Accidental Intervention: Prescribed Burning Alters Tidal Marsh Nitrogen Processing

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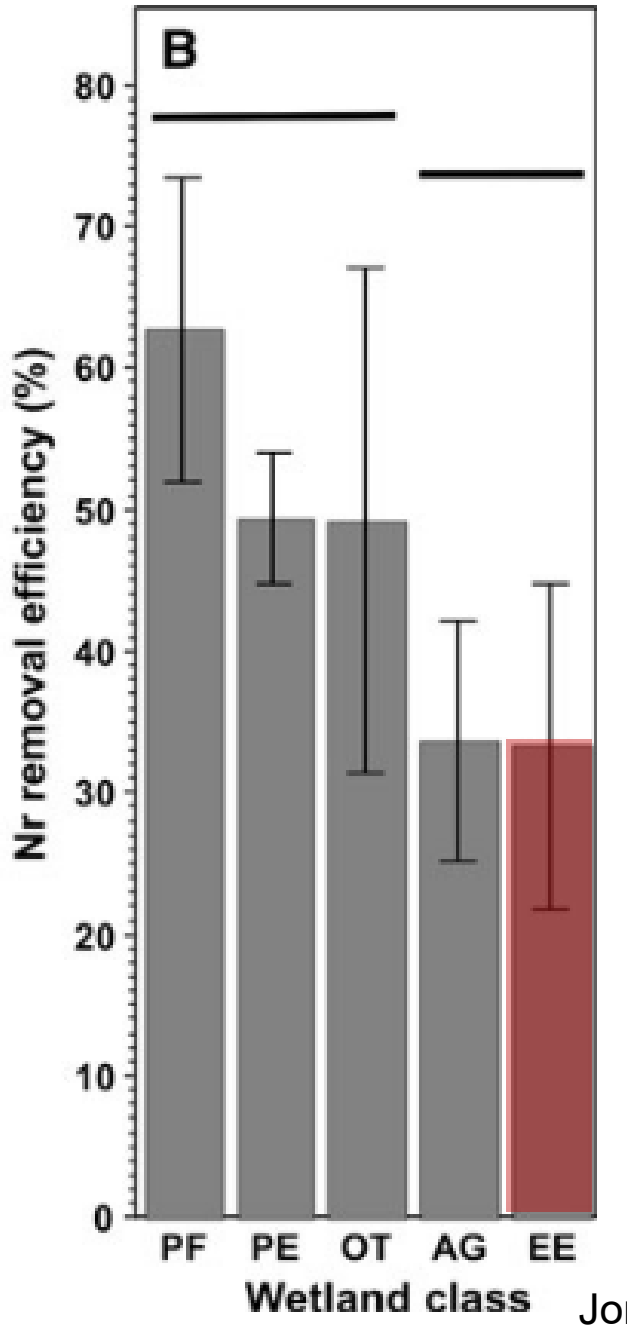
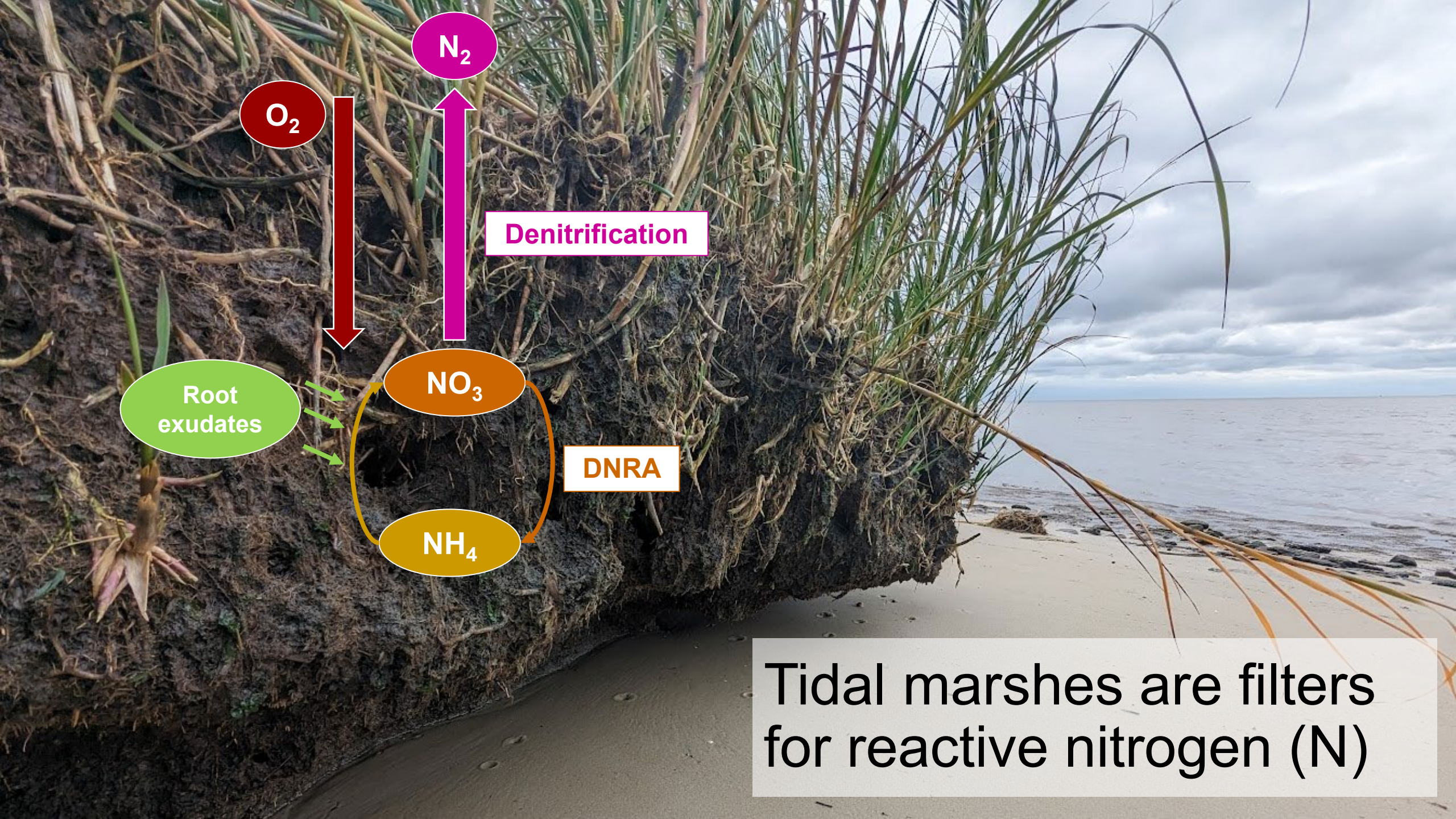
Salt marshes reduce nitrogen (N) loads to coastal waters through uptake, burial, and microbial denitrification



