Integrating climate, soil and hydrological monitoring data with ecological assessment for prescribed burn in pine woodlands.

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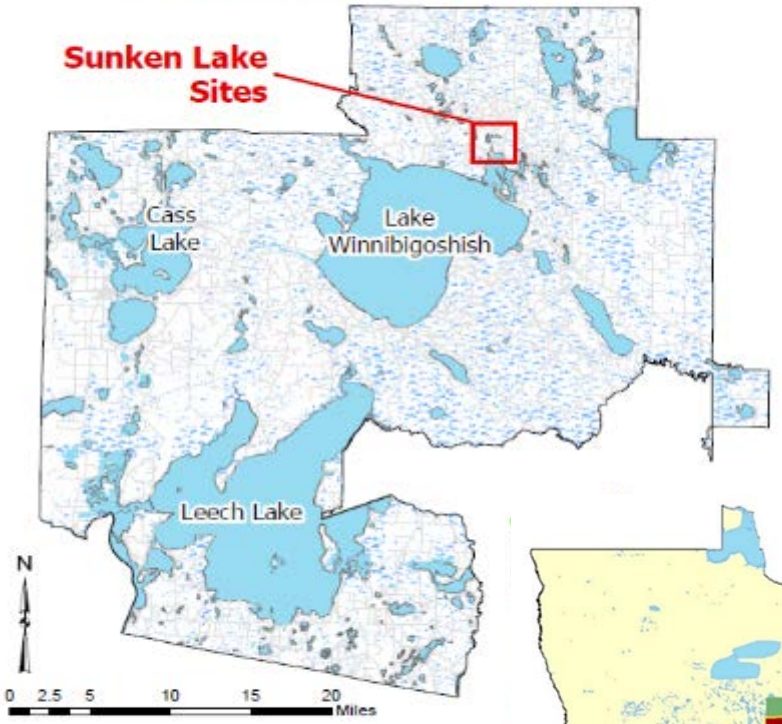
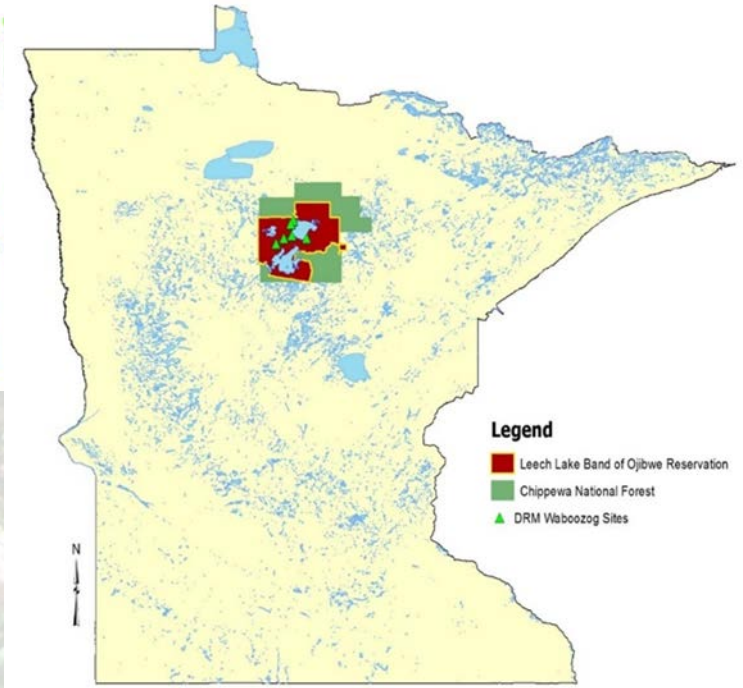
The LLBO Reservation is located in northern Minnesota, 90% of which is within the boundaries of the CNF





Shared Management

- The Leech Lake Band of Ojibwe Reservation is co-located with the Chippewa National Forest
- Management of the forest within treaty lands had a inequitable past, but recent efforts have begun to honor the legal trust obligations
- Traditional and sacred plant communities have declined in part due to long term fire suppression.
- Through conversations with the LLBO community, restoration of the forest will include management for important species like *miinan* (blueberries)

Main Project Goals

- Reintroduce fire into fire dependent communities
  - Use Rx fire to emulate disturbance regimes
  - Increase regeneration of fire tolerant pine species
  - Promote fire-dependent ground layer plant communities
- Reduce fuels in fire dependent communities

