Quantifying marsh aboveground net primary productivity along shifting freshwater-to-saltwater gradients

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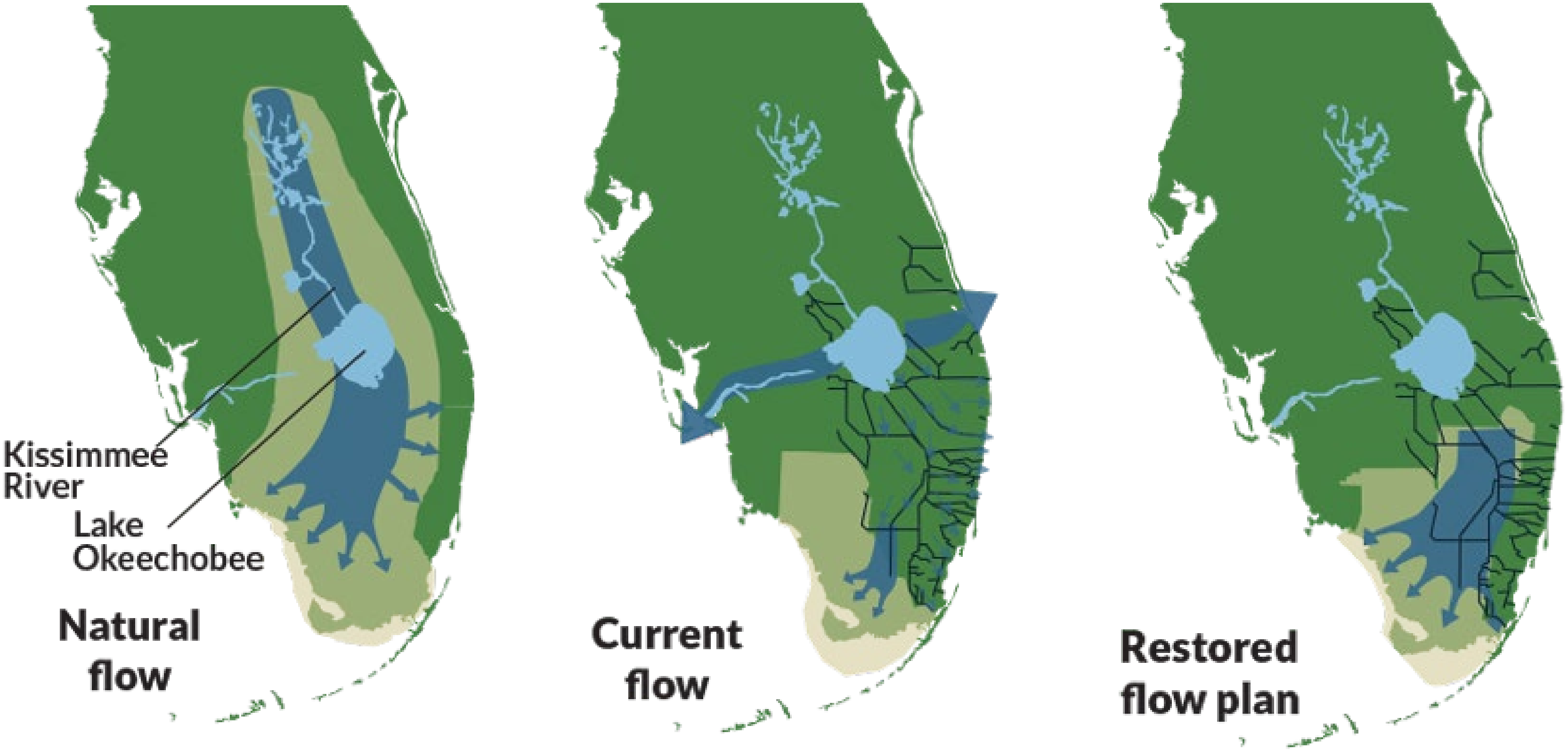
Everglades hydrological history

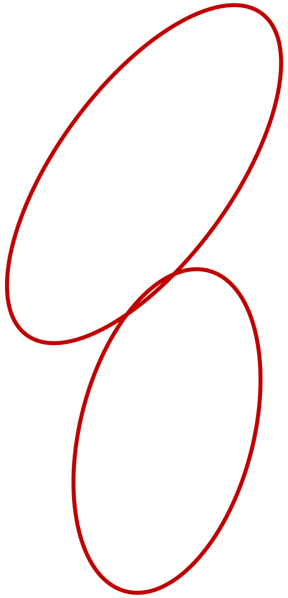


Drainage of the Everglades began in 1880s

- Disrupted natural water flow
- Altered vegetation, increased fire frequency, and accelerated soil subsidence

Comprehensive Everglades Restoration Plan (CERP)