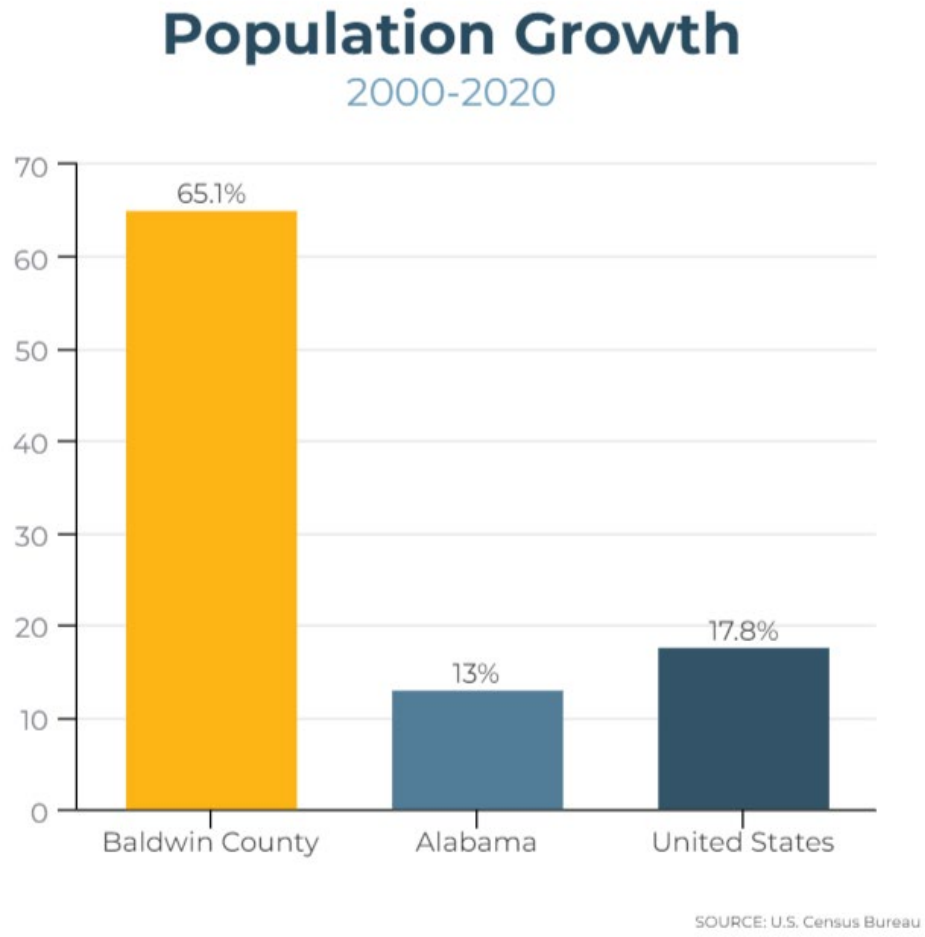
Jordan et al. 2011. *Ecosystems.*



Tidal marshes are filters for reactive nitrogen (N)

How do human management practices impact N removal in marshes?

Study system: Weeks Bay NERR

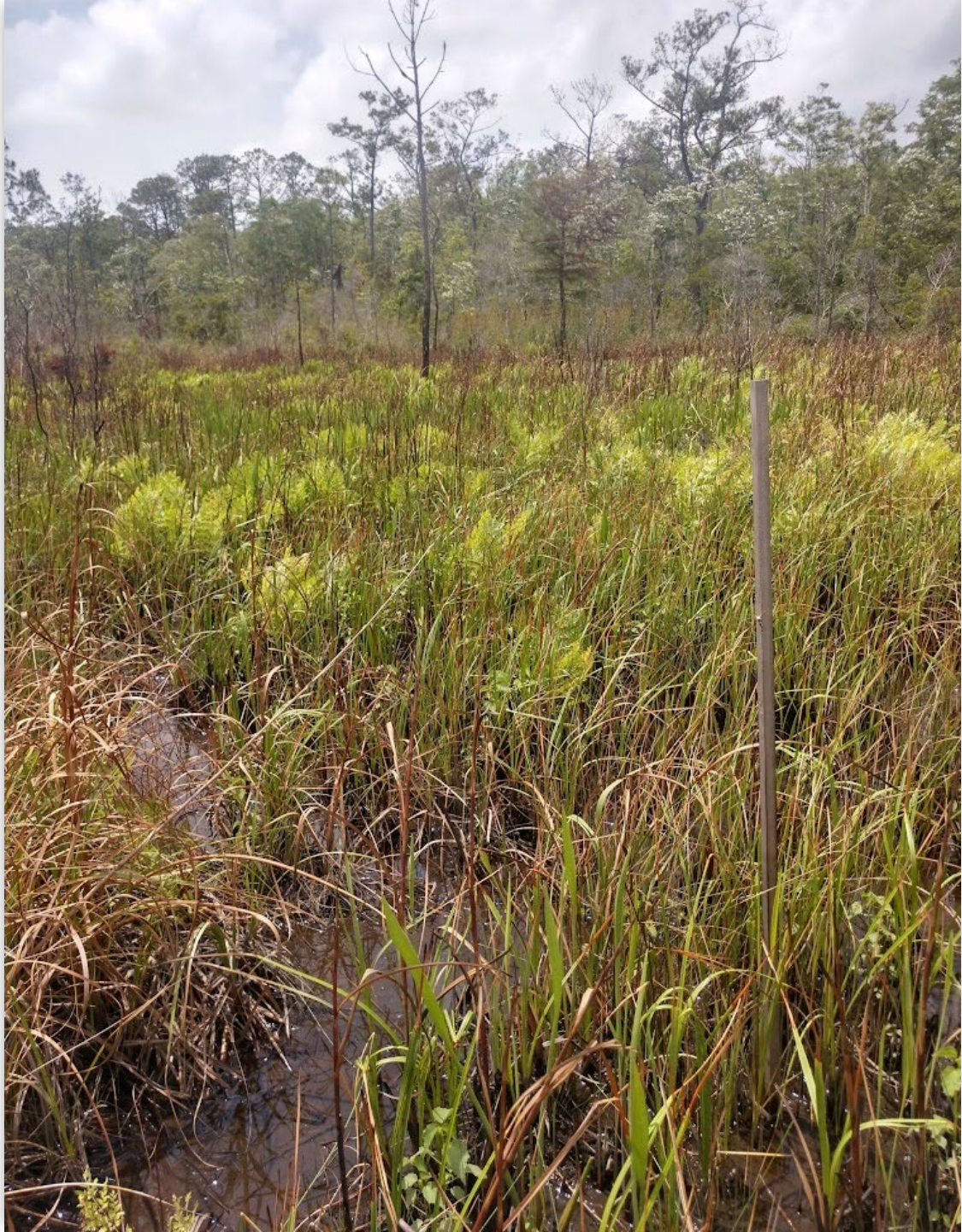


Weeks Bay NERR Management Plan 2017-2022

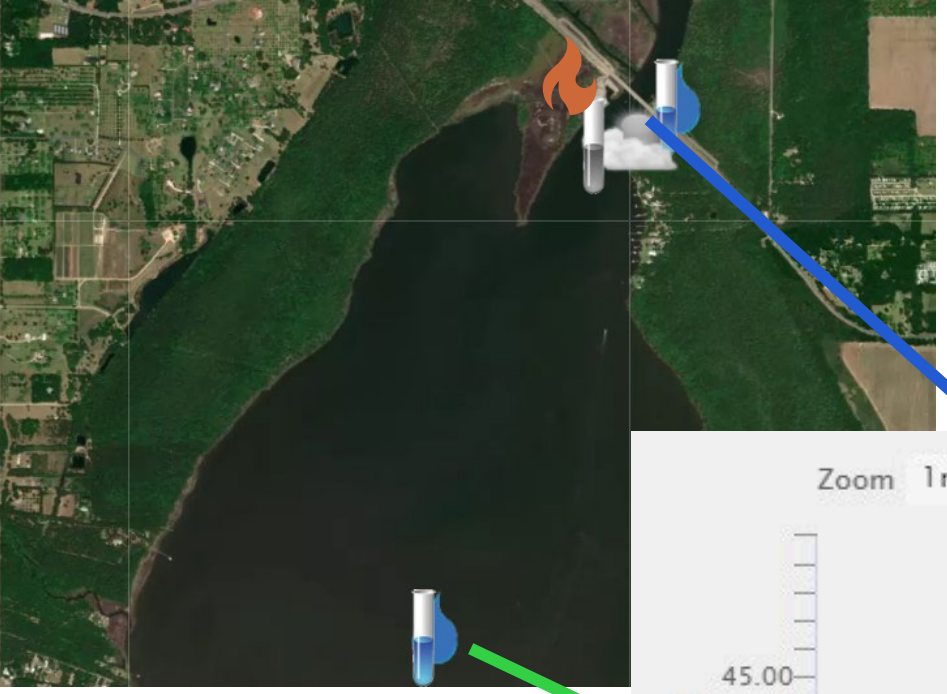
https://baldwineda.com/demographic-data/

