The effect of prescribed burning on nitrification-coupled denitrification in a restored tidal marsh

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UMCES 100 YEARS OF SCIENCE

University of Maryland
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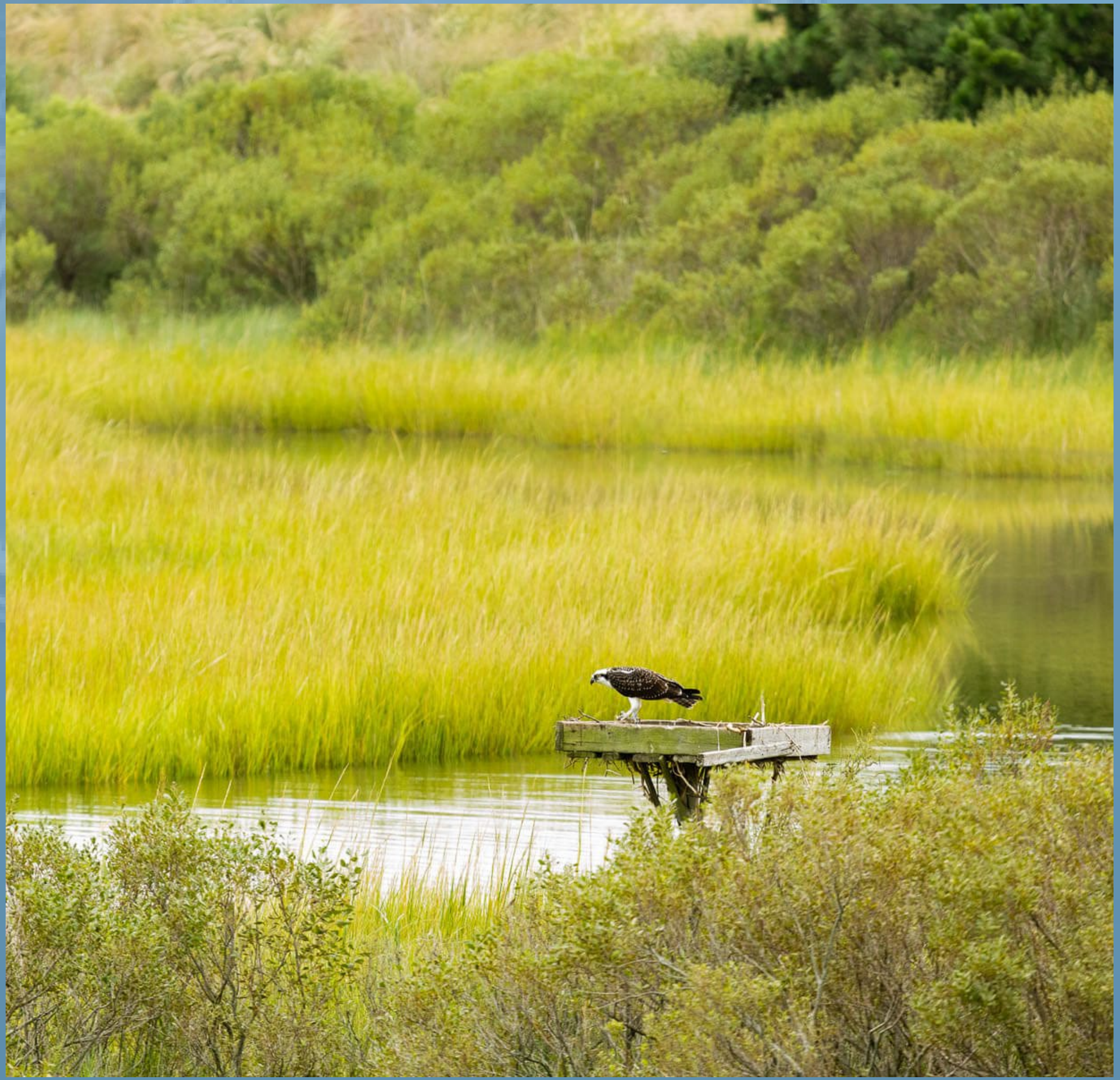
MARYLAND ENVIRONMENTAL SERVICE

Background

- This study builds on a larger study of the response of vegetation, insect, and microbial communities to prescribed burning of tidal marshes

- Objective: Investigate the effect of a prescribed burn on nitrification-coupled denitrification of restored tidal marshes on Poplar Island, MD, USA



