Microbe-mediated changes in soil organic matter processing following experimental additions of saltwater

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Acknowledgements

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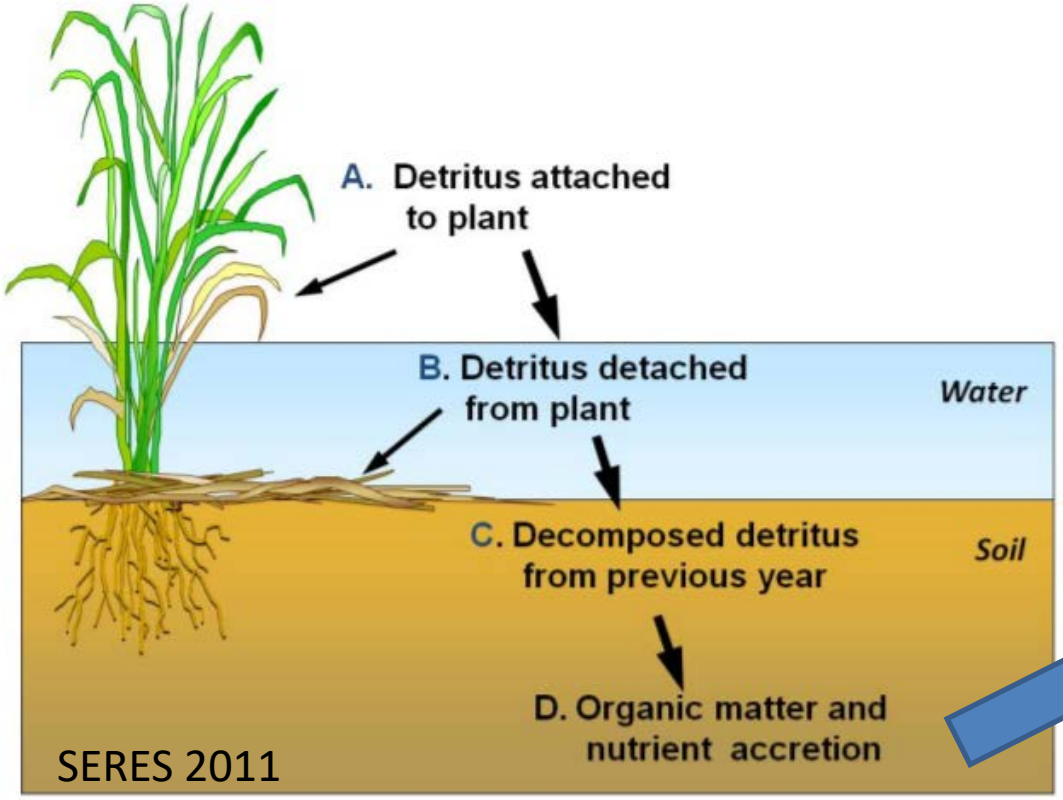
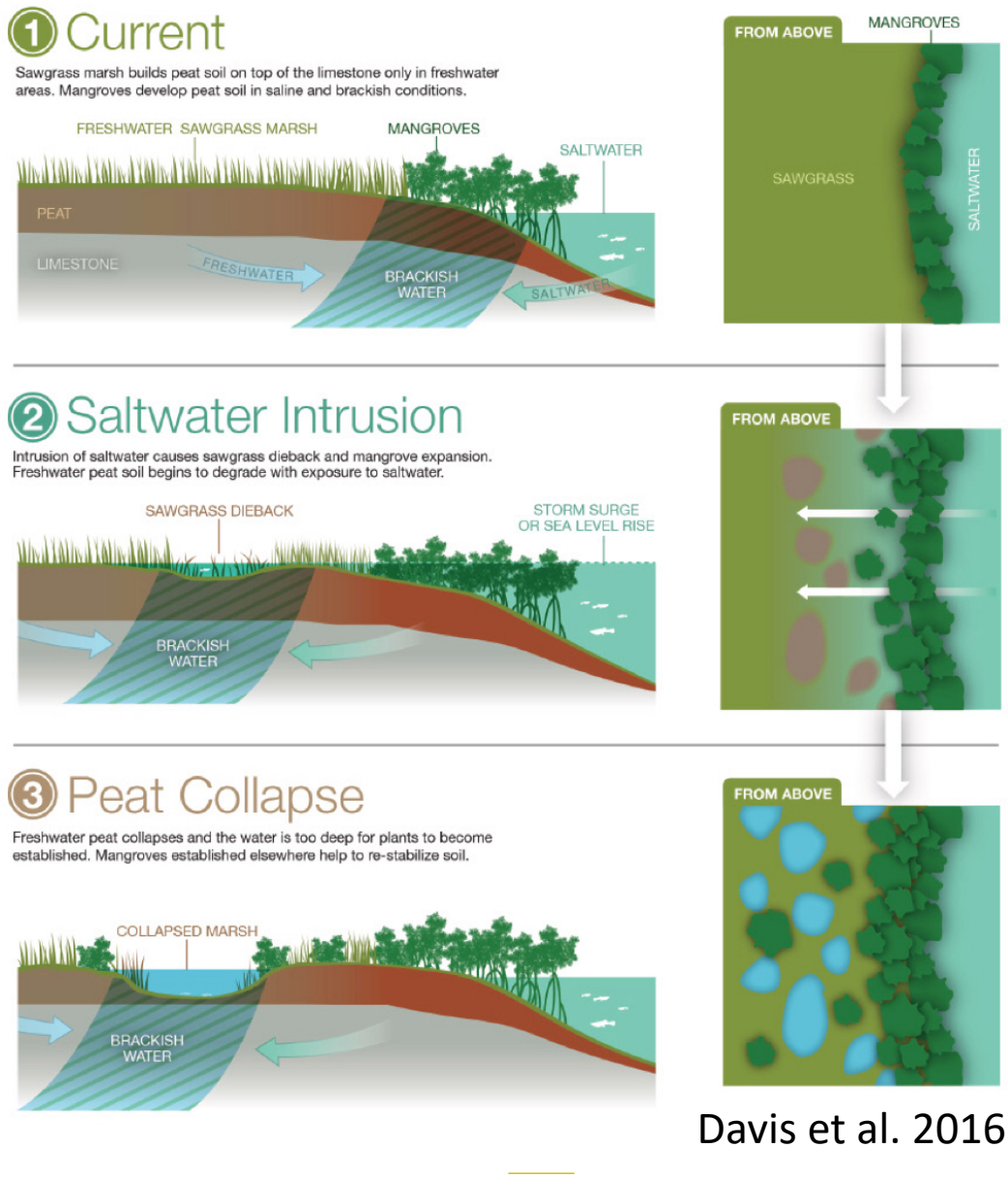
Coastal wetlands are at risk

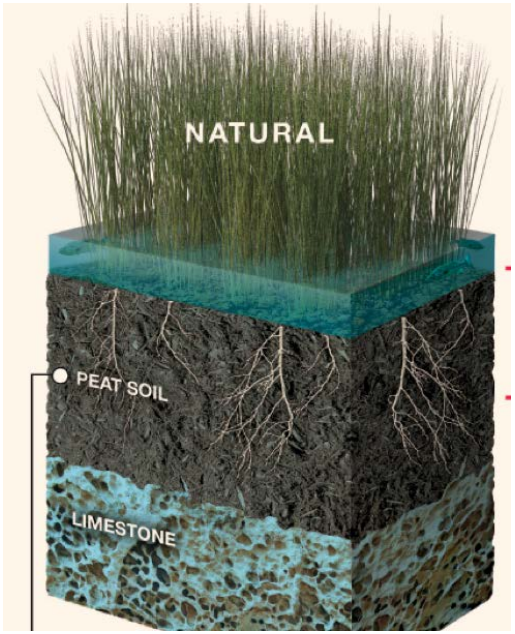


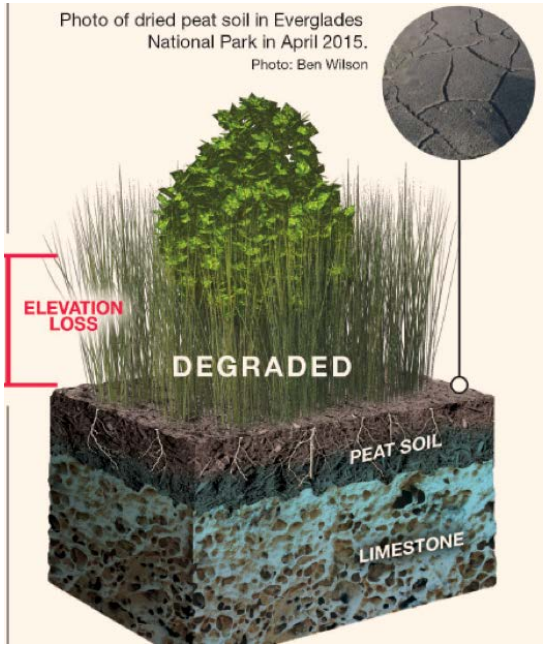
The effects of saltwater intrusion into freshwater sawgrass-dominated marsh



