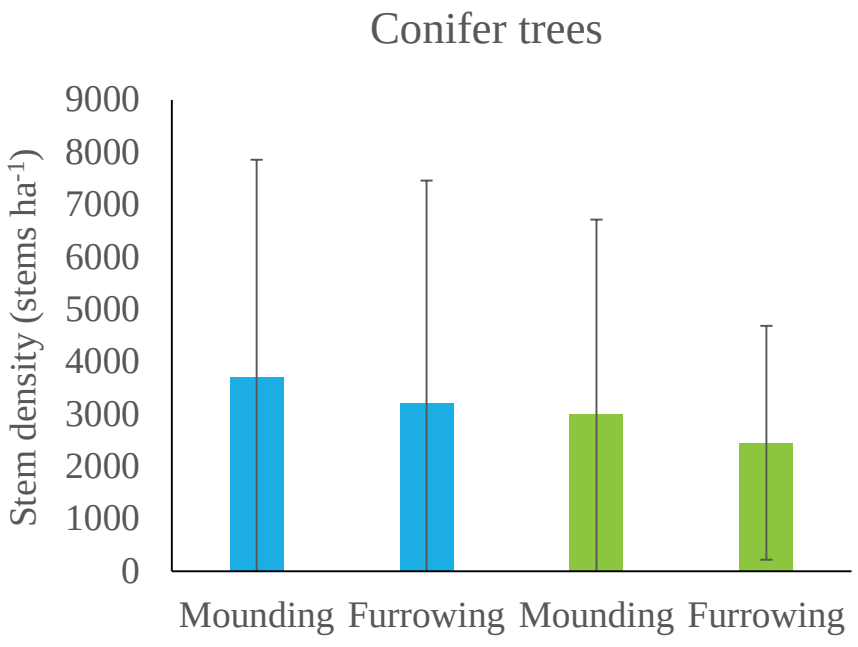
Tree and shrub regeneration: summer 2017

- Lots of natural ingress of trees and shrubs from surrounding forest
- Dominant shrubs were willows
- Fewer deciduous trees on site 4-35
- No systematic difference between mulch displacement approaches after 3 years