Chesapeake Bay Program

Chesapeake Bay Magazine

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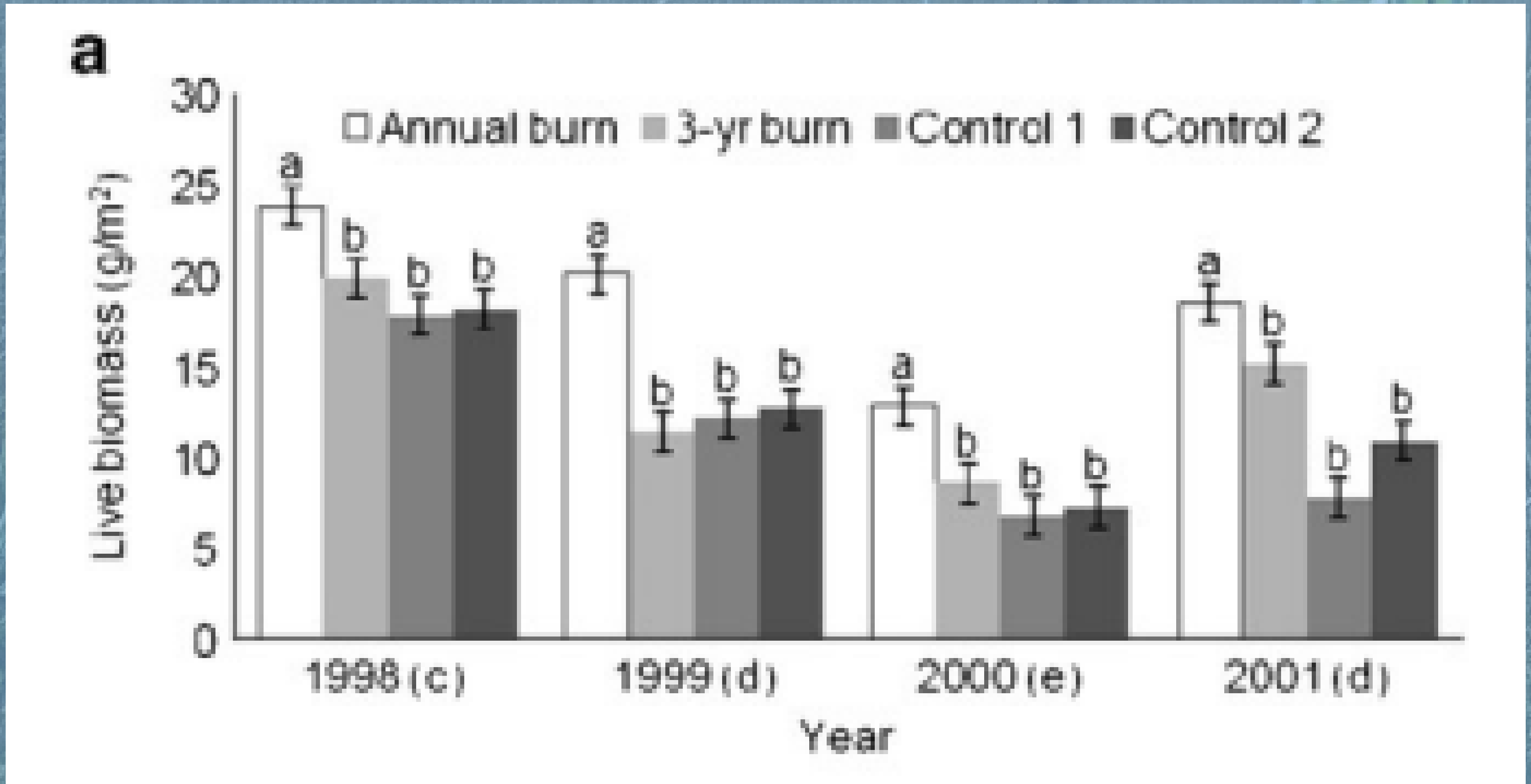
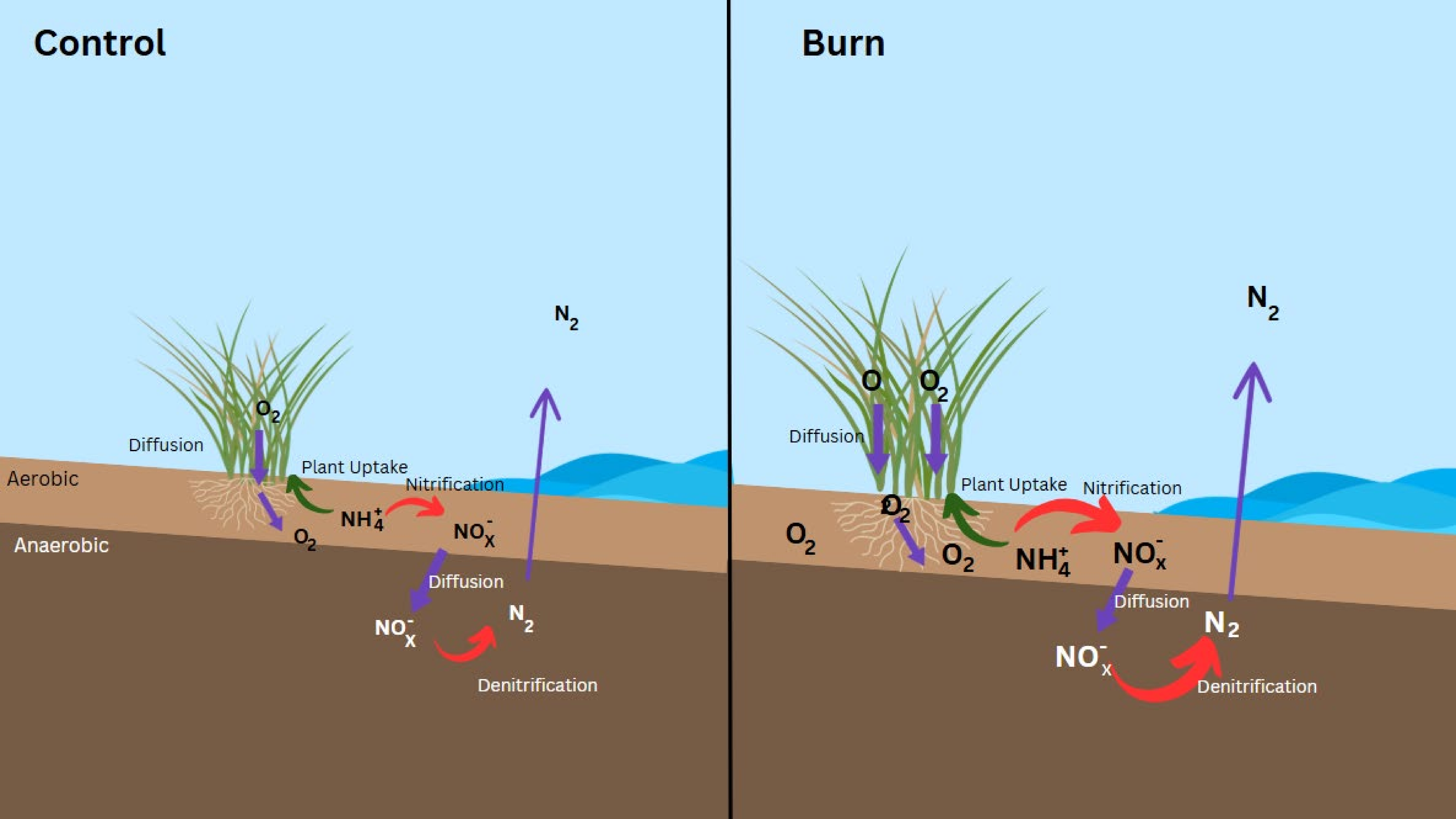
Chesapeake Bay Magazine

Background



Flores et al., 2011 (Blackwater National Wildlife Refuge)



Control
Burn
N_2
O_2
Diffusion
Aerobic
Anaerobic
Plant Uptake
Nitrification
NH_4^+
NO_X^-
O_2
Diffusion
NO_X^-
N_2
Denitrification
N_2
O
O_2
Diffusion
Plant Uptake
Nitrification
O_2
O_2
O_2
NH_4^+
NO_X^-
Diffusion
N_2
NO_X^-
Denitrification

Hypotheses

H1: Plant biomass production will increase in response to the prescribed burn due to release from growth limitation by insect herbivory and pathogens

H2: The flush of new growth following the prescribed burn will stimulate an increase in nitrification-coupled denitrification due to increased oxygenation of the rhizosphere