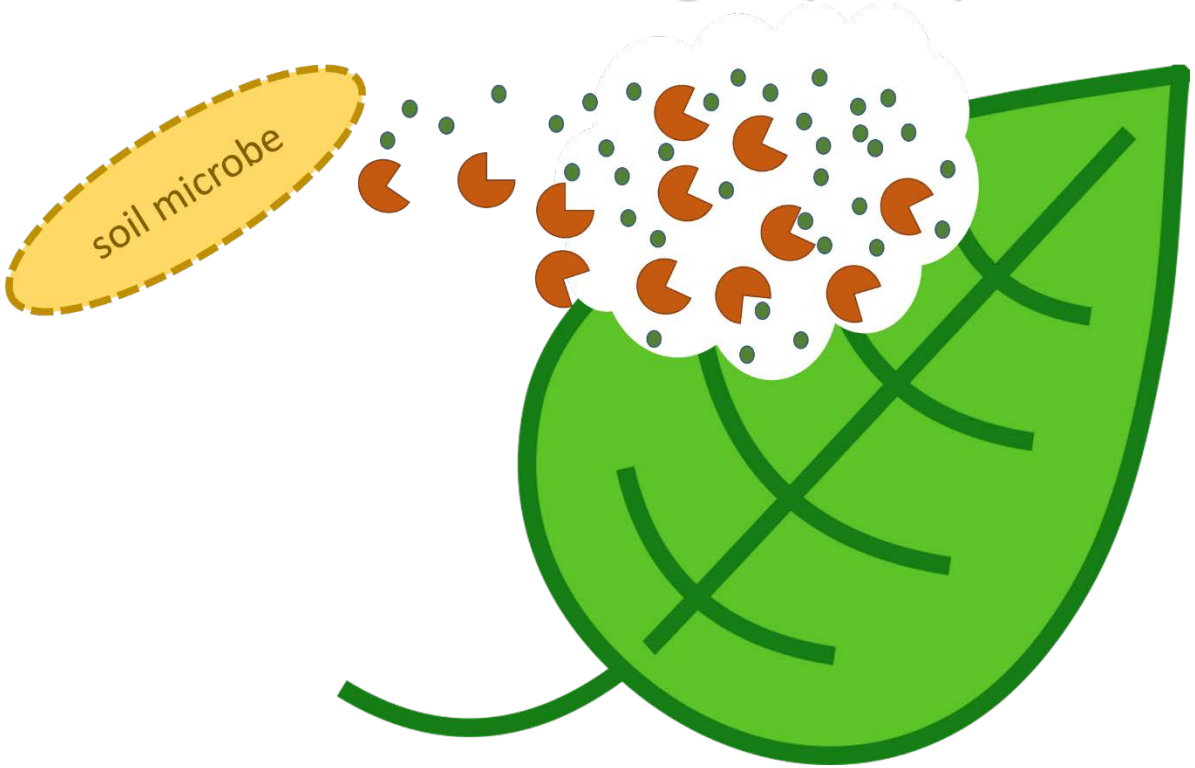
Davis et al. 2016

Modified from Davis et al. 2016

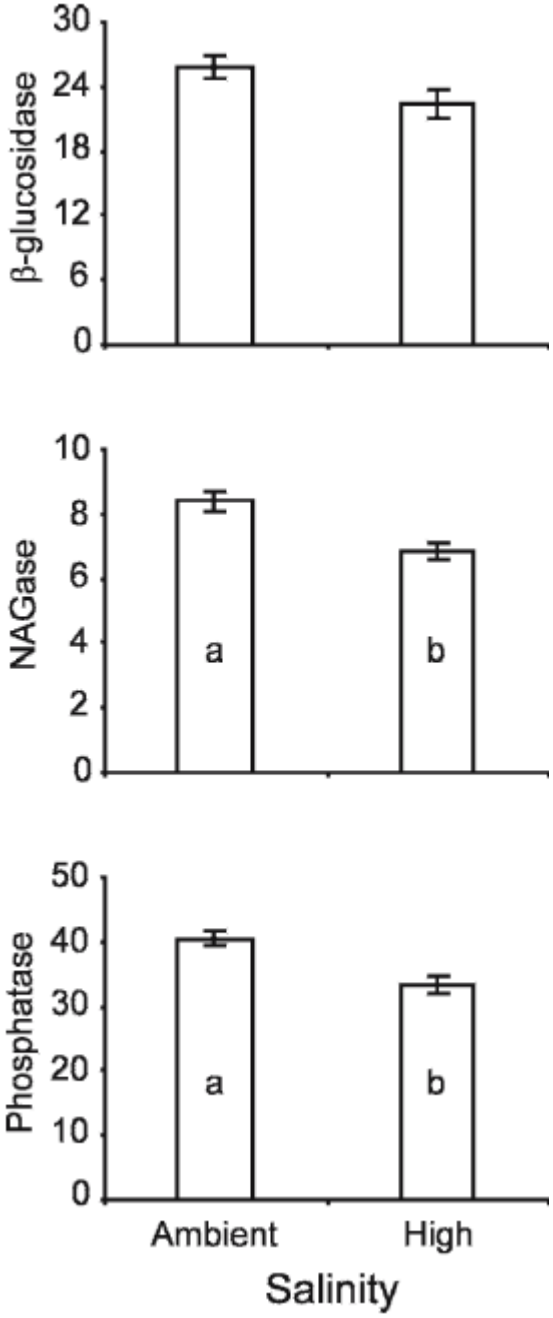




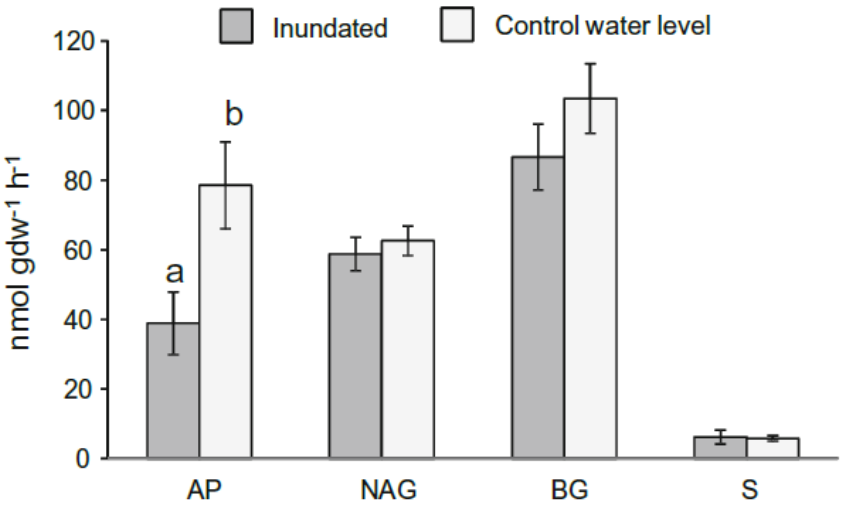
carbon:nitrogen:phosphorus



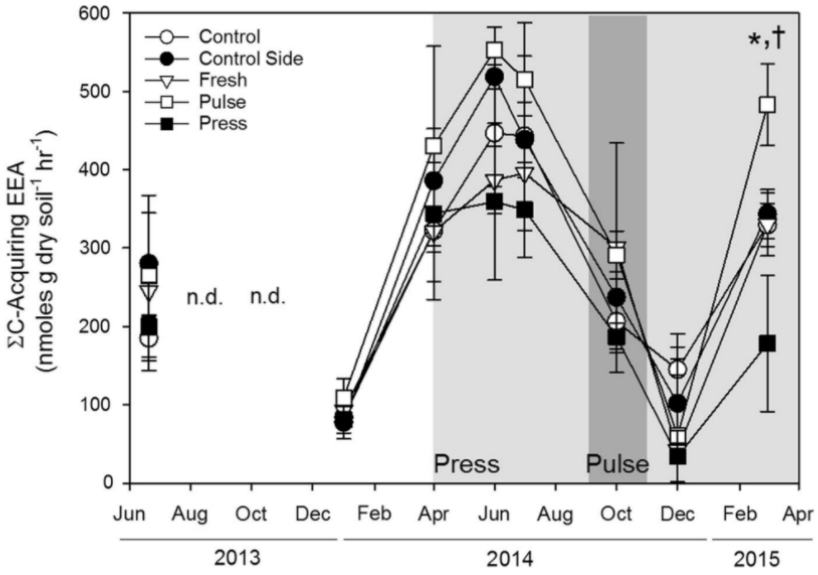
Do microbial extracellular enzyme activities provide information on how saltwater intrusion affects soil organic matter processing in wetlands?