Photo credit D. Kastendick

Forest Plan Objectives

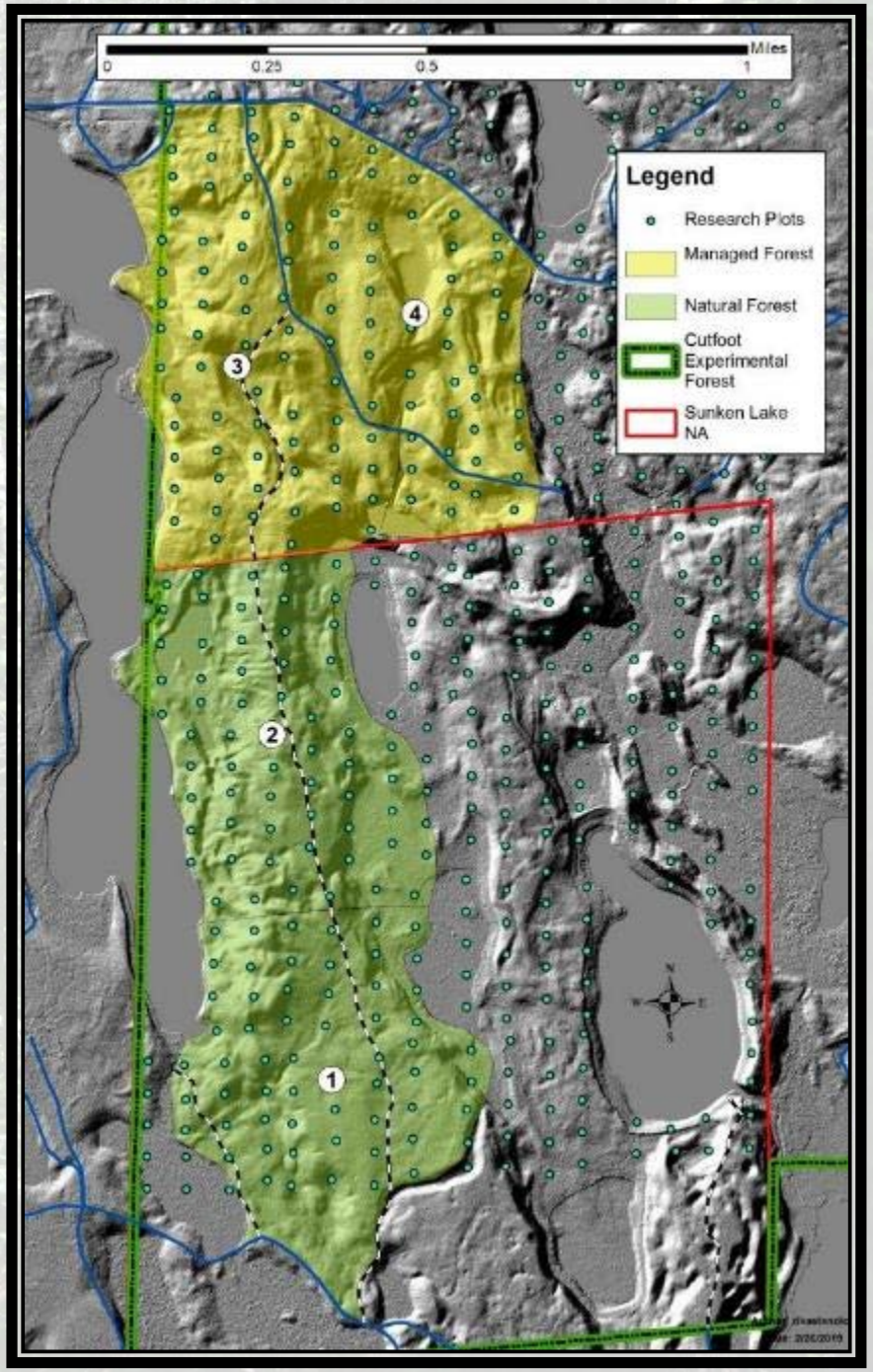
- Establish, maintain, or improve vegetation conditions using prescribed fire, mechanical treatments, and other tools.
- Restore structural diversity and ecosystem processes within stands:
  - a diverse mix of trees, shrubs, and herbs
  - live and dead standing trees
  - earth and tree root mounds caused by uprooted trees
  - coarse woody debris from fallen trees

Photo credit D. Kastendick

Project Design and Variables

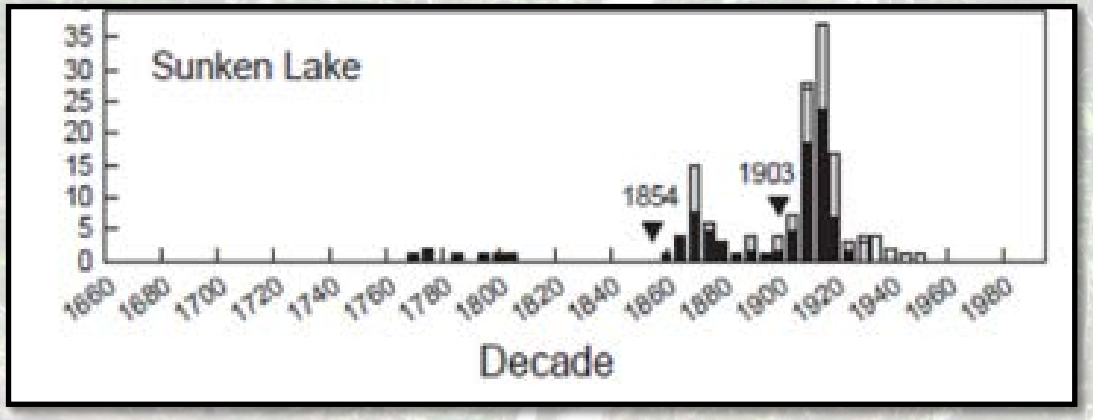
- Managed vs Unmanaged Rx and Control areas
- Pine and Mixed-Pine covertypes
- Average of 15 plots per TRT/Covertype

- Historic to current tree data
- Understory vegetation
- Fuels, fire severity
- Photo records
- Light environment
- Blueberries!