April 2023 — Veg + Insect Monitoring

June 2023 — Veg + Insect Monitoring

July 2023 — Biogeochemical

Aug 2023 — Veg + Insect Monitoring

Oct 2023 — Veg + Insect Monitoring/ Biogeochemical

March 2024 — Prescribed Burn

April 2024 — Veg + Insect Monitoring

June 2024 — Veg + Insect Monitoring

July 2023 — Biogeochemical

Aug 2023 — Veg + Insect Monitoring

Oct 2023 — Veg + Insect Monitoring/ Biogeochemical

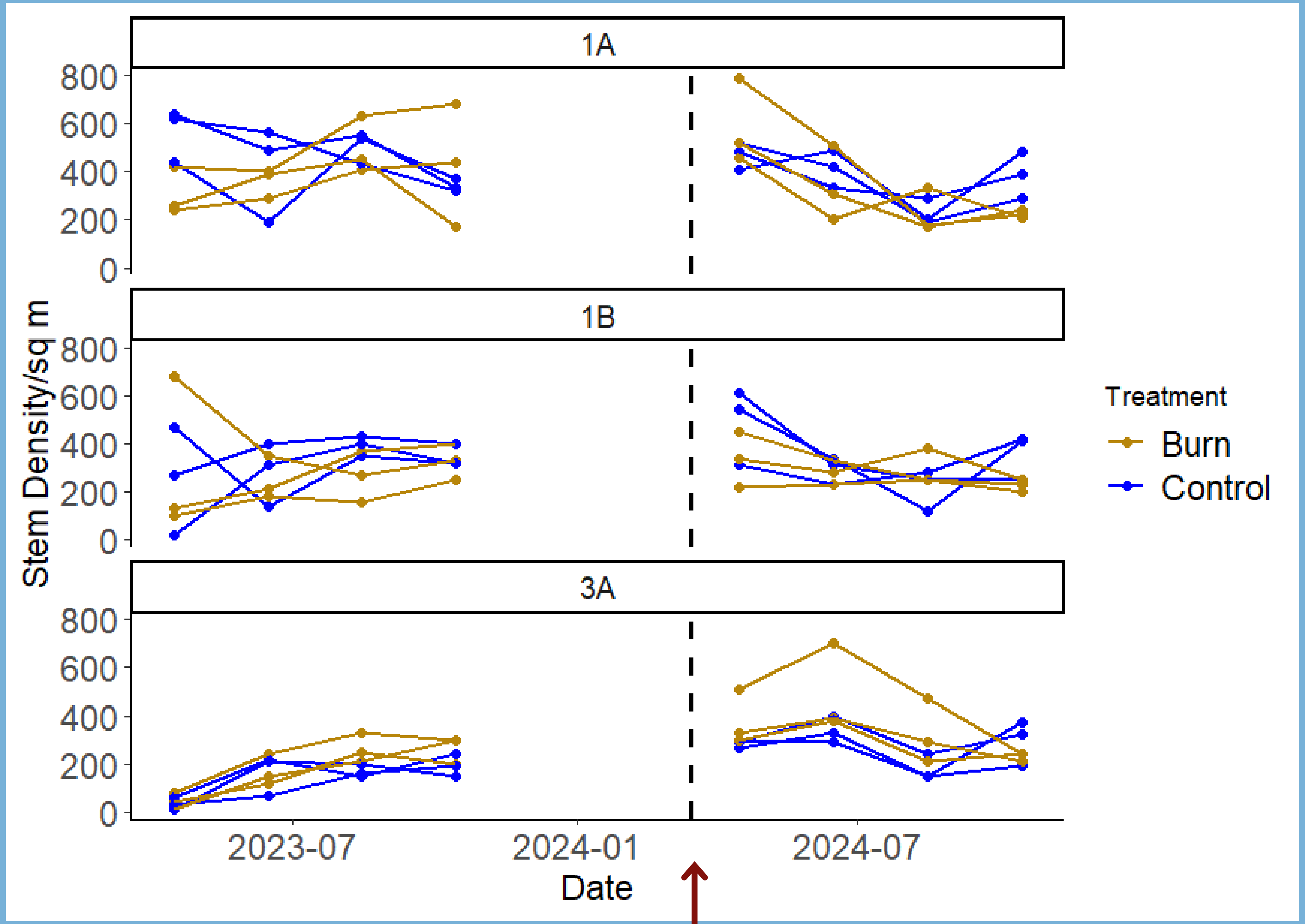
H1: Vegetation

Methods

- Stem Density
- Stem Heights
- Percent Cover
- End of Year Biomass

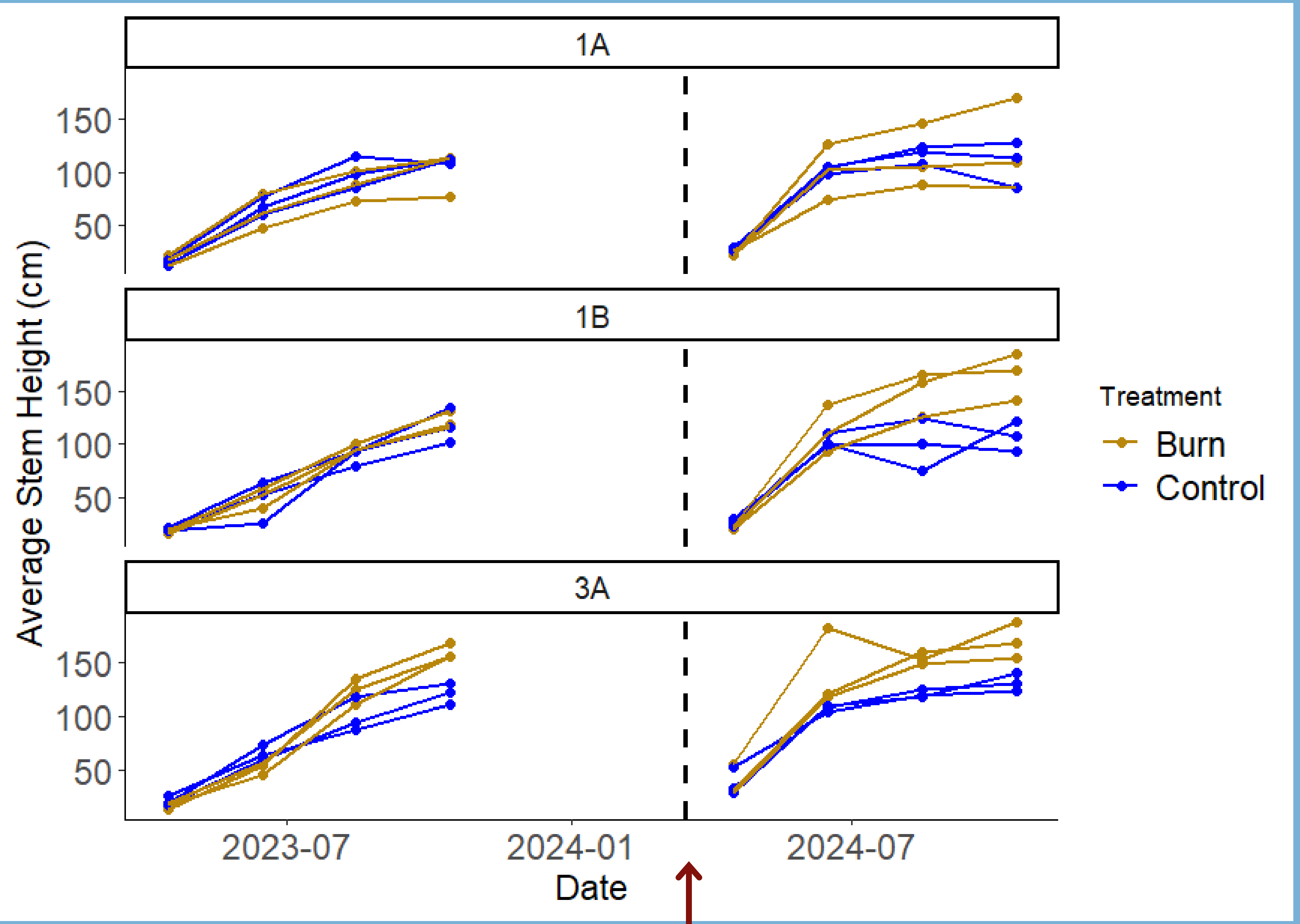
Vegetation Monitoring

Stem Density



Prescribed Burn

Stem Height



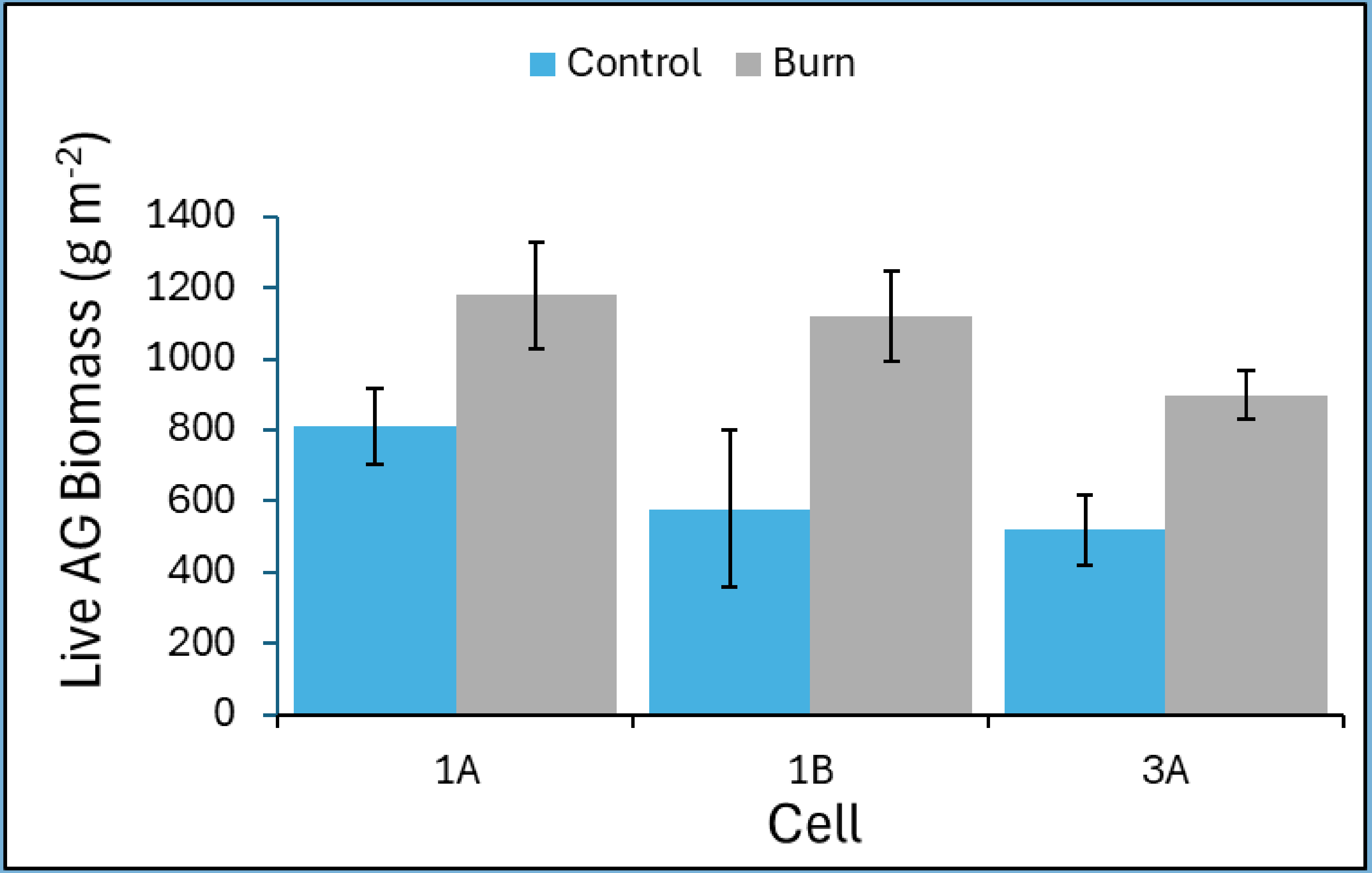
Prescribed Burn

Control

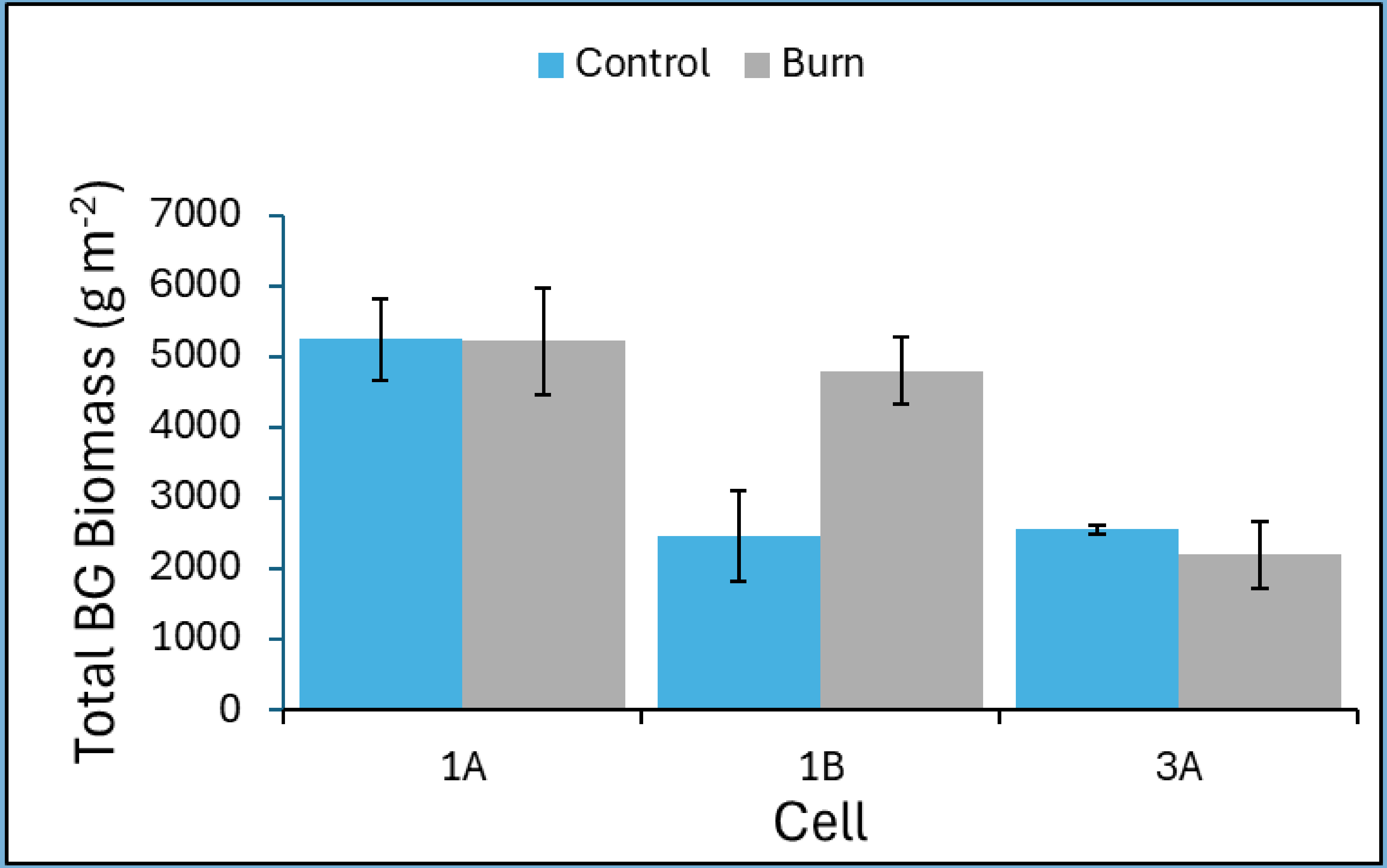
