Fire Legacy on Infiltration Rates and Nitrogen Species

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Introduction

Wildfires have increased in tundra ecosystems as climate change progresses. The Yukon-Kuskokwim Delta in southeast Alaska, for example, has seen strong increases in fire extent and severity. This will likely have major impacts on biogeochemistry and hydrology, as fires alter soil structure and the movement of nutrients to downstream aquatic ecosystems.

Our objectives were to assess the impacts of fire on nitrogen availability and soil hydraulic conductivity, and to infer impacts on the movement of water and nutrients through an Arctic tundra landscape.

Method

- Samples collected from areas burned in 1972 and 2015 and unburned sites.
- Porewater sampled at 70-80 cm depth.
- Falling head hydraulic conductivity measured in moss and lichen patches with piezometers at 10 and 20 cm depths.
- Soil samples collected to 20 cm in moss and lichen patches for water extractions.
- Vegetation patches in 2015 burn were remnant moss patches and burned ground (lichen). *Sphagnum* moss dominated in unburned areas; feathermoss and *Sphagnum* in the 1972 burn.

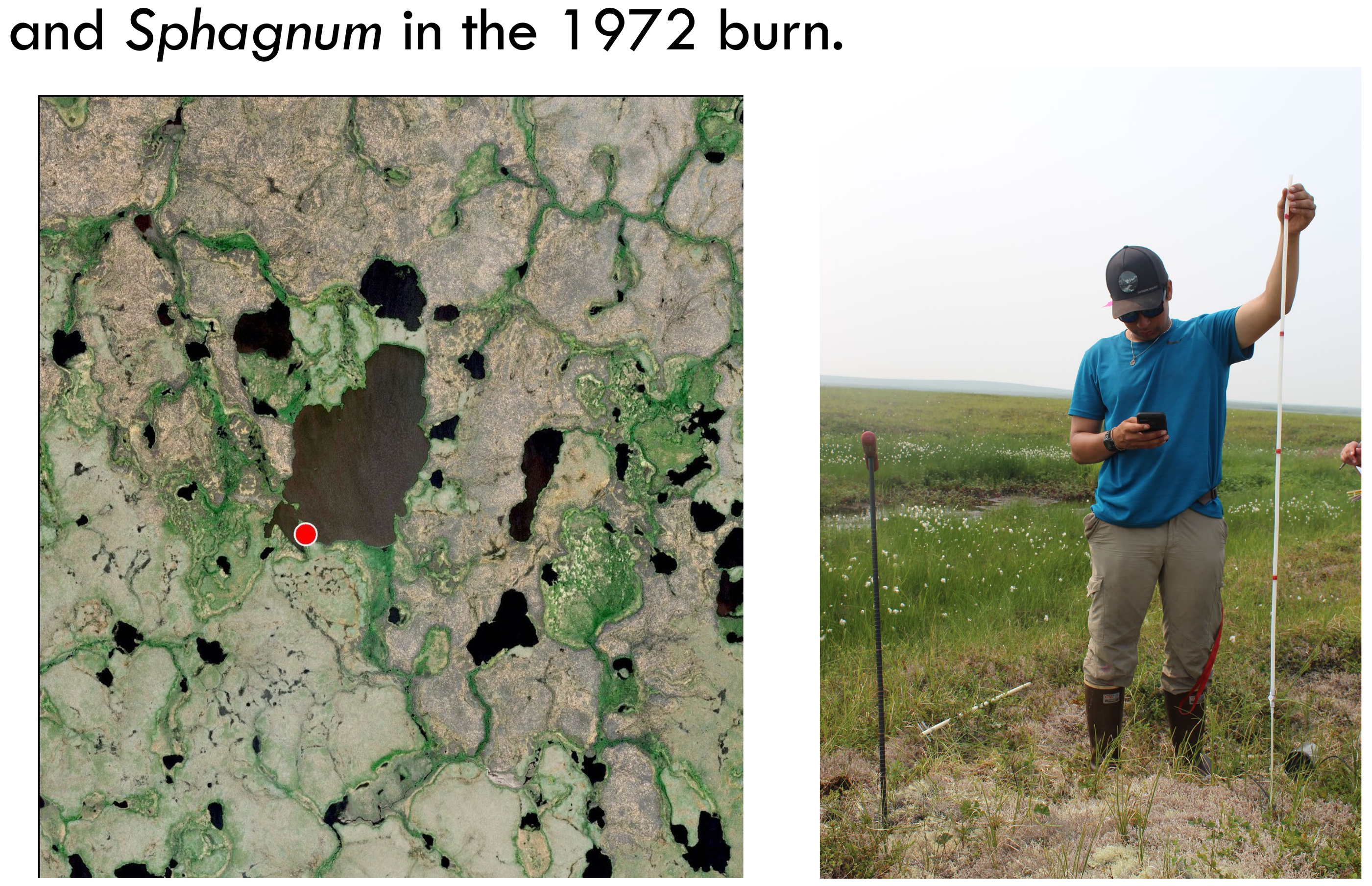

Figure 1: Sample area showing burned and unburned tundra (left); falling head hydraulic conductivity measurements (right),

Results

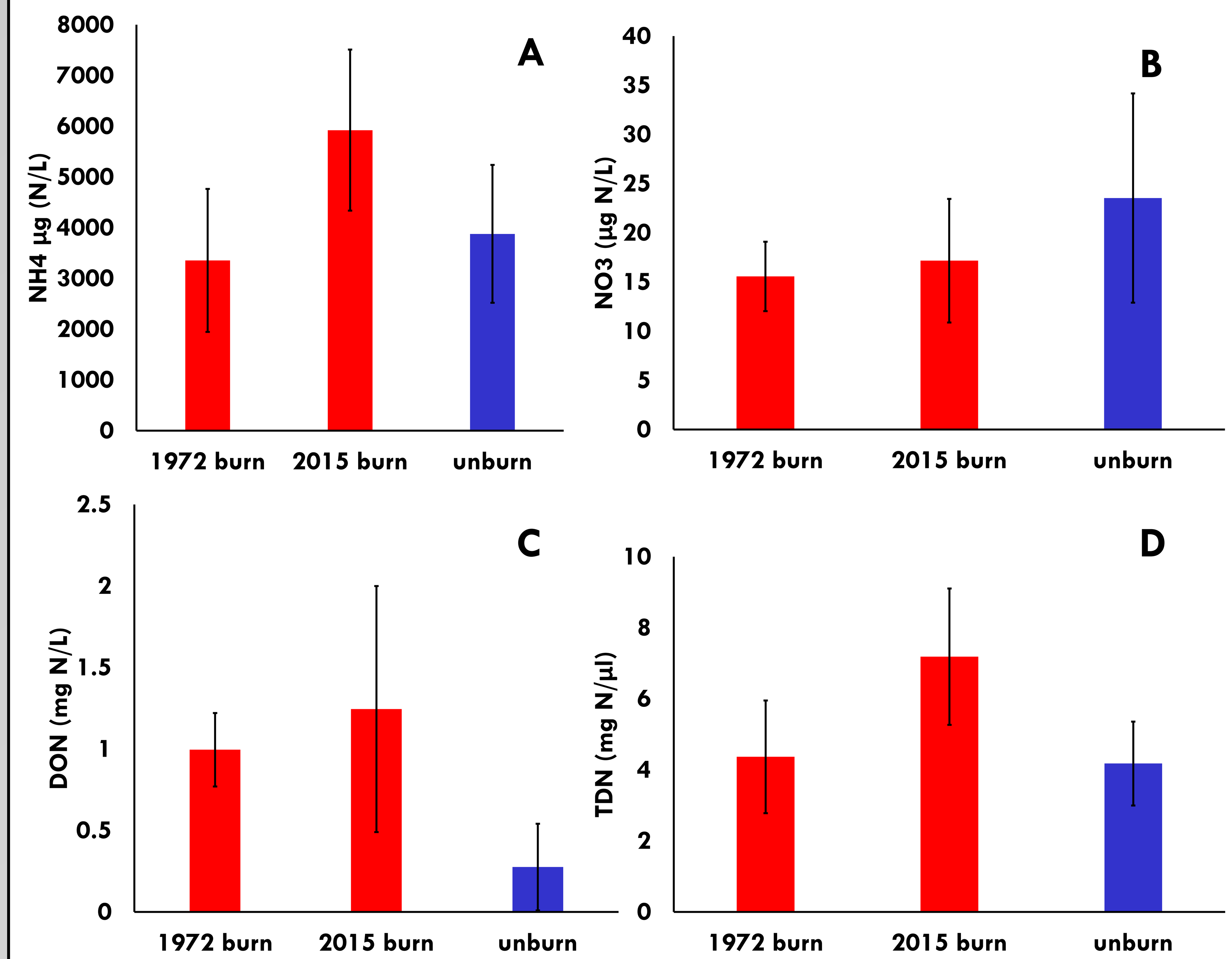

Figure 2 – Average porewater NH_4^+ (A), NO_3^- (B), dissolved organic nitrogen (DON; C) and total dissolved nitrogen (TDN; D) concentration. Error bars are standard errors.