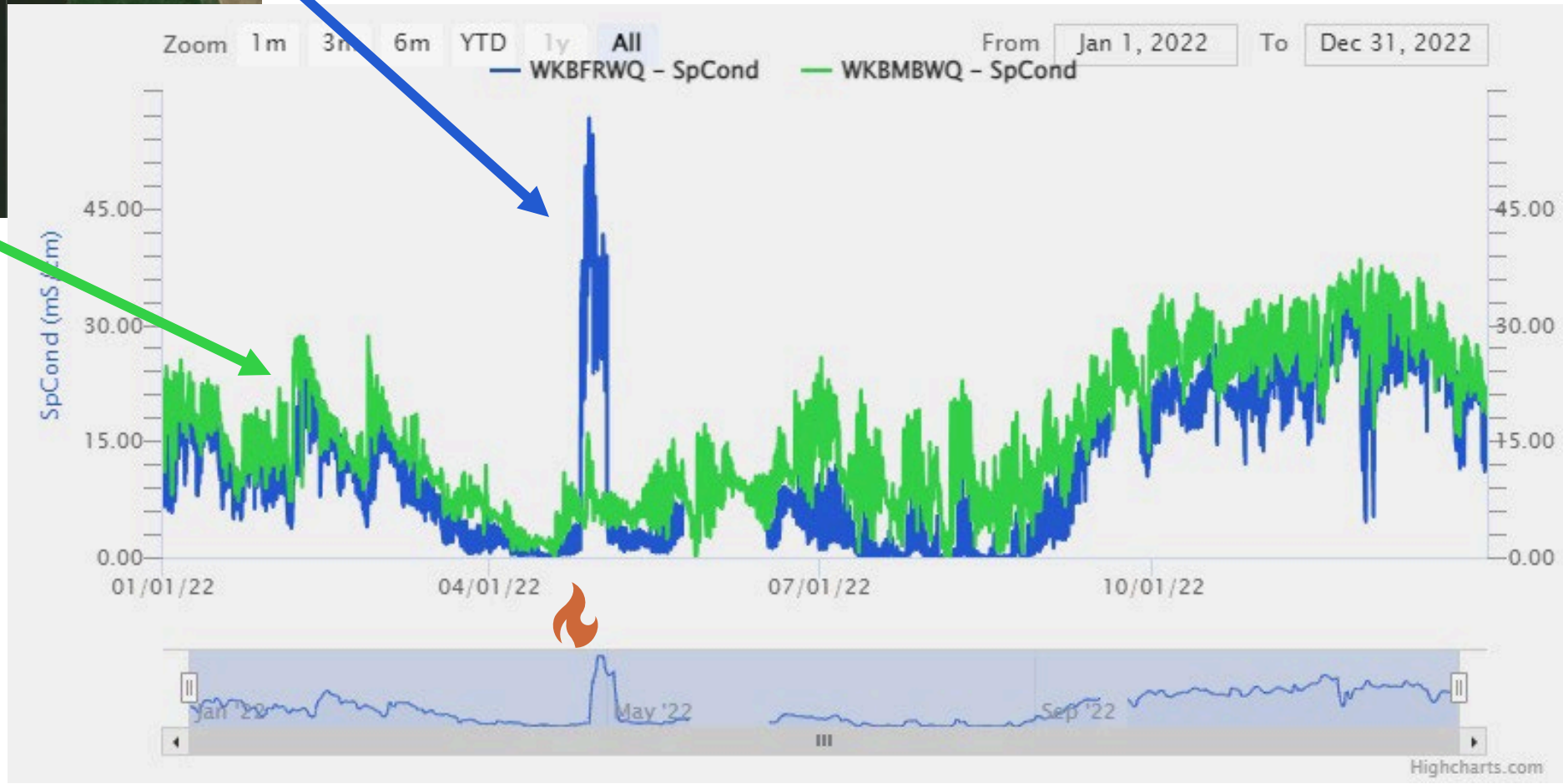
Prescribed burning

- Forest management strategy
- Promotes native plant growth
- Supports marsh landward migration
- *Might* result in short-term changes in estuarine water quality…



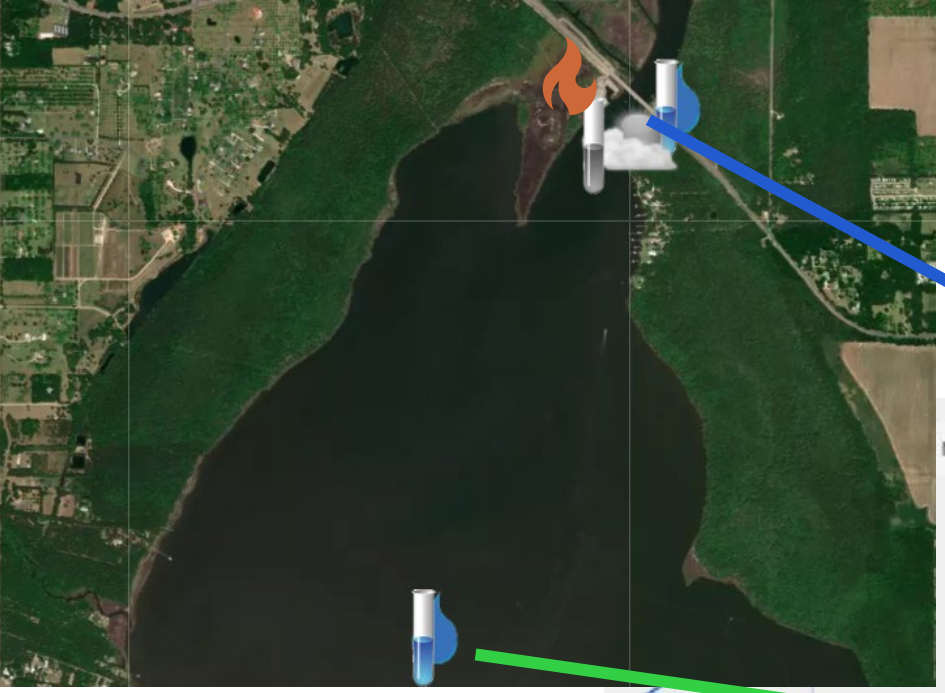
Conductivity spike right after fire!