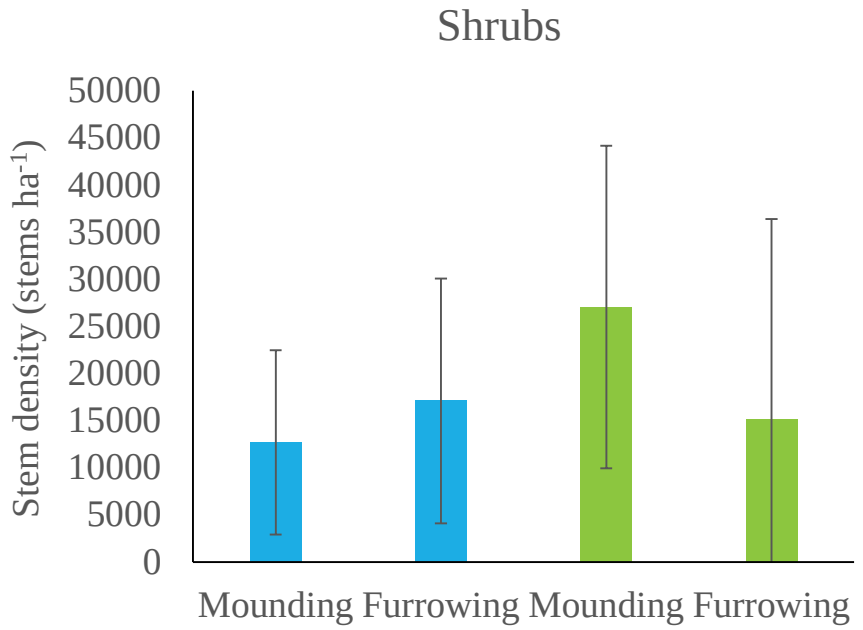
Blue bars = site 4-35

Green bars = site 7-31





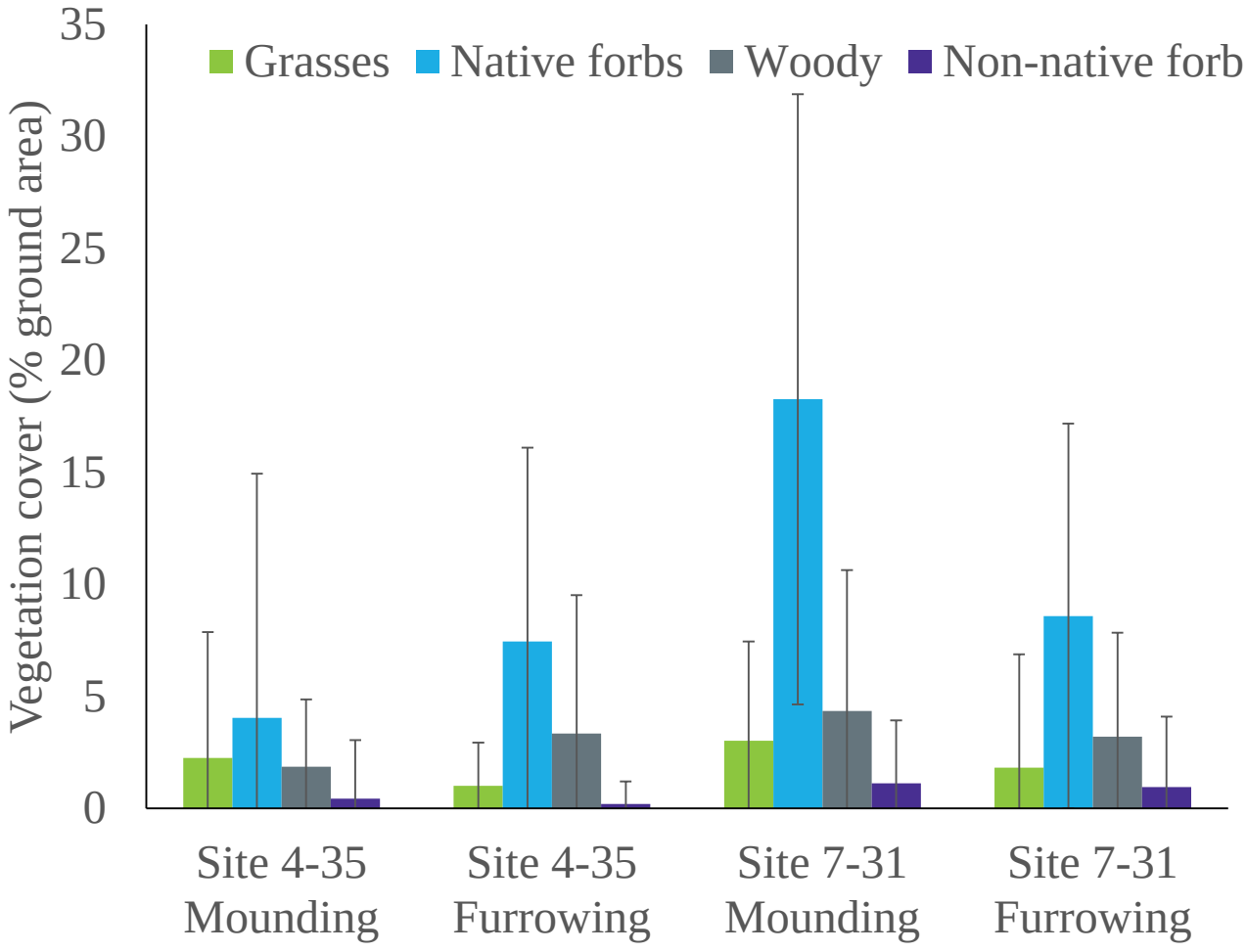
Species planted Fall 2014	# stems ha^{-1}
Black spruce	2,000
Tamarack	1,000
Labrador Tea	500
Bog cranberry	500
Green alder	500
Total woody	4,500



*Error bars = one standard deviation

Vegetation cover: summer 2017

- No systematic difference between mulch displacement approaches.
- Vegetation responses appear to be more of a function of site conditions:
  - Site 4-35 wetter site
  - Site 7-31 drier site



Summary learnings

- Exposing peat or mineral soil was successful with both techniques but there was greater effective soil exposure with mounding
- Greater quantity of wood mulch left at surface (though with greater microsites) with furrowing
- Planting on these site types (transitional areas) likely not necessary as simply exposing an adequate seed bed allowed for significant natural regeneration
- Recommendations:
  - Using a dozer and rippers likely fastest but less effective where mulch deepest; consider using excavator but with less intensive mounding to expose soil but with spending less time

Acknowledgements

- NSERC, Bonavista Energy and Obsidian (formerly Pennwest Exploration)
- Research staff and summer students at Center for Boreal Research that tirelessly planted trees and collected the vegetation data presented today