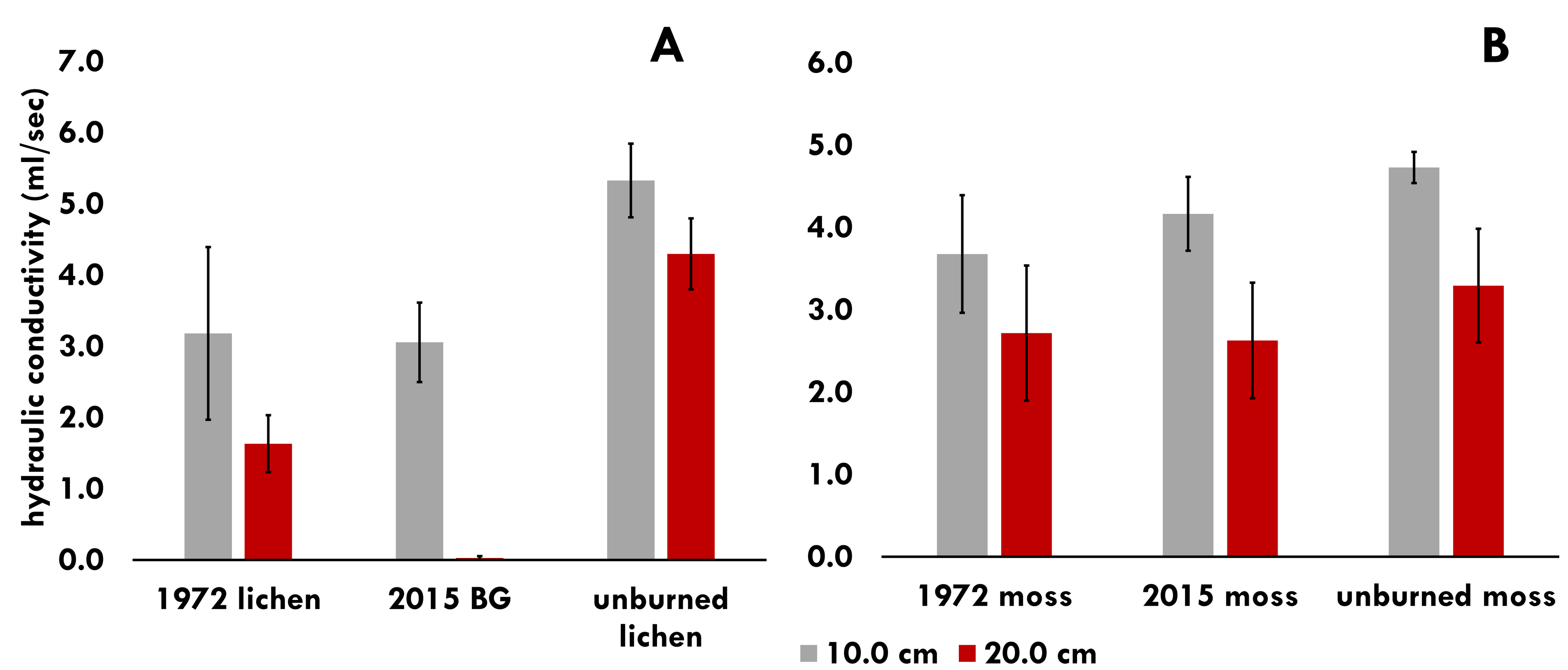

Figure 3A. Average hydraulic conductivity in lichen patches in the 1972 burn and unburned and burned ground (BG) in 2015 burn. Error bars represent standard error.

Figure 3B. Average hydraulic conductivity in moss patches in all sites. Error Bars represent standard error.