Everglades flow



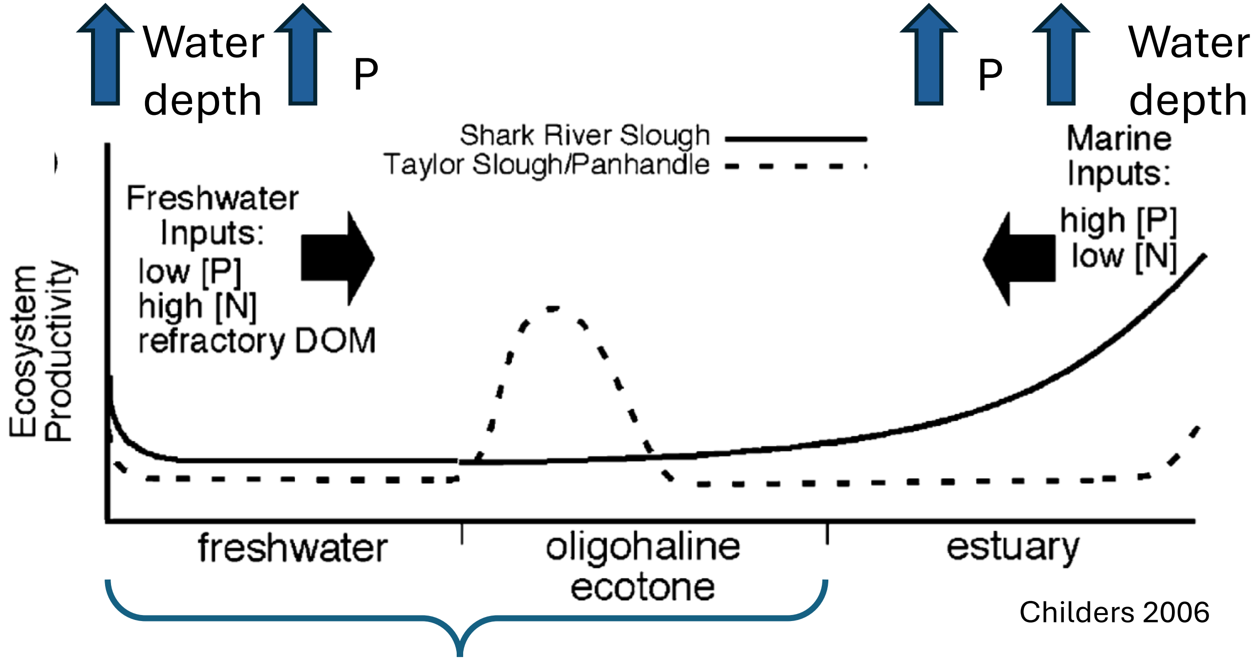
Shark River Slough
Taylor Slough/Panhandle

- ❖ Upstream: Freshwater restoration
- ❖ Downstream: Saltwater intrusion
- ❖ Long-term hydrologic change has altered vegetation patterns

Productivity gradients

- Plant aboveground productivity is key to predicting wetland C sequestration

- Productivity gradients along phosphorus (P) and hydrological gradients



Childers 2006

Knowledge Gap

How have **increasing phosphorus** and **water depths** from freshwater restoration and sea level rise **altered productivity gradients** along freshwater to oligohaline marshes?

Objective

To understand the effects of interactive hydrologic drivers (i.e., freshwater pulses and saltwater intrusion) on plant productivity and phosphorus retention

Research Questions

Q1: What are the long-term patterns of **aboveground net primary productivity** (ANPP) (i.e., growth) and **foliar P** in *Cladium jamaicense* (sawgrass) across two drainage basins with distinct hydrological regimes?

Q2: How are increasing water depths altering *Eleocharis cellulosa* density, and how does *E. cellulosa* mediate changes in sawgrass ANPP?

Q3: How are **P retention** patterns changing spatially among soil and sawgrass compartments with increasing water TP?

