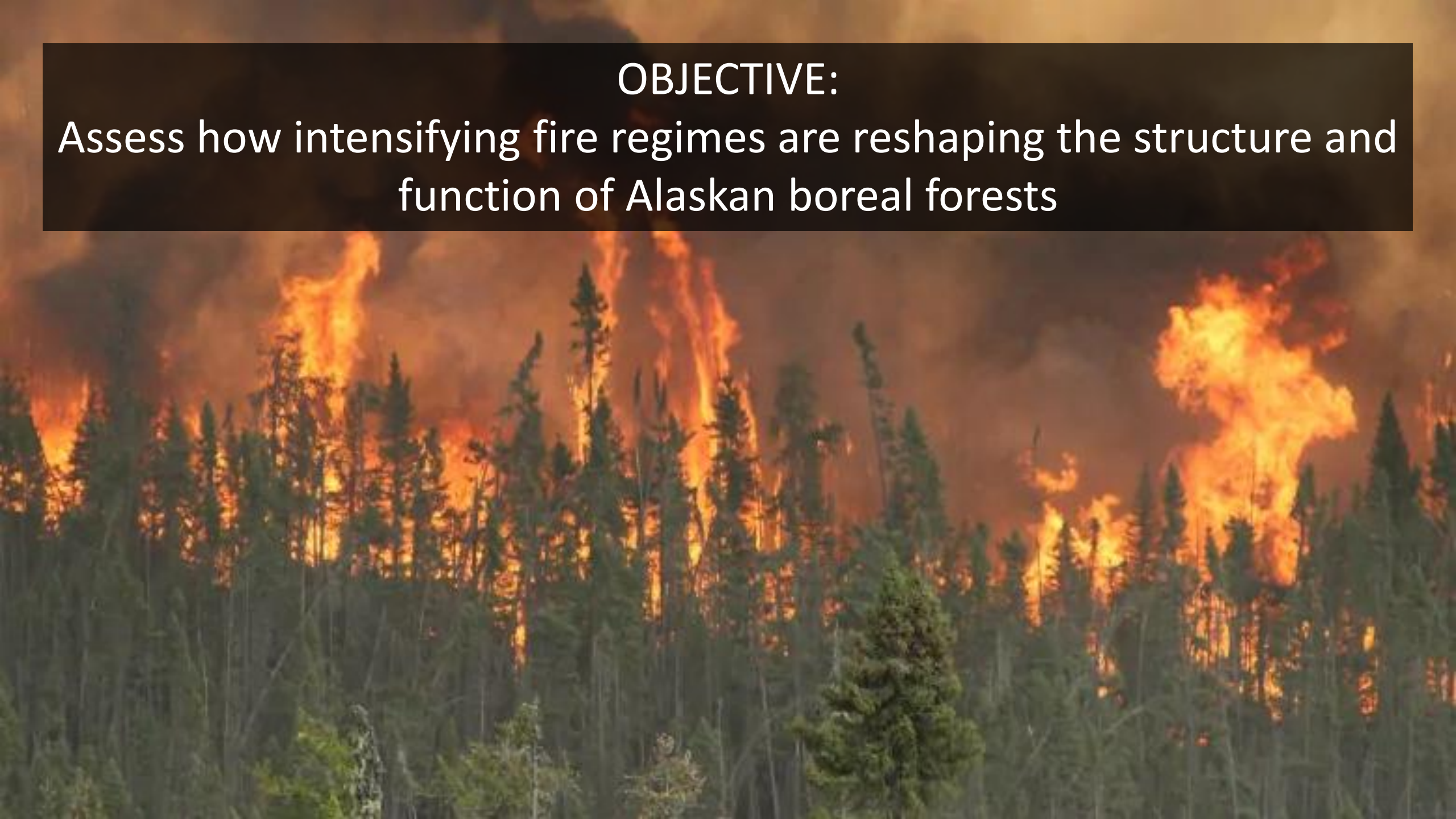
BNZ LTER: Wildfire Working Group

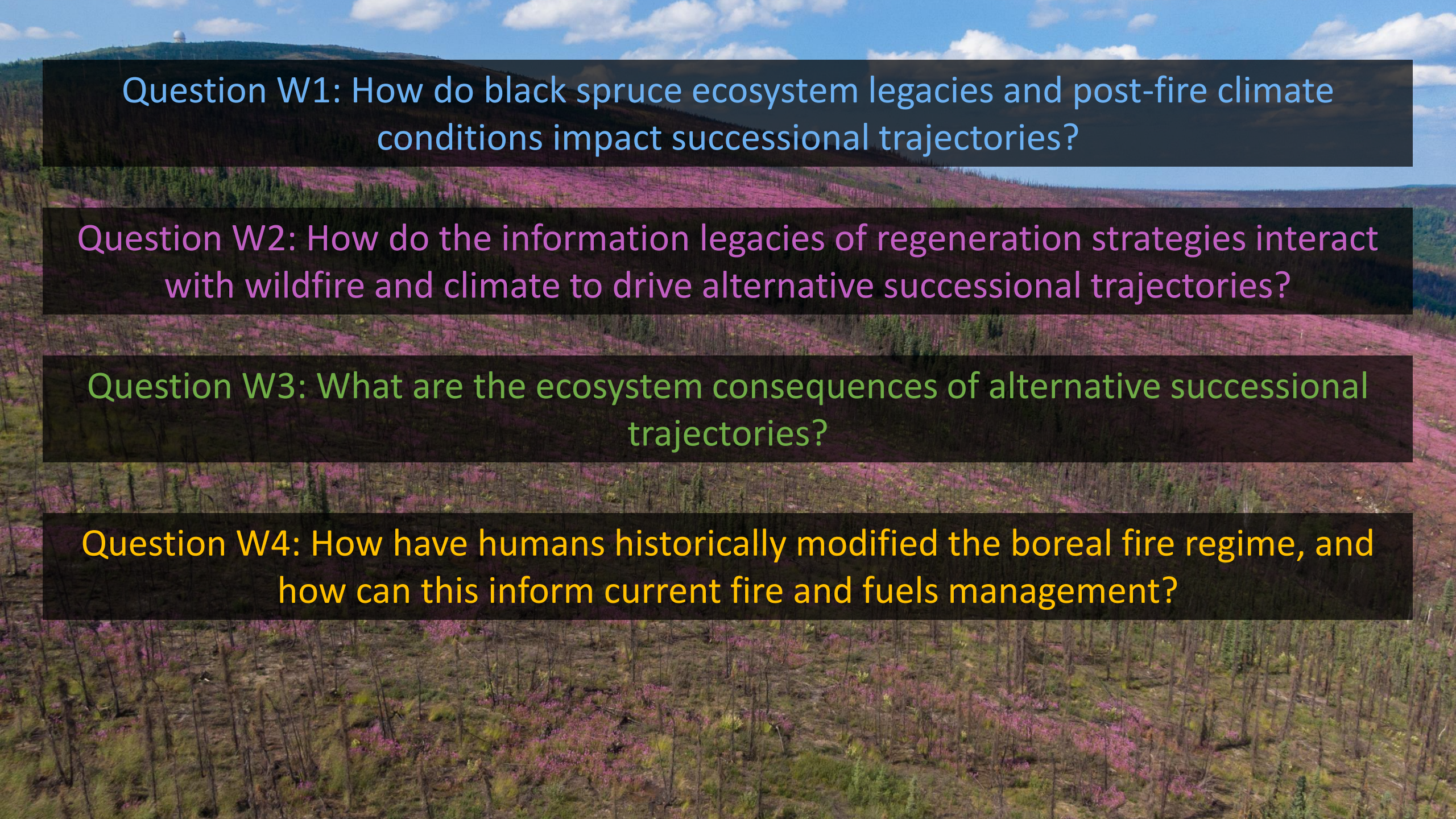
Leads: Xanthe Walker, Teresa Hollingsworth

