Hydrologic restoration of a shallow oligotrophic marl wetland.

What is the soil Telling us?

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Acknowledgements

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FCE LTER

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EVERGLADES FOUNDATION

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Capt. Terry "who's flying this thing anyway?" Jones

Aircoastal Helicopters

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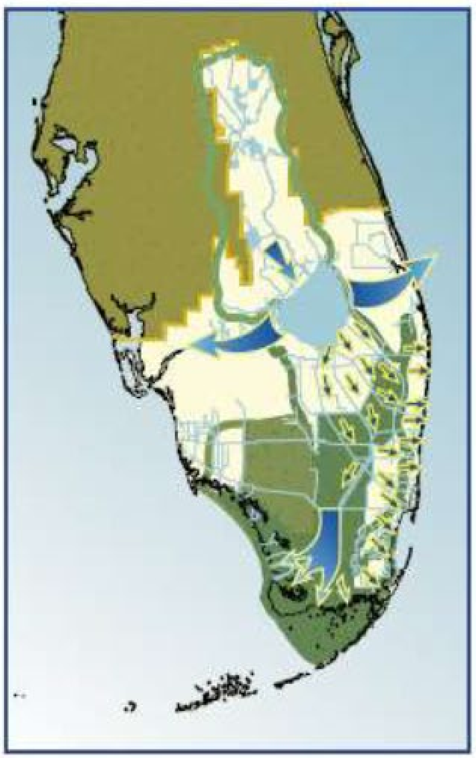
Restoration

Everglades restoration will enable the right quantity of water, at the right quality, to be distributed to the right place, at the right time throughout south Florida.

This will be accomplished through the implementation of multiple projects that will work together to provide:

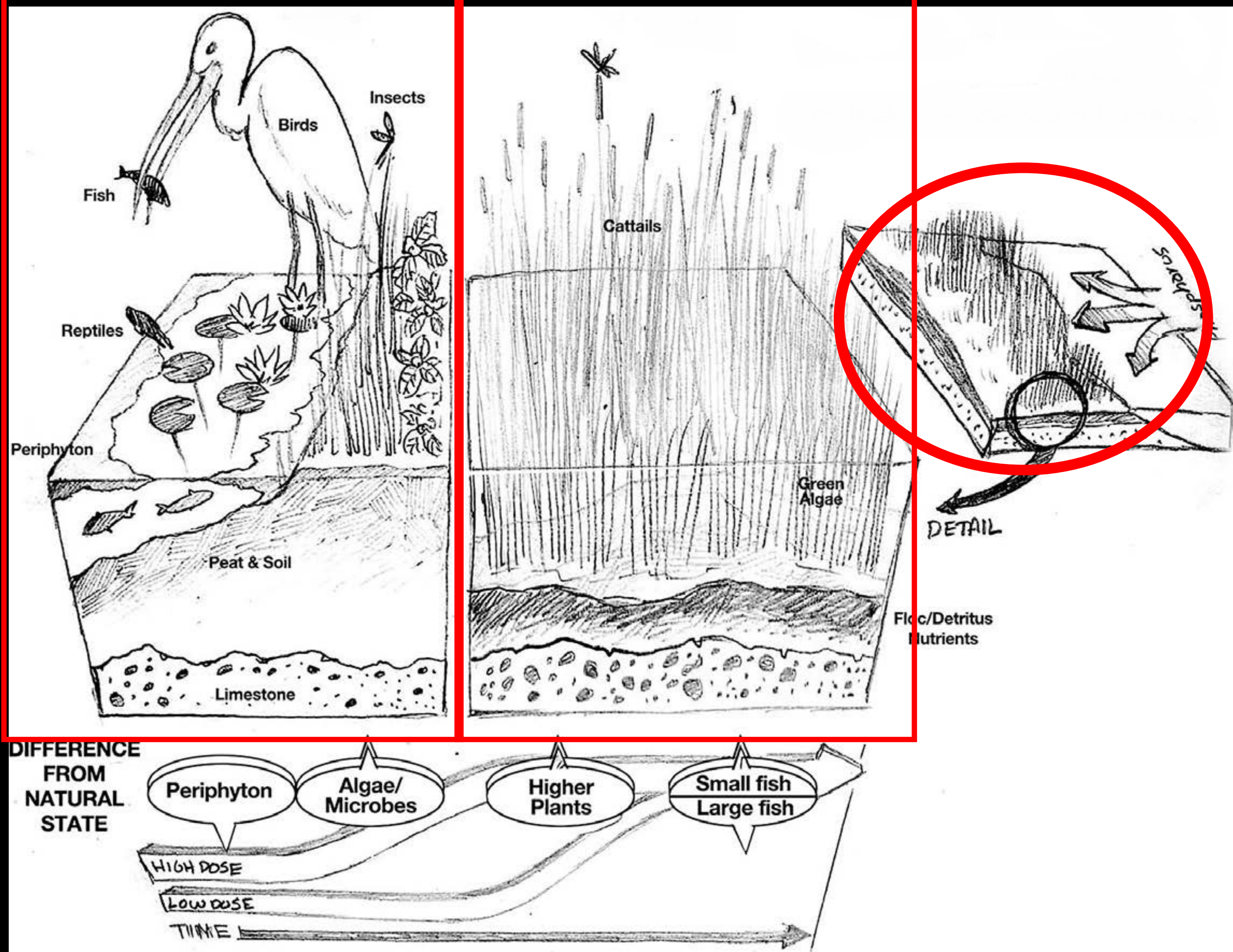
- Water Storage
- Water Treatment
- Water Conveyance
- Water Distribution