Burn

End of Year Biomass

Live Aboveground



Belowground

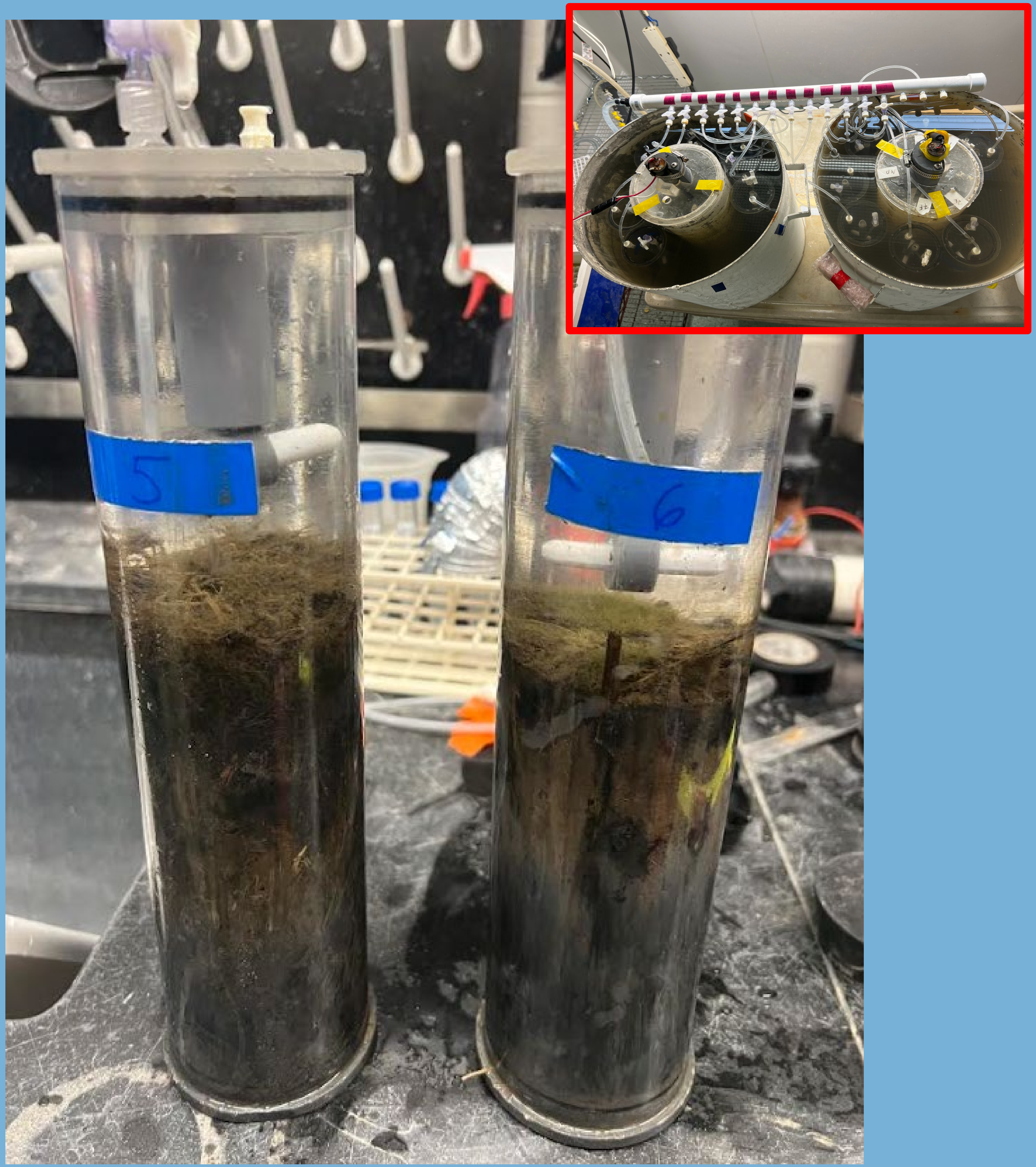


H2: Sediment-Water Exchange

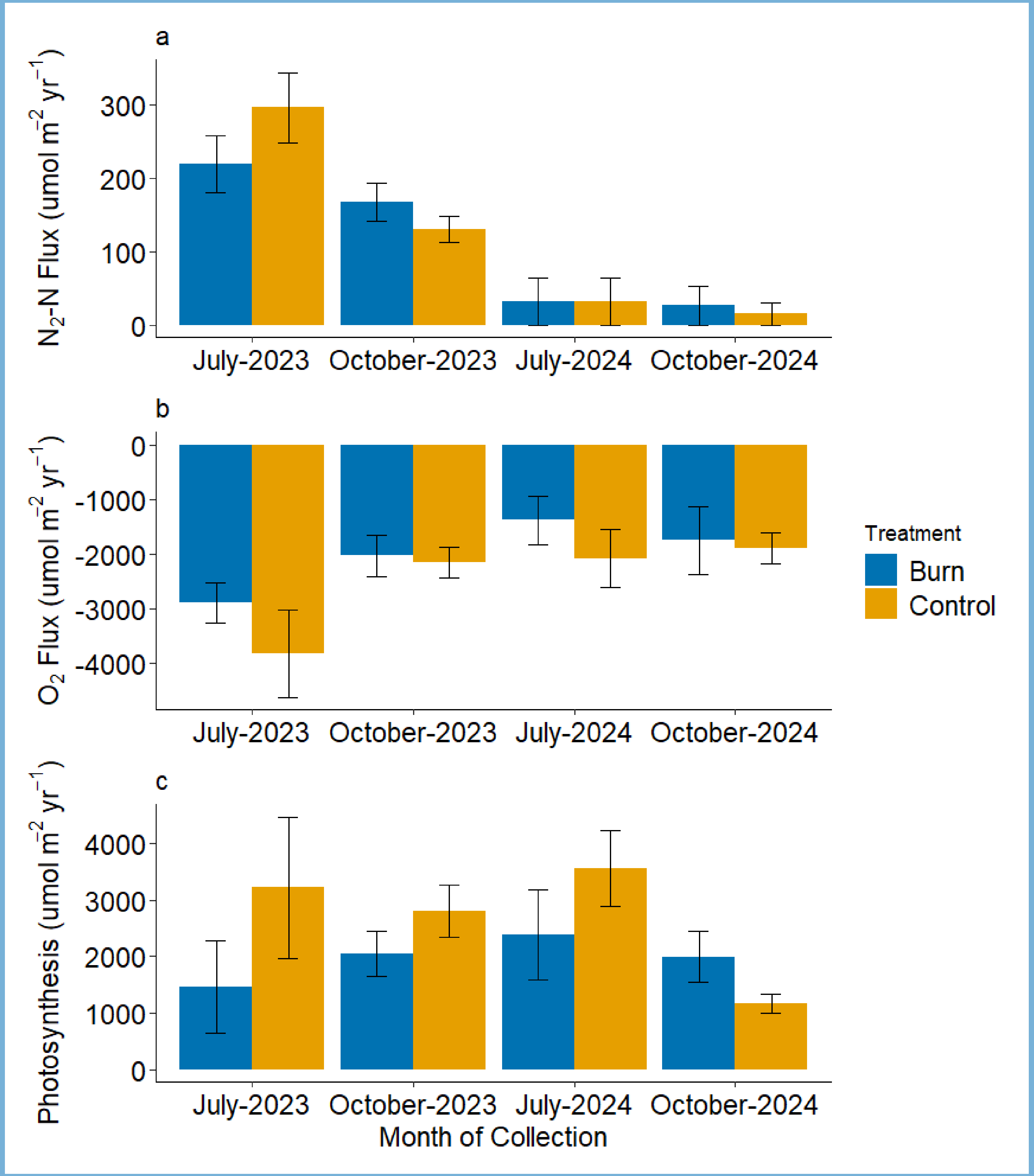
Methods

12 intact sediment cores

- Sediment-water exchange of N_2, O_2 using methods from Kana et al., 1994
- Sediment-water exchange of NH_4^+, NO_x^-
- 12 pore water equilibrators for pore water NH_4^+, H_2S

