Impacts of Wildfires on Plant Stoichiometry and Nitrogen Cycling in the Yukon–Kuskokwim Delta, AK.

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Introduction:

Anthropogenic climate change has increased average temperature and fire frequency in the arctic and boreal regions, including the Yukon–Kuskokwim Delta of western Alaska. We are investigating the impact of fire on plant stoichiometry and nitrogen (N) cycling over time using *Rhododendron subarcticum* (Labrador tea) and *Vaccinium uliginosum* (blueberry) as indicator species for evergreen shrubs and deciduous shrub, respectively. We also look at the recovery of moss and lichen species in this tundra ecosystem following fire.

Methods:

- In July 2018, we surveyed 4 paired 2015 burn and unburned sites and one site burned in 1972
- Each area consisted of:
  - Three 30 m transects that were 10m apart
  - Soil temperature (20 cm), active layer thaw depth, and percent cover using a point intercept method at 1 m intervals

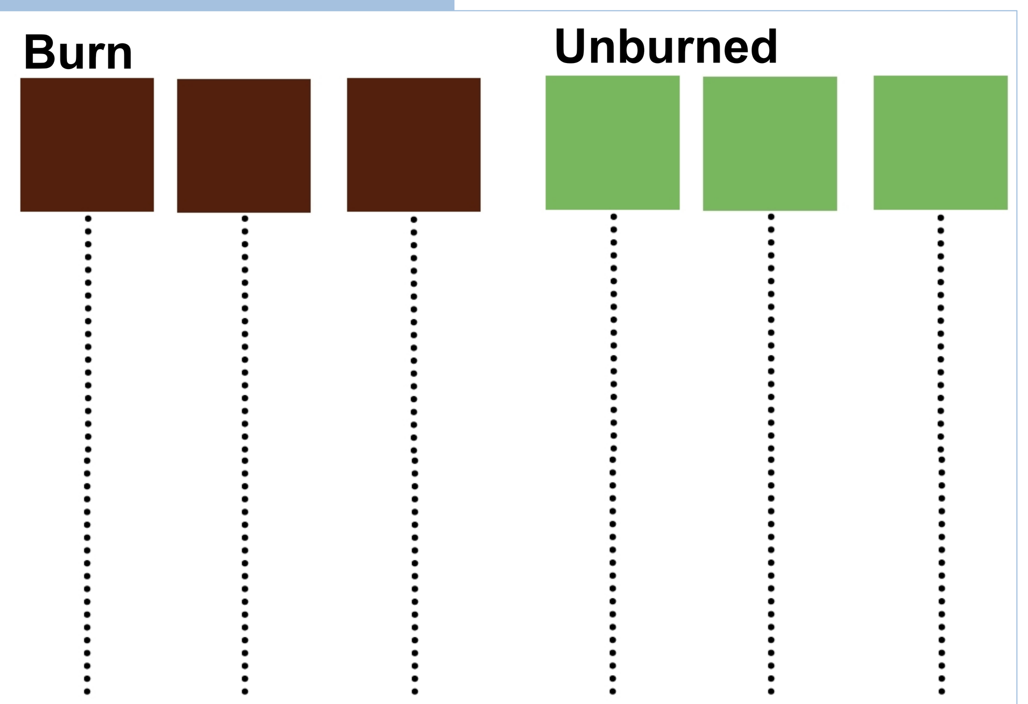

Figure 1. Experimental Design

- At the end of each transect, harvested aboveground biomass in 900 cm^2 area
- Biomass was divided into species or functional type and shrubs were sub-sorted into parts (leaves, stems, flower)
- Plant %C and %N measured on a Leco elemental analyzer