Members: Becky Hewitt, Brian Buma, Helene Genet, Jill Johnstone, Kate Hayes, Knut Kielland, Michelle Mack, Mario Muscarella, Mary Beth Leigh, Melissa Lucash, Randi Jandt, Tamara Harms, Ursel Schuette, Lee Taylor, Winslow Hansen



OBJECTIVE:

Assess how intensifying fire regimes are reshaping the structure and function of Alaskan boreal forests


Question W1: How do black spruce ecosystem legacies and post-fire climate conditions impact successional trajectories?
Question W2: How do the information legacies of regeneration strategies interact with wildfire and climate to drive alternative successional trajectories?
Question W3: What are the ecosystem consequences of alternative successional trajectories?
Question W4: How have humans historically modified the boreal fire regime, and how can this inform current fire and fuels management?

1. Across field research working groups

- Consumers
- Permafrost

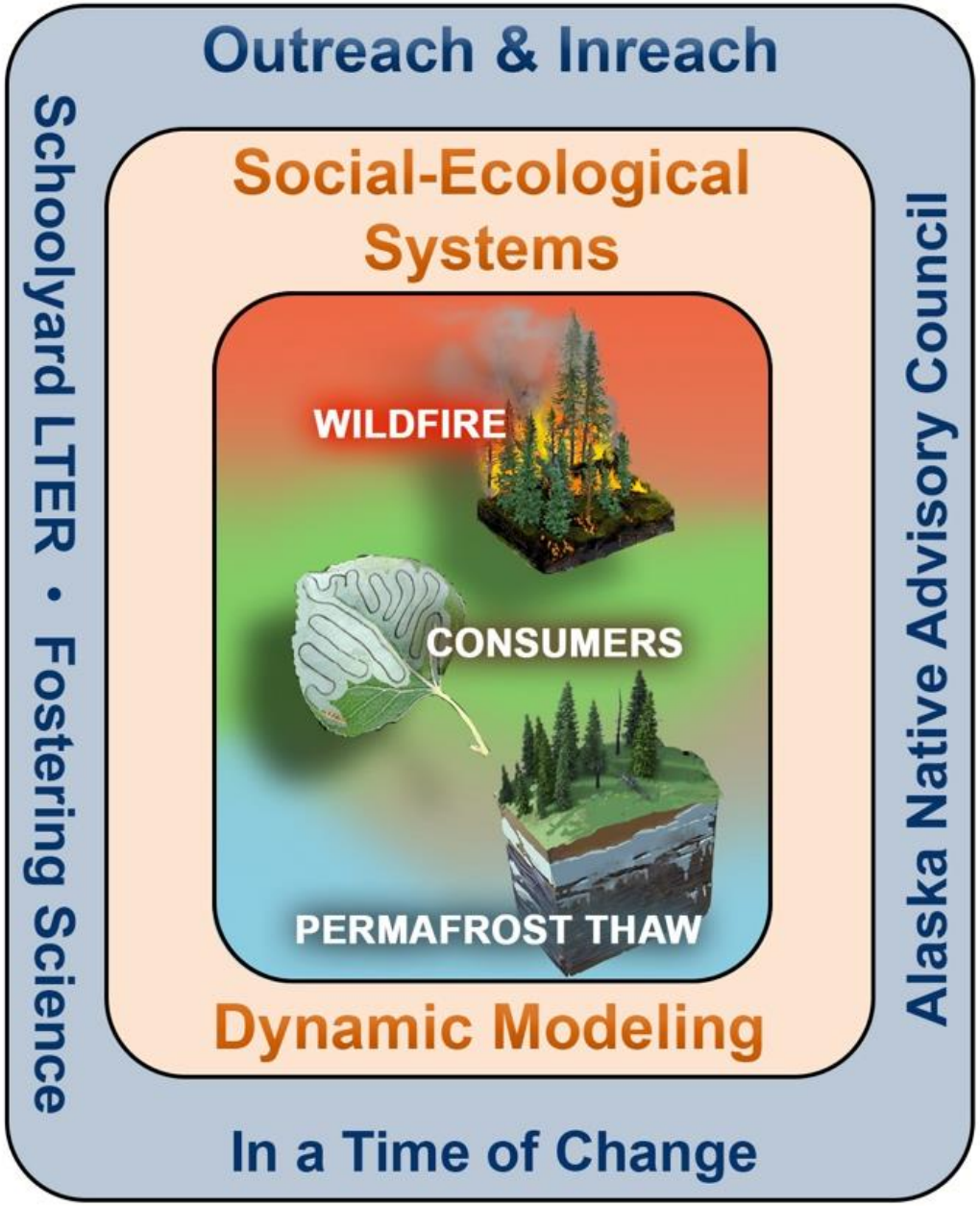
2. Social-Ecological Systems and Dynamic Modeling