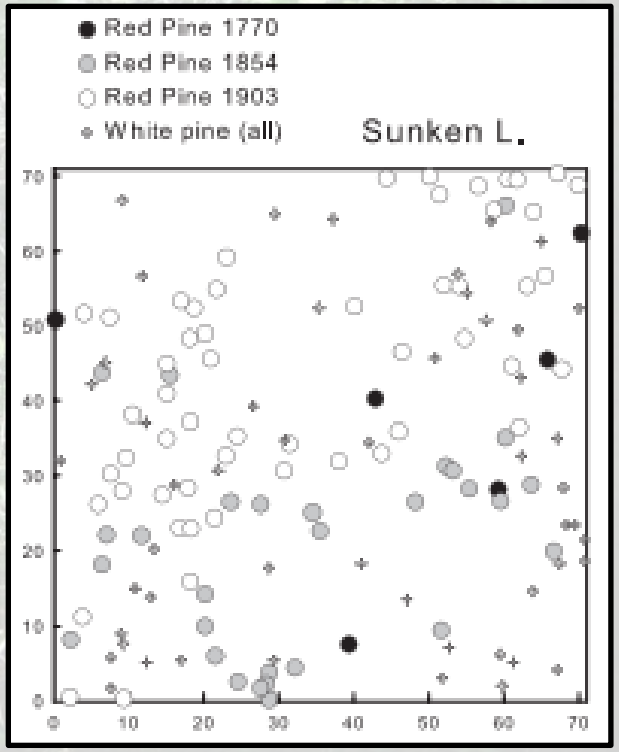


Experimental Forest Advantages

- Inventory plot data dating to 1940
- Known management history since logging era
- Contains old growth research stands
- Scale of project in size and forest types
- Comparisons to managed forest conditions
- Known historical fire frequencies



Fraver and Palik 2012



CUTFOOT Experimental Forest
NORTHERN RESEARCH STATION

Leech Lake Tribal College

Gaa'Oziskwaajimekaag
Gabe-gikendaasoowigamig
provides quality higher education
grounded in Anishinaabe values.

Year 1: 2018 Pre-burn assessments

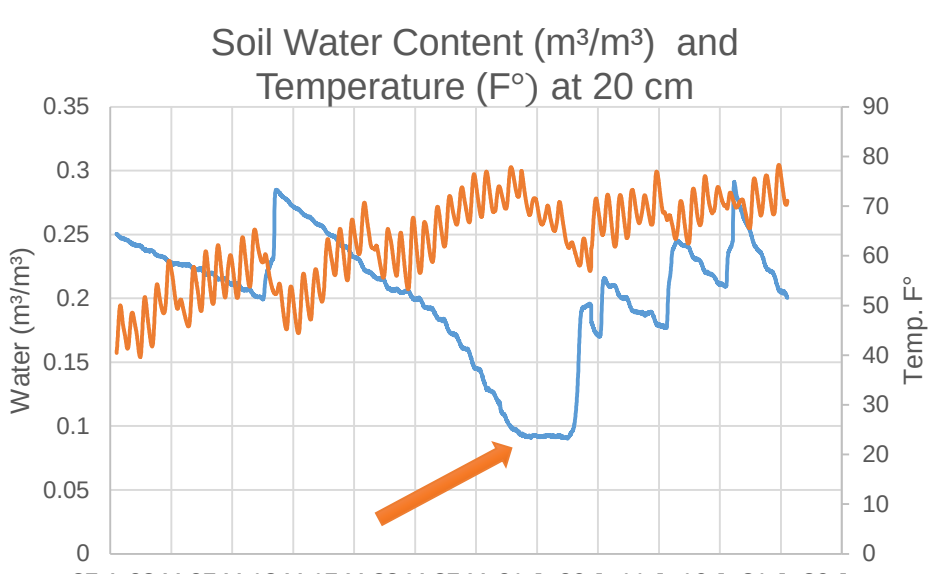
- Interns from Leech Lake Tribal College
- Collaborative approach: shared mentorship, resources, and training with DRM, CNF

Site surveys: 2018

- Pre-burn assessments specifically focused on blueberry plants and fruit production at 74 plots.
- The center of each plot was permanently marked to aid finding the plot after the fire treatment.
- Intersection lines and meter quads were laid out to document small woody herbs and forbs.
- Small trees within an 11.8 radius were counted, and canopy cover was documented and photographed.
- During this process interns gained skills in plant identification and data management.

Preliminary findings: 2018

- While blueberry plants were found at 58% of sites, only five beared fruit in 2018, despite the area being known by Elders as providing good berry picking in the past.
- Due to unseasonal drought conditions during the peak flowering time in 2018, it was not possible to tease out the effects of fire suppression from water stress.



Data from HOBO deployment at LLTC near Cass Lake

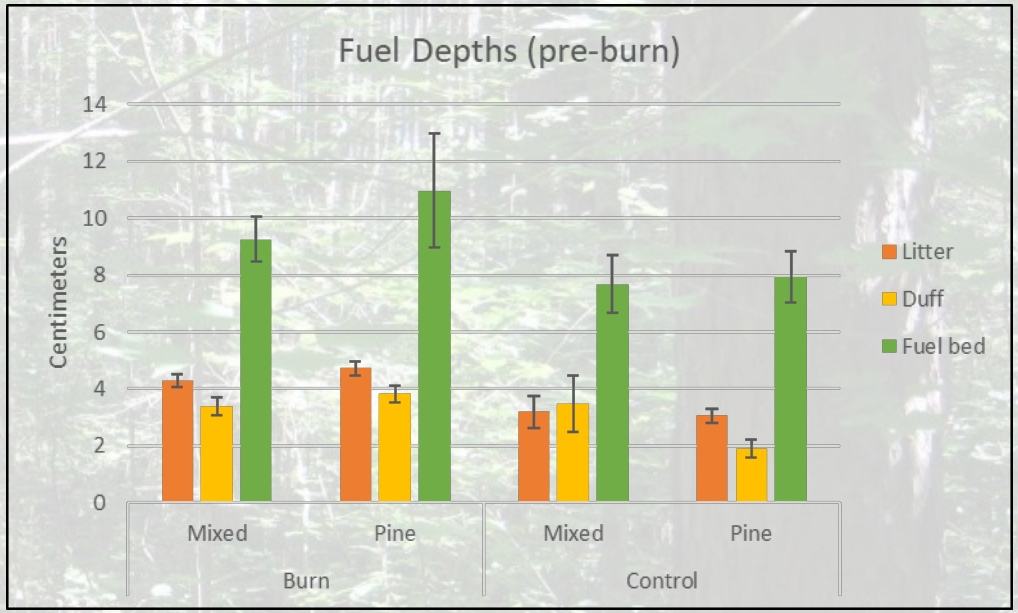
- While beta-testing HOBO environmental monitoring systems (EMS) at LLTC, we recorded shallow drought conditions during late May
- In late 2018, 3 HOBO stations were deployed at Sunken Lake

