

Short-term Response of Freshwater Wetland Soils to Saltwater Intrusion

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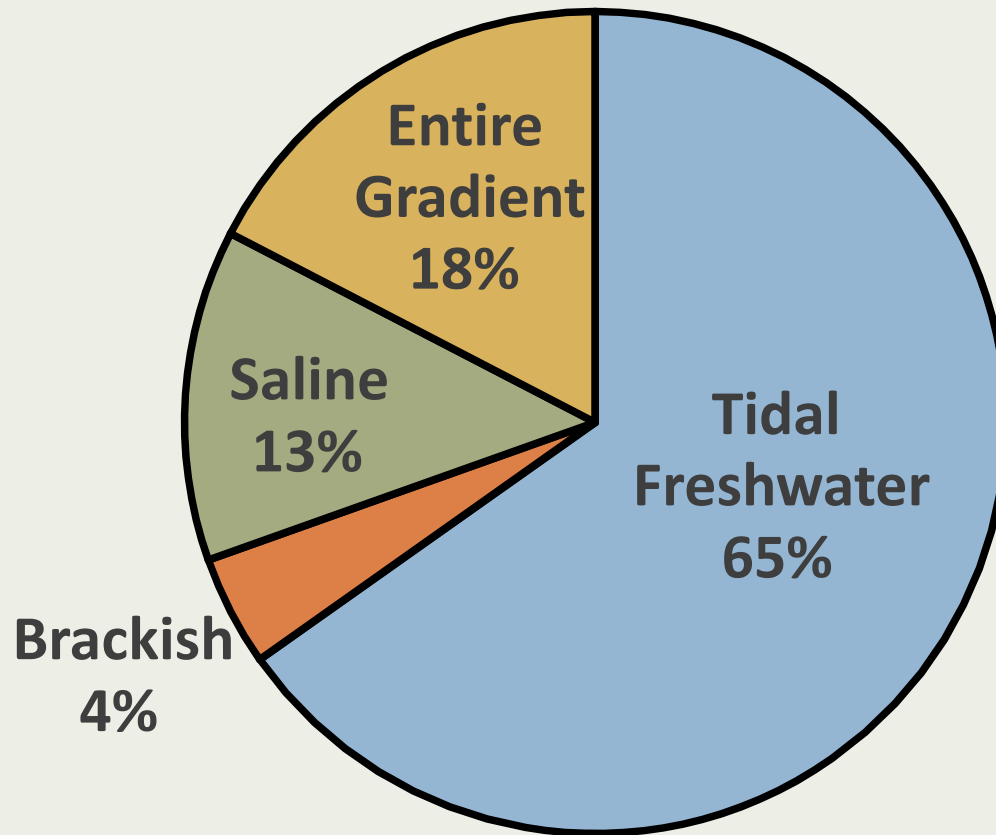
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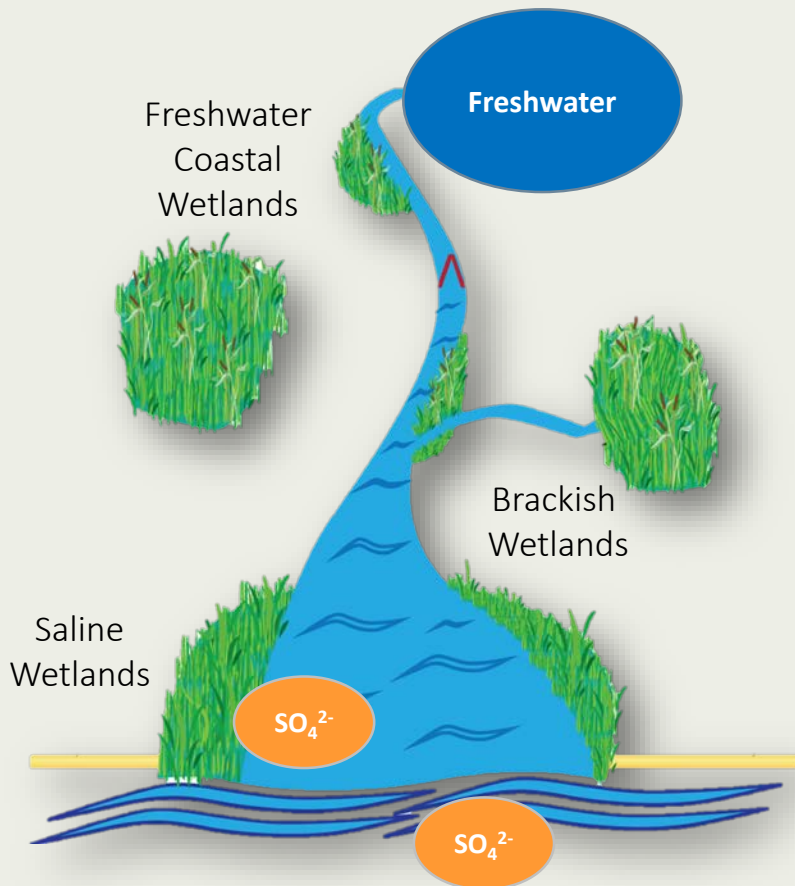
**Aquatic
Biogeochemistry
Lab**

Research on freshwater wetlands is disproportionately represented in the saltwater intrusion literature