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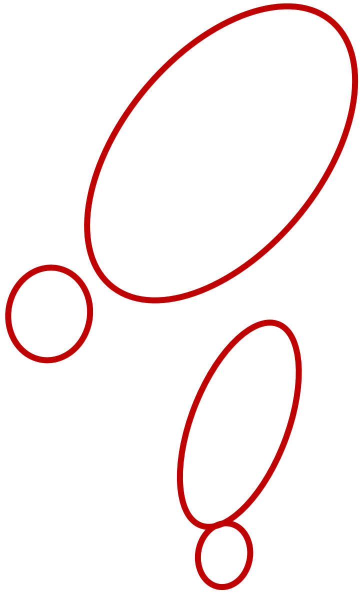
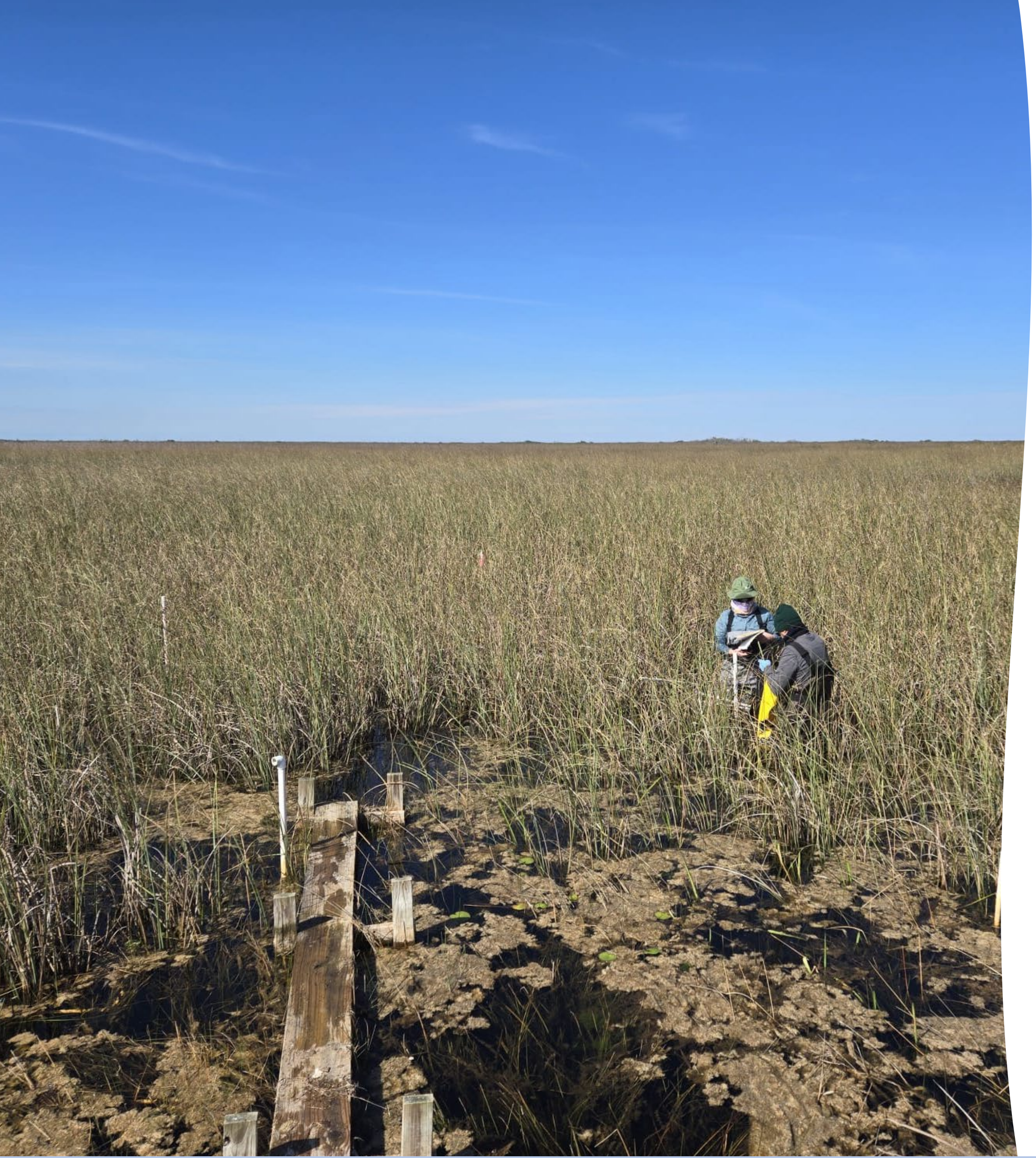
Study Sites

- Longer-hydroperiod sites:
  - Shark River Slough (SRS1-3)
- Shorter-hydroperiod sites:
  - Taylor Slough Panhandle (TS/Ph1-6)
- Oligohaline sites:
  - SRS-3 and TS/Ph6





Methods

2006 - Ongoing

Annually:

- Surface soil cores (0–10 cm) collected
  - TP
- Three live sawgrass plants
  - TP

Bi-monthly:

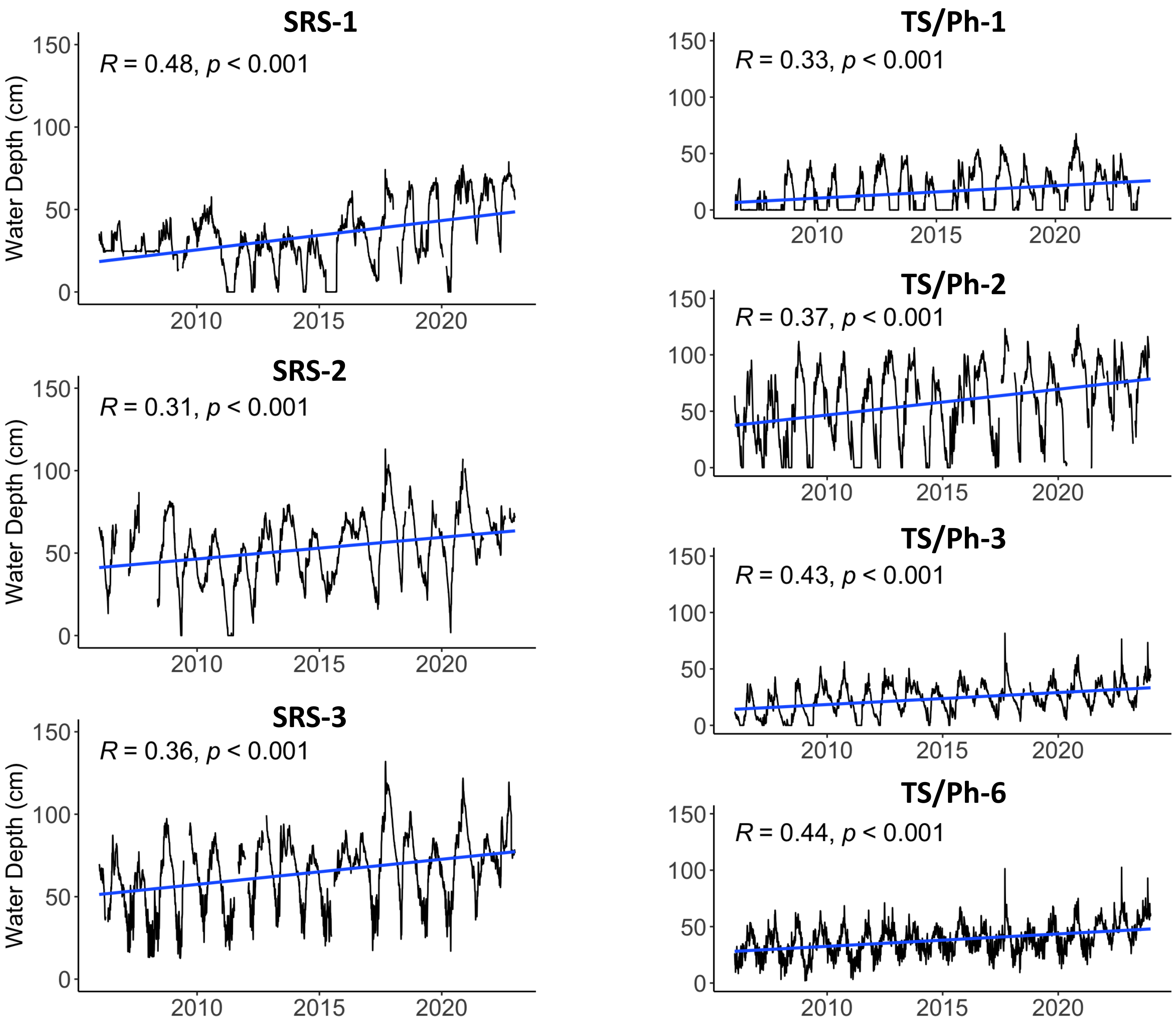
- Non-destructive phenometric measurements used to estimate biomass and calculate ANPP
  - triplicate plots (1 m^2)

Continuous:

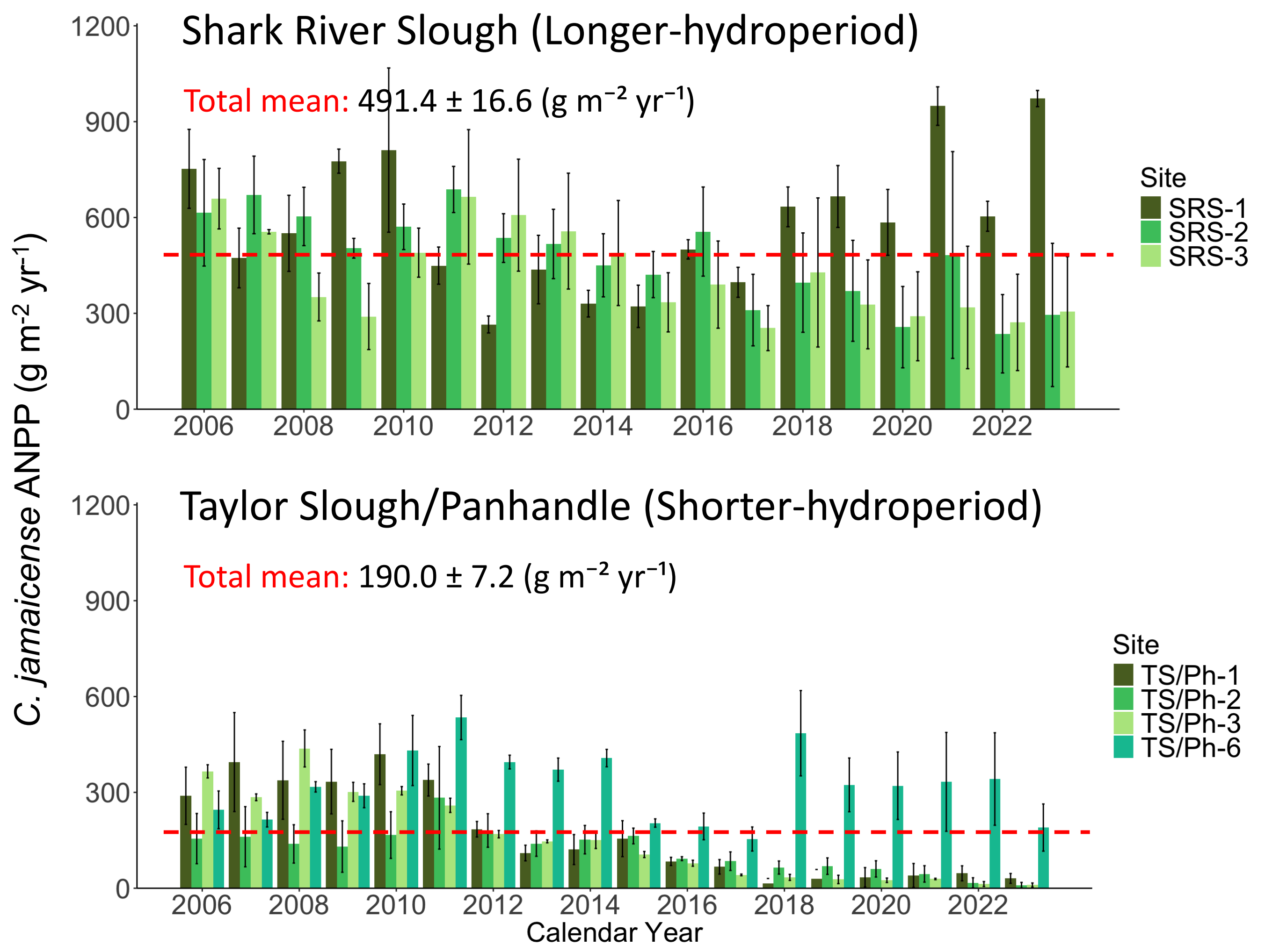
- Water depth using submerged pressure transducers
- Water quality samples
  - TP