Year Two: Soil and Fuel Assessments

- The fire plan was approved in June 2019, but was not implemented.
- LLTC interns were able to complete dead and downed wood assessments, though data are still being analyzed.
- Soil testing and characterization at the EMS sites was completed.
- Students have been collecting and analyzing the HOBO EMS data

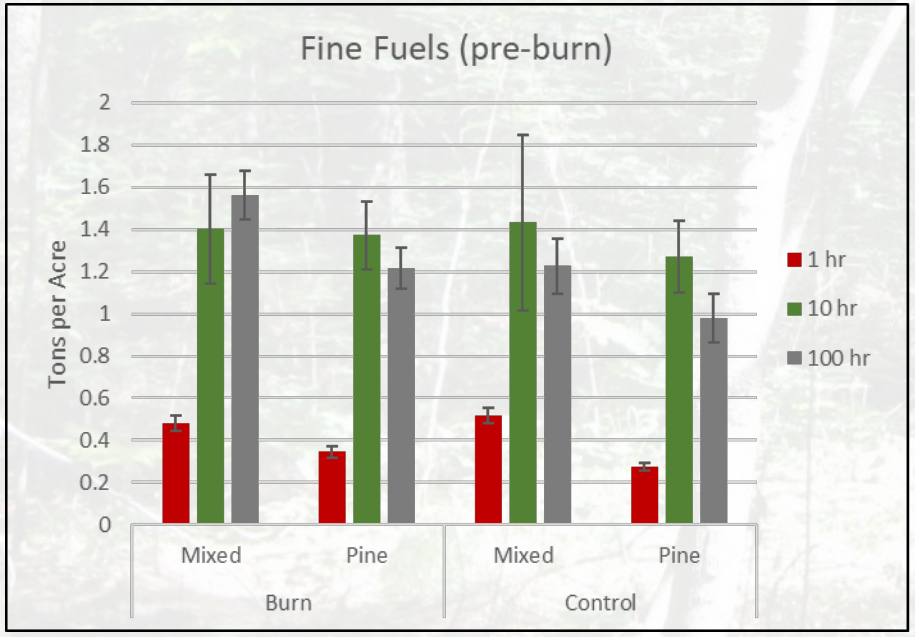
2019 Fuel Sampling Results (pre-burn)

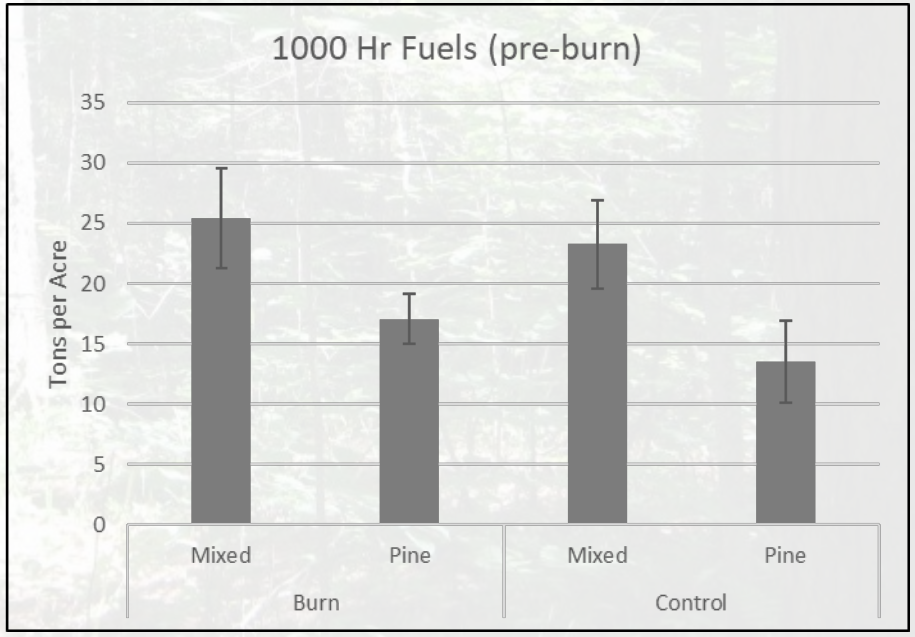
- Over 9300 feet of Brown's transects sampled to date!
- Litter and Duff depths variable by stand type but lower in control treatment
- Fuel depths similar by stand type but lower in control treatment
    - All Post-burn results will compare reductions relative to pre-burn conditions