Results

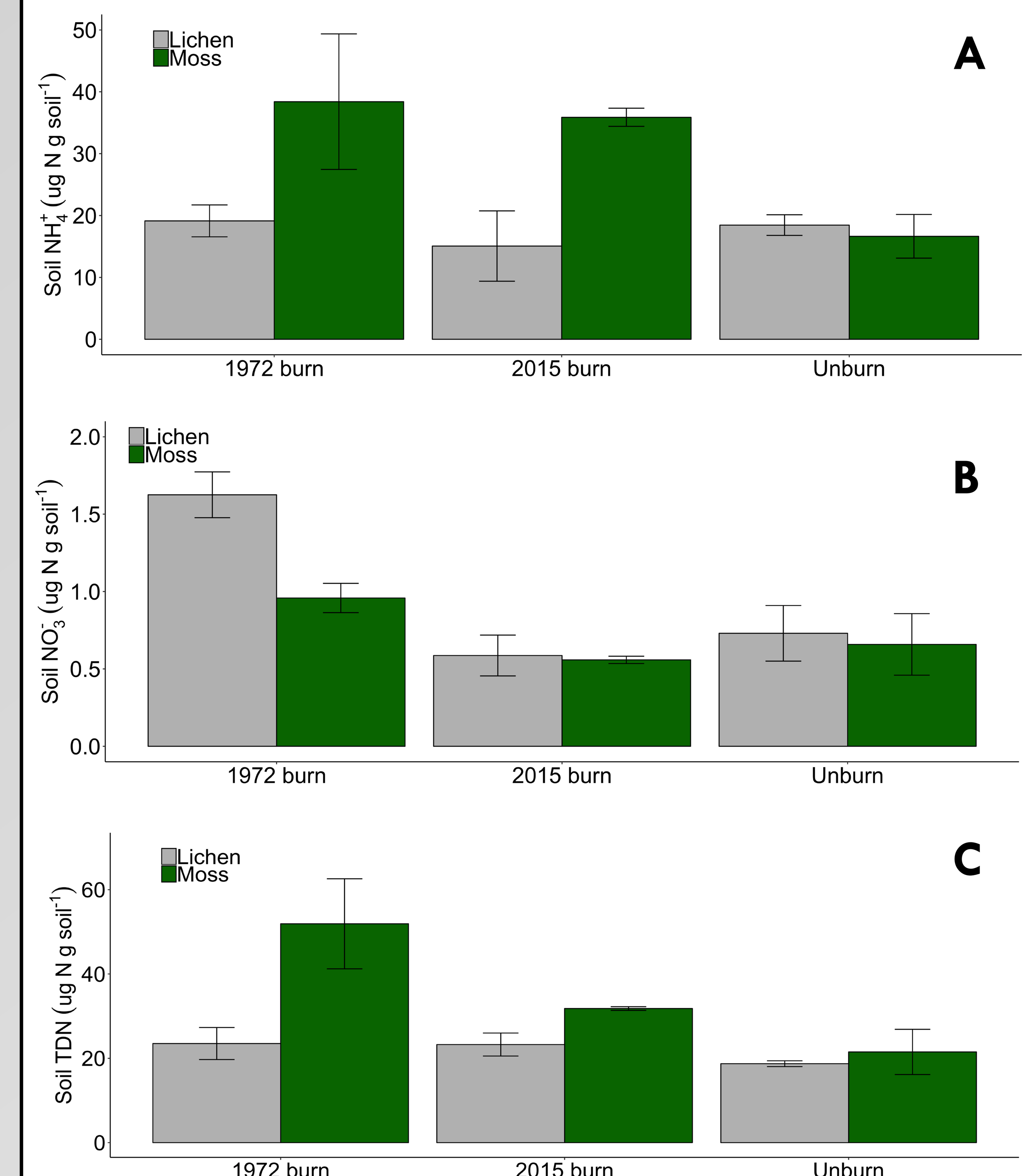

Figure 4: Average water extractable NH_4^+ (A), NO_3^- (B), and total dissolved nitrogen (TDN; C) from soils collected from lichen and moss patches in burned and unburned sites. There were significant effects of vegetation and burn history on NO_3^- and TDN, and significant vegetation and burn-vegetation interaction on NH_4^+ ($p<0.05$).

Summary

Fires increase nitrogen in both porewater and soils decades post-fire, but the impact depends on the type of vegetation burned. Fires also affect soil hydraulic conductivity, suggesting an influence on the rate of movement of water through tundra landscapes. In spite of these effects, we did not find clear evidence that fire influences the movement of nitrogen from tundra to downstream ecosystems. These results show that fire has long-term consequences for nitrogen cycling and water movement in tundra ecosystems.