Jackson and Vallaire 2009

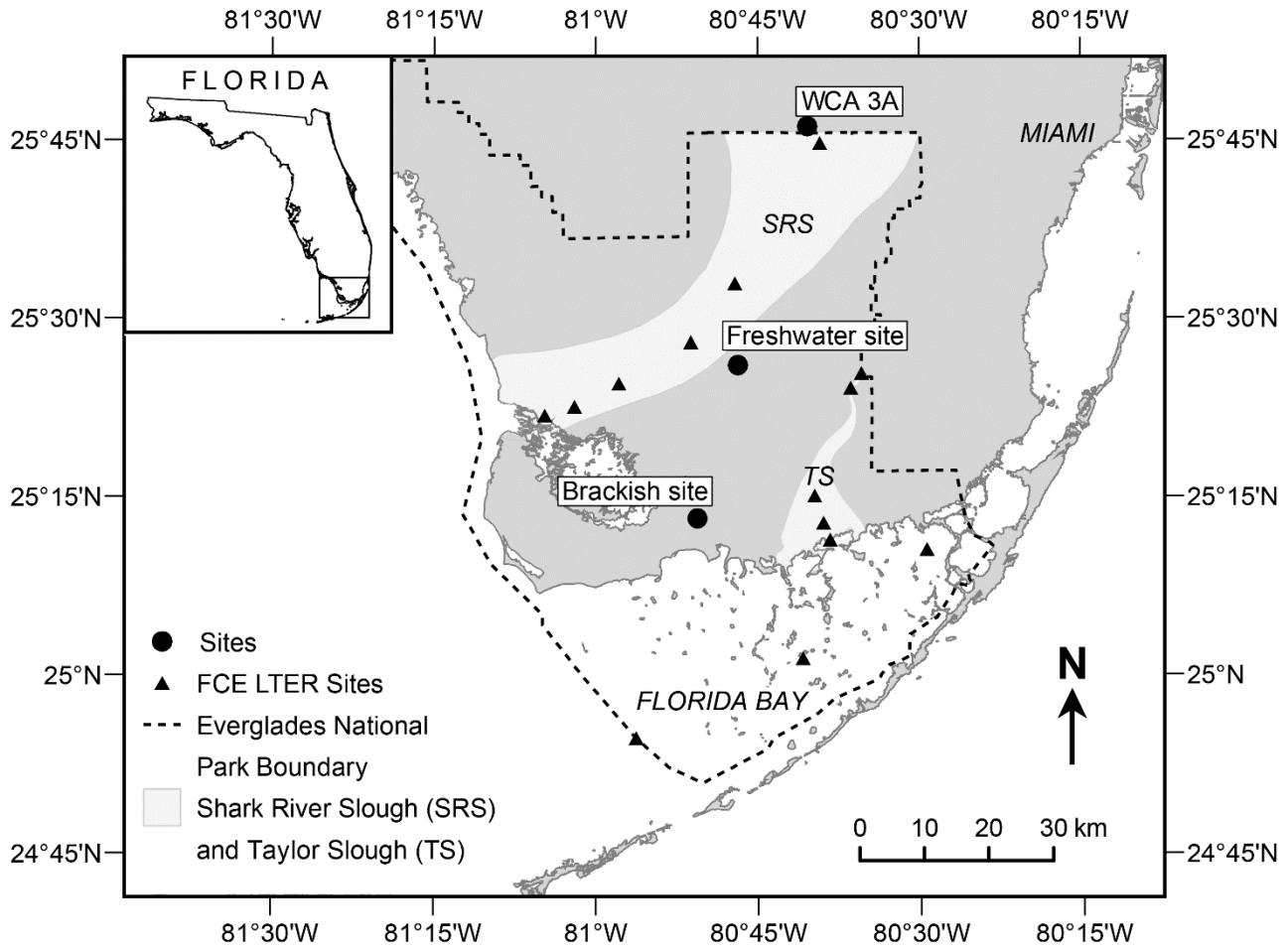


Chambers et al. 2016



Herbert et al. 2018

How is soil microbial functioning (extracellular enzyme activity and organic matter breakdown) altered by pulsed additions of saltwater?



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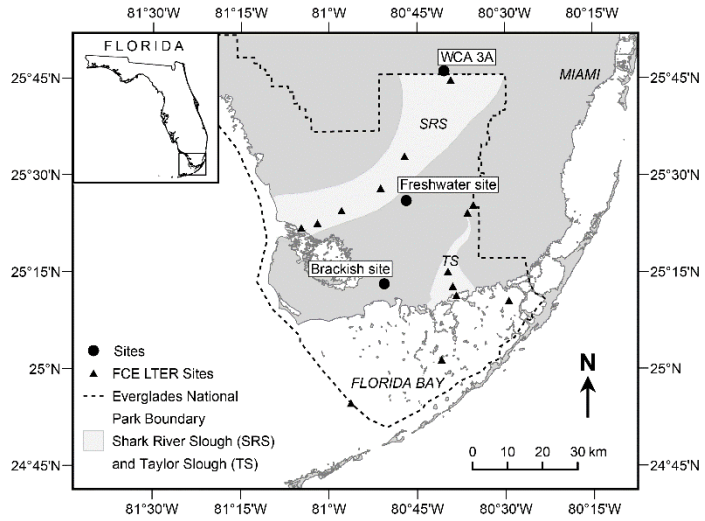
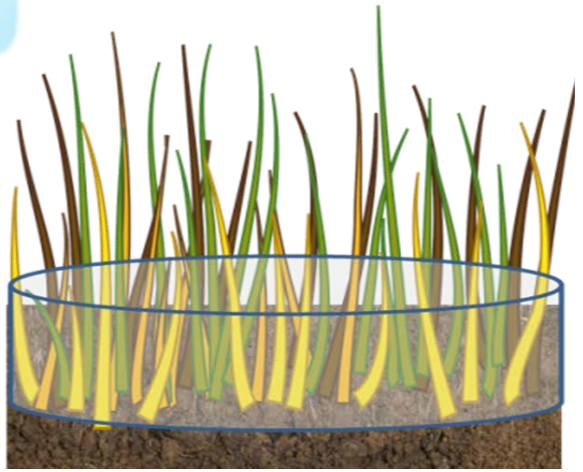
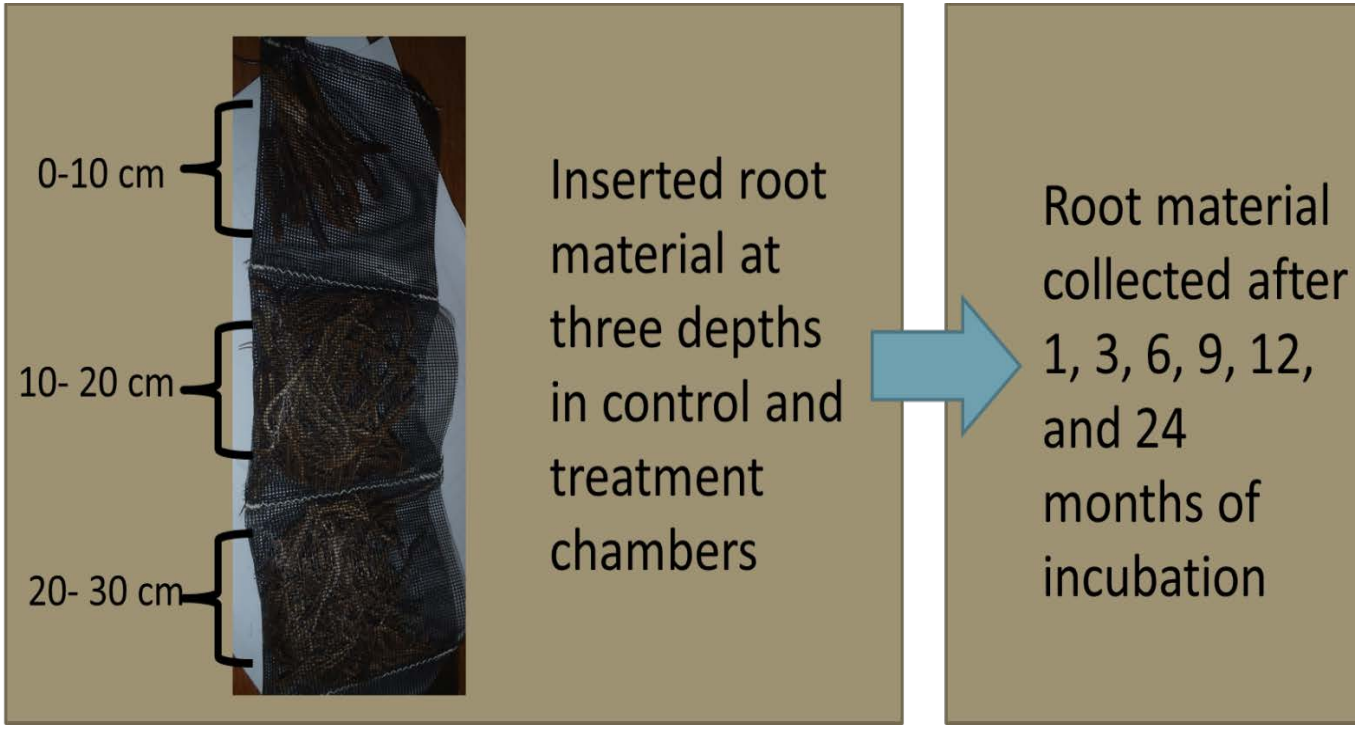