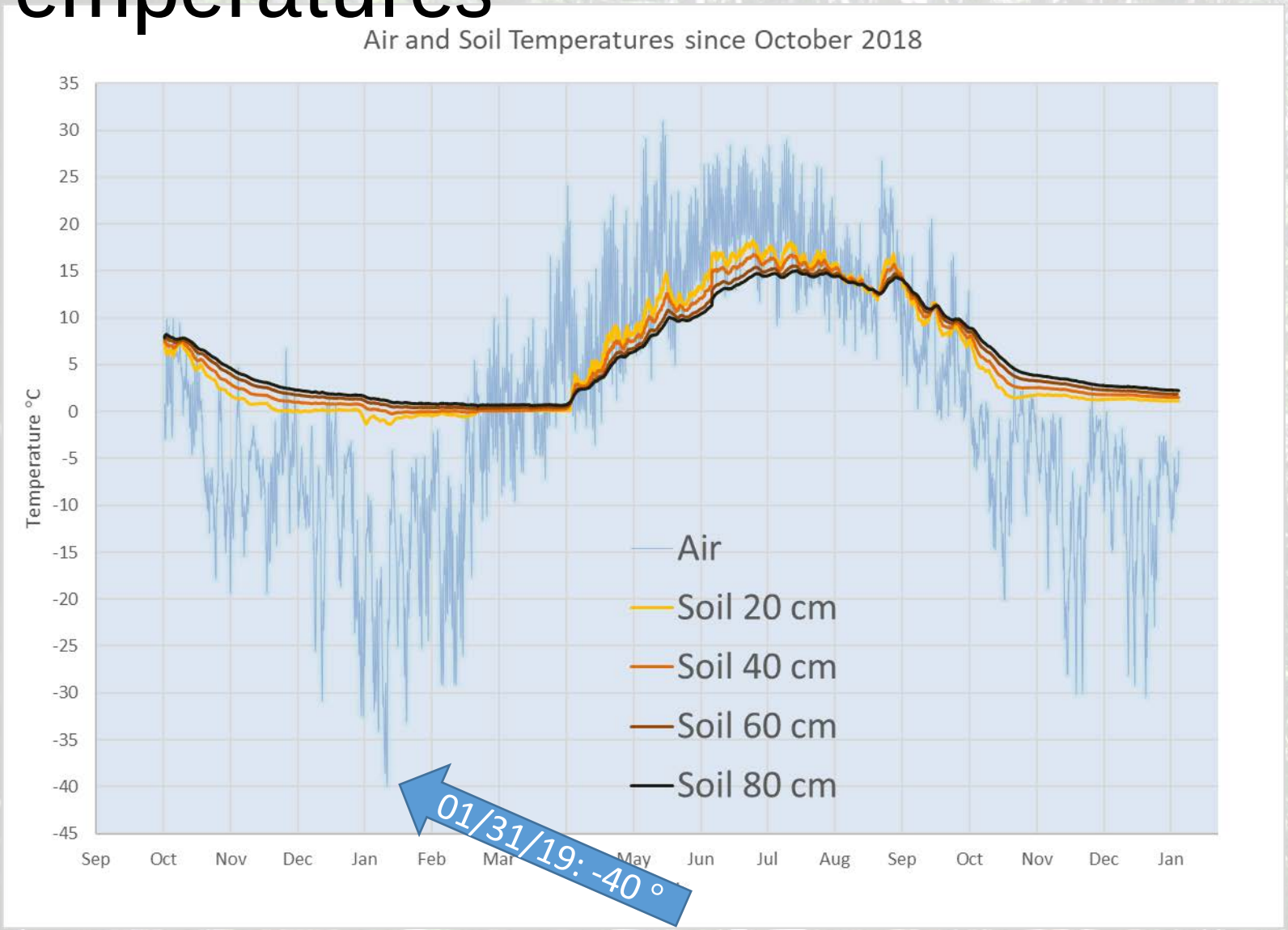
2019 Fuel Sampling Results (pre-burn)

- 1 and 100 Hr fuels higher in mixed pine stands (25-75% pine BA) vs pine stands (>75% pine BA)
- 10 Hr fuels similar by treatments and stand types
- 1000 Hr fuels higher in mixed pine stands but similar by treatment