Increasing water depths

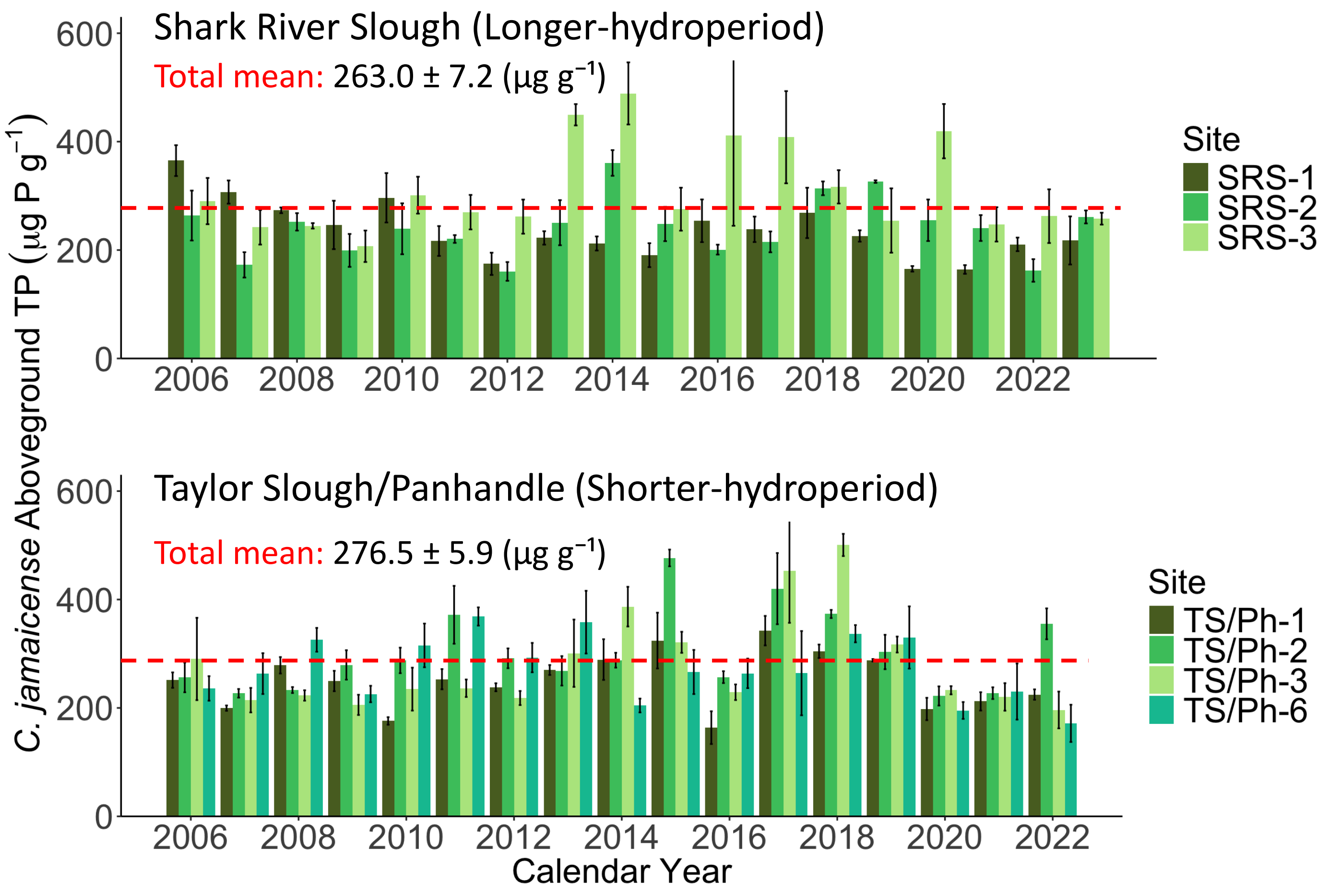
- Shark River Slough has higher water depths than Taylor Slough
- Increasing water depths across sites