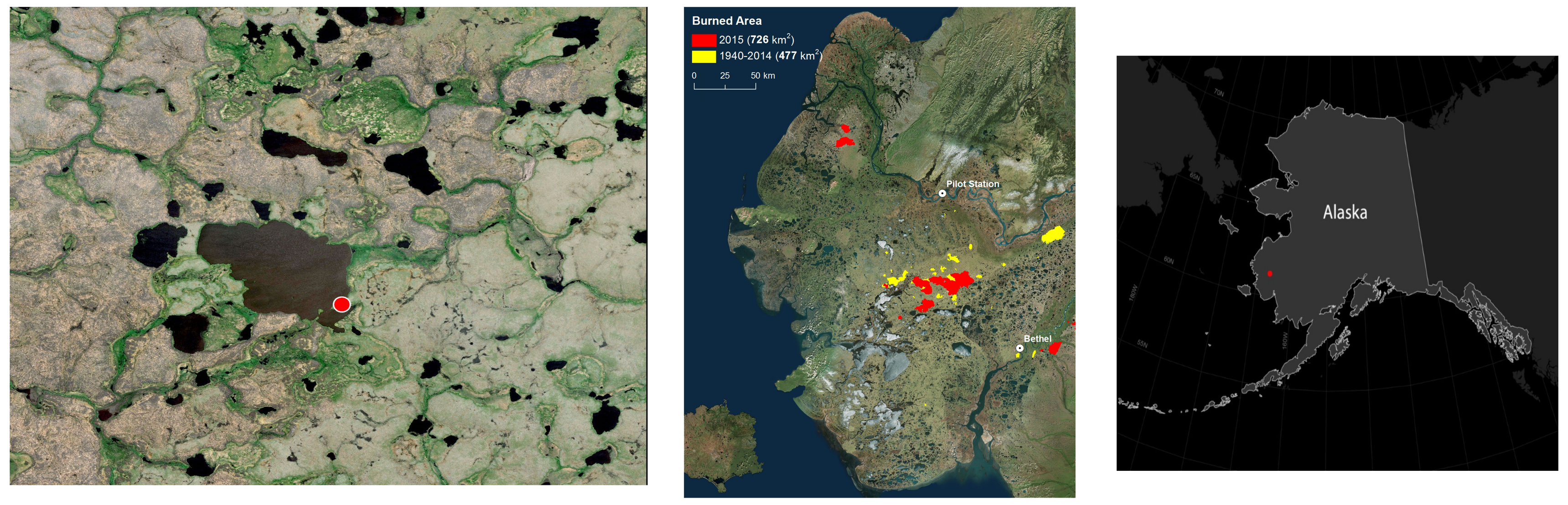

Figure 1. Maps the Yukon-Kuskokwim Delta

Figure 3. Shrub 1972 Burn vs Unburn

Figure 2. Harvesting aboveground biomass

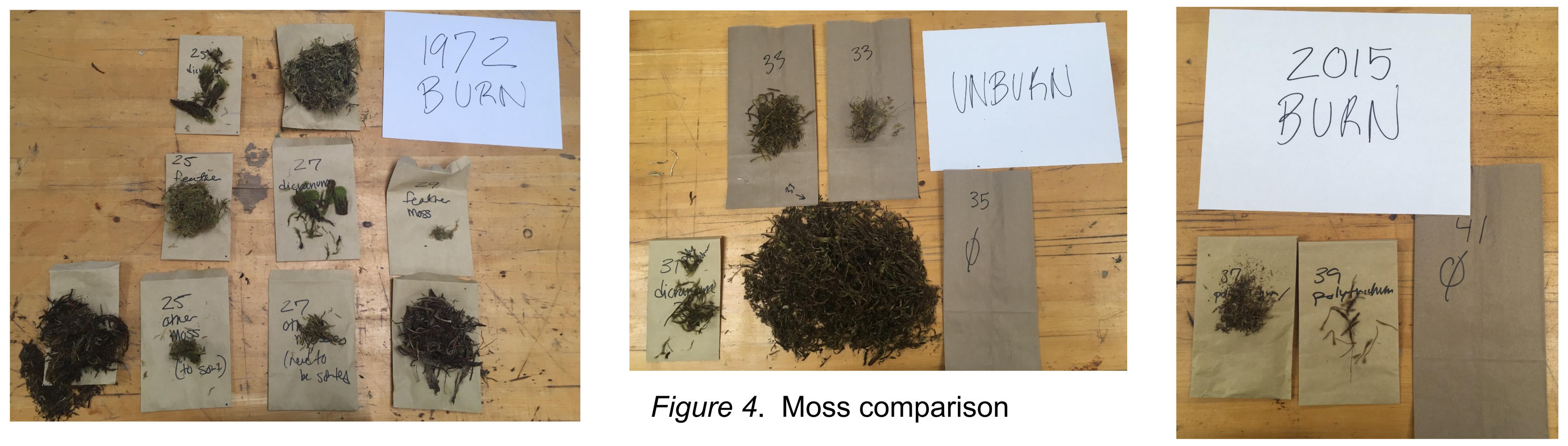

Figure 4. Moss comparison

Conceptual Model:

Climate Change → + Temperature → + Drier Conditions +Storms → + Wildfires → N; + Wildfires → Vegetation → N

Hypothesis:

We hypothesized that burning would change the stoichiometry of shrub by reducing their carbon (C) to N ratio due to an increase in plant-available N. We also hypothesized that fire would drive a shift from a lichen-dominant to moss-dominant ecosystems.

Figure 5. Aerial of the Yukon-Kuskokwim Delta

Results:

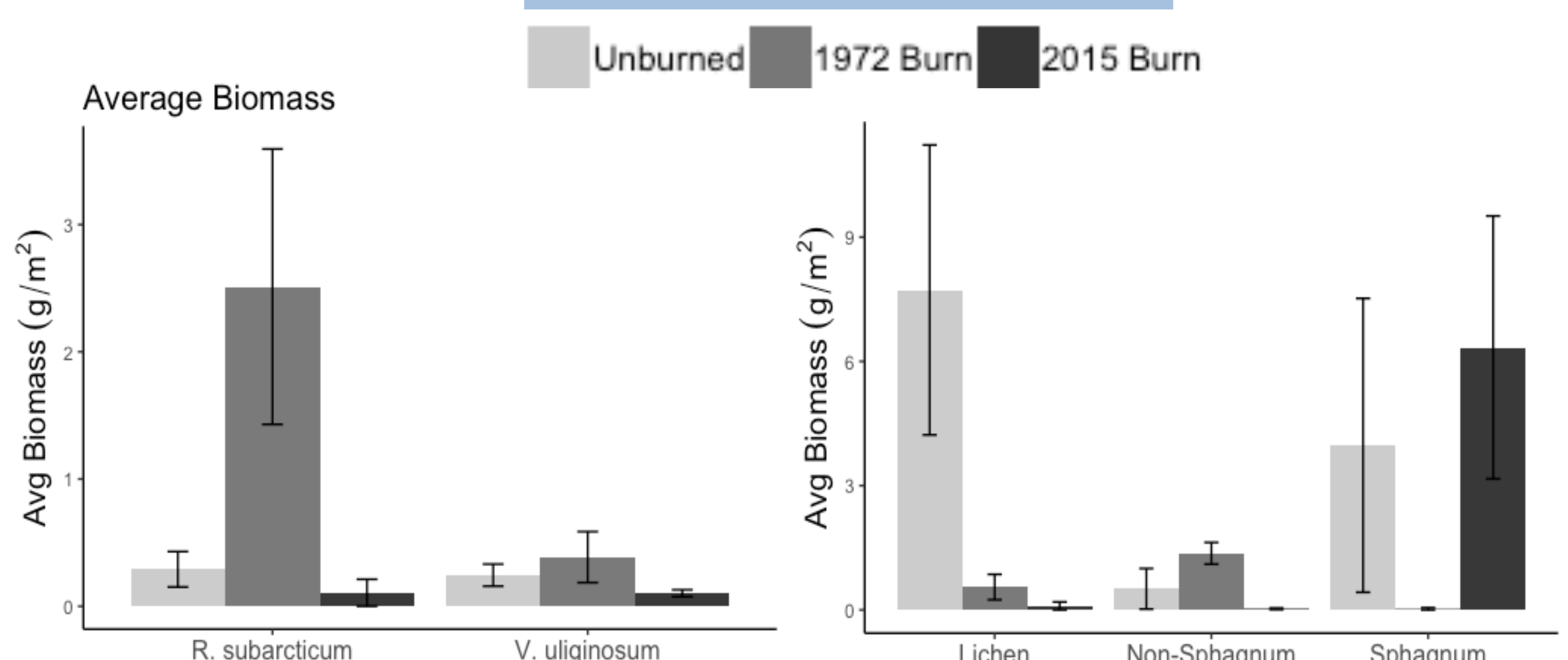

Figure 6.