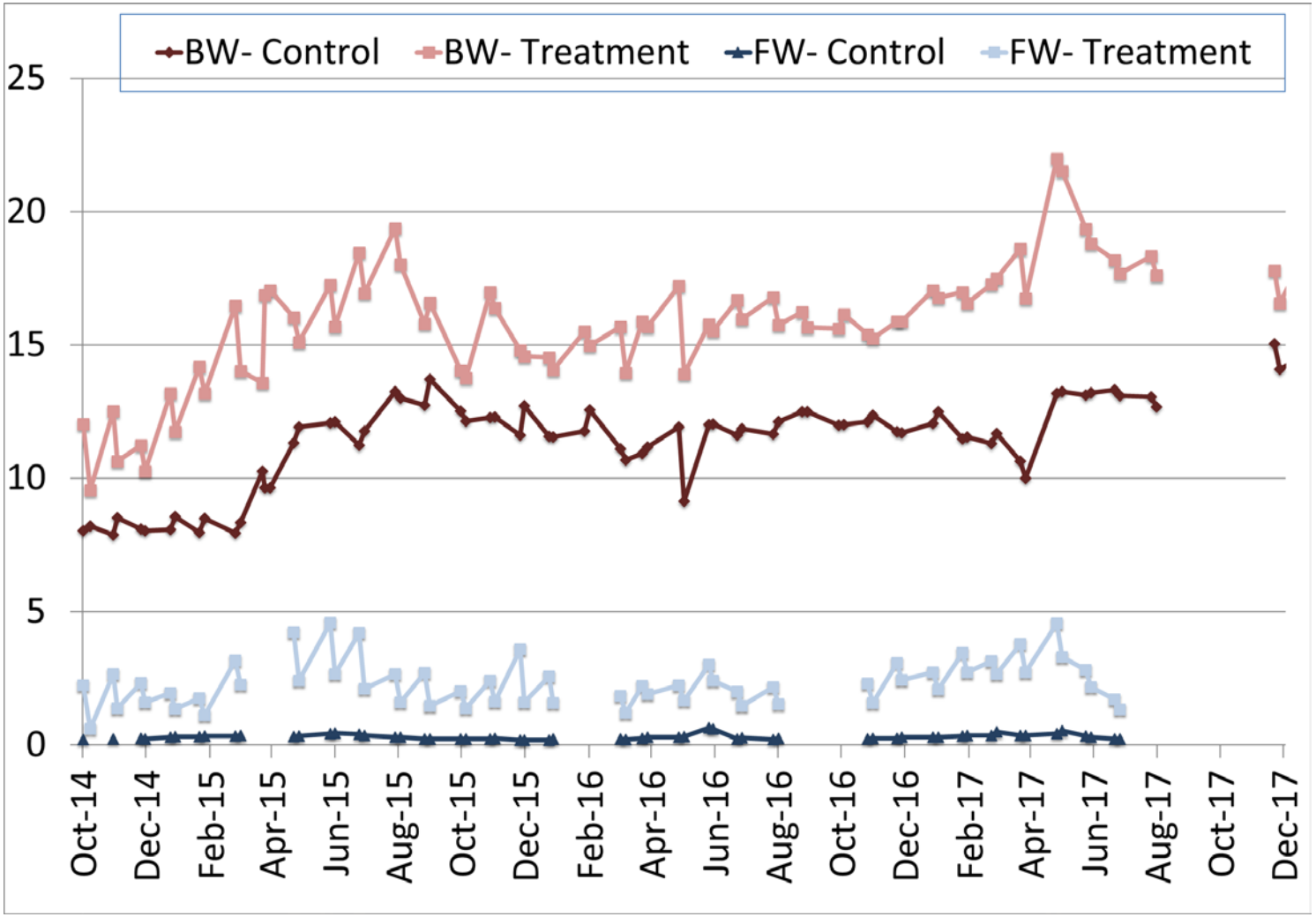
Add salt once a month



Root material is incubated in experimental field chambers



Porewater salinity



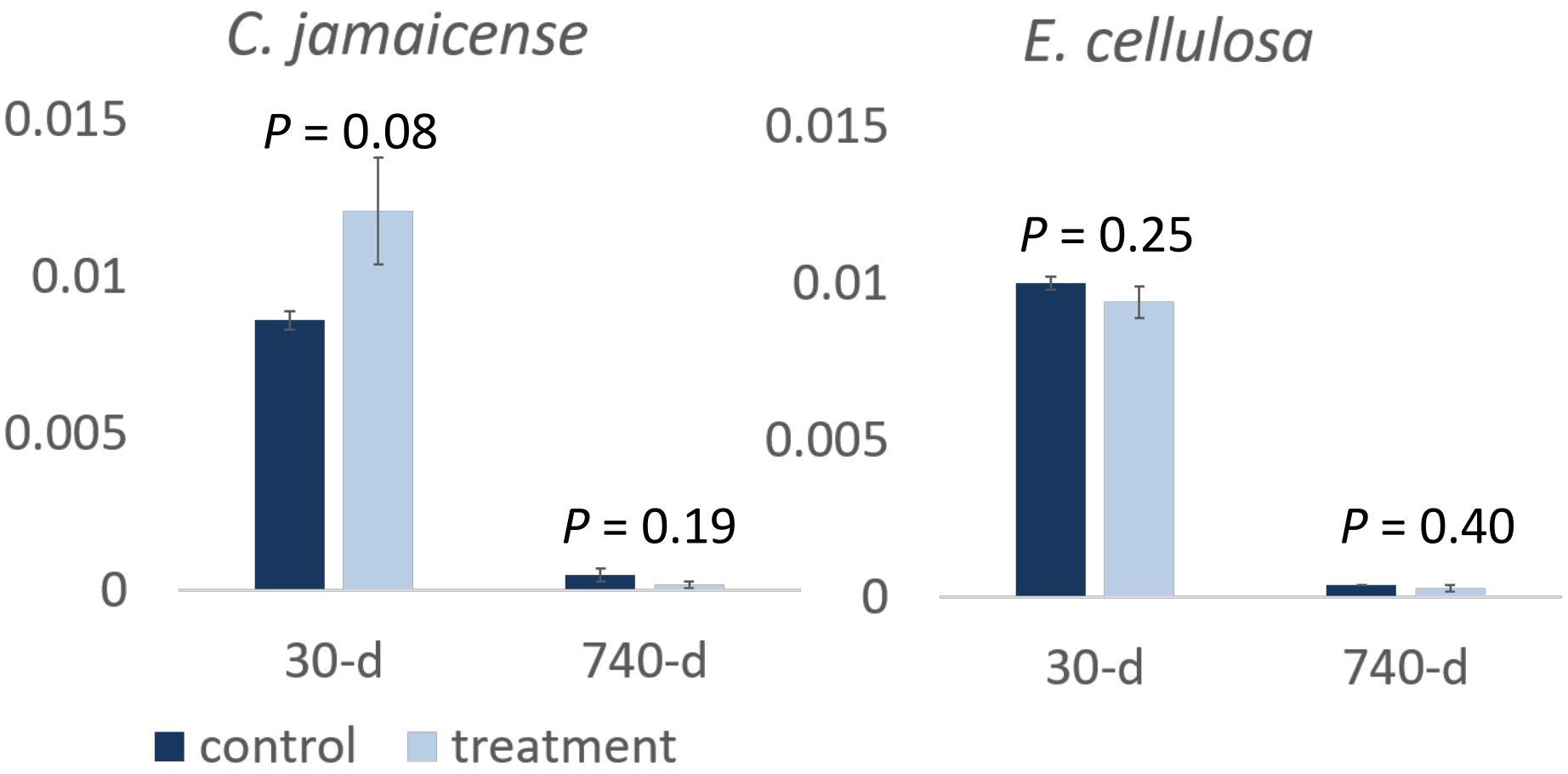
Effect of saltwater addition on porewater constituents from the **freshwater** site

	salt effect	significance
salinity	**9×**	***P* < 0.01**
DOC	NS	*P* = 0.06
TDN	**1.5×**	***P* < 0.01**
NH_4^+	**2.2×**	***P* < 0.01**
SRP	NS	*P* = 0.86
TDP	NS	*P* = 0.37
SO_4^{2-}	**208×**	***P* < 0.01**
HS^-	**50×**	***P* < 0.01**
soil redox	NS	*P* = 0.32