Sawgrass ANPP is decreasing at most sites



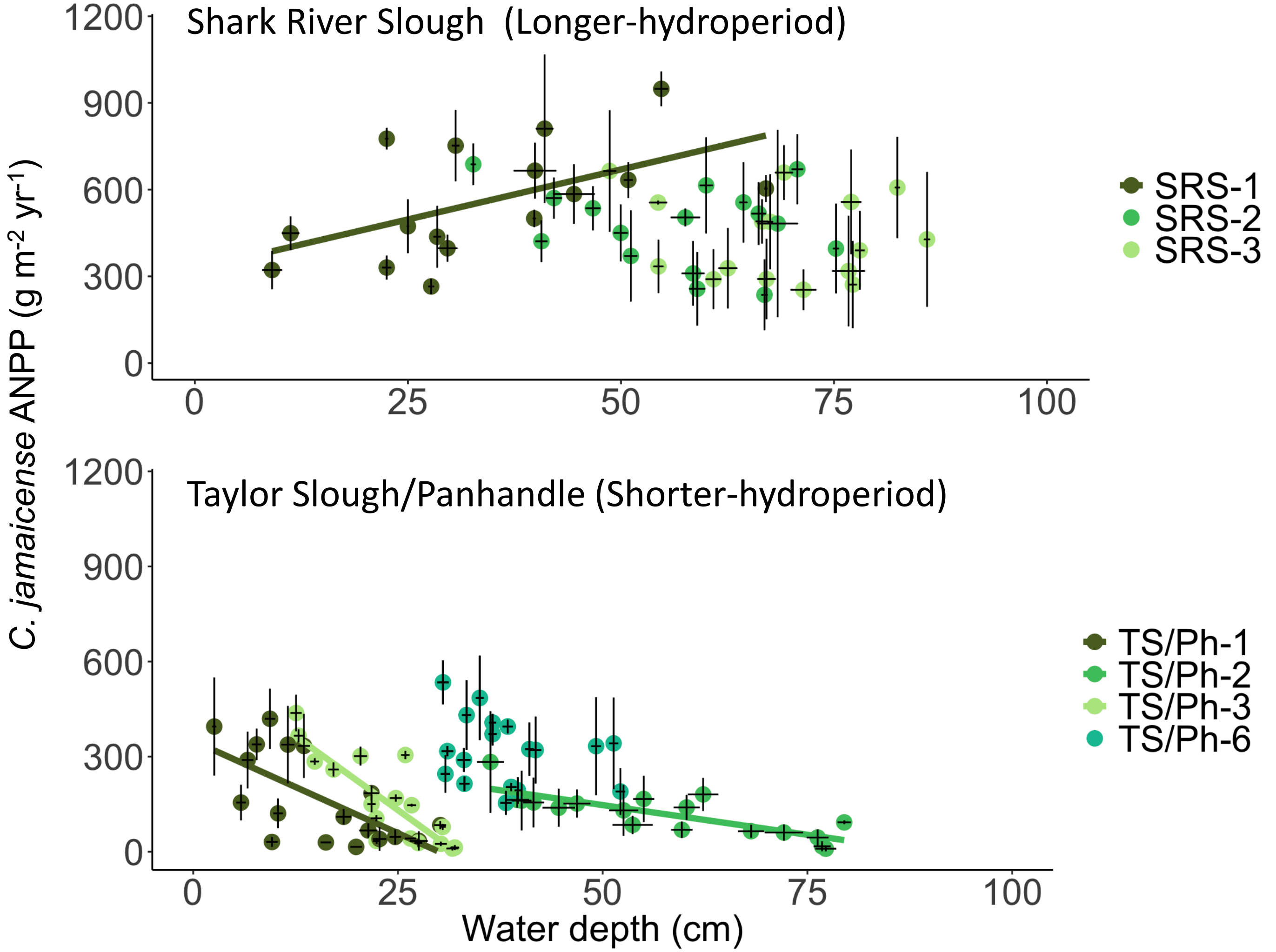
Sawgrass foliar TP is not increasing with ANPP



