Local hydrologic conditions and seismic lines in the Boreal forest of Northern Alberta

SY1.1 & 1.2 Lelia Weiland[1] Scott Ketcheson[2] Maria Strack[3]

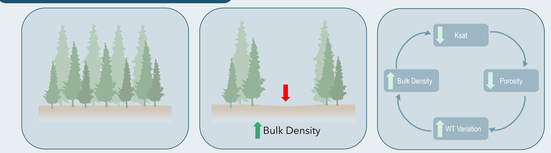
lelia.weiland@ucalgary.ca sketcheson@athabascau.ca mstrack@uwaterloo.ca

[1]University of Calgary, [2]Athabasca University, [3]University of Waterloo

Boreal Ecosystem Recovery & Assessment

AU Hydrology

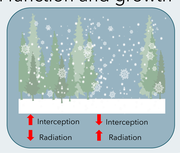
Objectives



1) Determine how soil hydrophysical properties, such as porosity, hydraulic conductivity and bulk density, are affected by the formation of seismic lines

2) Make connections on how the altered soil hydrophysical properties affect the surrounding ecosystem function and growth

3) Understand how snow properties, such as density, depth and SWE are affected by the formation and restoration of seismic lines.



Methods

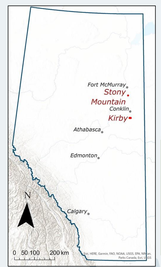


Figure 1. A map of the study sites

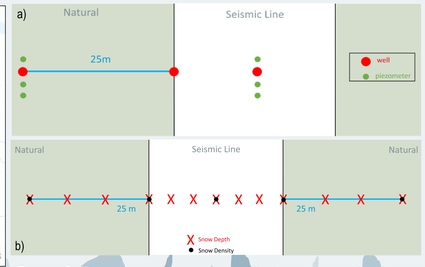


Figure 2. The transect set up at each site, perpendicular to line direction for summer (a) and winter (b)

- **Transects** perpendicular to line direction (Fig 2)
- **Water levels** measured weekly (summer 2021-22)
- **Microtopography** measured with an altimeter
- **Soil samples** taken on the line, edge and 25 m into the natural area at the surface, and 10-15 cm below the surface at the rooting zone
- Samples run through a saturated hydraulic conductivity machine to determine the Ksat of the soils
- **Snow** depth and density measured across transect in March 2022

Results

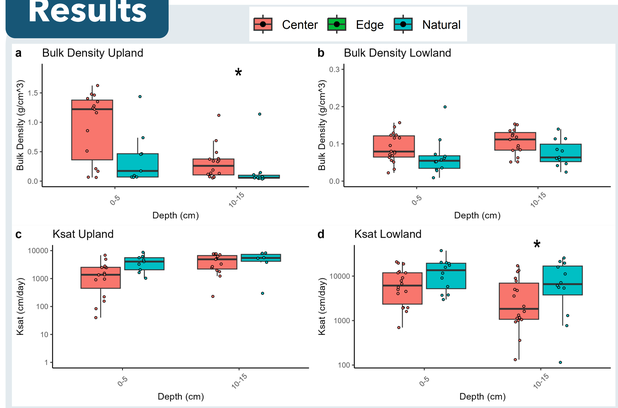


Figure 3. a) Bulk density of upland soils b) Bulk density of lowland soils c) Saturated Hydraulic Conductivity of upland soils d) Saturated Hydraulic Conductivity of lowland soils all sorted by line position and depth

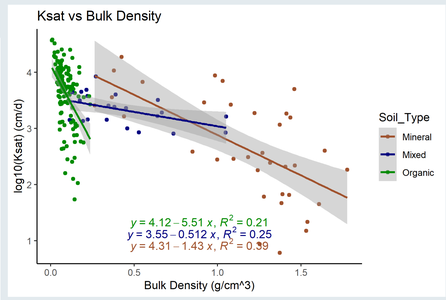


Figure 4. The bulk density of soils plotted against saturated hydraulic conductivity. The data is sorted into mineral, mixed and organic soils. Each data type was run through a linear regression model and the line of best fit and regression equation are shown here.