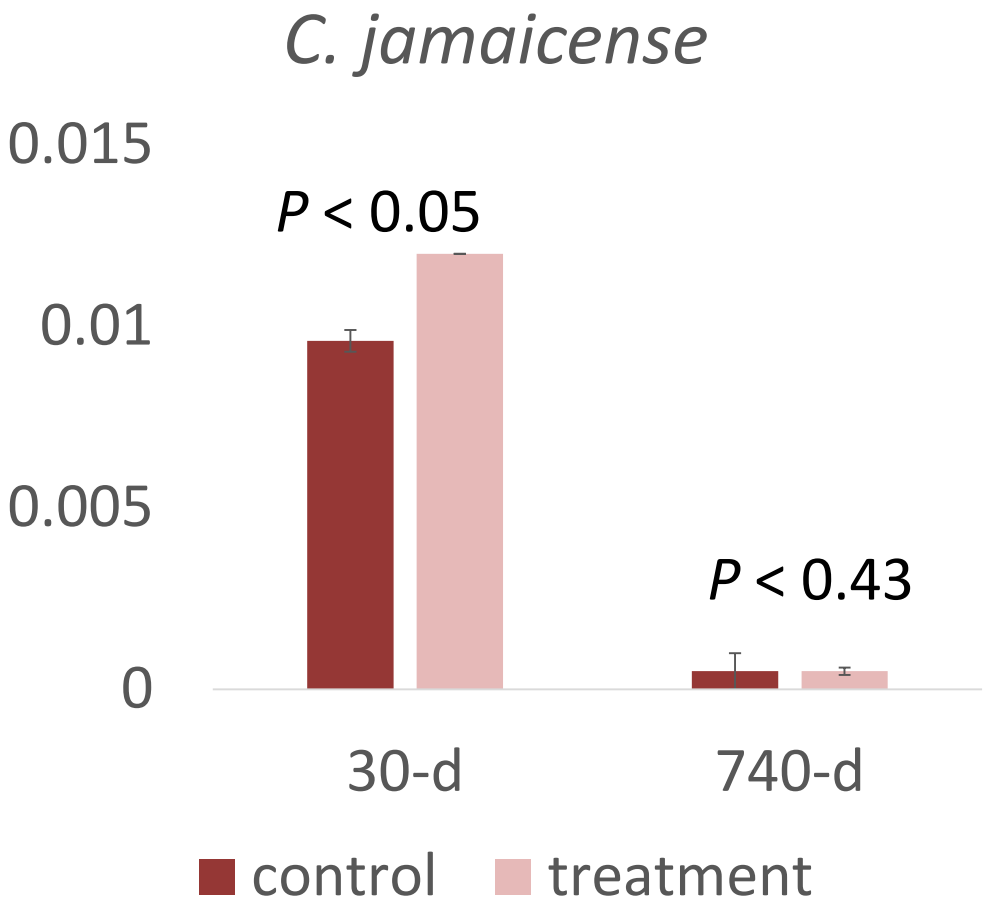
Effect of saltwater addition on porewater constituents from the **brackish** site

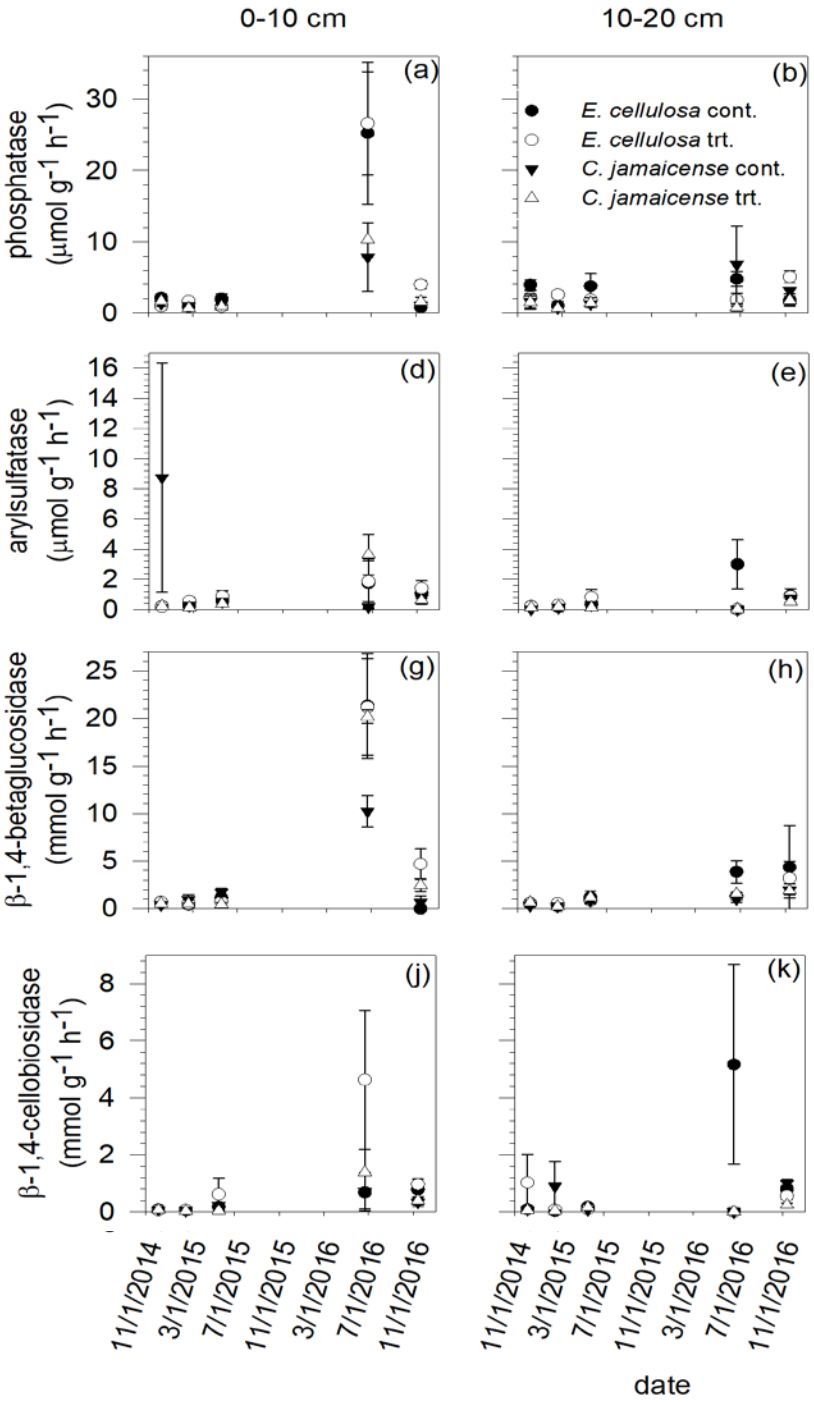
	salt effect	significance
salinity	**1.4×**	***P* < 0.01**
DOC	**0.99×**	***P* < 0.01**
TDN	**0.70×**	***P* < 0.01**
NH_4^+	**0.45×**	***P* < 0.01**
SRP	**0.47×**	***P* < 0.01**
TDP	**0.45×**	***P* < 0.01**
SO_4^{2-}	**2.4×**	***P* < 0.01**
HS^-	**0.44×**	***P* < 0.01**
soil redox	**2.2×**	***P* < 0.01**