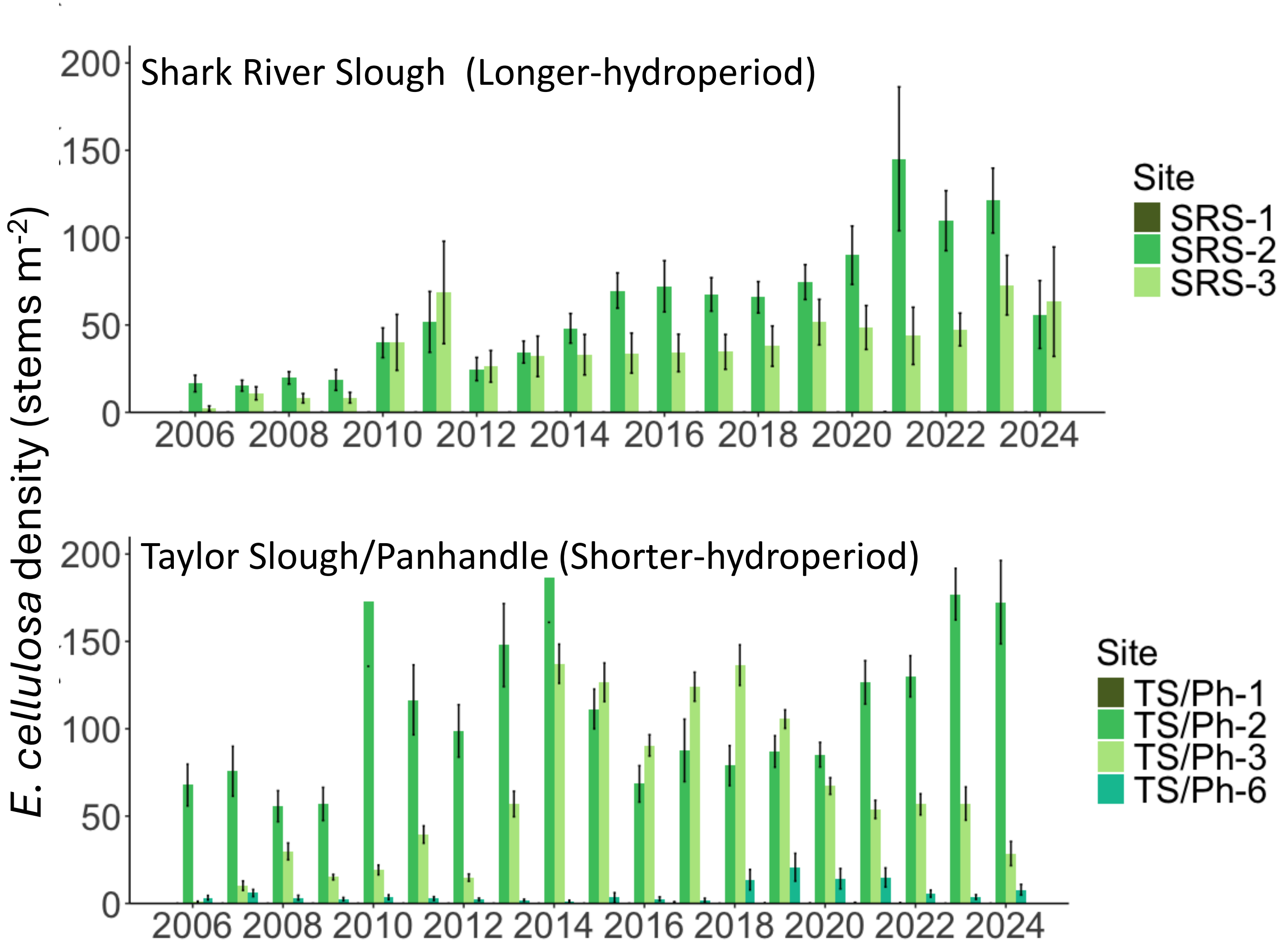
Increasing water depths decreased productivity at short-hydroperiod sites

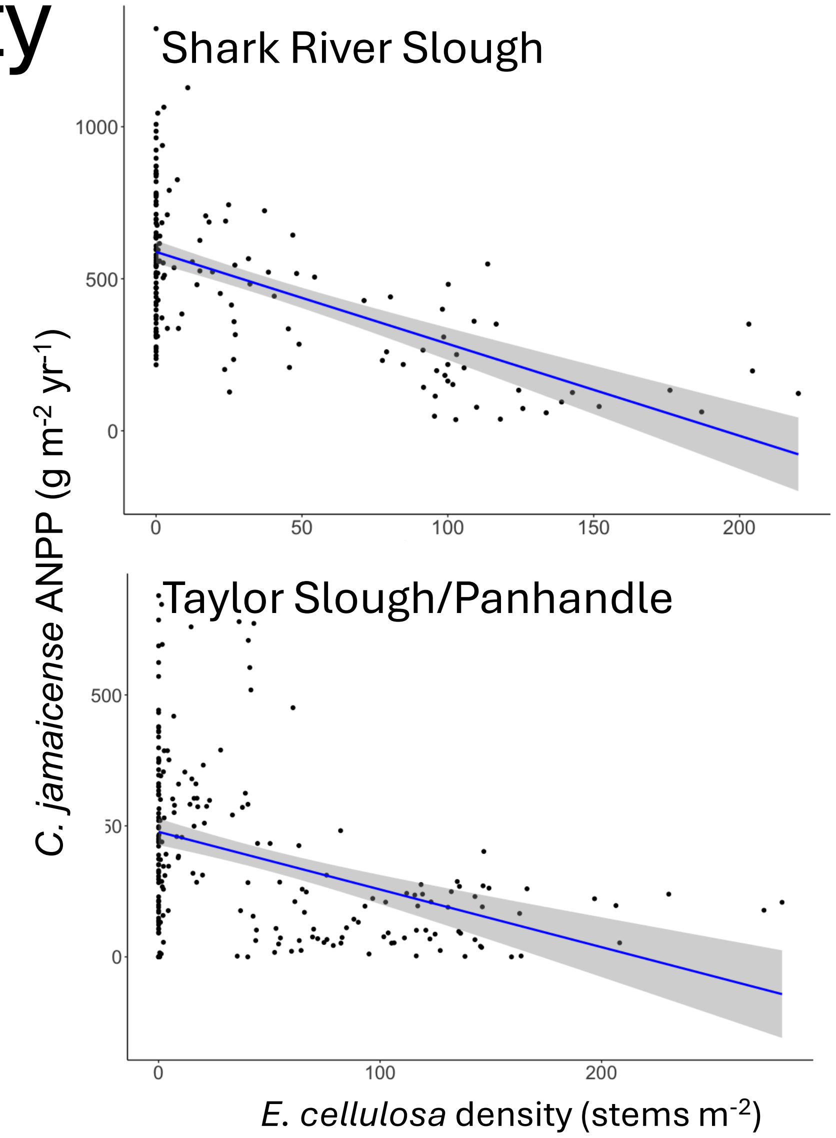
SRS-1:
y = 324 + 6.29x, $R^2 = 0.30$, $p < 0.05$
SRS-2:
y = 627 - 2.69x,$R^2 = 0.06$, $p = 0.37$
SRS-3
y = 551 - 1.71x, $R^2 = 0.02$, $p = 0.64$