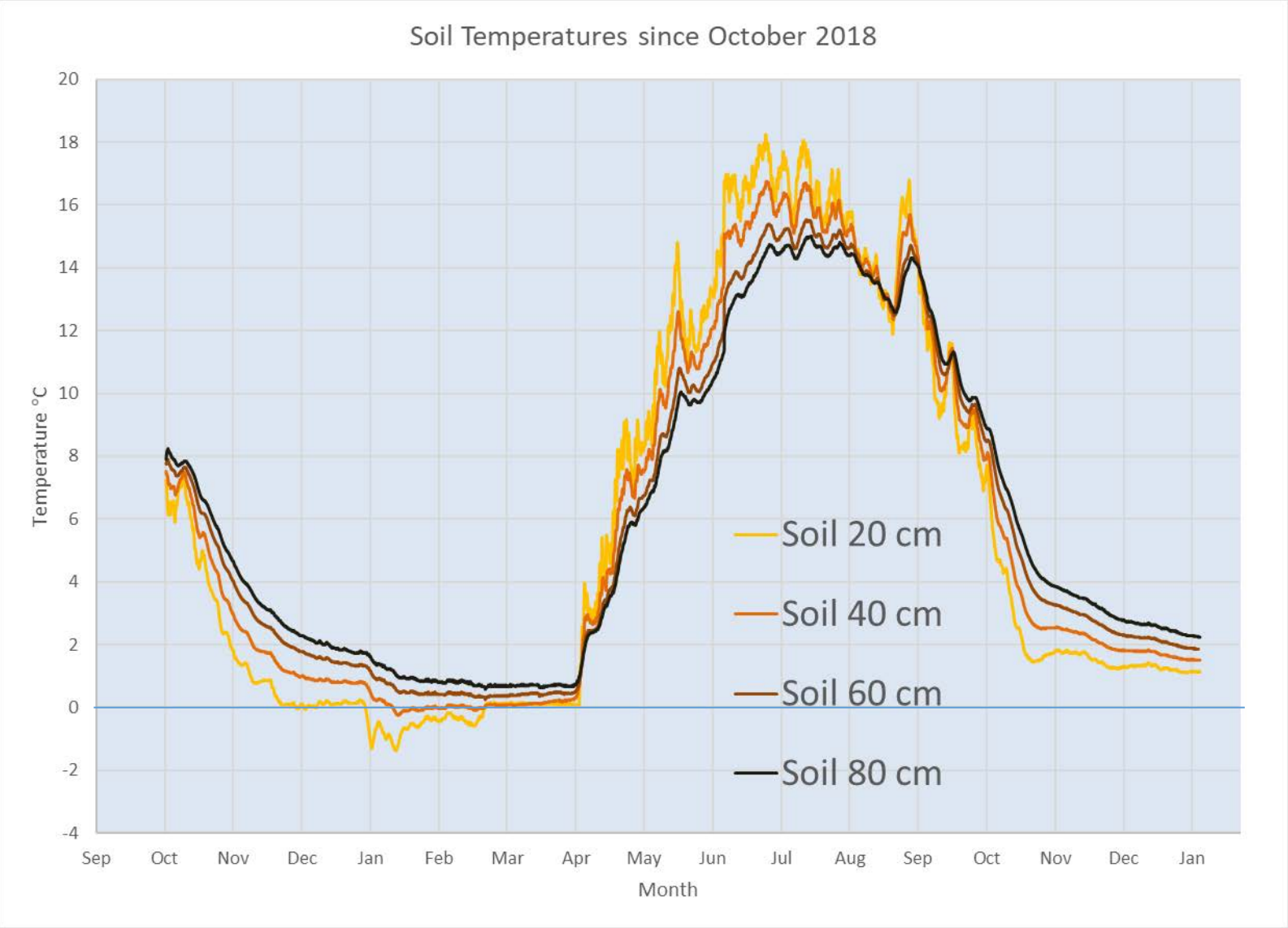




Sunken Lake HOBO Air and Soil Temperatures

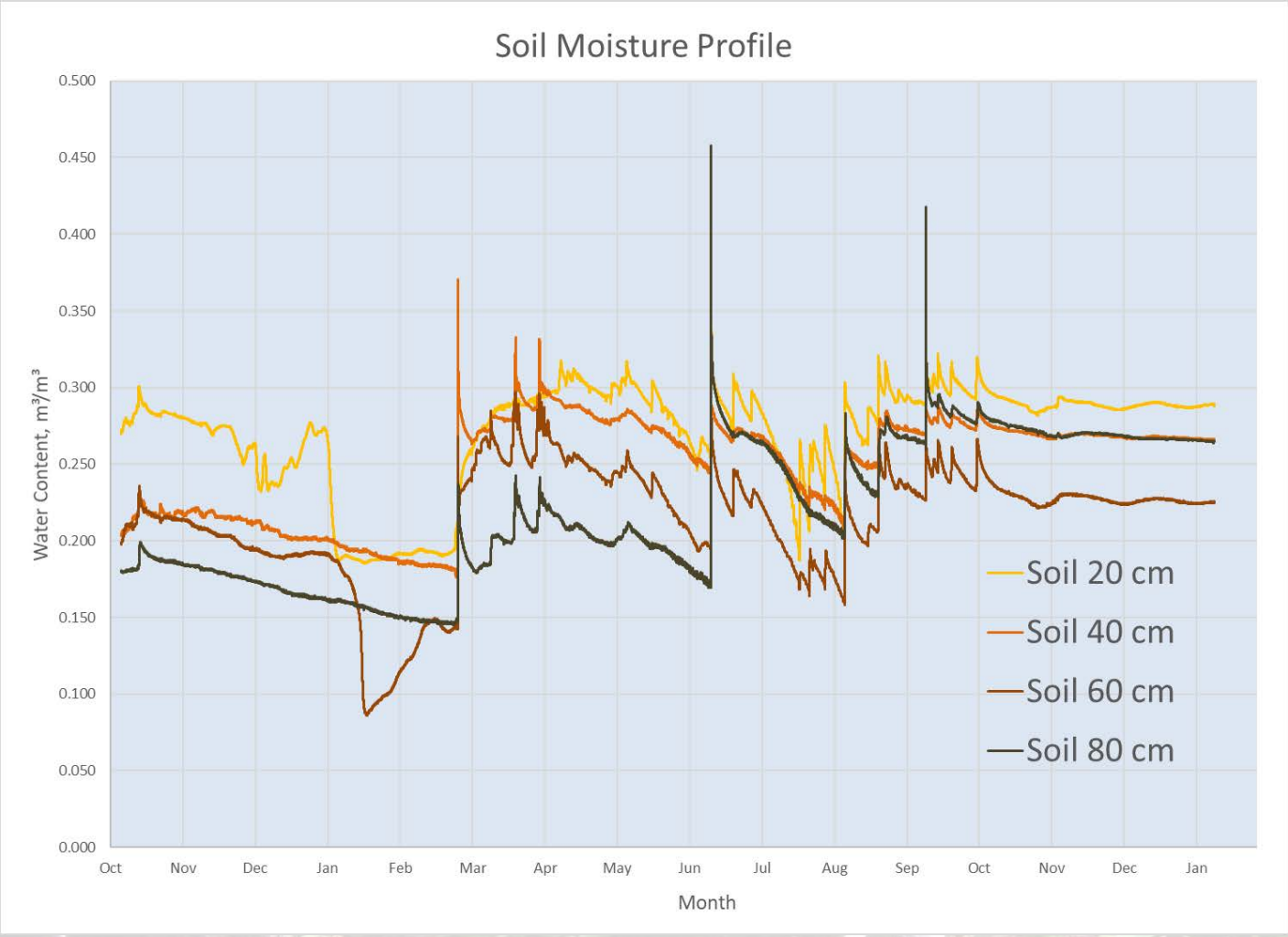


HOBO Soil Profile Temperatures



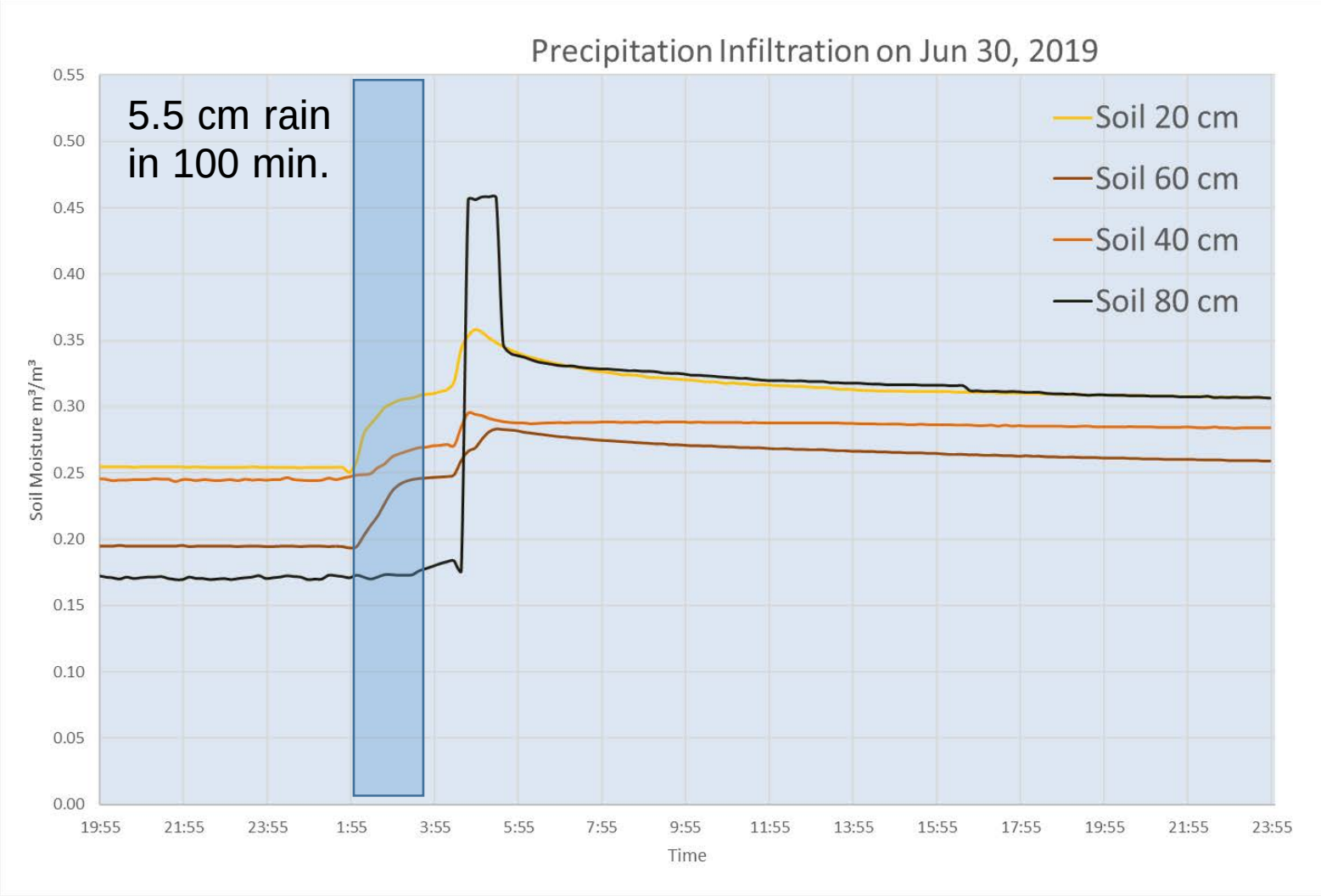
- Shallow sensors are subject to surface conditions, though winter snow lessens the signal
- Little differentiation between 20 – 80 cm depth
- 20 cm soil freezing when air temp dropped below -24° C

Soil Moisture



- Excessively drained soils
- Very fast infiltration
- Seasonal and event response rates differ