Saltwater addition had no effect on freshwater *k*



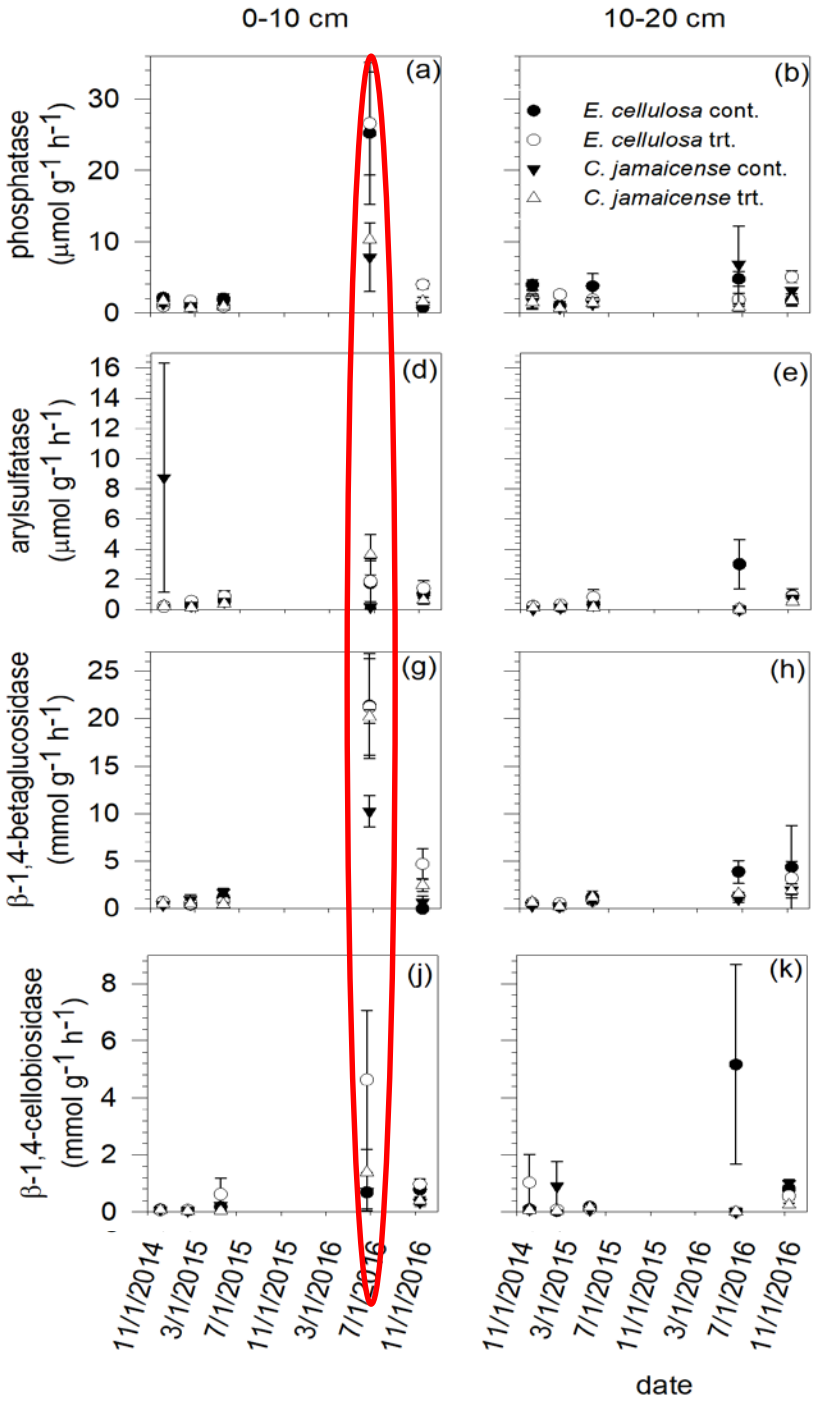
Saltwater addition increased short-term *k* at the brackish site





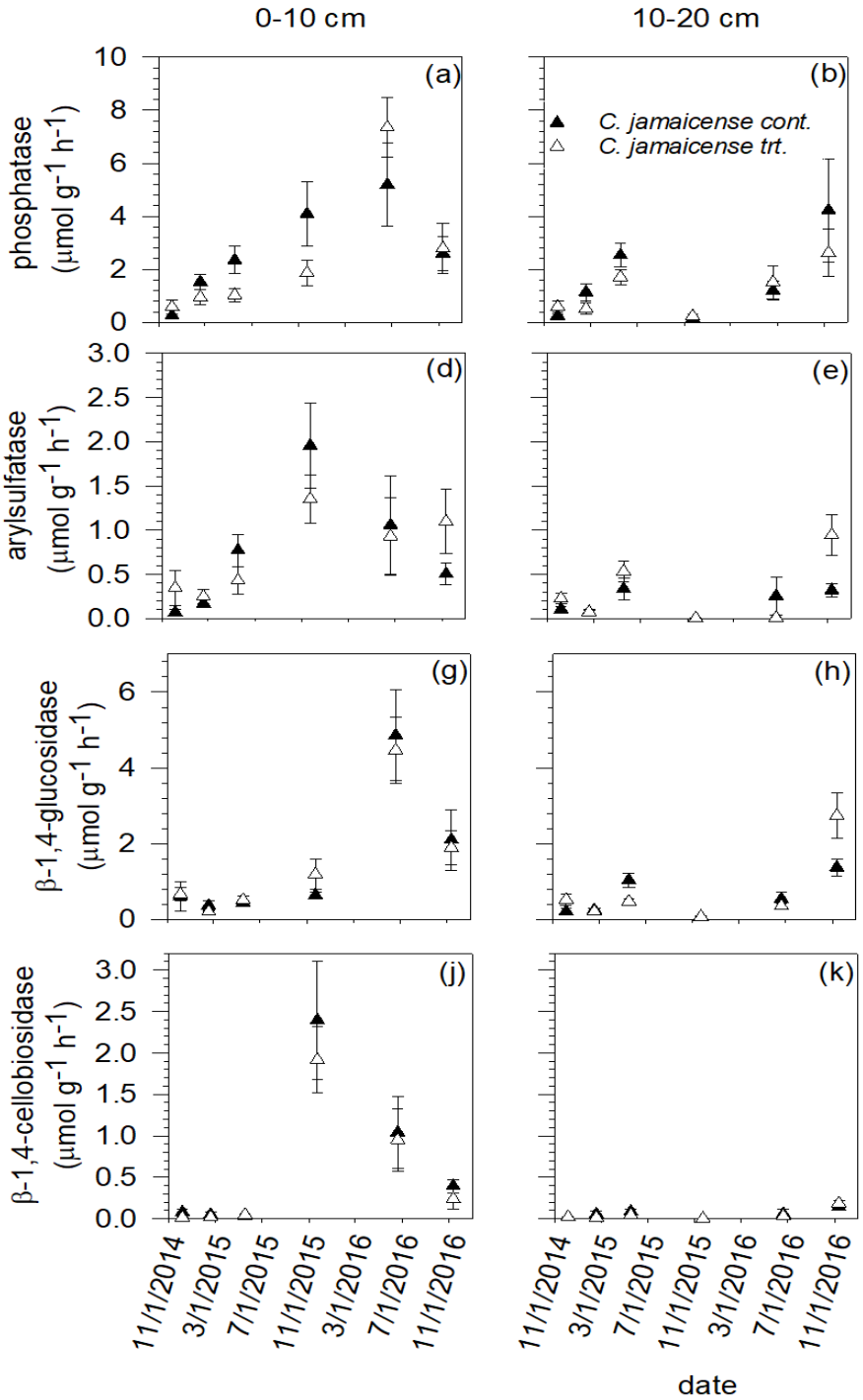
Freshwater site

- Enzymes varied over time and between species but were largely unaffected by saltwater addition
- Higher activities after 1.5 years of incubation



Freshwater site

- Enzymes varied over time and between species but were largely unaffected by saltwater addition
- Higher activities in surface soil and after 1.5 years of incubation