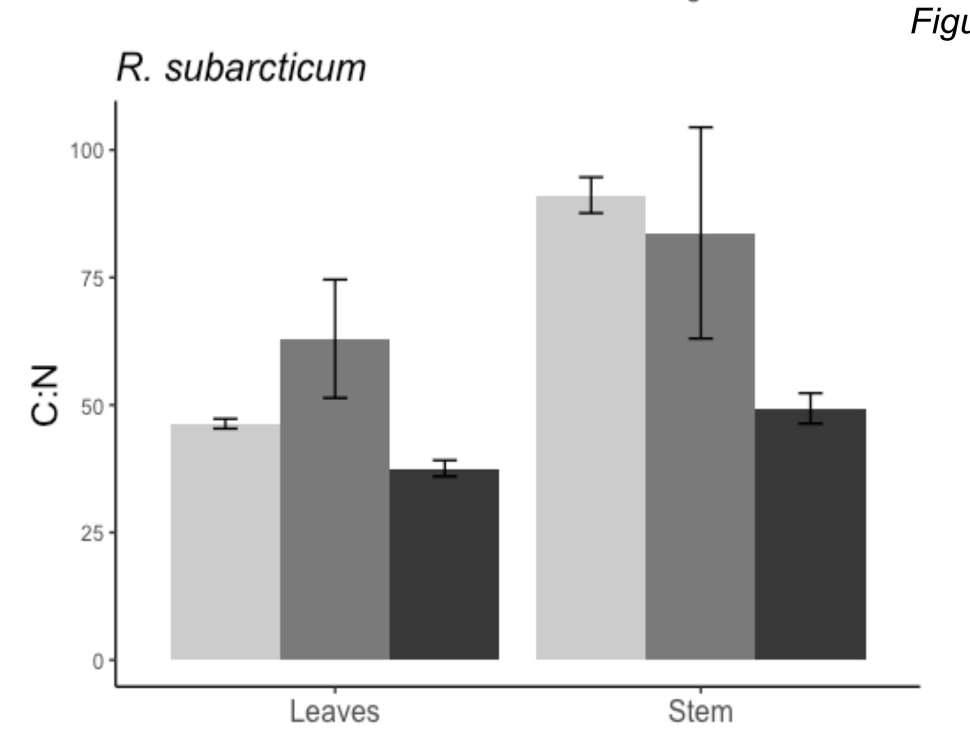

Figure 7.