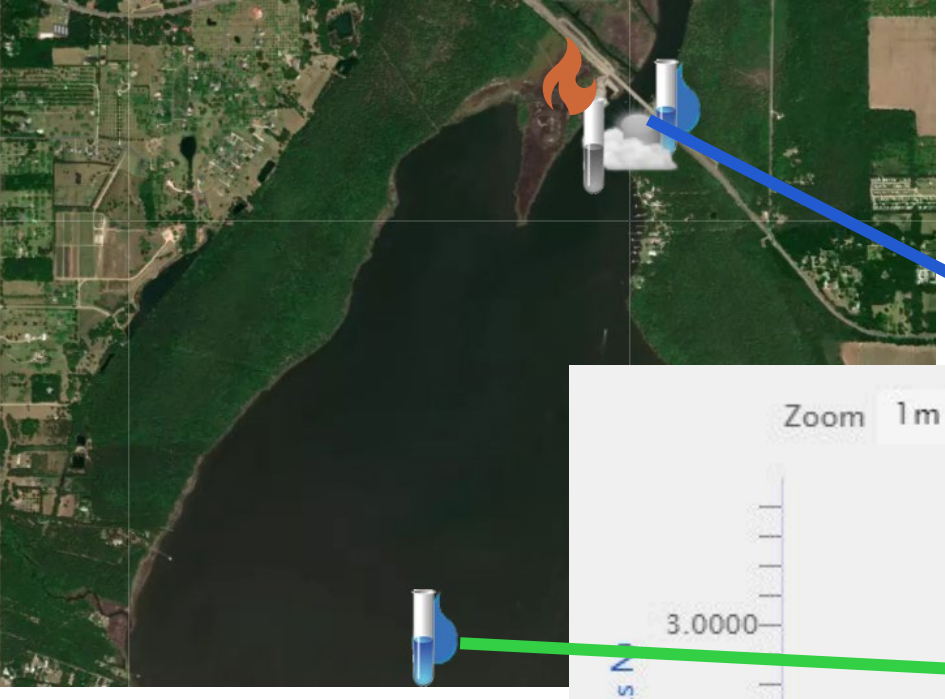
Data from NERR Centralized Data Management Office, accessed 02/19/2024

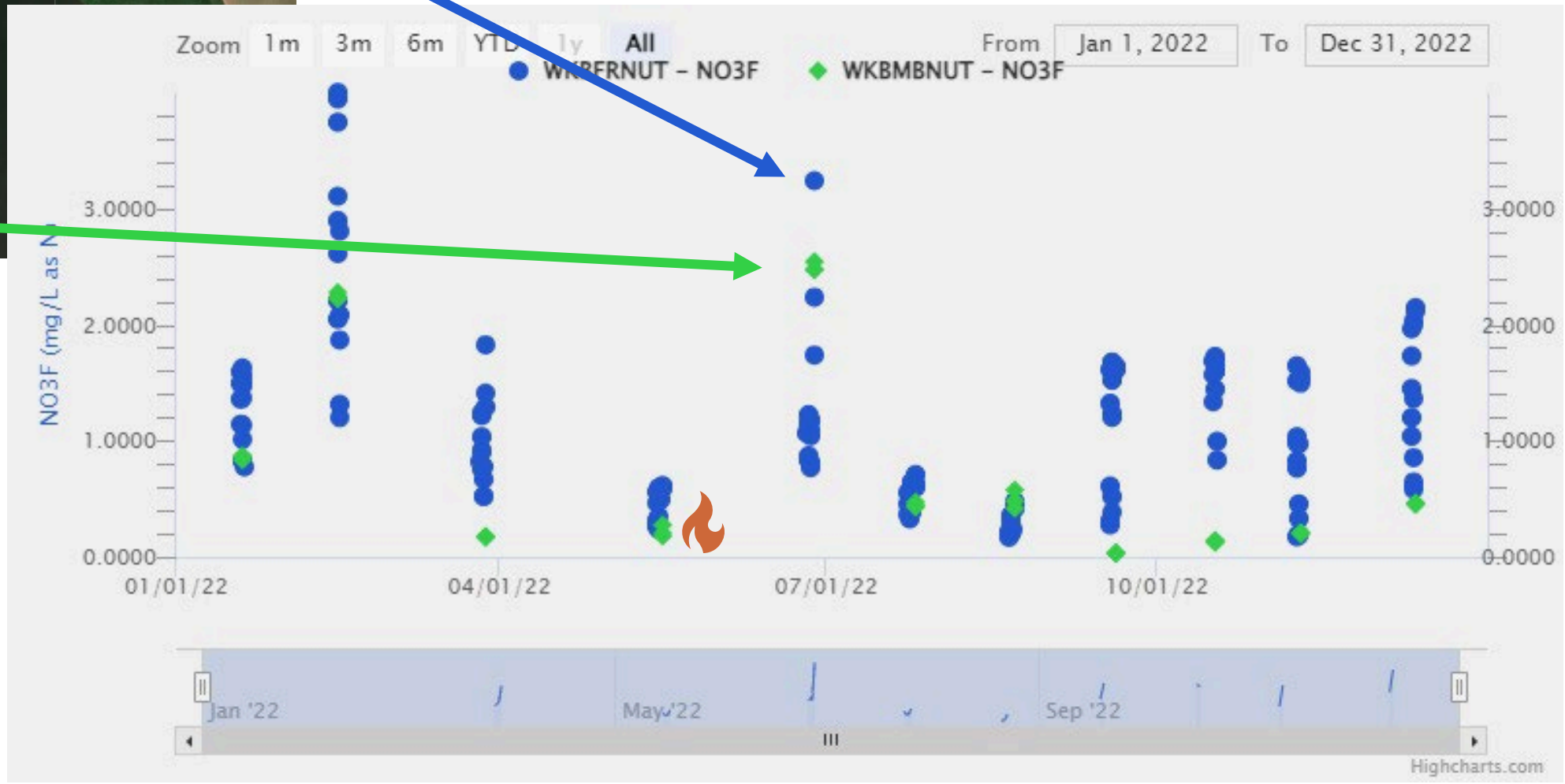
Maybe more ammonium?