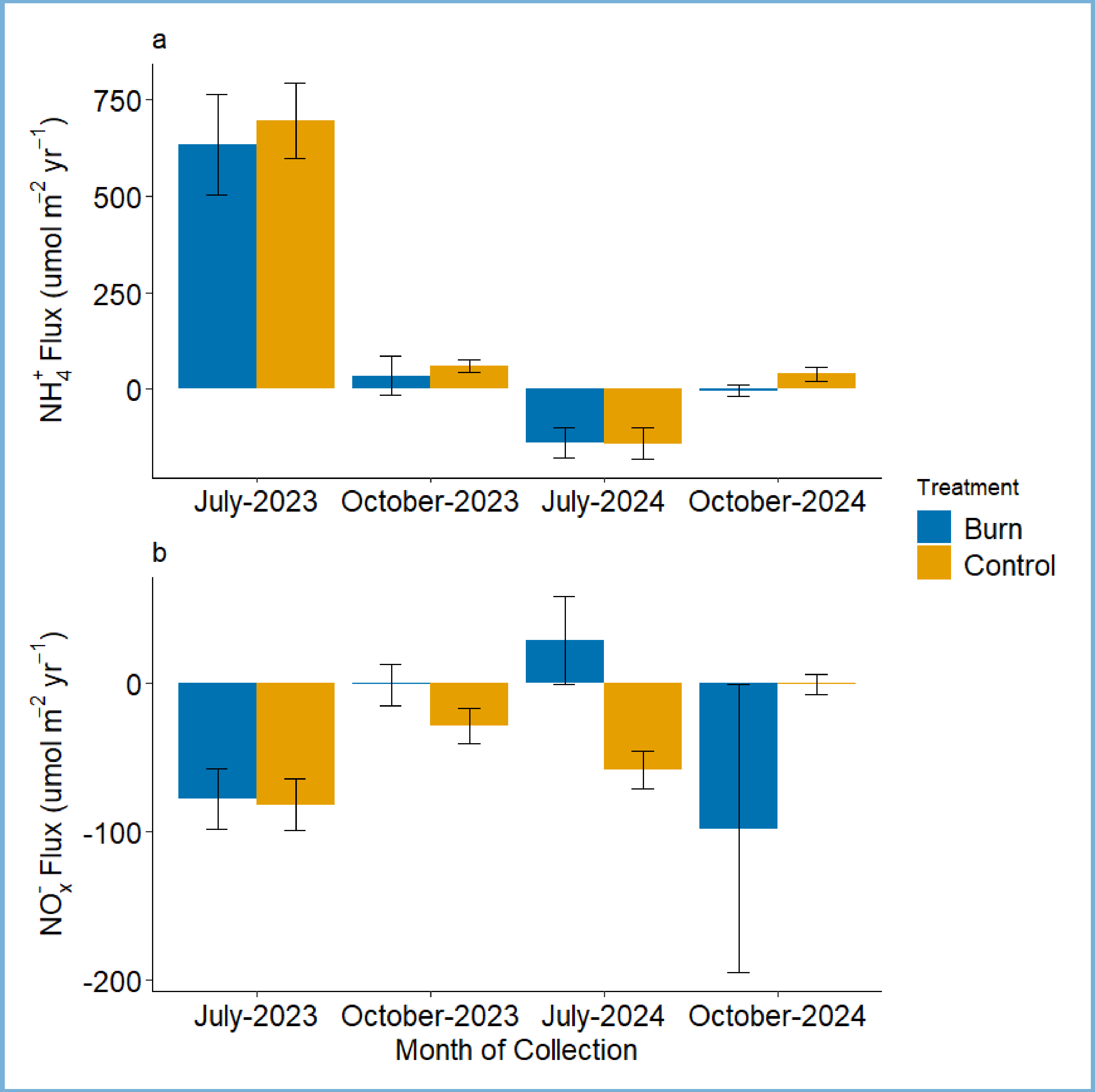


Gas Fluxes



a
N_2-N Flux (umol m^{-2} yr^{-1})
300
200
100
0
July-2023
October-2023
July-2024
October-2024
b
O_2 Flux (umol m^{-2} yr^{-1})
0
-1000
-2000
-3000
-4000
July-2023
October-2023
July-2024
October-2024
c
Photosynthesis (umol m^{-2} yr^{-1})
4000
3000
2000
1000
0
July-2023
October-2023
July-2024
October-2024
Month of Collection
Treatment
Burn
Control

Nutrient Fluxes



H1: There was a flush of aboveground plant growth in response to the prescribed burn