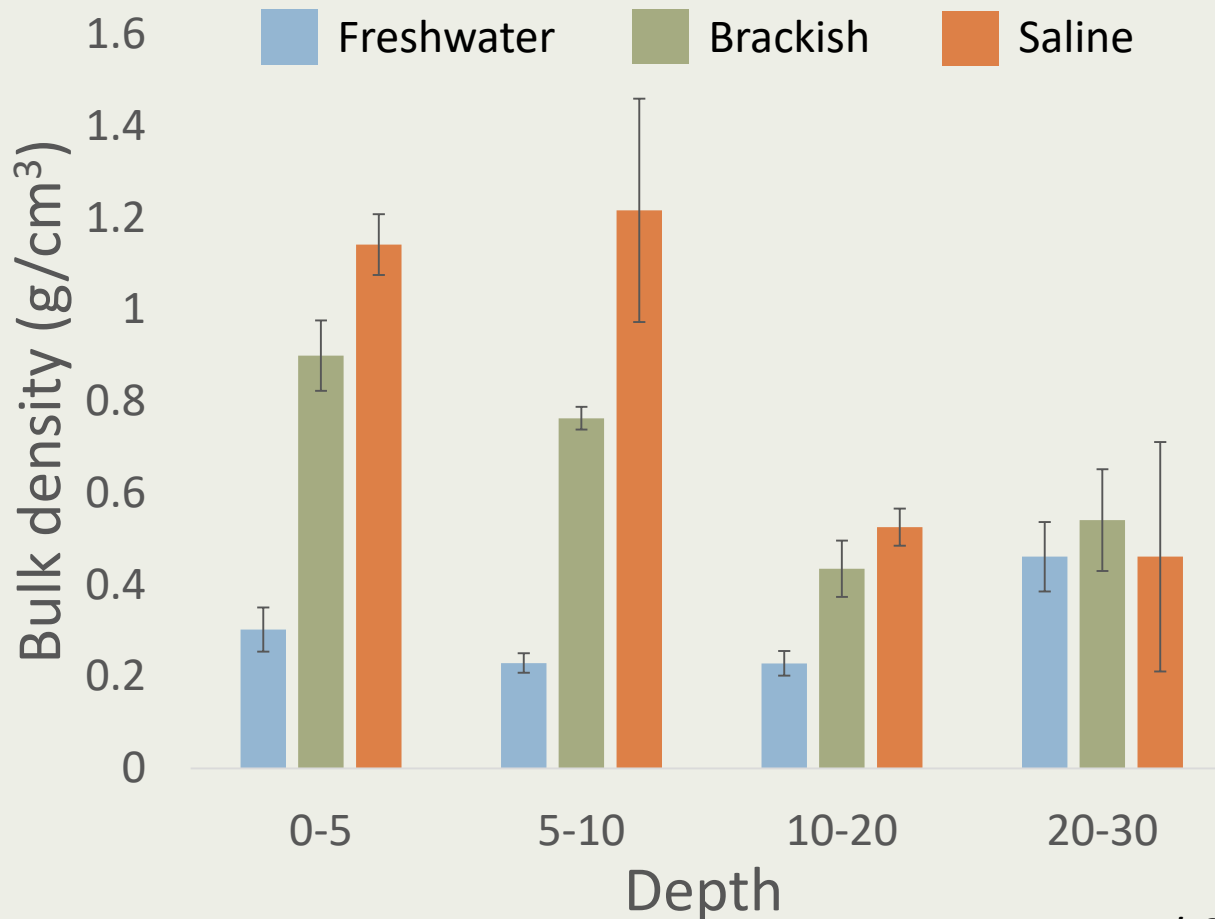
Articles limited to 2000-2016, n = 23

Freshwater wetlands may be most vulnerable to saltwater intrusion



Electron Acceptor	Electron Donor	End Products
O_2	Organic matter	$\text{CO}_2 + \text{H}_2\text{O}$
NO_3^-	Organic matter	$\text{CO}_2 + \text{N}_2\text{O} / \text{N}_2$
Mn^{4+}	Organic matter	$\text{CO}_2 + \text{Mn}^{2+}$
Fe^{3+}	Organic matter	$\text{CO}_2 + \text{Fe}^{2+}$
SO_4^{2-}	Organic matter	$\text{CO}_2 + \text{H}_2\text{S}, \text{S}$
CO_2 / H_2	Organic matter	CH_4

Soil organic matter content is higher in freshwater wetlands



Freshwater wetlands under saltwater intrusion

Abundant Soil OM
(electron donors)

+

Abundant SO_4^{2-}
(electron acceptors)

= Increased vulnerability?



Saltwater intrusion is of ecological significance

C Loss and
Greenhouse gas
emissions
(CO₂/CH₄)