Data from NERR Centralized Data Management Office, accessed 02/19/2024

Nitrate…

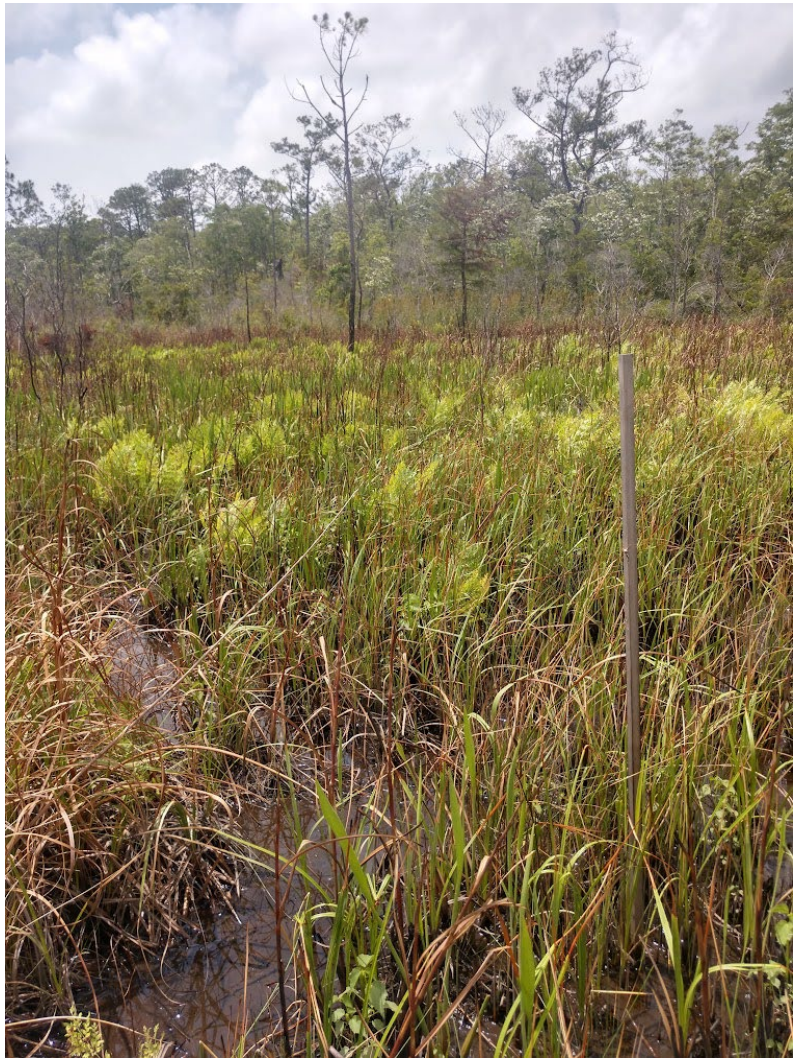




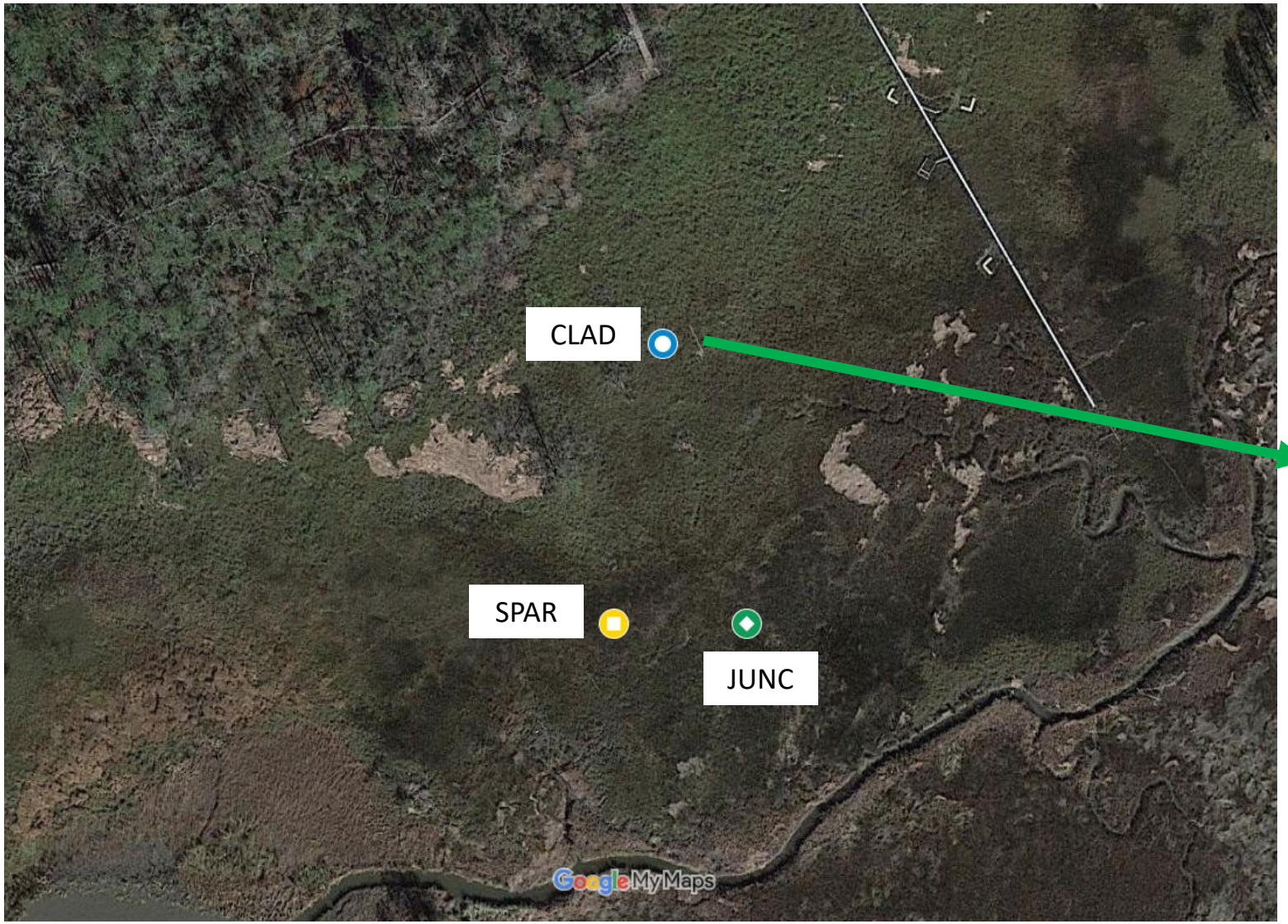
Data from NERR Centralized Data Management Office, accessed 02/19/2024

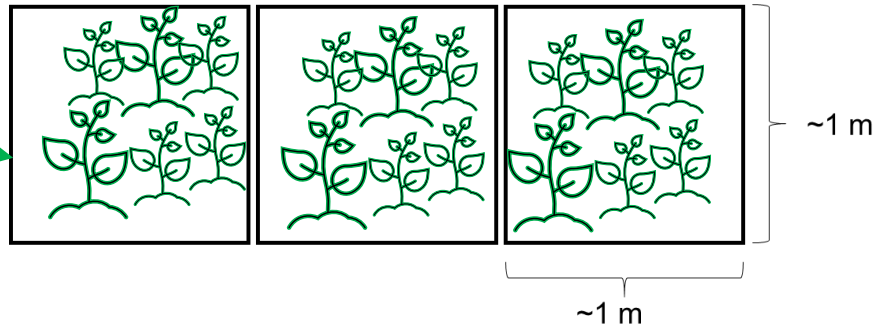
Question: Does prescribed burning impact N processing in tidal marshes?