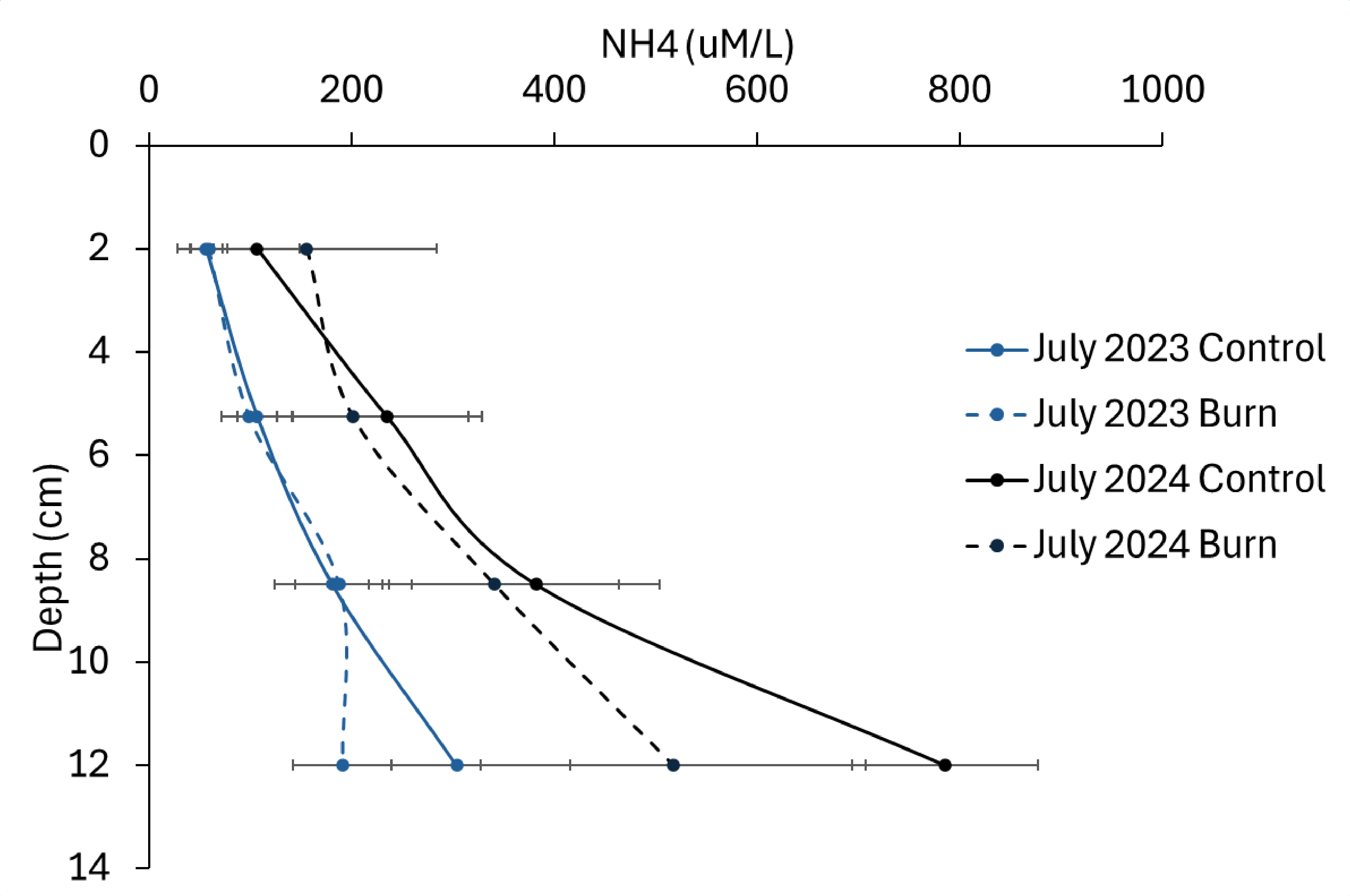
H2: There was interannual variation in dissolved gas and nutrient fluxes, but NOT due to the prescribed burn

…so what could be causing this interannual variation?

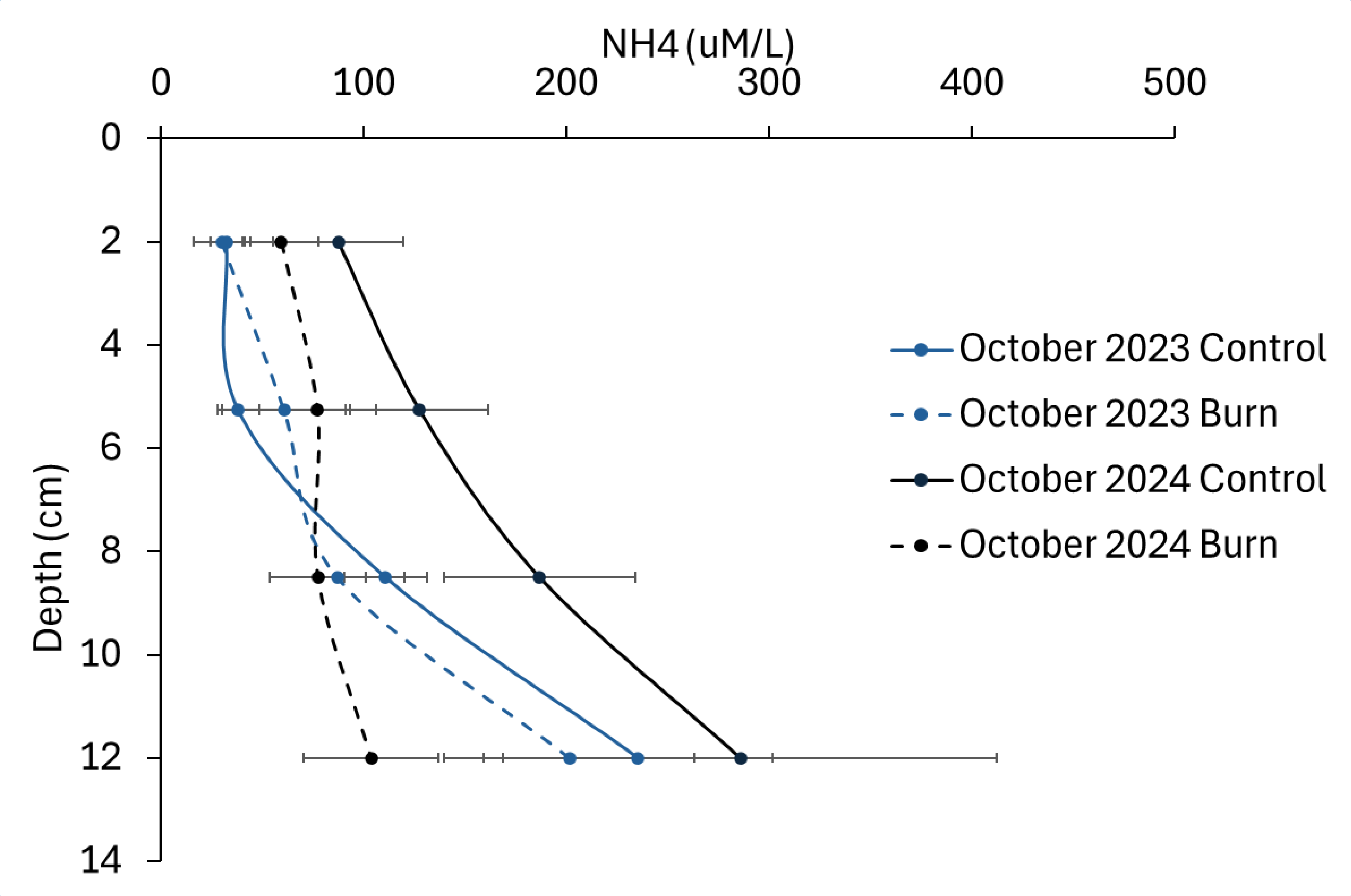
- Soil temperature
- Water level
- Salinity
- Pore water nutrient concentrations