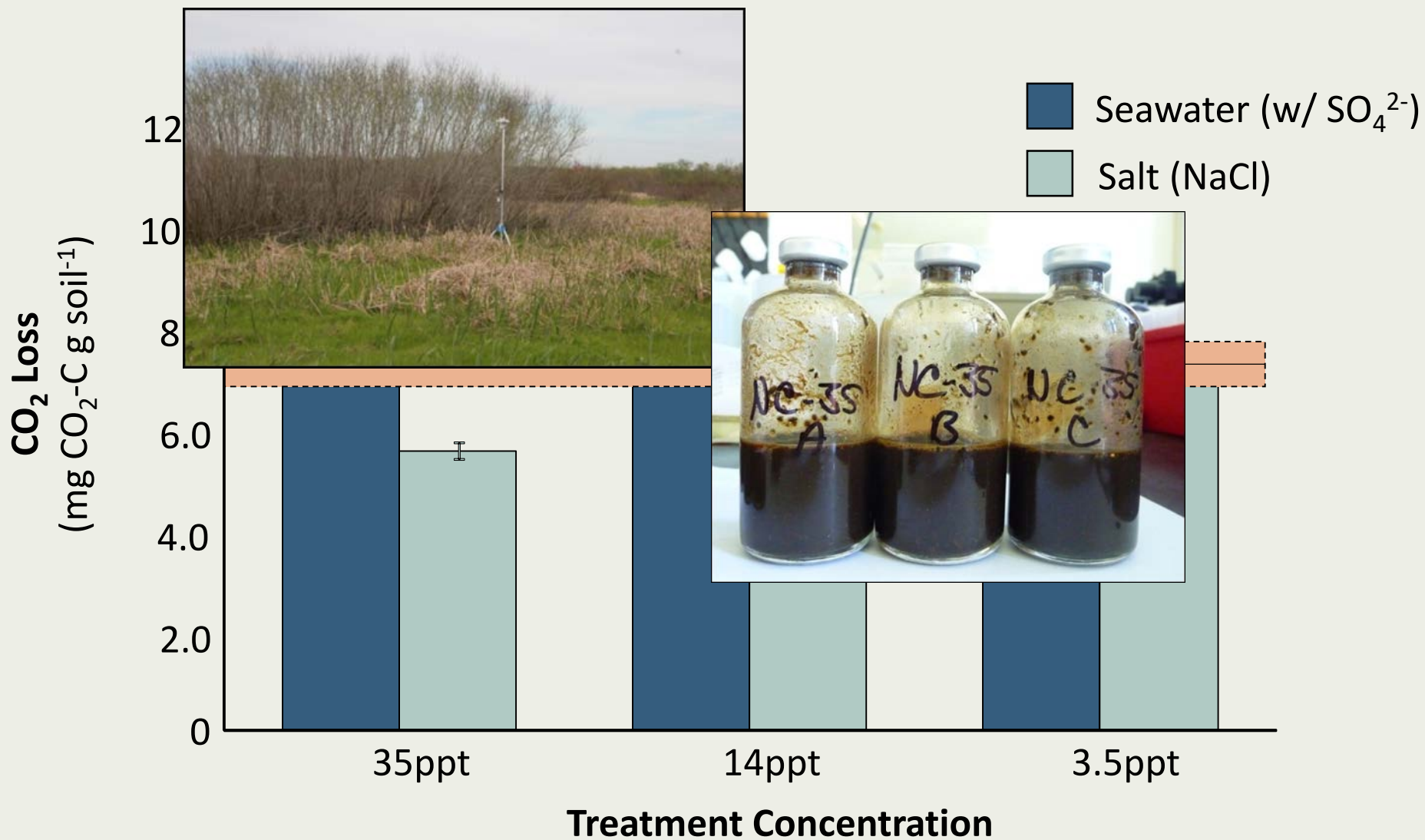


DOC,
NH₄⁺,
ortho-P

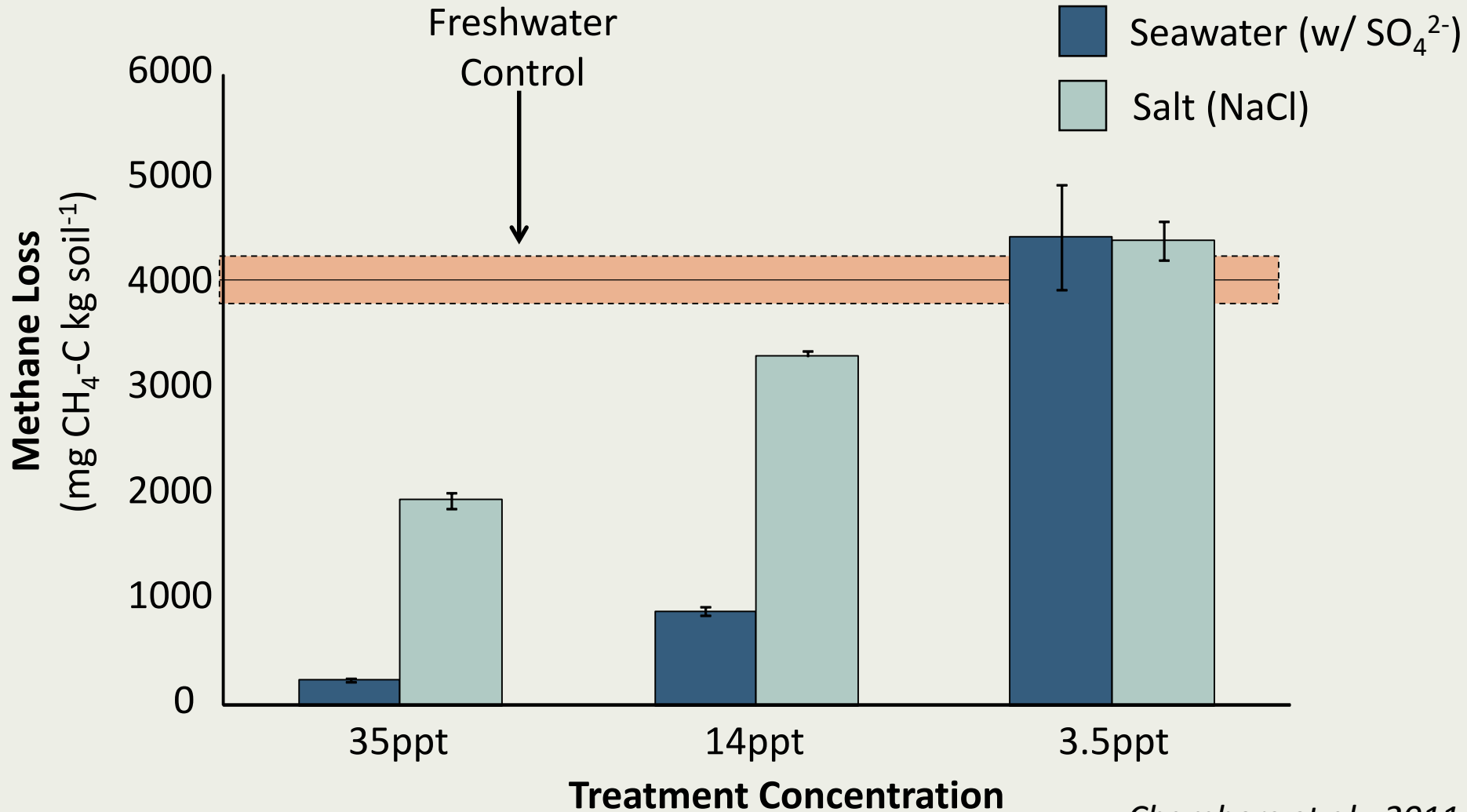
1. How does SO_4^{2-} influence microbial respiration? Is it concentration dependent?
2. Can bioavailable nutrients be released following saltwater intrusion?