3. Outreach & Inreach

- Education
- Arts & Humanities
- ANAC

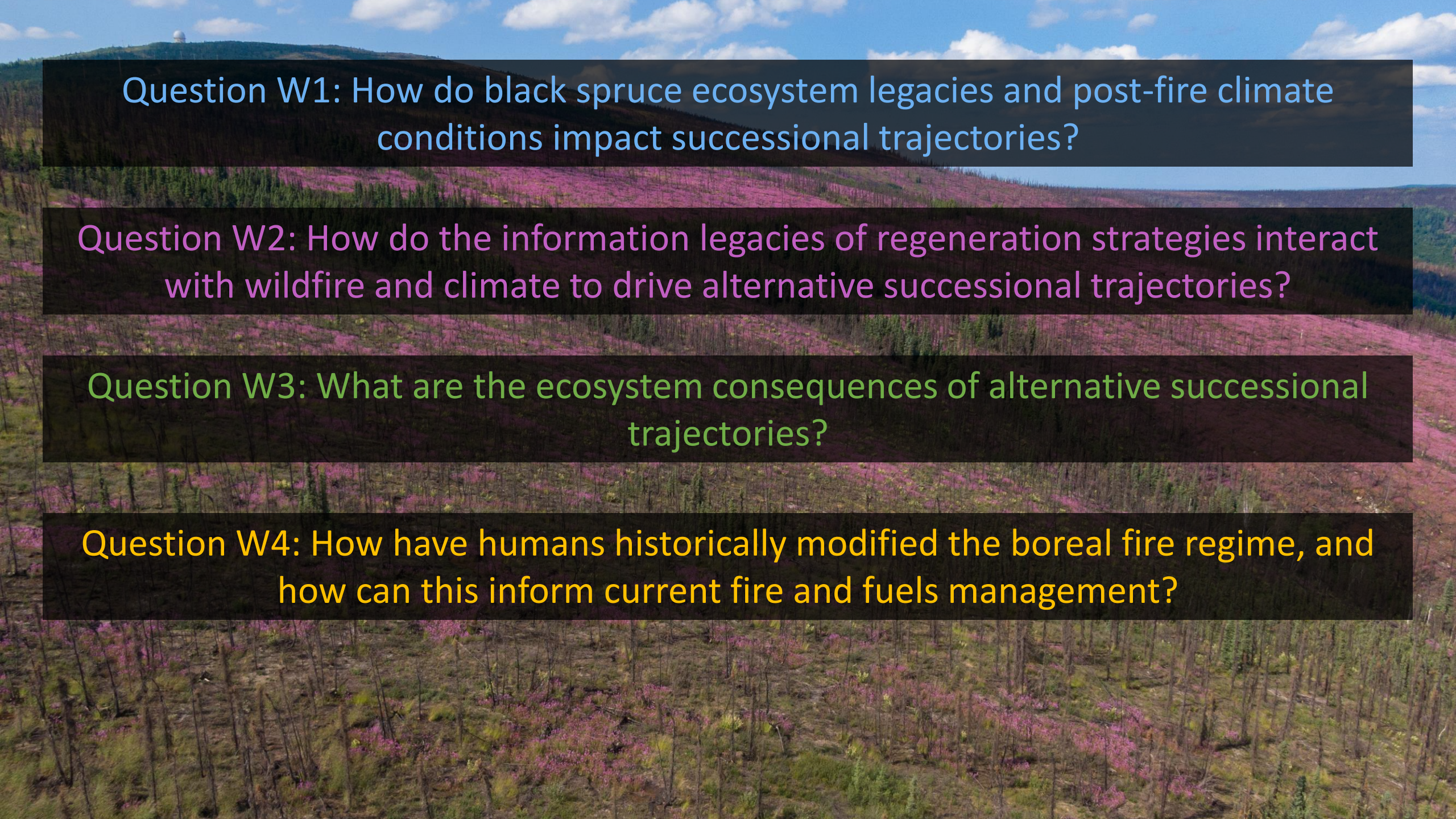
4. Collaboration with other wildfire research

5. Other cool research questions



JamBoards: https://bit.ly/BNZwildfire

- One Jam board per research question
- Populate with ideas/pictures/research questions/collaborations etc.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Question W1: How do black spruce ecosystem legacies and post-fire climate conditions impact successional trajectories?

Hypothesis W1a:

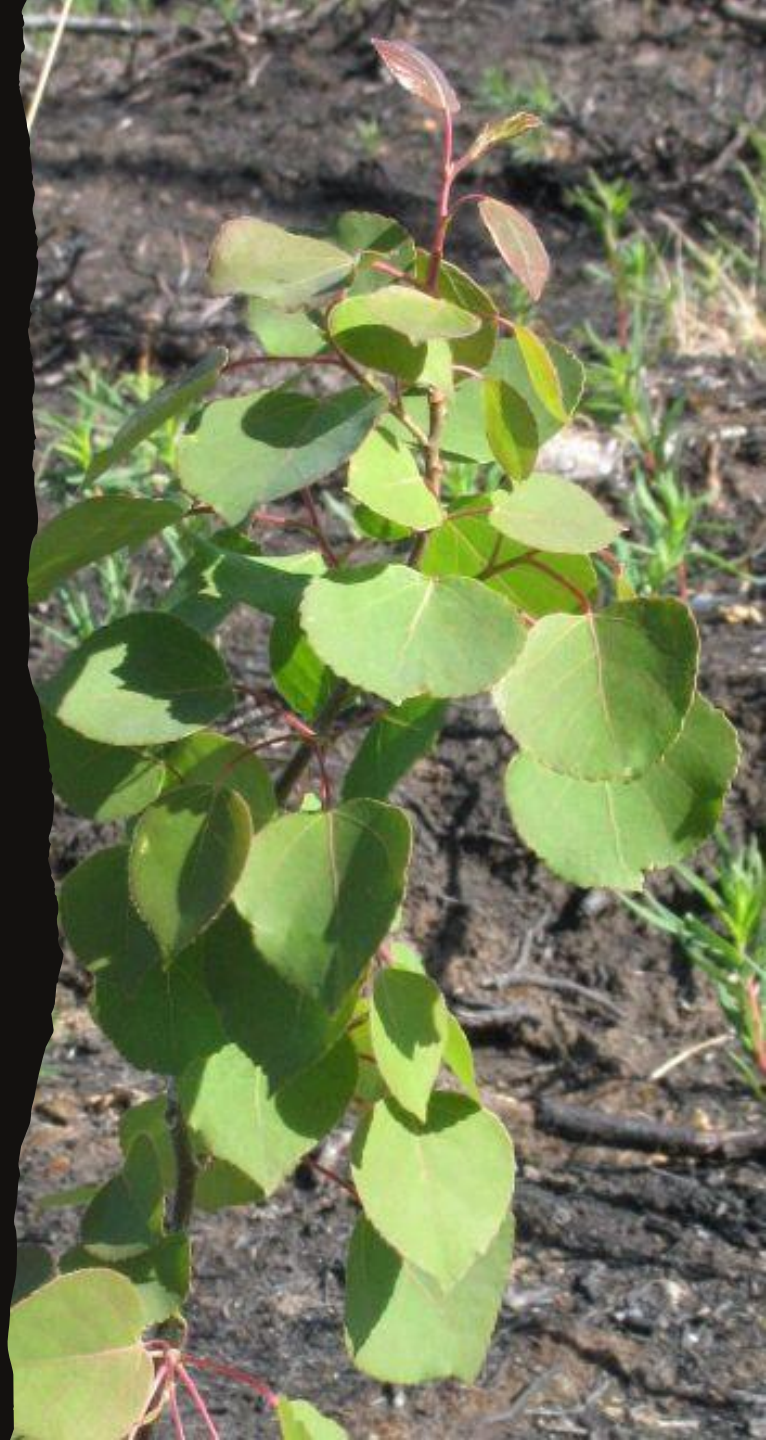
warm and dry post-fire conditions will reduce spruce establishment and lead to deciduous dominance or recruitment failure independent of fire severity