Pore Water NH_4^+

July

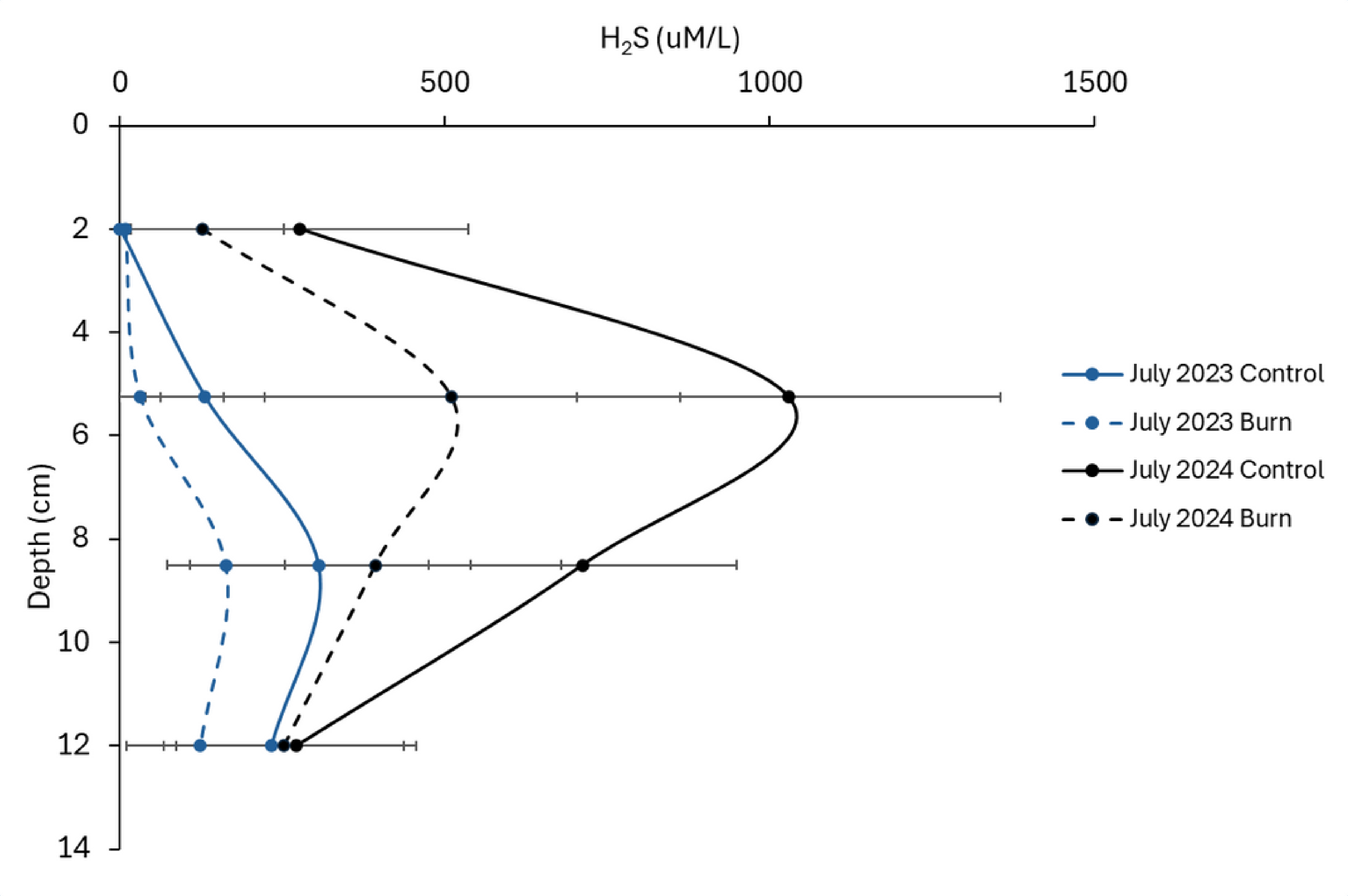


October

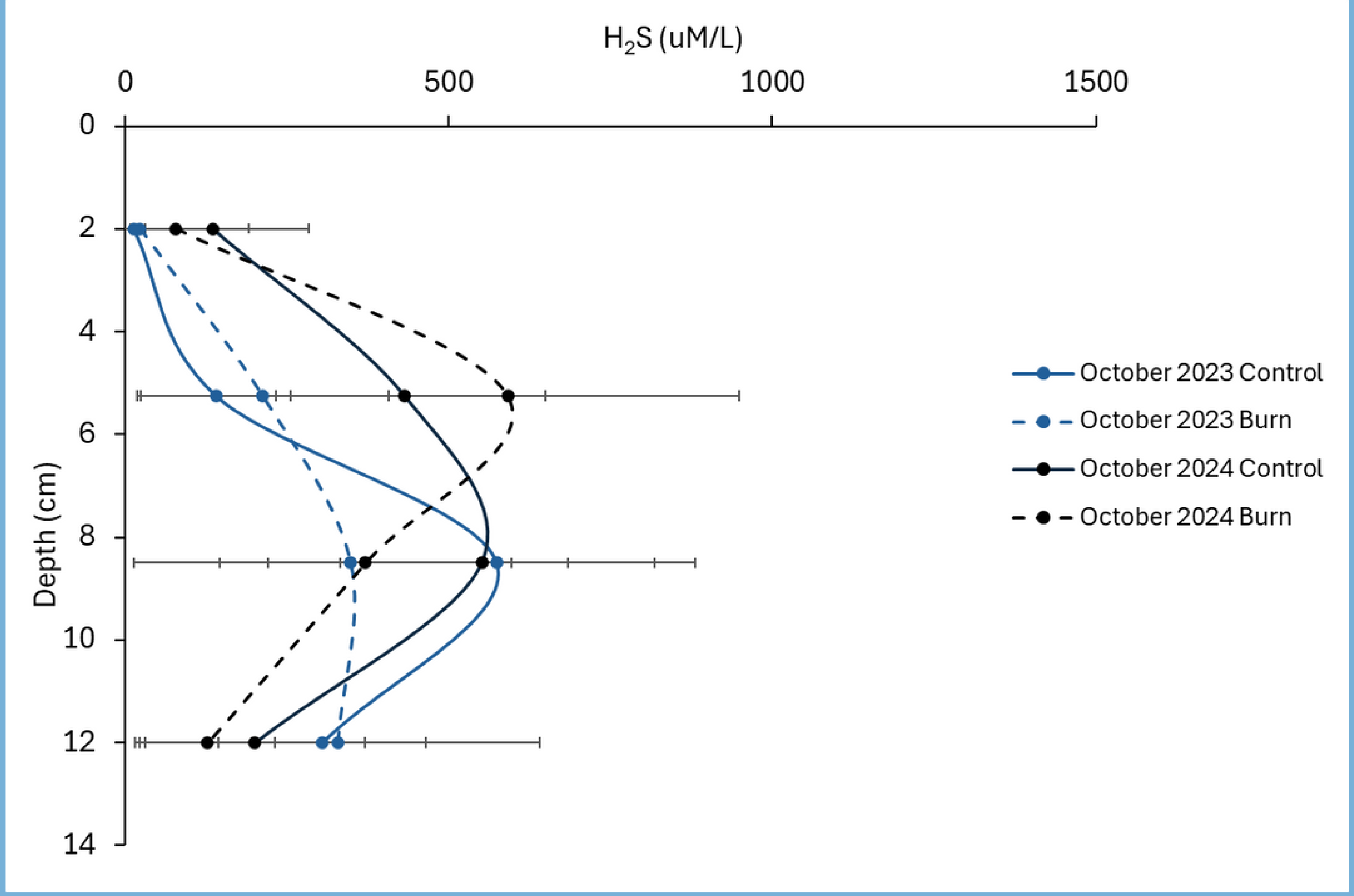


Pore Water H_2S

July



October



Conclusion

Our methodology may not have captured the rhizosphere effect because no live plants were included in our cores

Abiotic conditions are at least as, if not more important than the impact of biota (in this case the response of vegetation to the prescribed burn)

The prescribed burn did not have any unintended harmful consequences on N cycling processes in this system

Acknowledgements

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