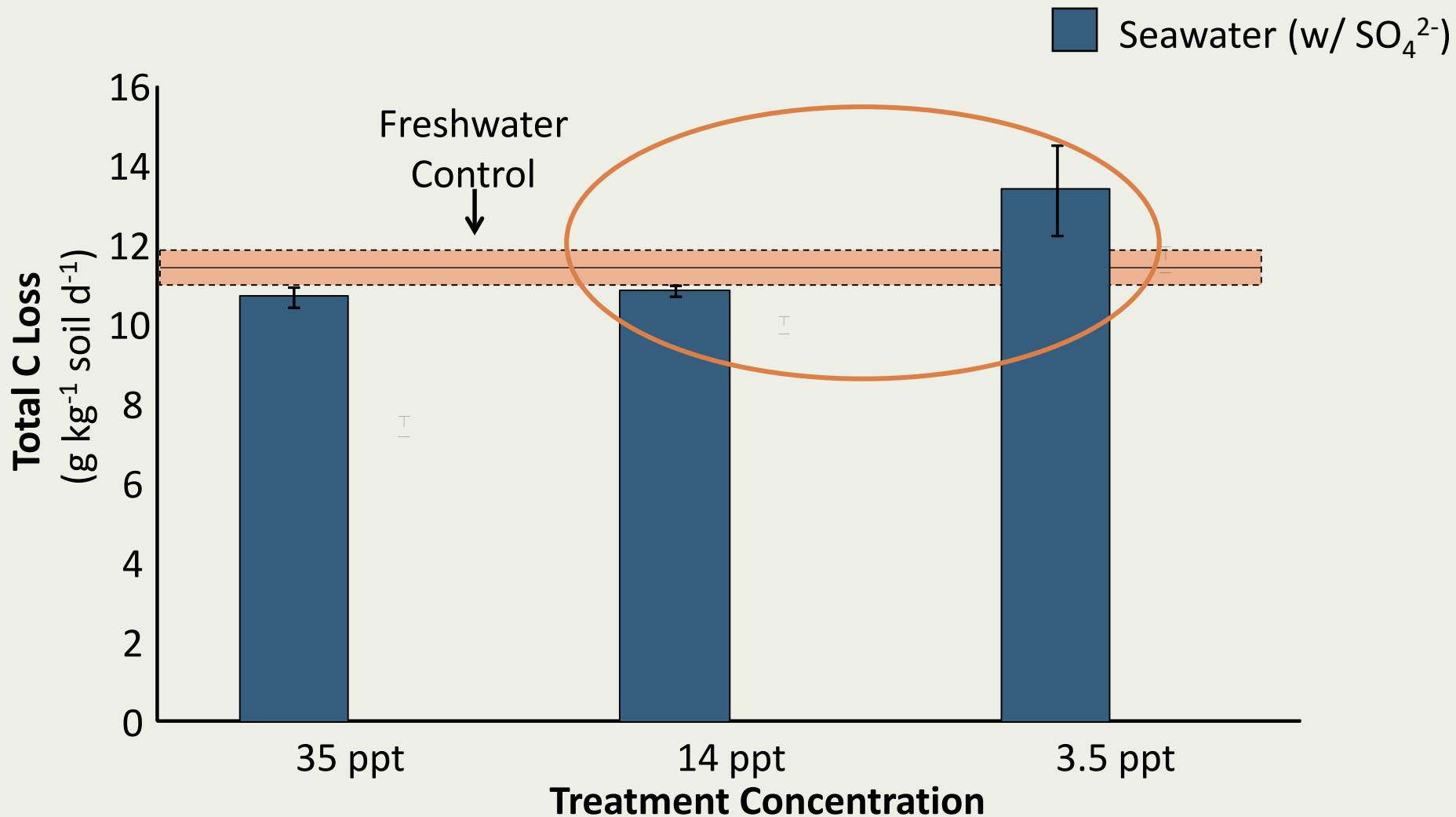
SO_4^{2-} stimulates microbial respiration