Before and After



Experimental Design – Started October 2021



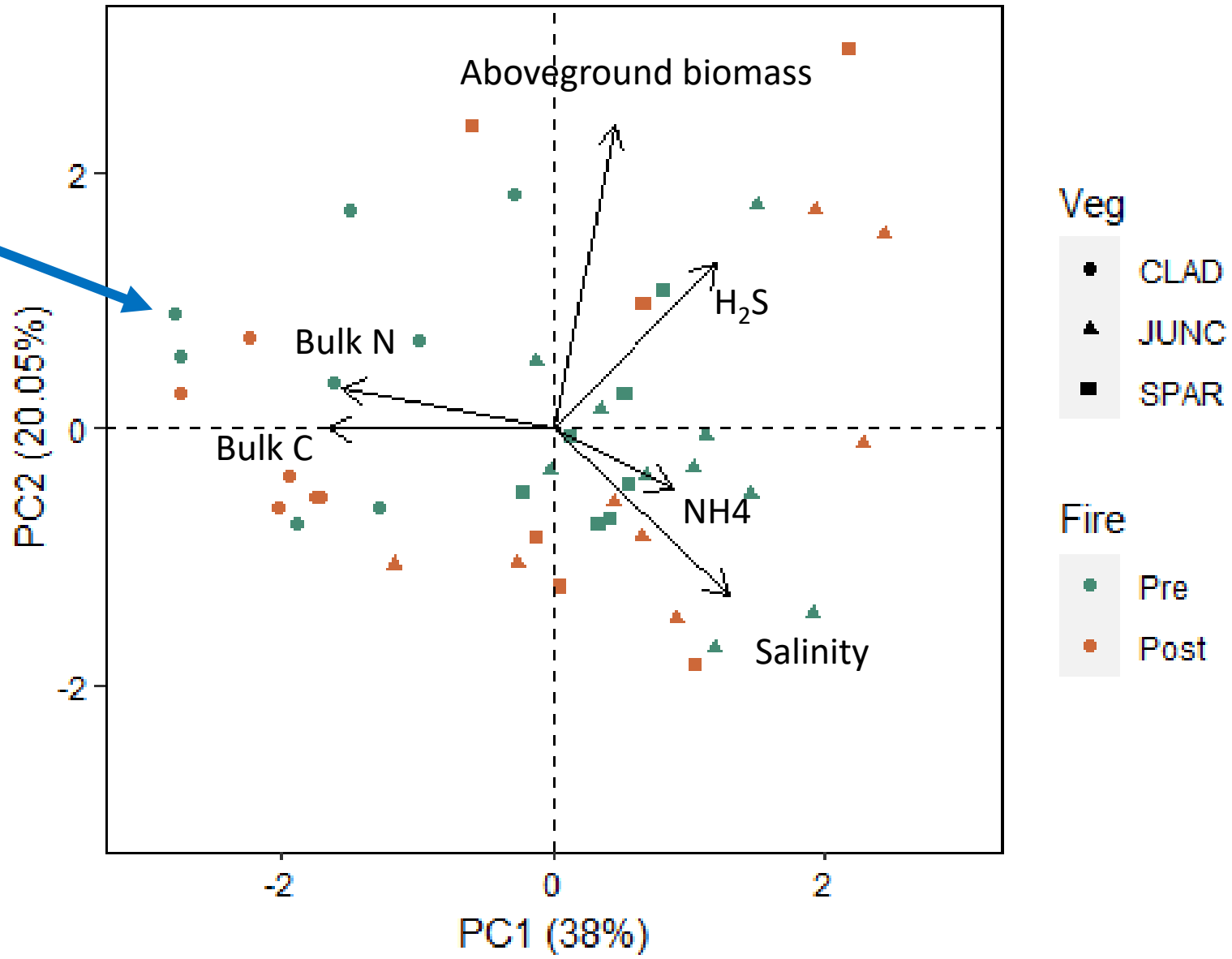


Experimental “Design” – Burned April 2023

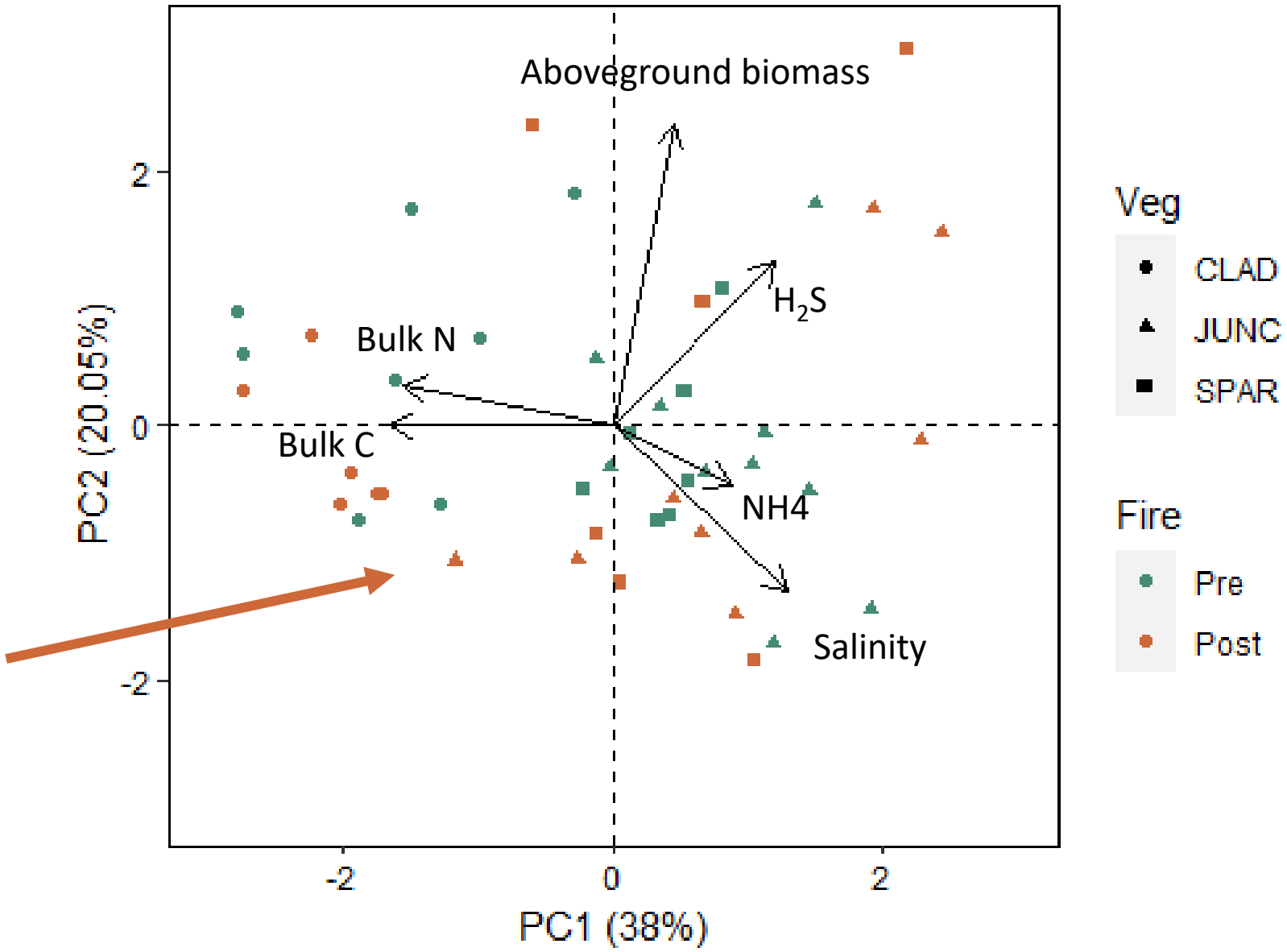
Sampling Dates
10/11/2021
11/16/2021
12/7/2021
2/20/2022
3/24/2022
5/24/2022
6/20/2022
9/6/2022
11/8/2022

- Denitrification and DNRA potentials using IPT on sediment slurries
  - Top 5 cm of sediment
  - Nitrate saturated (50 µM $^{15}NO_3^-$)
  - Anaerobic
  - 5 PPT artificial seawater
- Aboveground biomass outside of plots
- Porewater sulfide (H_2S)
- Porewater NH_4^+
- Sediment bulk C and N