Approach:

1) CCE: new sites capturing interactions of climate, combustion, and establishment

- 162 new, mature, burned black spruce sites
- 2023: new sites established by Walker NSF
- Stand age at time of fire, burn depth, combustion (year 1)
- Seedling densities, understory vegetation, SOL, active layer, soil moisture (year 1, 3, 5, 10, 20)

2) Resurvey JFSP sites in 2024



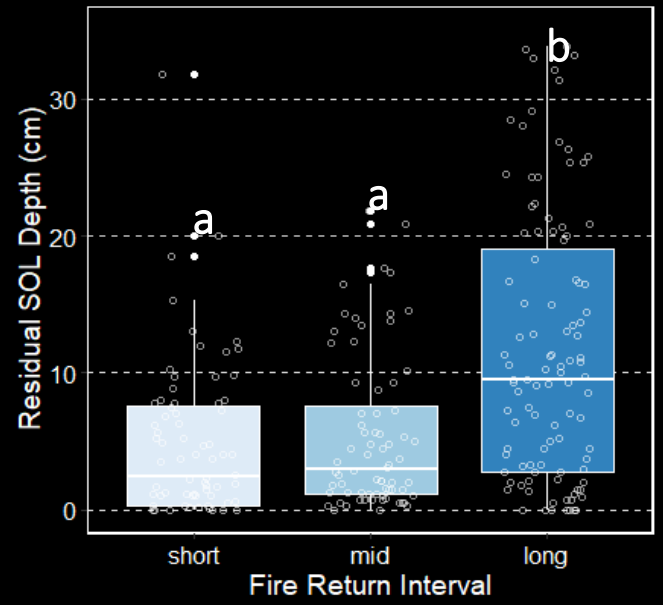
Question W1: How do black spruce ecosystem legacies and post-fire climate conditions impact successional trajectories?

Hypothesis W1b:

as fire frequency increases so will the loss of SOL legacies, resulting in alternative successional trajectories

Approache:

- 54 “reburned” stands from 2021-2024
- choose 18 sites/year to resurvey (Walker NSF)
- CCE protocol



Question W1: How do black spruce ecosystem legacies and post-fire climate conditions impact successional trajectories?

Hypothesis W1c:

the effects of increasing fire severity on microbial legacies of black spruce forests will reduce the establishment and growth of spruce seedlings, reinforcing alternative successional trajectories

Approach:

- 5 high-severity & 5 low-severity newly established burned sites
- Sample soils & 20 regenerating seedlings: ~1 month, 3, 5, and 10 years post-fire

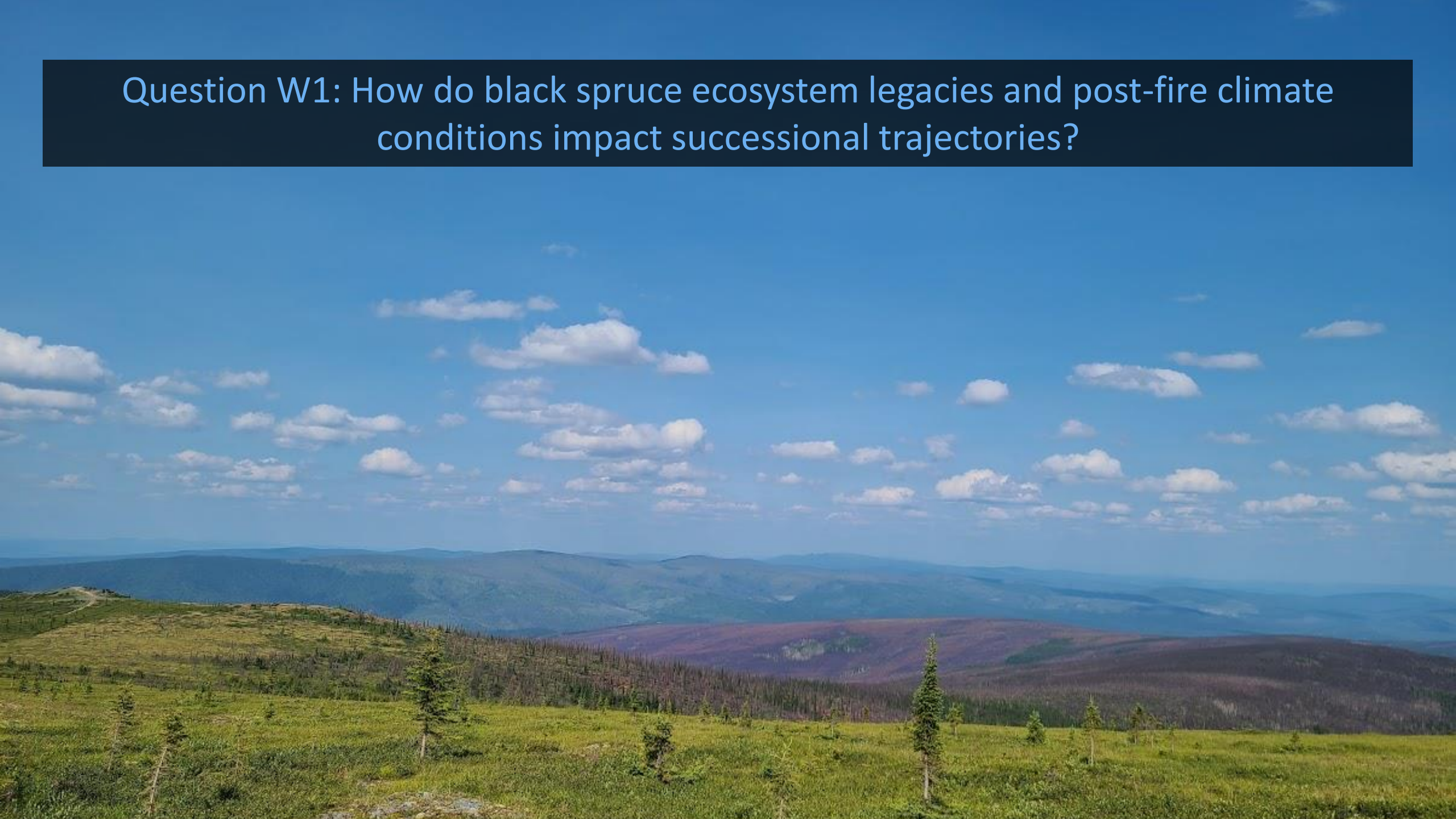
Seedling establishment:

- Quantify mycorrhizal association
- Compare root-associated fungi to the fungi that are present as inoculum in soil

Microbial community composition and survivorship:

- Sample entire active layer and ~1m of permafrost
- Depth-wise sampling within each core
- Amplicon sequencing
- Use PMA and/or DNase treatment

Question W1: How do black spruce ecosystem legacies and post-fire climate conditions impact successional trajectories?