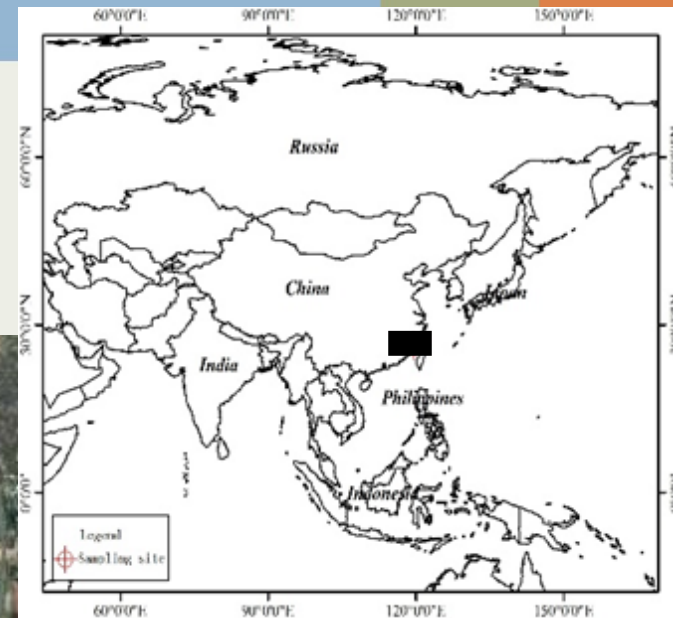
...and suppresses CH₄ production



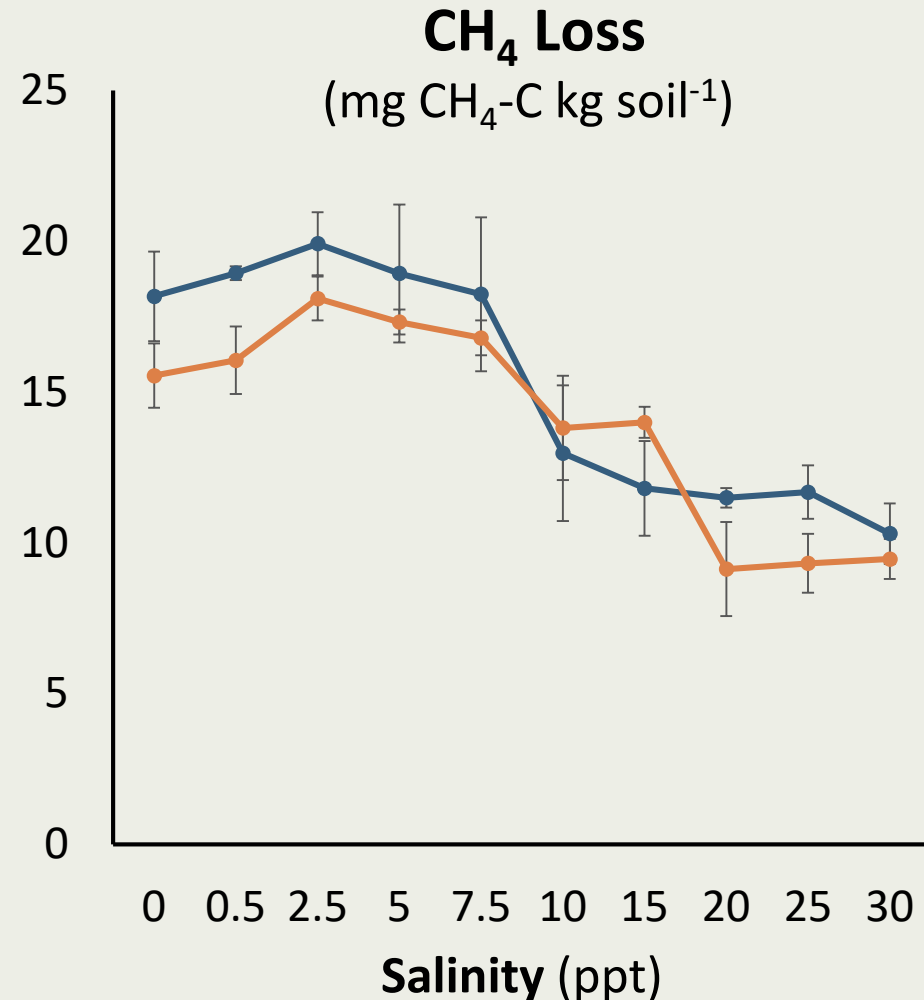
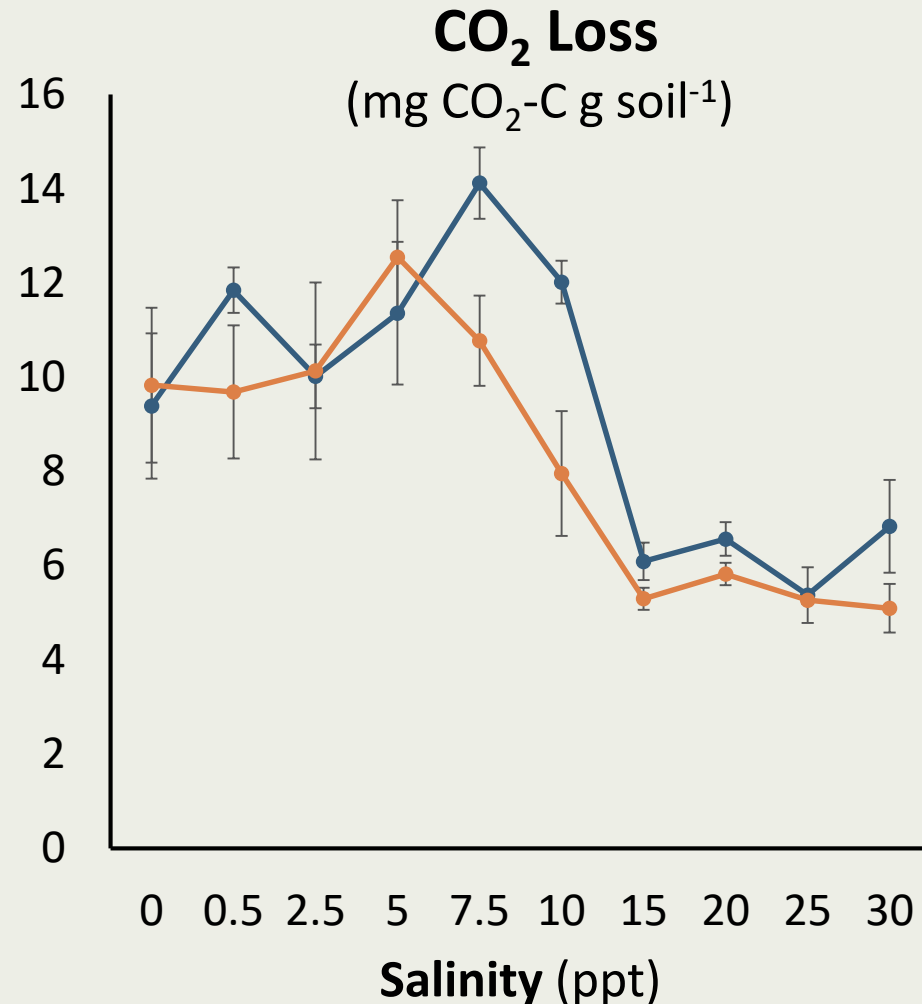
Where is the tipping point?



