The effects of fire on greenhouse gas fluxes from mosses and lichen patches in the Yukon Kuskokwim Delta, AK.

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Introduction:

Climate change is predicted to cause an increases in fire frequency and intensity in the Arctic, which is likely to cause major changes in vegetation patterns, particularly the relative importance of mosses and lichens. These changes alter soil temperatures, nutrient availability, and moisture, potentially affecting microbial processes and the release of greenhouse gases (GHG) such as N2O, CO2 and CH4. In 2015, a record fire season burned a large area of Yukon-Kuskokwim River Delta in southwest Alaska. The objective of this research is to investigate how recent fires in the YK Delta are affecting the emission of GHGs from peat plateau soils.

We hypothesized that:

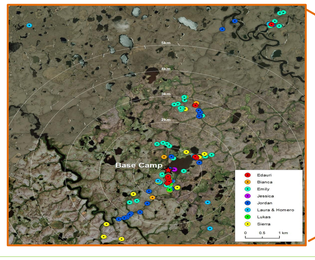
- The loss of lichen and moss biomass to fire will reduce soil moisture and increase soil temperature, leading to higher rates of GHG emission.
- Fire would increase soil nutrient availability, which would increase microbial process rates and GHG emissions.

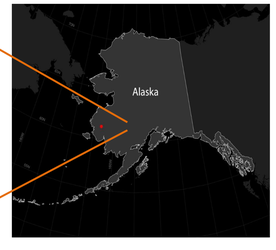
Materials and Methods:

- In July 2017, we measured CH4 and CO2 fluxes from moss (*Sphagnum fuscum)* and lichen (*Cladonia/Cladina spp)* patches in three burned and unburned areas using a static chamber attached to a Los Gatos Research Ultraportable Gas analyser (LGR). N2O flux was measured by collecting gas from the same chambers into evacuated gas vials, which were analysed on a gas chromatograph at the Woods Hole Research Center.
- We collected thaw depth and soil temperature data from all flux measurement sites.
- In addition, we collected 10 cm deep soil cores for analyses of gravimetric soil moisture, carbon and nitrogen concentrations.
- Soil samples were also incubated in the lab to estimate GHG production.

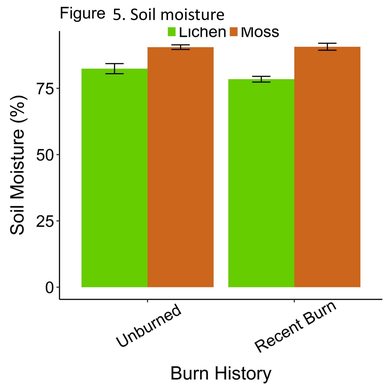
Figure 1. Measuring fluxes.

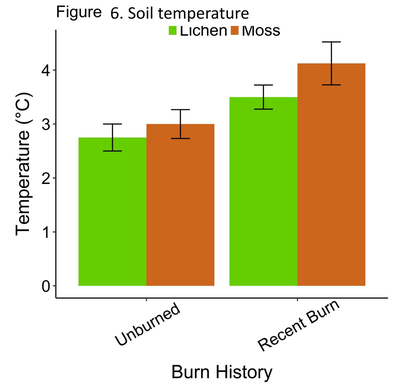
Figure 2. Unburned moss and lichen patches

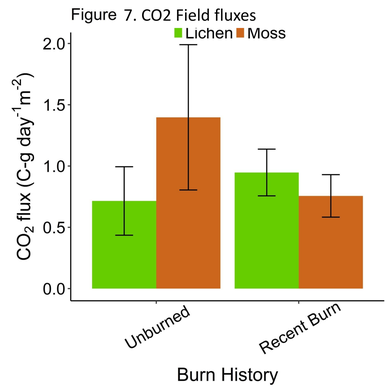


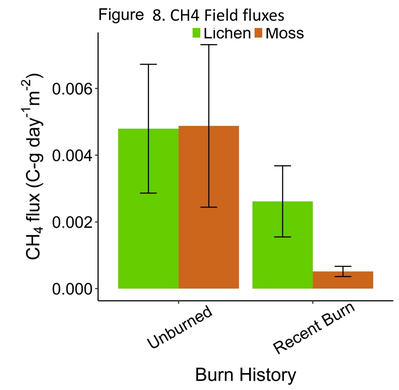


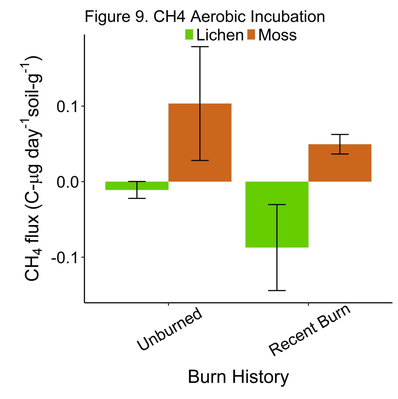
Results:

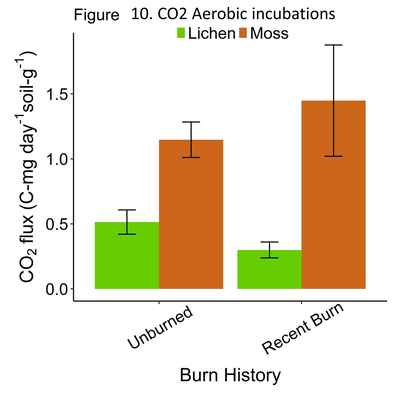


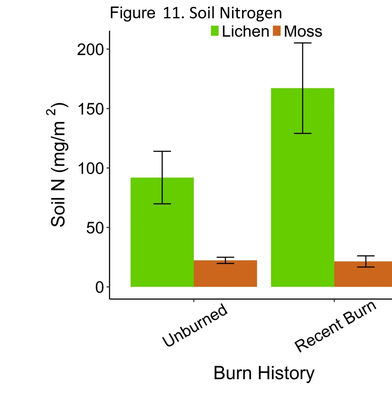


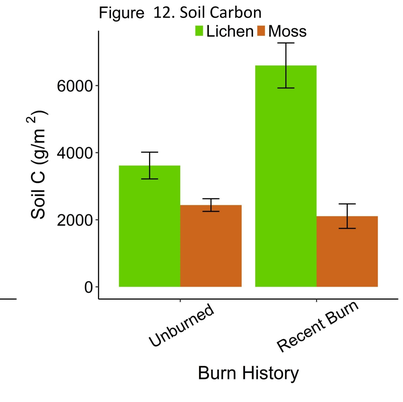












Discussion:

Overall:

(Figure 5 and 6)

- Mosses have higher moisture.
- Burned areas have higher temperature.

Field Fluxes:

(Figure 7 and 8)

- Unburned areas and mosses have higher CO2 and CH4 emission.

Aerobic incubations:

(Figure 9 and 10)

- Unburned areas have higher CH4 production.
- Mosses have higher CO2 and CH4 production.
- Overall, burned areas have lower production than unburned areas.

Nutrients:

(Figure 11 and 12)

- Lichens have higher soil N and C overall, but in burned areas the amount of N and C increases.

Summary:

Fire appears to increase soil temperature and N and C availability, but reduces CH4 emissions in both lichen and moss patches. CO2 production in aerobic incubations was unaffected by fire. In addition, lichens show higher soil carbon and nutrient availability, but aerobic incubations suggest soils from moss patches have higher microbial activity.

Acknowledgments:

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Figure 5. Taking some soil samples.

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