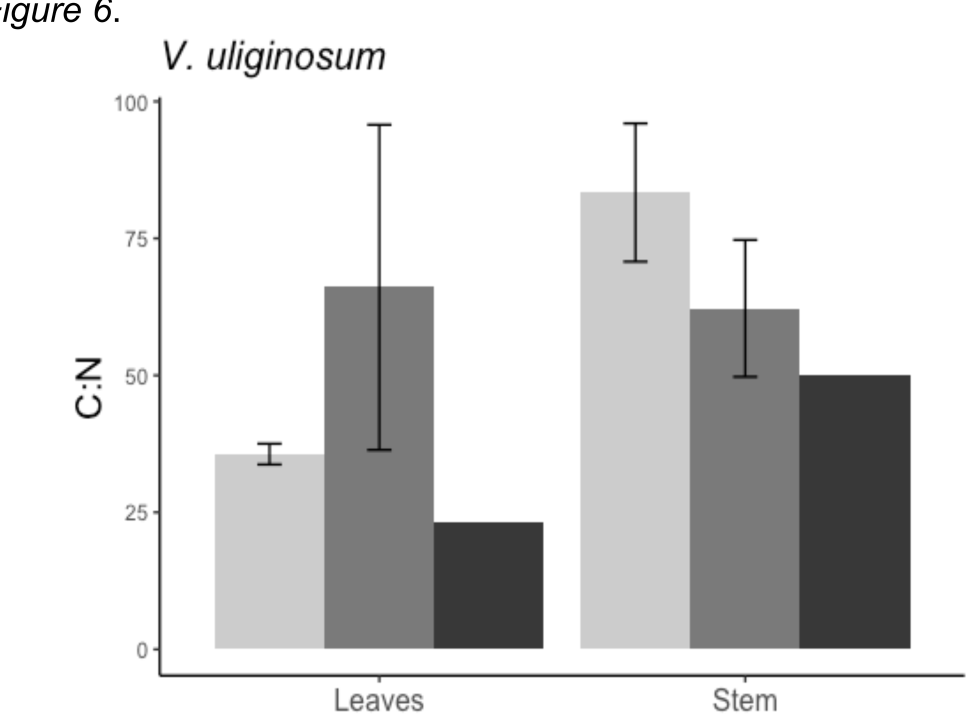

Figure 8

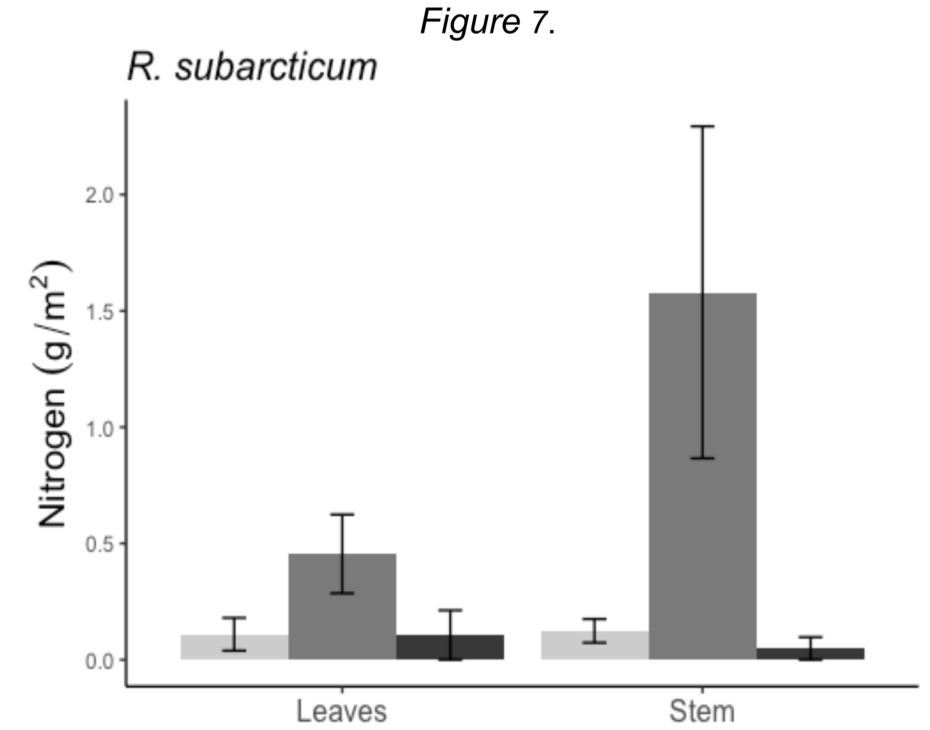

Figure 9.