Question W2: How do the information legacies of regeneration strategies interact with wildfire and climate to drive alternative successional trajectories?

Hypothesis W2a:

white spruce regeneration following wildfire is dependent on the climatic drivers (i.e., warm and dry) that synchronize seed masting with large fire years

Approach:

- Continue monitoring seed traps @ seven sites (white spruce)
- Test aspen and birch protocol @ subset of RSN

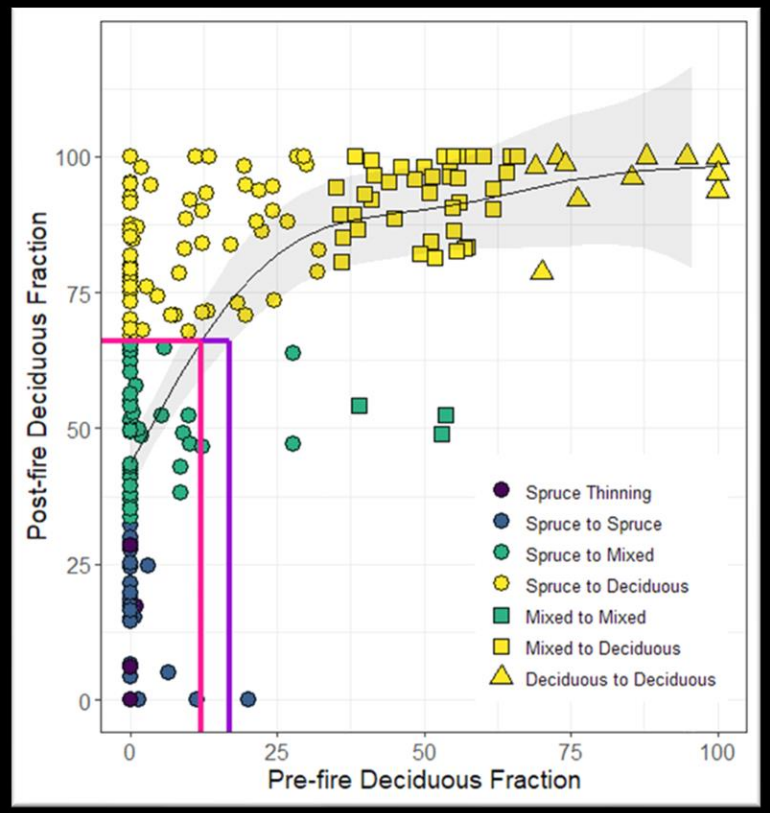
Question W2: How do the information legacies of regeneration strategies interact with wildfire and climate to drive alternative successional trajectories?

Hypothesis W2b:

pre-fire deciduous presence and regeneration via suckers will result in post-fire deciduous dominance

Approach:

Add 54 sites to CCE from recently burned deciduous or mixed stands (established in 2022 – Mack NSF)



Question W2: How do the information legacies of regeneration strategies interact with wildfire and climate to drive alternative successional trajectories?

Question W3: What are the ecosystem consequences of alternative successional trajectories?

Hypothesis W3a:

black spruce forests promote high N fixation inputs coupled with slow decomposition of moss litter, N will accumulate over time leading to N x P co-limitation or P limitation as permafrost reaccumulates over succession

Approach (2023-2024):

- continue studies across RSN+ sites, filling data gaps in our chronosequence with new long-term monitoring plots in mixed and deciduous stands from the oldest age class

Approach (long-term):

- combine foliar and litterfall data with tree inventories to estimate stand-level plant nutrient uptake, loss, and nutrient use efficiency for deciduous and black spruce successional trajectories

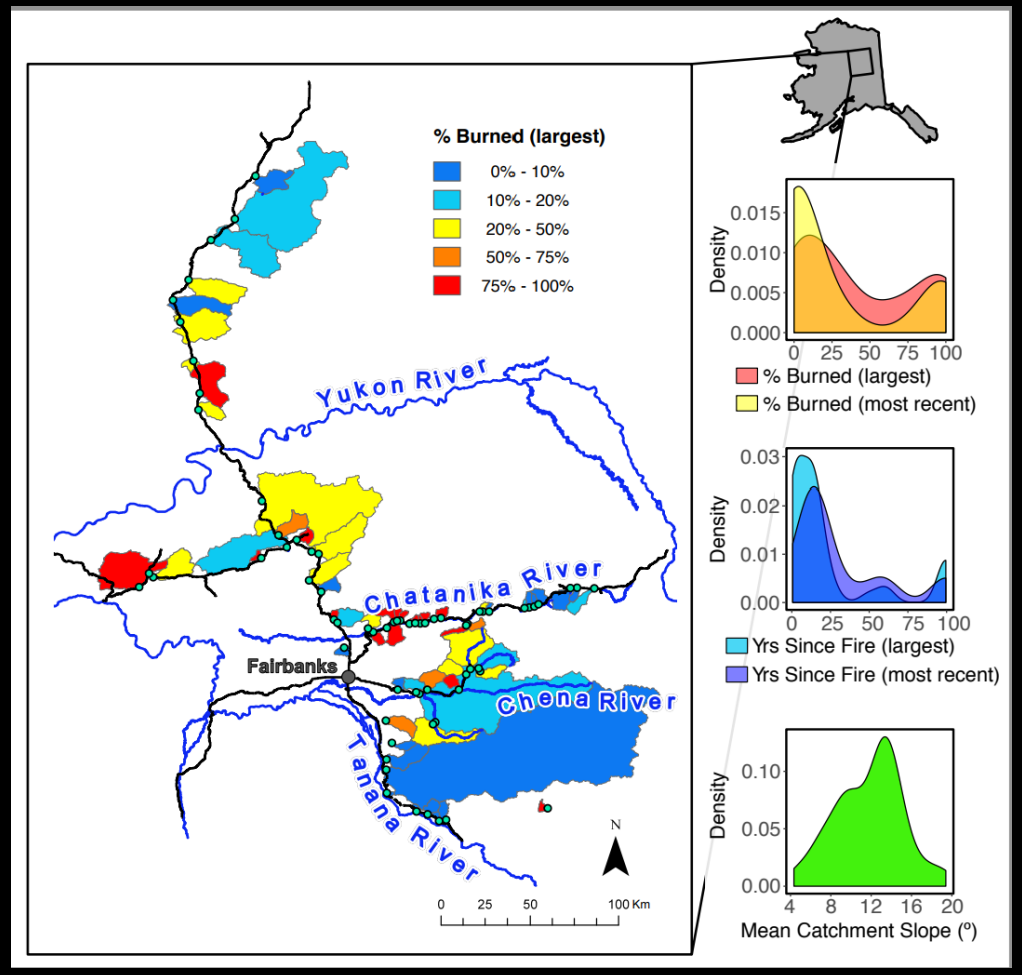
Question W3: What are the ecosystem consequences of alternative successional trajectories?