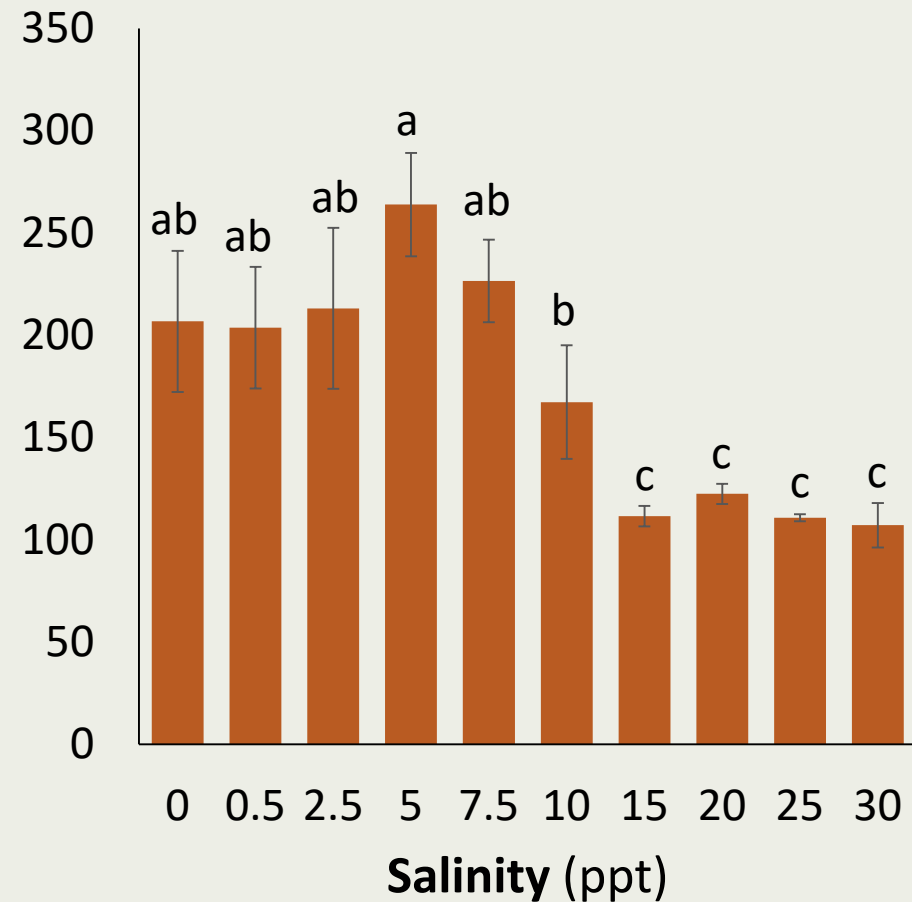
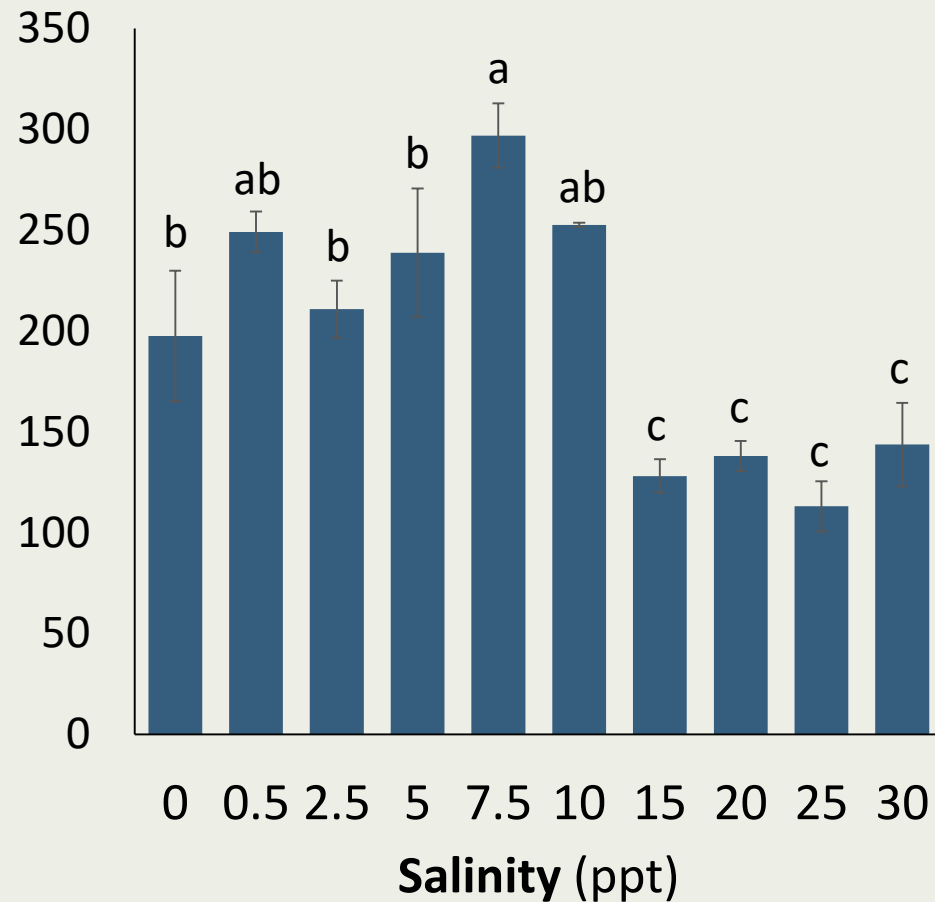
Salinity gradient study



Osmotic stress overwhelms SO_4^{2-} simulation at ~ 10 ppt

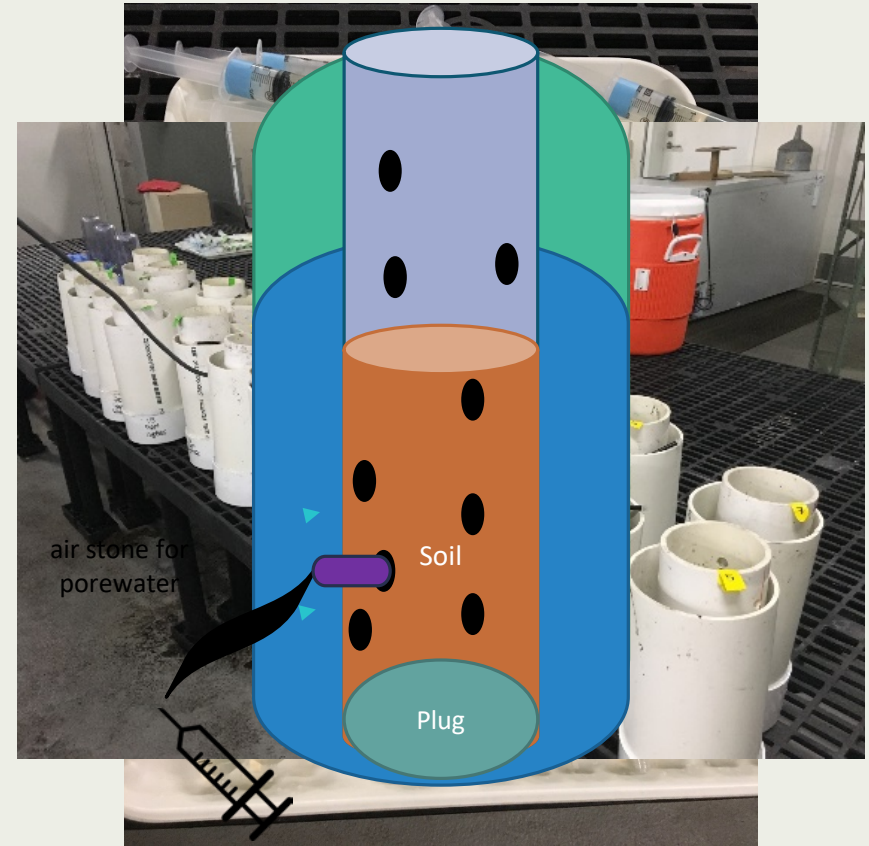


Total C Mineralization (mg C g soil⁻¹)