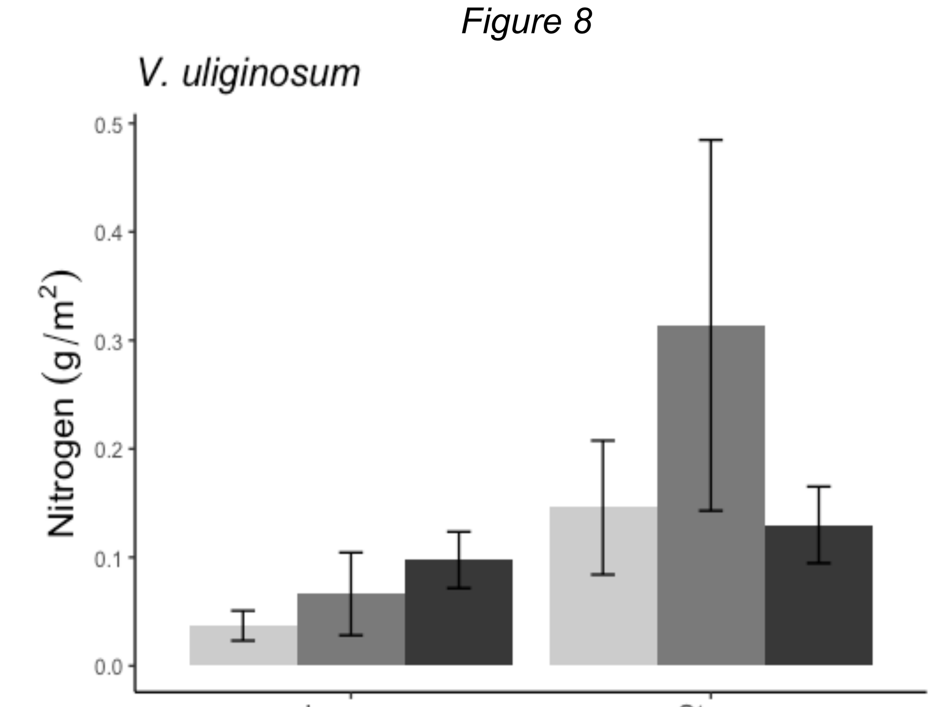

Figure 10.

Discussion:

Aboveground Biomass:
(Figure 6)

- Immediately after fire, all aboveground biomass was reduced, except for *Sphagnum*
- 46 years after fire, shrub and non-*Sphagnum* moss biomass was greater than unburned areas
- Lichen and *Sphagnum* did not recover even 46 years after fire

Shrub Leaf and Stem C:N
(Figure 7 and 8)

- Fire reduced shrub leaf and stem C:N in the short term, likely due to increased soil N availability
- 46 years after fire, C:N was still lower for stems than unburned areas, but close to recovering completely
- Leaf C:N for the 1972 burn was higher than unburned levels due to an increase in C

Shrub Leaf and Stem total C and N
(Figure 9 and 10)

- More N and C was stored in shrub biomass 46 years after the fire
- Increased N availability may promote greater shrub biomass nearly five decades post-fire.

Conclusion:

In the short term, fire alters plant stoichiometry of *R. subarcticum*, *V. uliginosum*, and other shrubs by decreasing C:N (driven by an increase in % N). However, over decadal time scales, the C:N increases, in leaves, relative to unburned areas, while remaining lower relative to unburned areas in stems. Yet, the total N in our indicator species continued to be greater than neighboring unburned areas due to increased biomass. Thus, increased N may facilitate a positive feedback of N cycling in the burned ecosystem. We also found a recovery change in the lichen to moss ratio over time after fire. It is possible that change was facilitated by a stoichiometric swift. Even 46 years after fire, lichen does not recover, but there is some moss recovery with a replacement of *Sphagnum* with non-*Sphagnum* moss. It also indicates that the impacts from fires in this system may propagate for decades, and that wildfire-driven biogeochemical changes will become more prevalent in the Yukon–Kuskokwim Delta.

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