TS/Ph-1:
y = 350 - 11.7x, $R^2 = 0.43$, $p < 0.01$
TS/Ph-2:
y = 334 - 3.75x, $R^2 = 0.64$, $p < 0.001$
TS/Ph-3:
y = 598 - 18.6x, $R^2 = 0.70$, $p < 0.001$
TS/Ph-6:
y = 510 – 5.03x, $R^2 = 0.07$, p = 0.14



Inverse Relationship Between Sawgrass ANPP and *E. cellulosa* Density





Conclusions

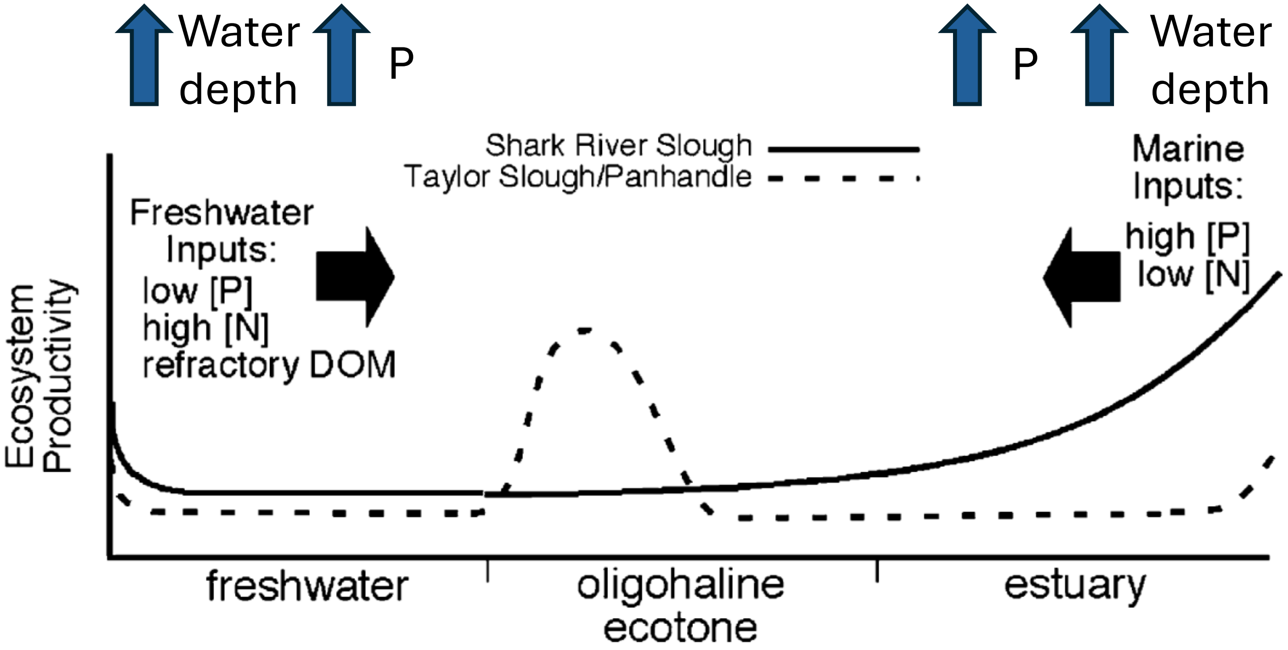
Increased water depths affect marsh productivity differently in short- and long-hydroperiod wetlands

Disturbance legacies (e.g., drought and saltwater intrusion) can increase sawgrass ANPP in freshwater and oligohaline marshes

Wetter conditions from restoration are leading to more hydric species

Broader Impacts

How have ***increasing phosphorus*** *and* ***water depths*** *from freshwater restoration and sea level rise* ***altered productivity gradients*** *along freshwater to oligohaline marshes?*



Establish a new baseline for understanding how changing hydrologic and nutrient gradients interact to drive productivity in wetland systems

Improve predictions of vegetation responses to restoration under climate change and sea level rise

Inform adaptive management strategies in the face of accelerating environmental change

Acknowledgments

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