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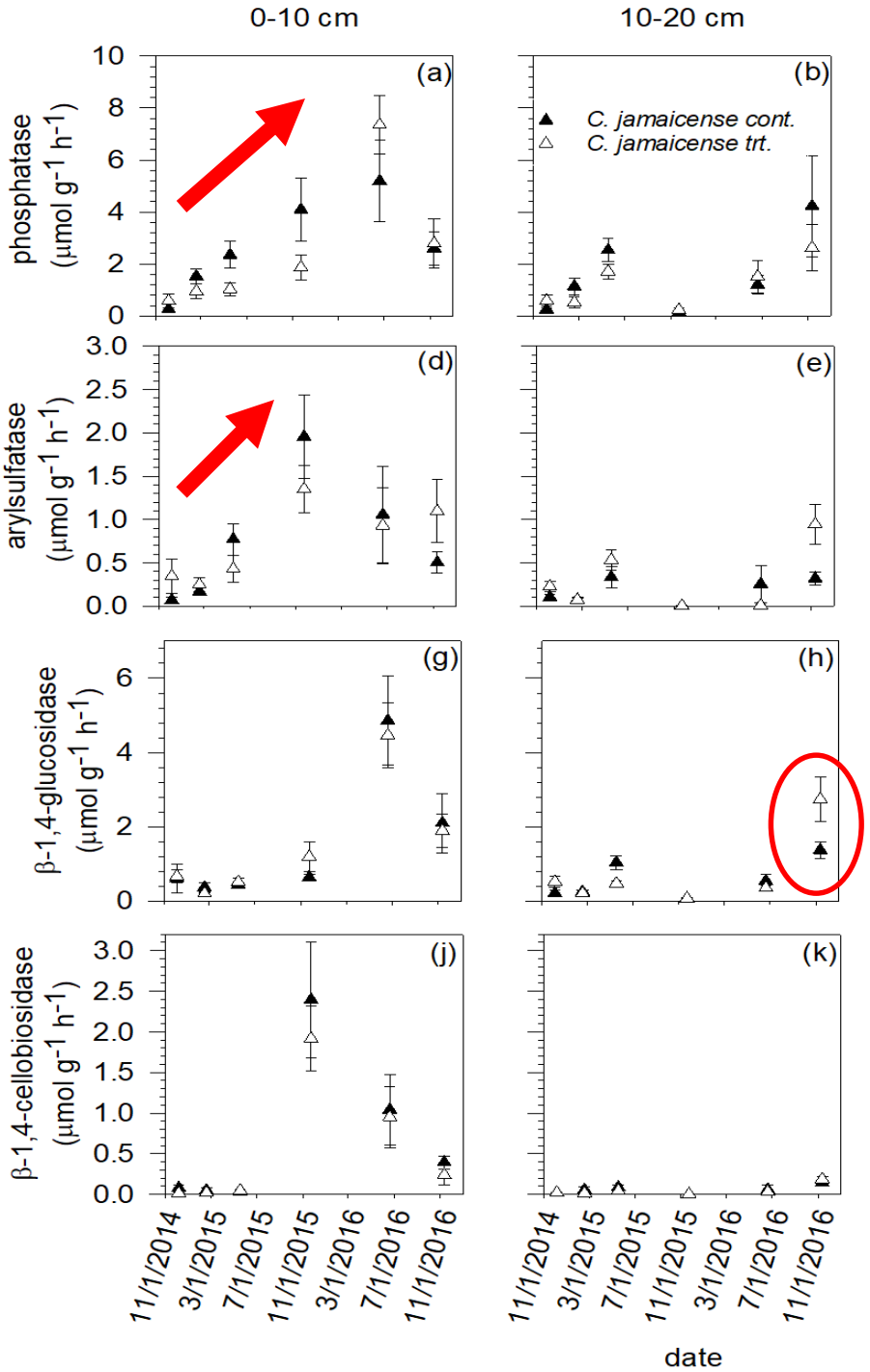
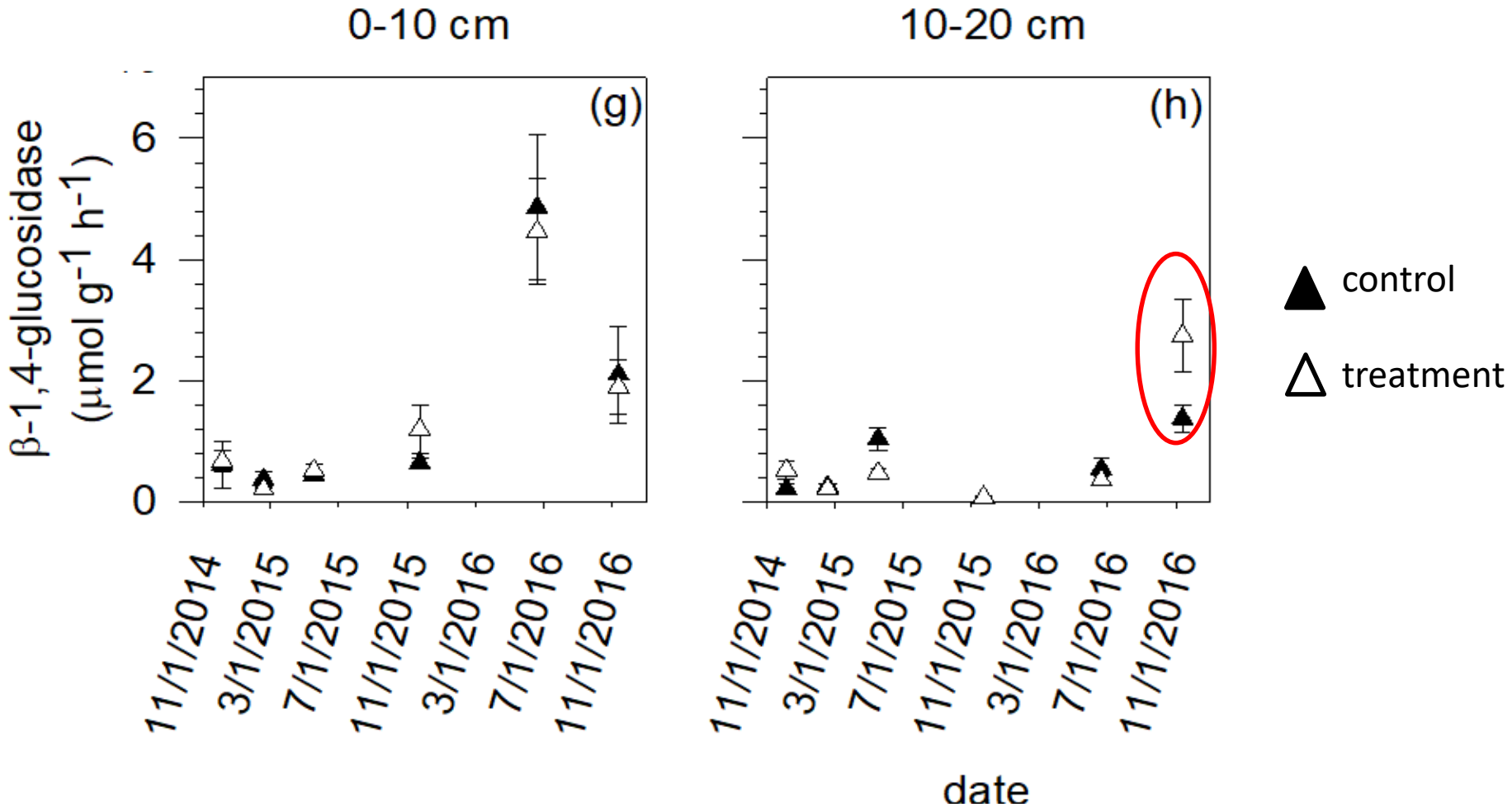


Brackish site

- Enzymes varied over time and were largely unaffected by saltwater addition
- Higher activities in surface soil and after 1 year of incubation

Closer look at β-1,4-glucosidase activity



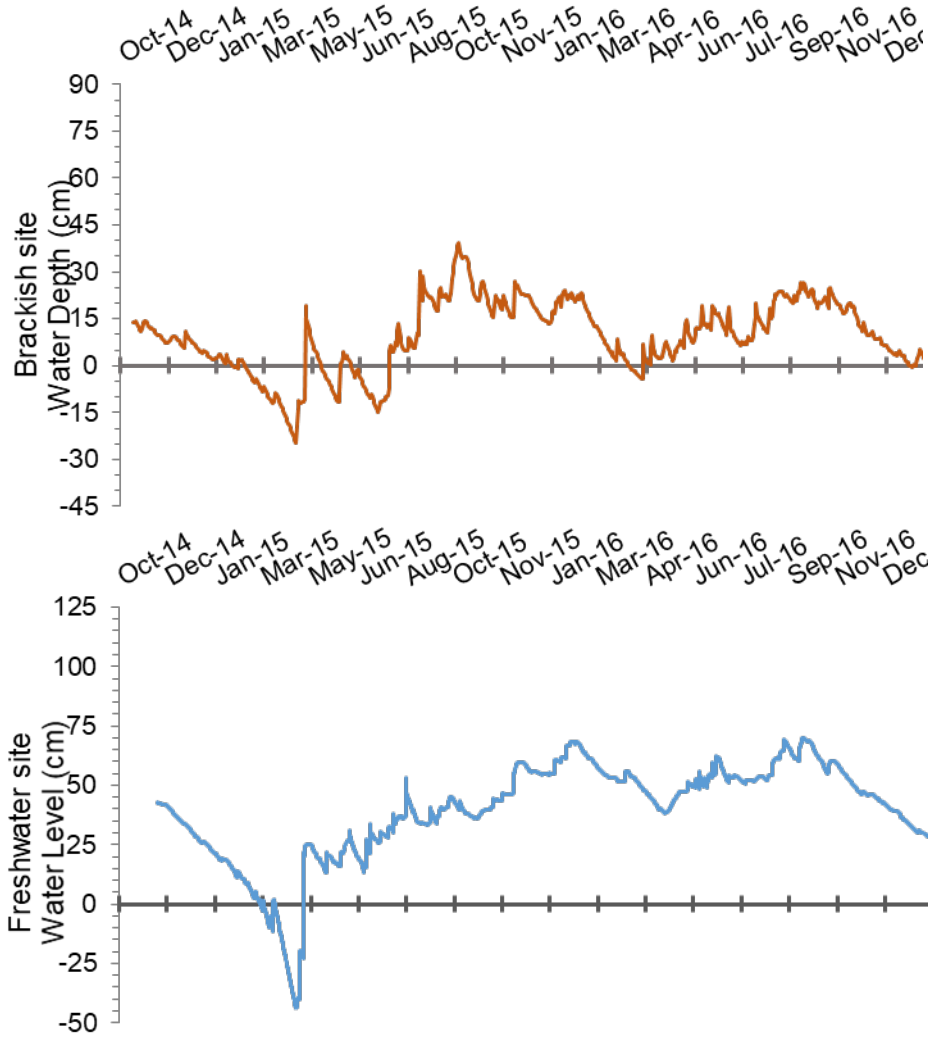
How is soil microbial functioning (extracellular enzyme activity and organic matter breakdown) altered by pulsed additions of saltwater?

- Enzyme potential was not affected by pulsed salinity exposure
- No long-term effects on *k*

WHY??