Hypothesis W3b:

on alternative deciduous trajectories, low N inputs and rapid decomposition will enhance lateral and gaseous losses of N, leading to N limitation over succession

Approach:

- Estimate N inputs and turnover across the RSN+
- continue our studies of gaseous N losses and N and P transfer to aquatic ecosystems
- compare rates of loss
- Previous synoptic sampling:
  - ↓ DOM in extensively burned catchments
  - ↑ NH_4^+ and NO_3^- in absence of shallow (1 m) permafrost
- Repeat sampling in years 1 & 5
  - Trends in solute concentration indicating recovery from fire



Question W3: What are the ecosystem consequences of alternative successional trajectories?

Hypothesis W3c:

outbreaks of leaf-mining herbivores will reinforce plant-soil-microbial feedbacks in the deciduous domain, while lethal pathogens will push deciduous ecosystems into the spruce domain

Approach:

examine the impact of leaf mining on plant-level foliar nutrients, nutrient loss, and nutrient retranslocation by assessing nutrient concentrations and leaf miner damage on foliage and freshly senesced litter of aspen and birch

Question W3: What are the ecosystem consequences of alternative successional trajectories?

Question W4: How have humans historically modified the boreal fire regime, and how can this inform current fire and fuels management?

Hypothesis W4a:

the historic use of fire as a land management tool shifted species dominance, stimulated understory productivity, and increased permafrost thaw

Approach:

collect and archive data related to IK:

1) on fire history and cultural uses of fire
2) landscape fragmentation and connectivity
3) key plant and animal species impacted by fire

Question W4: How have humans historically modified the boreal fire regime, and how can this inform current fire and fuels management?

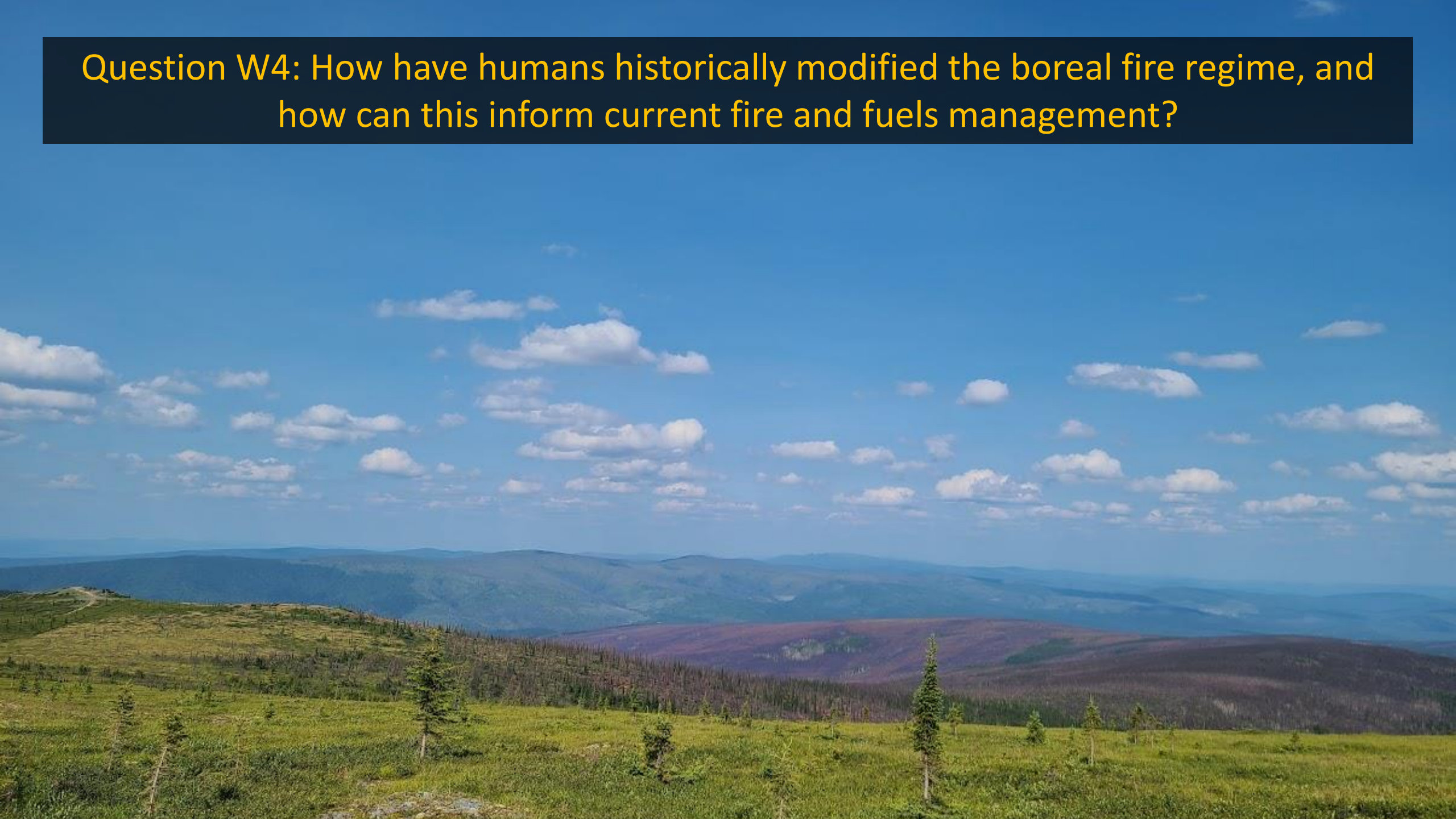
Hypothesis W4b:

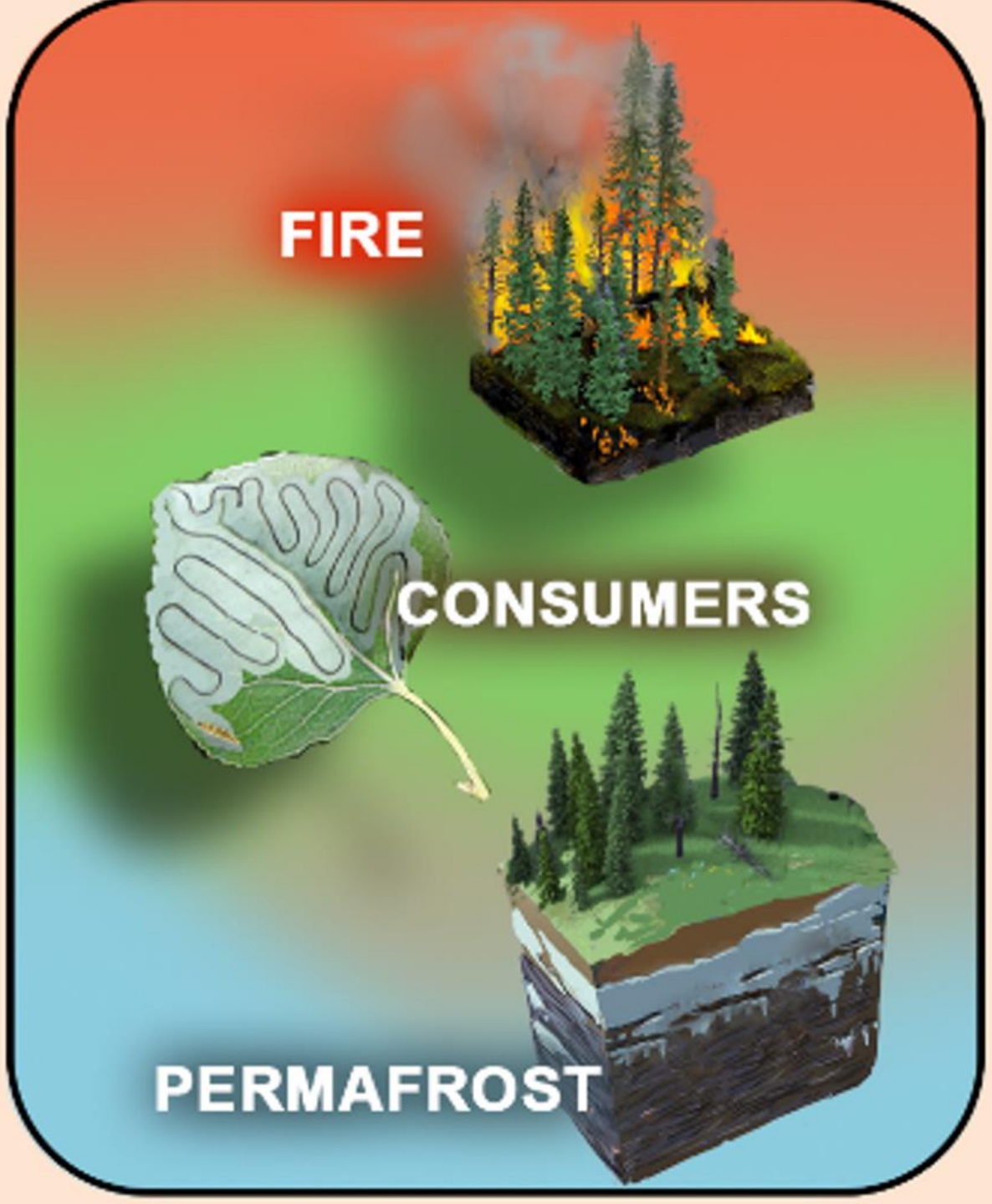
experimental ground disturbance and seeding of deciduous trees will promote deciduous tree dominance in fuel breaks

Approach:

- In fuel reduction treatments, we will establish experimental manipulations of tree seed sources and seedbeds, soil fertility, and conifer density to test mechanisms of community assembly in 2023 (Mack NSF).
- Resurvey these treatments in 2028.

Question W4: How have humans historically modified the boreal fire regime, and how can this inform current fire and fuels management?





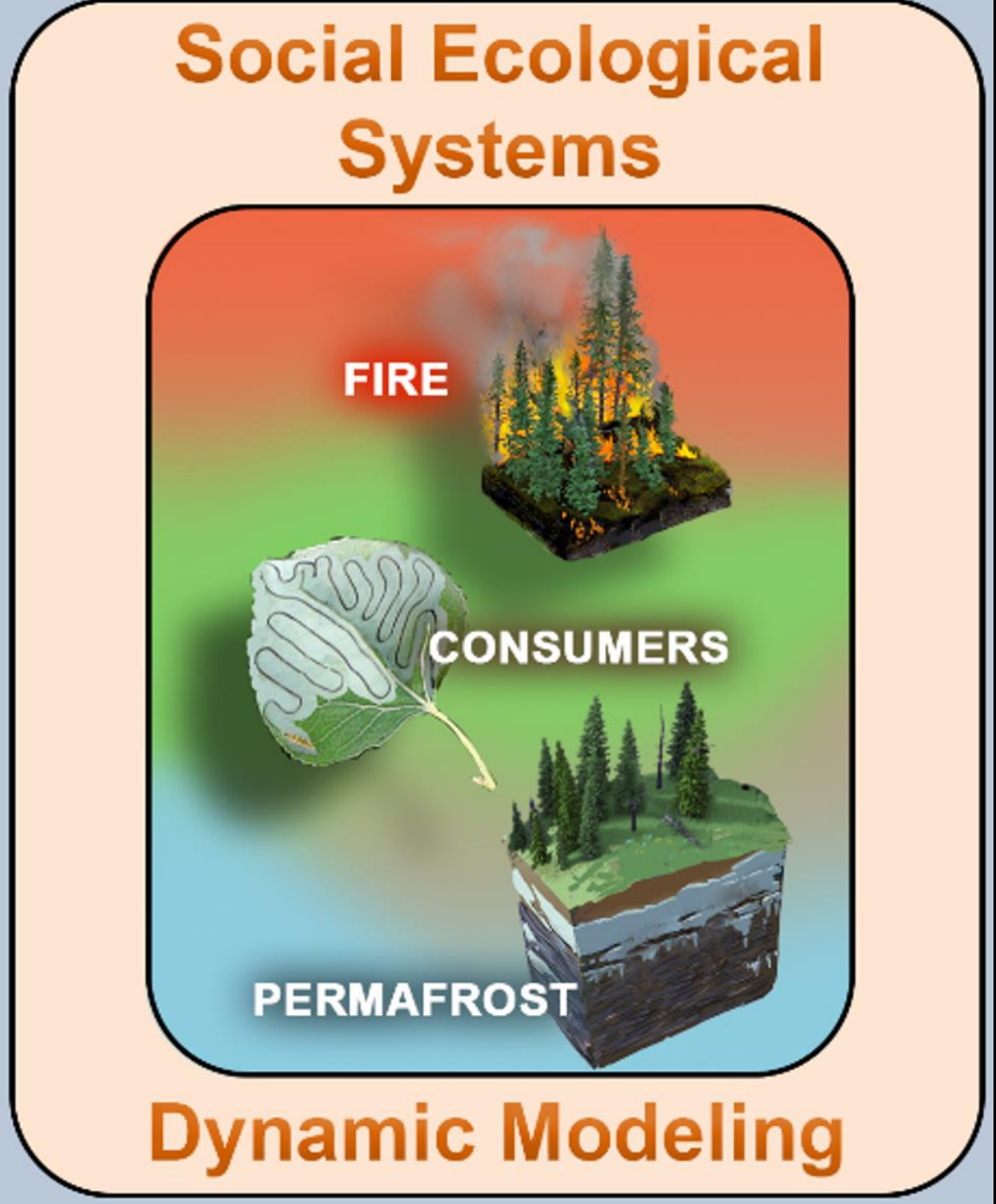
Integration across field research working groups