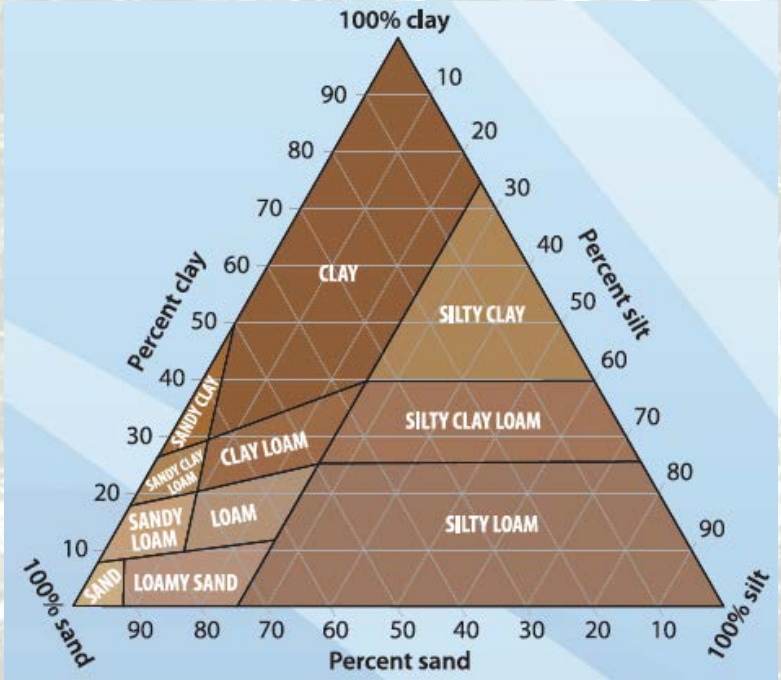
HOBO Soil Profile Moisture and Infiltration



- Less than 2 hour lag for infiltration to 80 cm
- Saturation at 80 cm is 0.45 m^3/m^3
- Plant uptake mutes shallow signals during growing season?

Soil texture and LOI

- Six mineral soil samples were collected from each EMS site
- Dried and sieved for texture determination
- Dried, weighed, and heated to 500°C for estimating organic matter by loss on ignition



Name	Soil type	Pre burn	500 burn	1000 burn	% LOI
H1-1a	Clay	5.576	5.477	5.313	1.8%
H1-1b	Clay Loam	5.682	5.594	5.565	1.6%
H1-2a	Clay	5.393	5.301	5.257	1.7%
H1-2b	Silt Loam	5.357	5.265	5.228	1.7%
H1-3a	Clay Loam	5.415	5.307	5.281	2.0%
H1-3b	Silt Loam	5.860	5.787	5.354	1.2%
H2-1a	Clay Loam	5.583	5.386	5.353	3.5%
H2-1b	Loam	5.595	5.478	5.149	2.1%
H2-2a	Clay Loam	5.463	5.321	5.290	2.6%
H2-2b	Loam	5.482	5.364	5.328	2.2%
H2-3a	Clay Loam	5.585	5.436	5.389	2.7%
H2-3b	Silt Loam	5.930	5.825	5.795	1.8%
H3-1a	Loam	5.478	5.248	5.206	4.2%
H3-1b	Sandy Loam	5.689	5.551	5.514	2.4%
H3-2a	Loam	5.585	5.450	5.415	2.4%
H3-2b	Sandy Loam	5.299	5.170	5.143	2.4%
H3-3a	Loam	5.616	5.363	5.395	4.5%
H3-3b	Sandy Loam	5.611	5.477	5.446	2.4%

Expected Soil Results

- Prescribed fire will result in a decrease in litter and duff layers, exposing patches of mineral soil.
- Exposed soils will likely show increased infiltration rates and temperature reactivity.
- Low initial organic matter within the mineral soil likely won't change significantly on the short term, though nutrient availability (P, Ca, Mg) is expected to increase.

Next Steps

- Nutrient availability, LOI, and texture will be measured pre and post burn.
- HOBO EMS will be dug up and serviced during the burn, and replaced shortly after.
- Ongoing project will yield data for several years, continuing the partnership.

2020 Sampling Planned (post-burn)

- Repeat sampling of Fuels
- Fire severity effects on forest floor and vegetation
- Photo records and light environment (PAR and densiometer)
- Meteorological and soil moisture monitoring
- Vegetation, and blueberry sampling one year post-burn
- Continued monitoring of all variables over time and with planned repeated burning

Wild blueberries: Miinan

- Berries are 88% water
  - Wild blueberries are smaller and more nutrient dense than cultivated berries
- Primarily spread by rhizomes
- Generally produce berries on a bi-annual cycle
- Require pruning so more energy is put into berry production
- Do not like competition

Lowbush: ***Vaccinium angustifolium***
Velvetleaf: ***V.myrtilloides***

Fire effects on blueberries

- Reduces competition
- Reduces insects, disease and fungal organisms that accumulate throughout the winter
- Need acidic soil of 4.0 -5.0 pH

Photo: Creative Commons

- Intensity of fire changes soil texture thus changing nutrient availability
- Plants in these communities have adaptive traits to allow them to thrive with fire

Source: Forest Encyclopedia Network

Future considerations

- Burns should happen before bees begin to look for nesting sites or after a hard frost in the fall
- Drought may be affecting flower timing

- Dependent on pollinators
- Conduct a pollinator visitor study

(Collaborators for this please contact Kate)

Pollinator on Blueberry photo by Jeremy Baker

Miigwech
To all our collaborators!

For Follow Up Discussions:

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