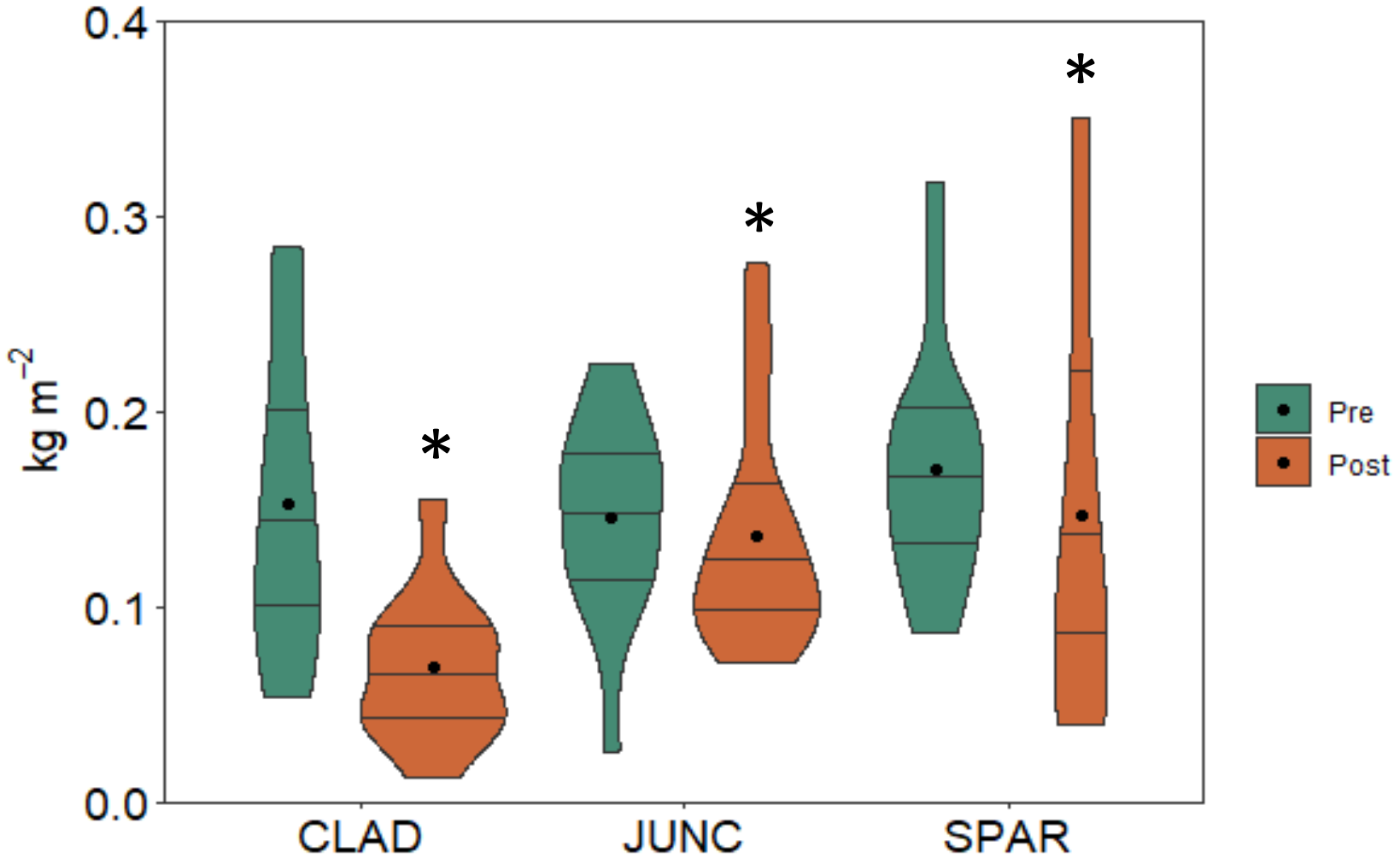
Cladium separates from *Juncus* and *Spartina* along PC1



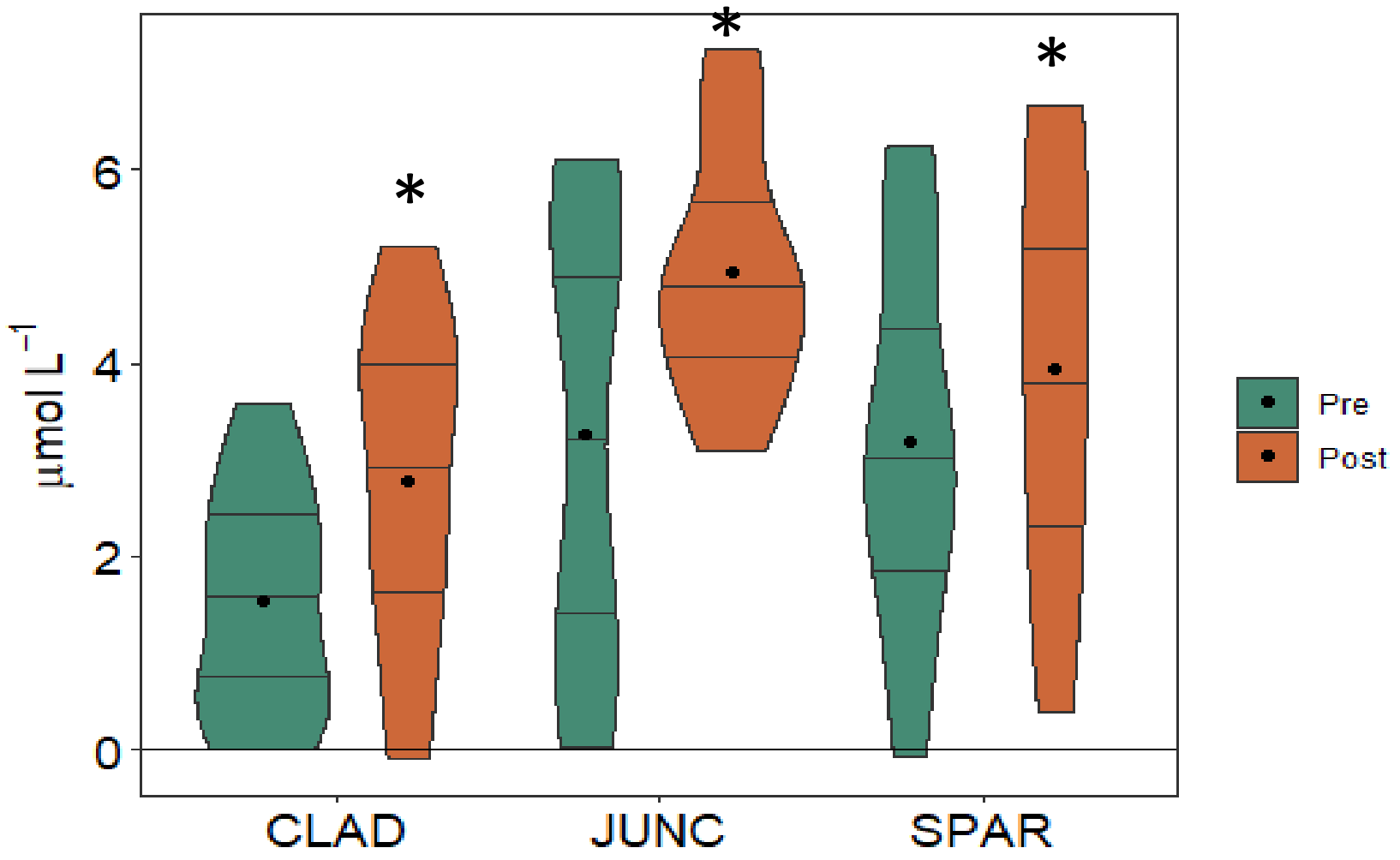
Maybe a little clustering Pre/ Post fire along PC2?
(if you squint)