- We need to better understand the timing and duration of salinity exposure affects detection of enzyme responses
- Is inundation acting as a control on microbially-mediated decomposition?

Anoxic conditions can act as a control on microbial processing of organic matter

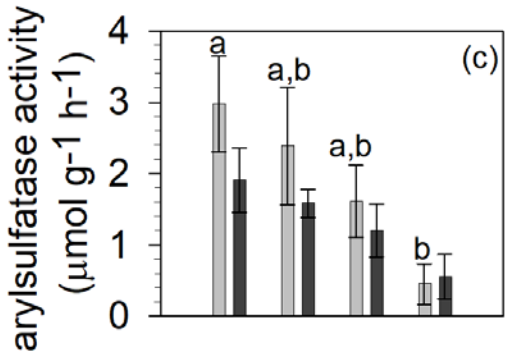


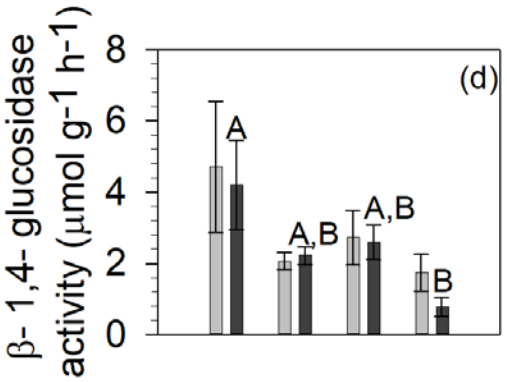
Brackish site	
Minimum	-20.2 cm
Maximum	41.7 cm
Average	7.12 cm
Days dry	132 days
Percent dry	18 %

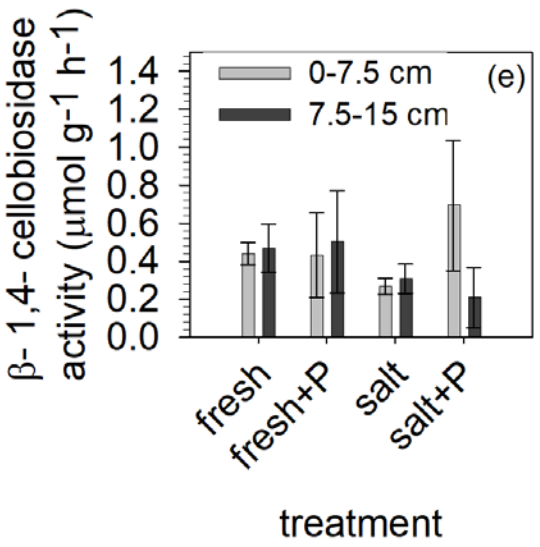
Freshwater site	
Minimum	-37.3 cm
Maximum	71.0 cm
Average	36.4 cm
Days dry	39 days
Percent dry	5.3 %

What about peat collapse?

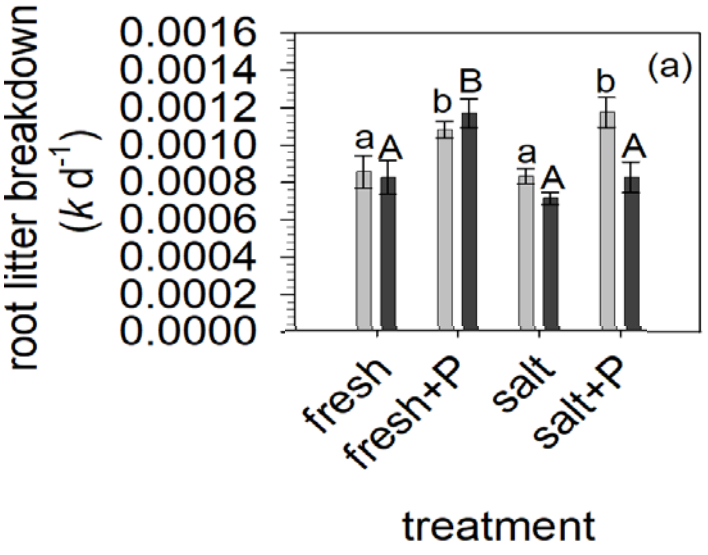
- Accelerated microbially mediated decomposition is not what is causing peat collapse at our site
- Is the Everglades soil microbe community adapted to pulses of salinity
- Experiments testing sustained exposure to salinity shows changes in enzyme activities



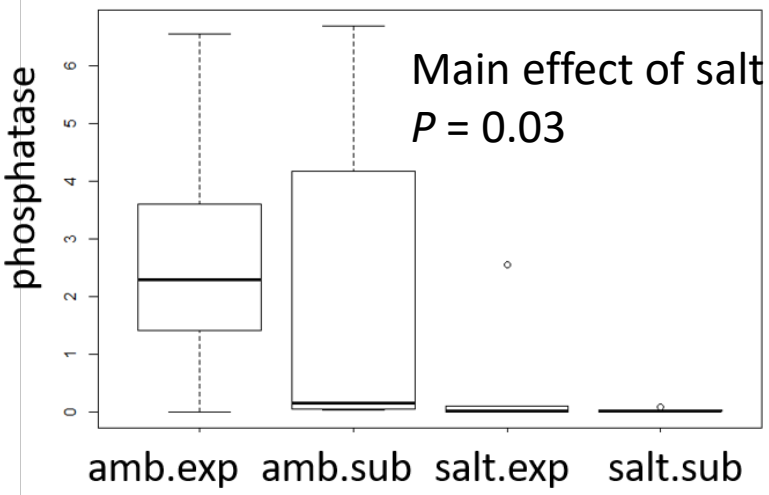


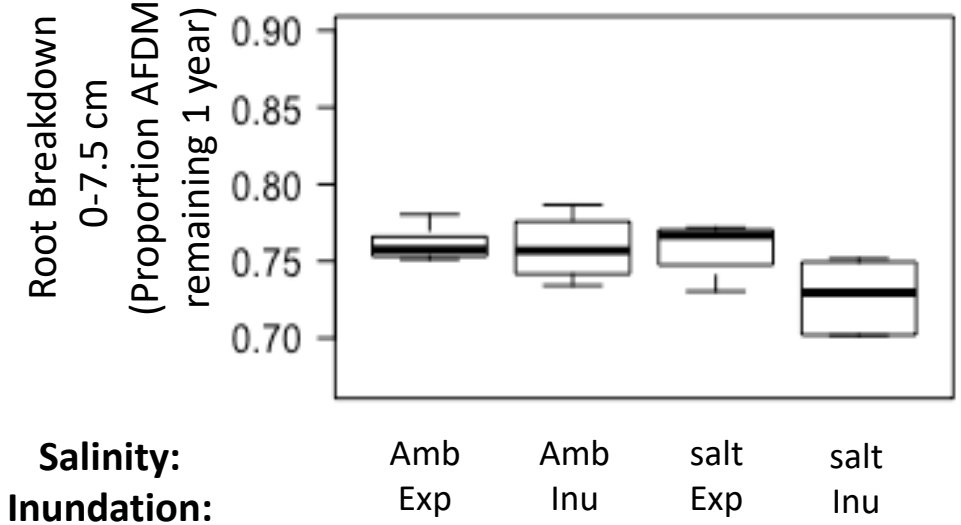


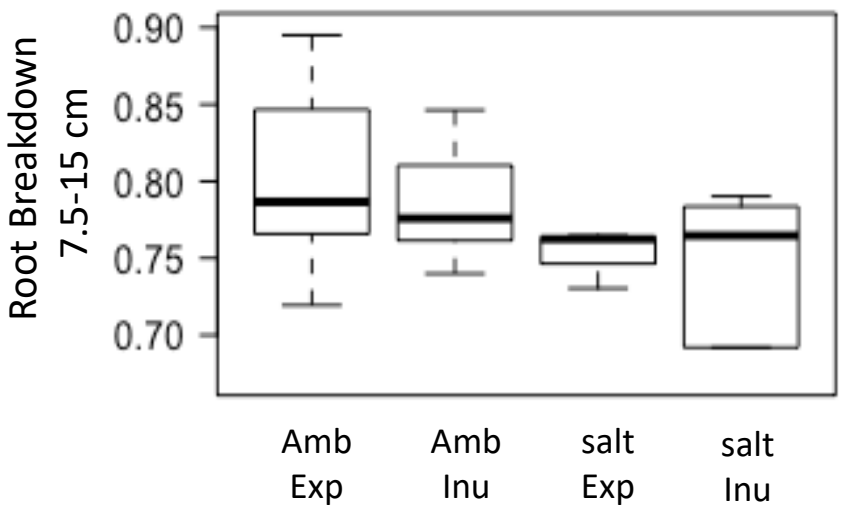
In press experiments we can see the effect of salt on enzyme activity but not on root liter breakdown



In press experiments in brackish soils we can see the effect of salt on enzyme activity but not on root breakdown







Charles et al. *in prep*


Questions