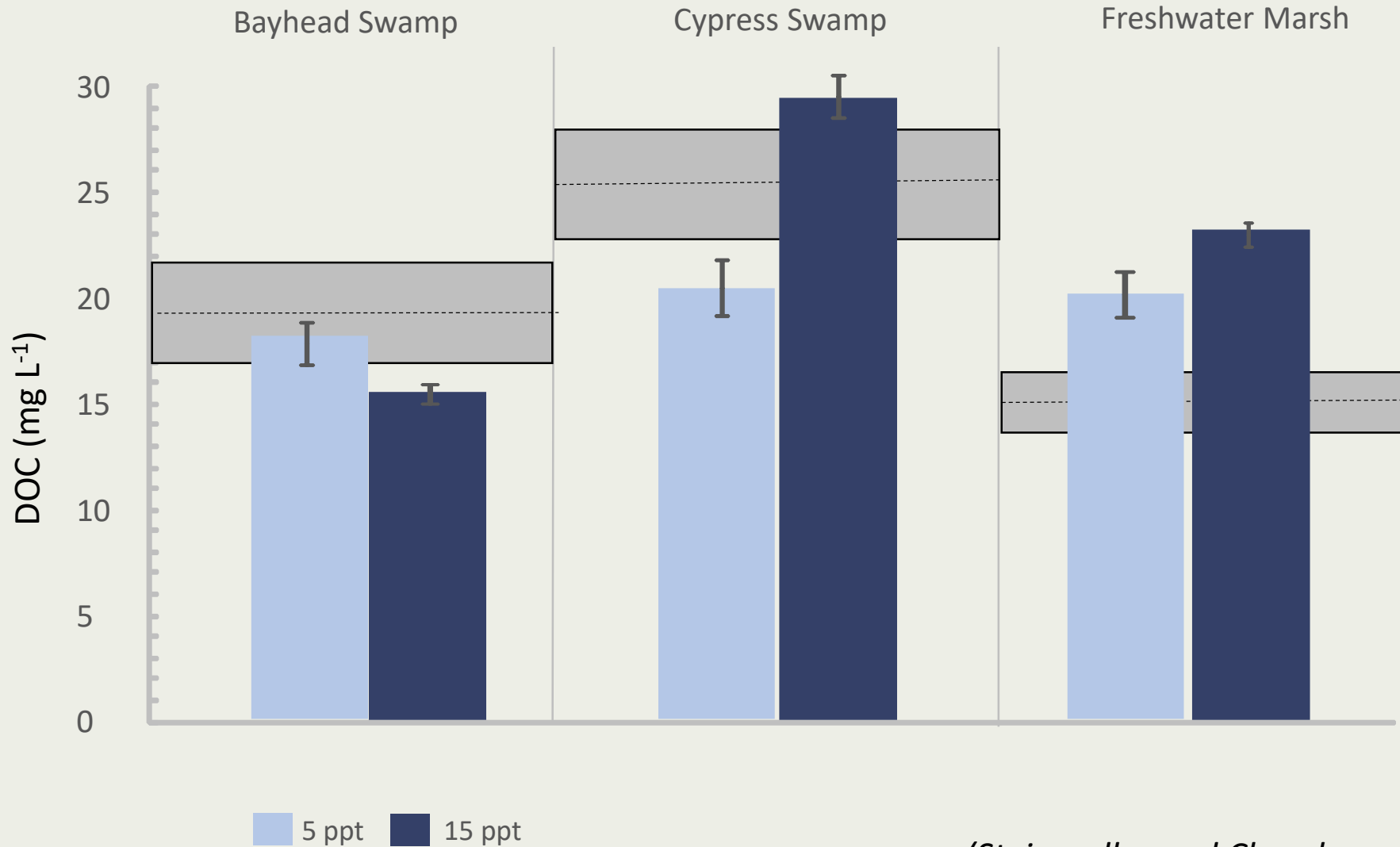


What about dissolved nutrients?

- 3 freshwater wetland soils
- 3 salinity treatments: fresh, 5ppt, 15ppt
- Porewater and surface water