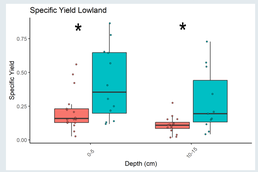


Figure 5. The specific yield of lowland soils sorted by depth and line position

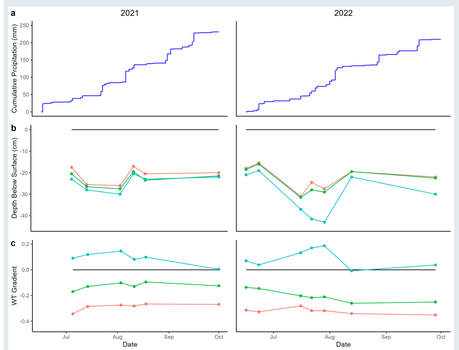


Figure 6. At a lowland ecosite a) precipitation in 2021 and 2022 b) water table depth below surface over time c) water table gradient over time

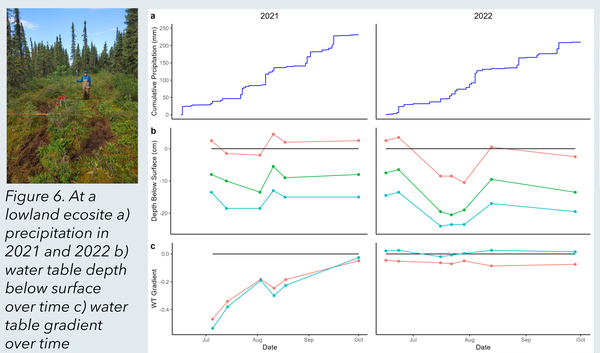


Figure 7. At a lowland ecosite a) precipitation in 2021 and 2022 b) water table depth below surface over time c) water table gradient over time

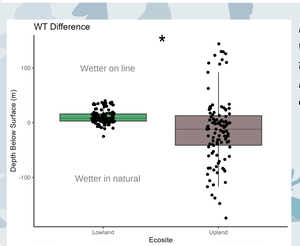


Figure 8. The difference in water table depth between the seismic line and the natural area compared by ecosite type

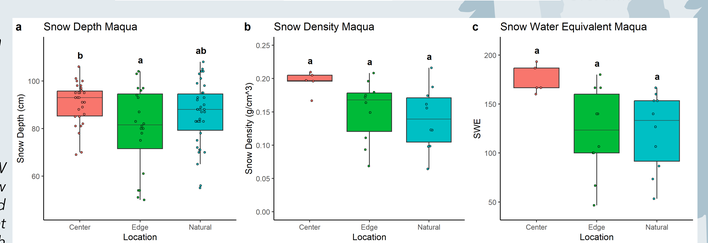


Figure 9. Along an EW seismic line the a) snow depth b) snow density and c) snow water equivalent at peak snow depth

Discussion

- Soils have greater bulk density and lower saturated hydraulic conductivity at both depths, at both ecosite types (*Fig 3*)
- As bulk density increases, saturated hydraulic conductivity decreases (*Fig 4*)
  - Organic soils are more sensitive to changes in bulk density
  - Mineral soils can have more variability in bulk density with less impact on Ksat
- Specific yield is decreased on seismic lines (*Fig 5*)
  - Lower specific yield caused by increased bulk density
  - Indicates a potential for increased water table variability
- Water table response not consistent across ecosite types (*Fig 6 and 7*)
- Water table generally closer to surface of seismic lines, but great variability (*Fig 8*)
- Snow water is greater on seismic lines due to greater snow density (*Fig 9*)

Conclusion

Seismic lines do affect hydrologic properties though inconsistently.

Further research needed to be able to pinpoint other factors (e.g. regional topography)

Next Steps

Research landscape scale hydrology-seismic line interactions

Relate changes to vegetation growth to understand seismic line growth behaviour

3rd Annual BERA 2
Fall Research Workshop 2023
Nov. 15, 2023 | Edmonton, AB