Aboveground biomass was 25% lower on-average after the fire

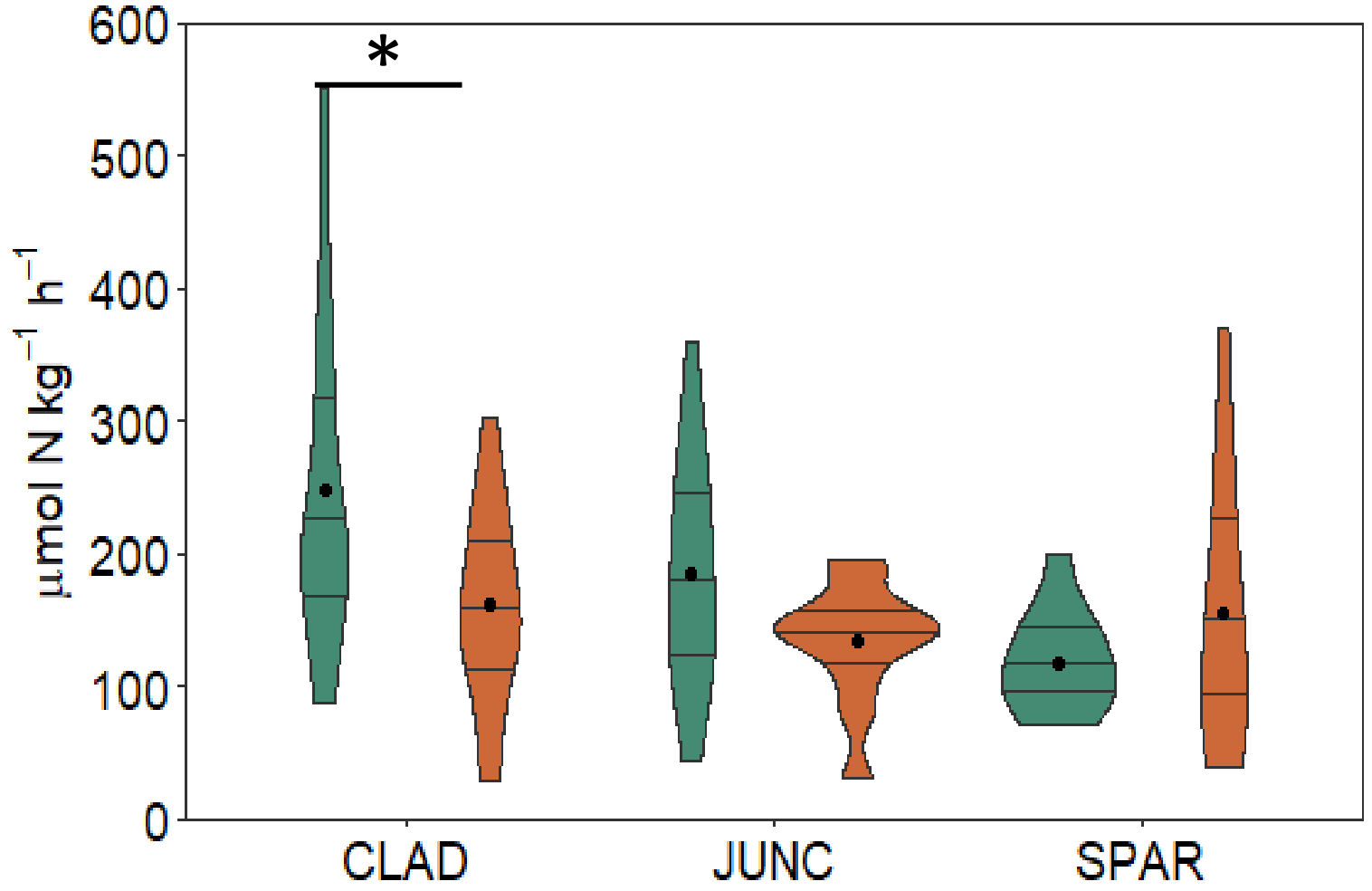


On average, porewater H_2S more than doubled after the fire



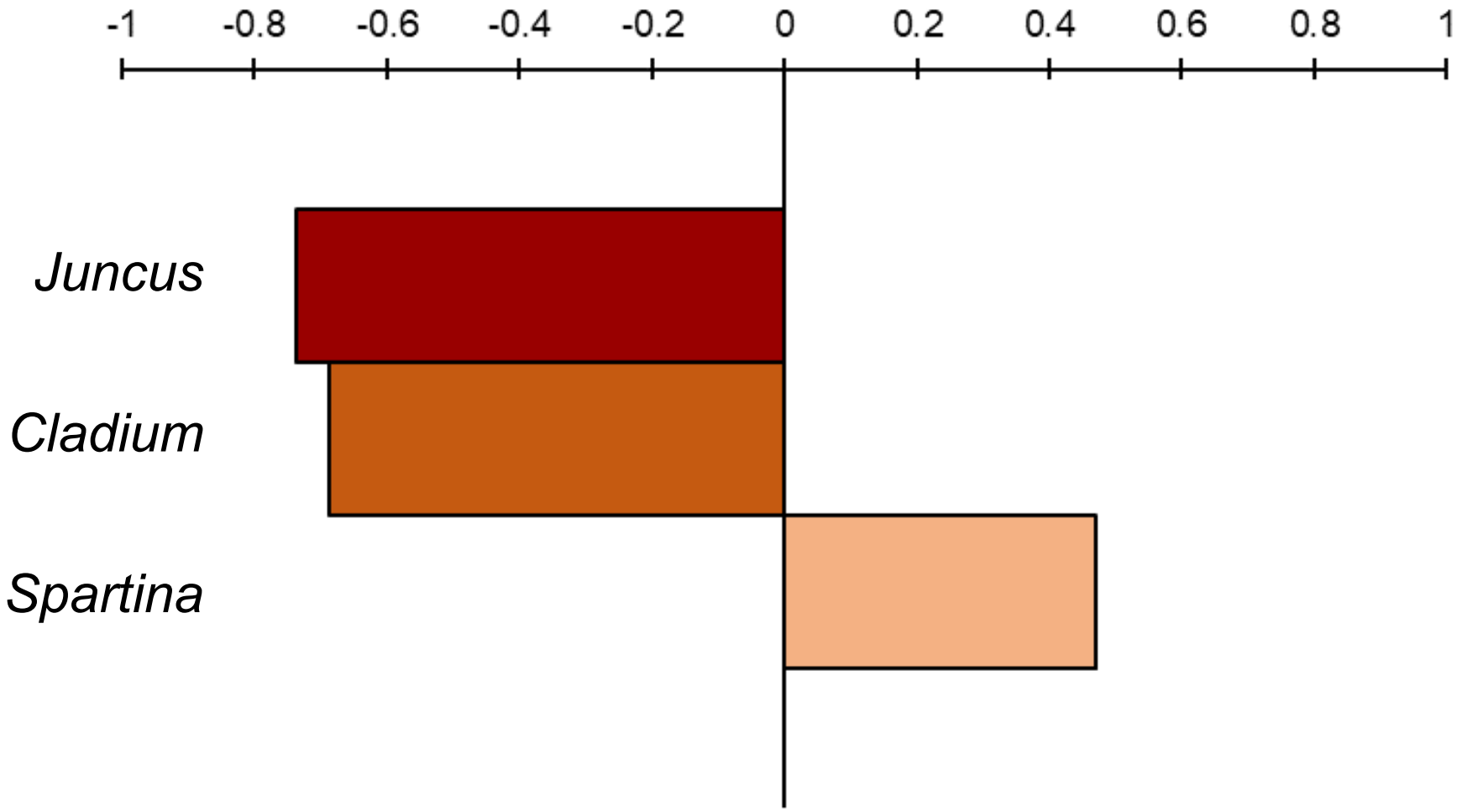
*natural log-transformed!

No effect of burning on N-removal, but rates were about 1.4X higher in *Cladium* plots



But there may be a pattern of lower denitrification for *Cladium and Juncus*…..

Effect sizes (Hedges' d) show that burning may have an impact on N removal potential



Burning had a medium negative effect on denitrification potential in *Juncus* and *Cladium plots*

Take-home Message

- Burning impacted key drivers of N-processing, but the actual impacts on N-processing *potentials* were variable
- The rhizosphere may be what drives resilience
- For management, we need to link microbial processes to ecosystem fluxes