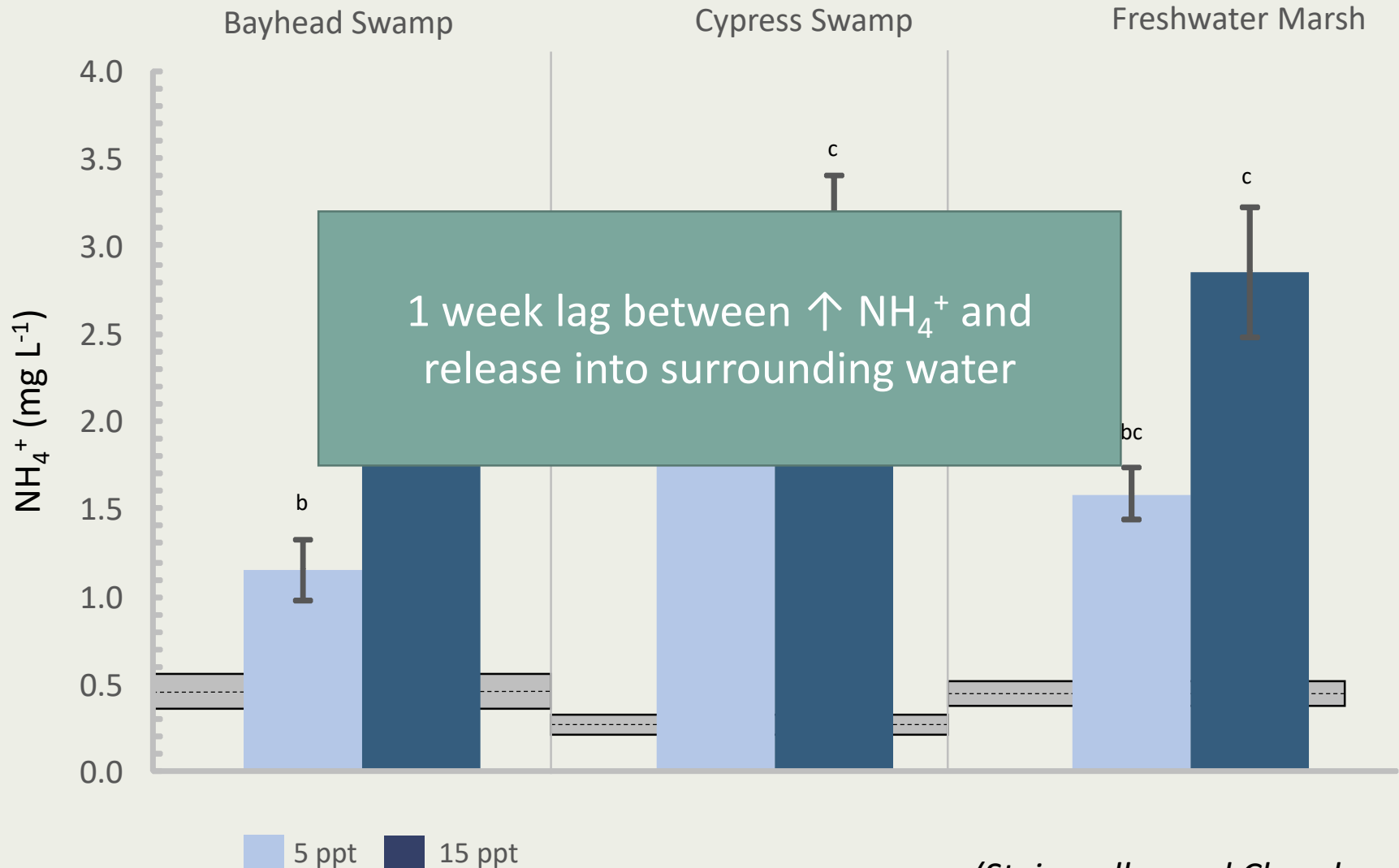


Porewater DOC



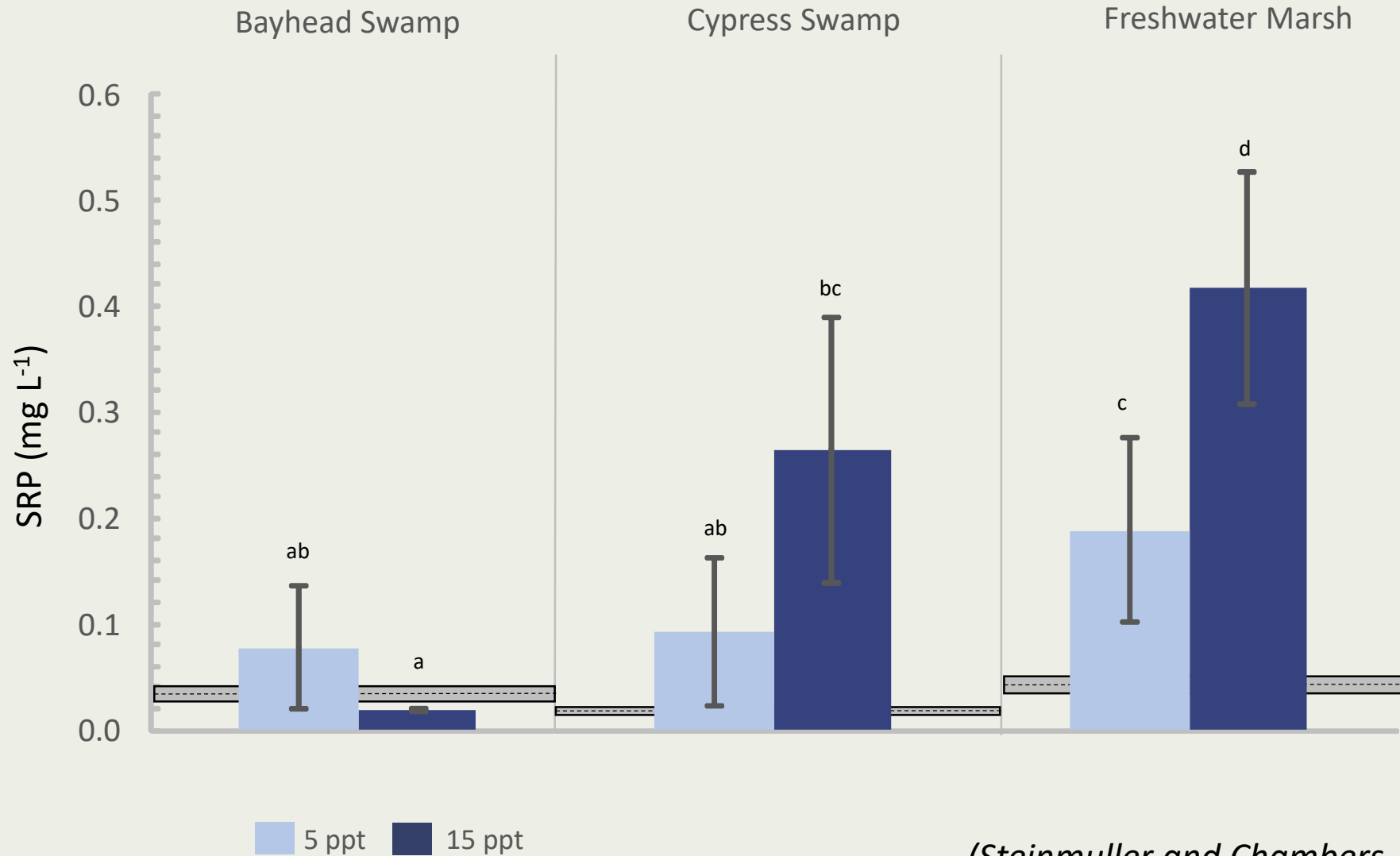
(Steinmuller and Chambers, 2018)

Porewater NH_4^+



(Steinmuller and Chambers, 2018)

Porewater Ortho-P



(Steinmuller and Chambers, 2018)

Percent exported to surface water

Bayhead Swamp



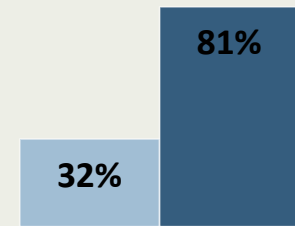
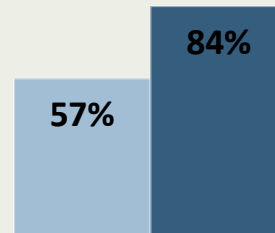
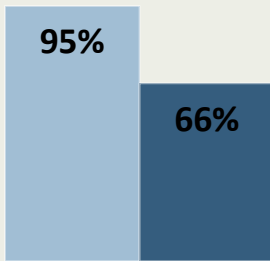
Cypress Swamp



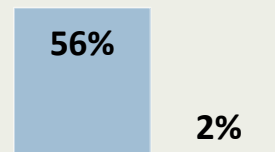
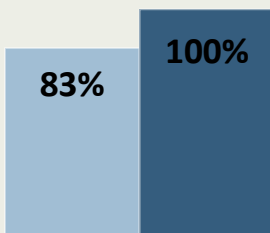
Freshwater Marsh



NH_4^+



Ortho
-P



5 ppt

15 ppt

Key Findings

1. SO_4^{2-} in low concentrations (<15 ppt) enhances total C mineralization and NH_4^+ export in freshwater wetlands
2. Low salinity may also enhance ortho-P export, but it depends on soil type (OM content)
3. High OM content and low salinities lead to freshwater wetland vulnerability due to accelerated C loss and N and P release

Thank you