Consumers Q3:

- Establish and monitor the RSN+ sites, examine interactions of consumers with successional trajectories (W3)

Permafrost Q4:

- Revisit JFSP sites in 2024 (W1)
- Stream chemistry (W3)



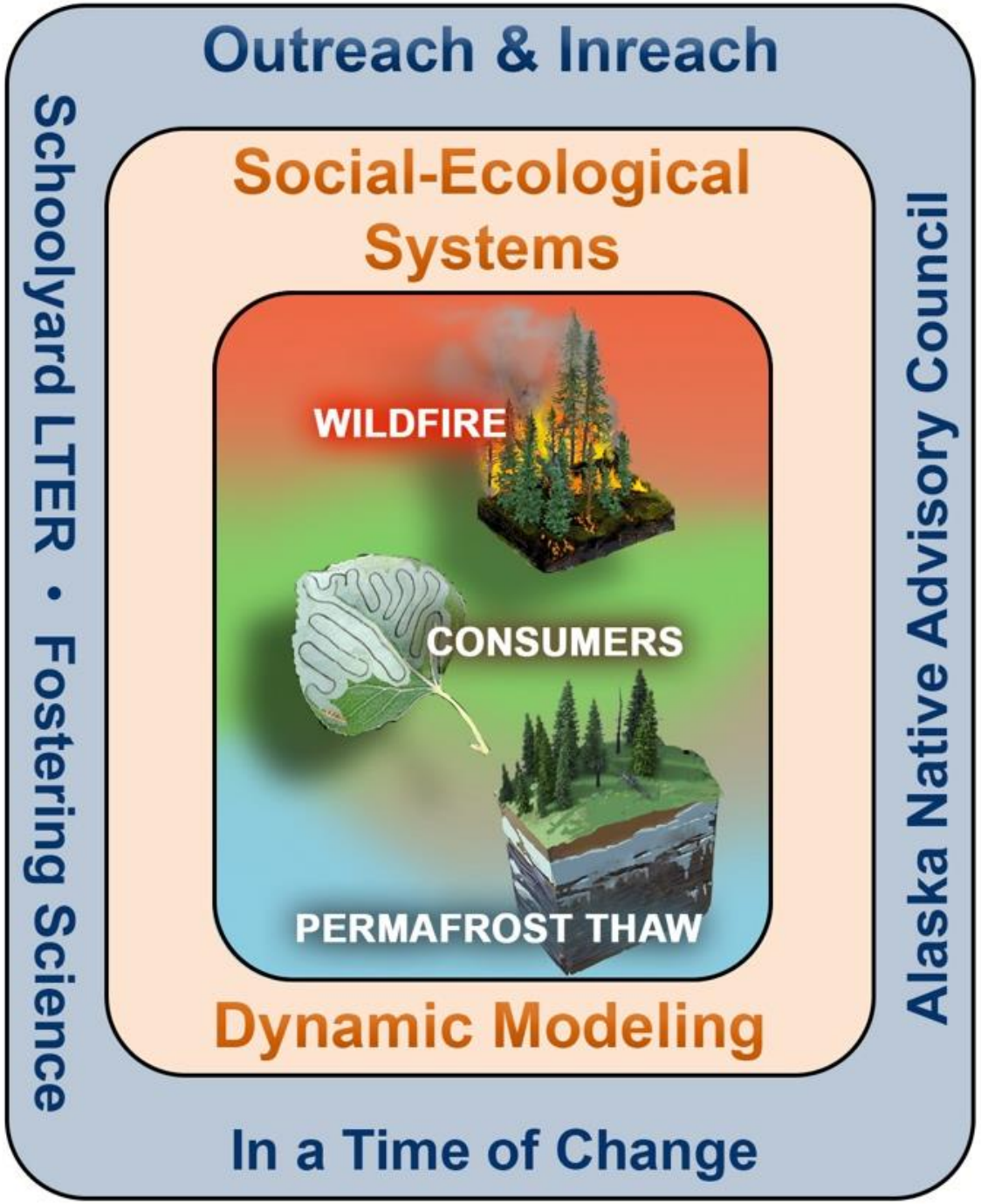
Integration with SES and Modeling

Dynamic Modeling Q1:

- compare model outputs with field observations of recruitment, pre- and post-fire SOL depth, vegetation and soil C and N pools, and active layer thickness in early-, mid-, and late-successional stages from the CCE and RSN+ (W1, W3)

Social-Ecological System

- use of historical fuel breaks (W4)



Integration with Inreach & Outreach

- Education
  - Summer REU students (W1 and W3)
- Arts and Humanities
  - Potential to pair with artists (ITOC) and non-scientists to visit recent road network fires (W1), JFSP sites (W1), new deciduous sites (W2), streams (W3), and fuel breaks (W4) depending on collaborator interests
- Alaska Native Advisory Council
  - Historical use of fire
  - Changes in ecosystem services with increasing wildfire
- DEIJ
  - Focused recruitment of graduate and undergraduate students to increase DEIJ goals

Breakout Rooms

W1: How do black spruce ecosystem legacies and post-fire climate conditions impact successional trajectories?

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W3: Question W3: What are the ecosystem consequences of alternative successional trajectories?

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Tasks:

1. Identify a **presenter** – report back to the larger group
2. Identify a **manager -** ensure that the group stays on task and that there is room for everyone in the conversation
3. Identify a **timekeeper** – keep track of time
4. **EVERYONE** records on the jam board

10 minutes discussion and jam board ideas:

1. collaboration across WGs and other wildfire researchers

2. integration with inreach/outreach

3. Any thought/ideas related to the Q