Current Flow

Restored Flow

Natural/Restored | Disturbed

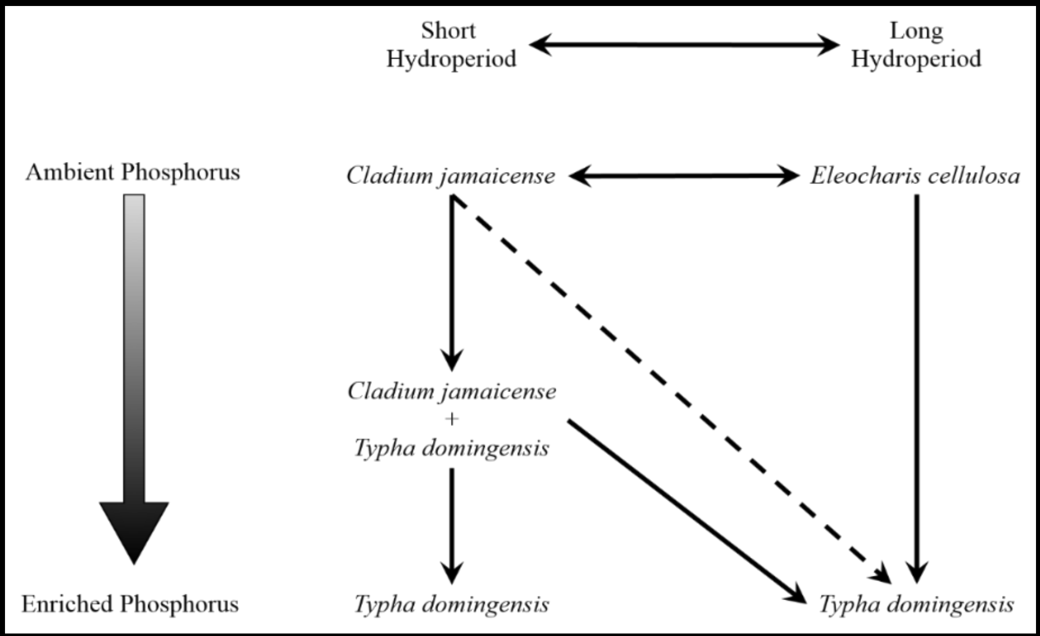


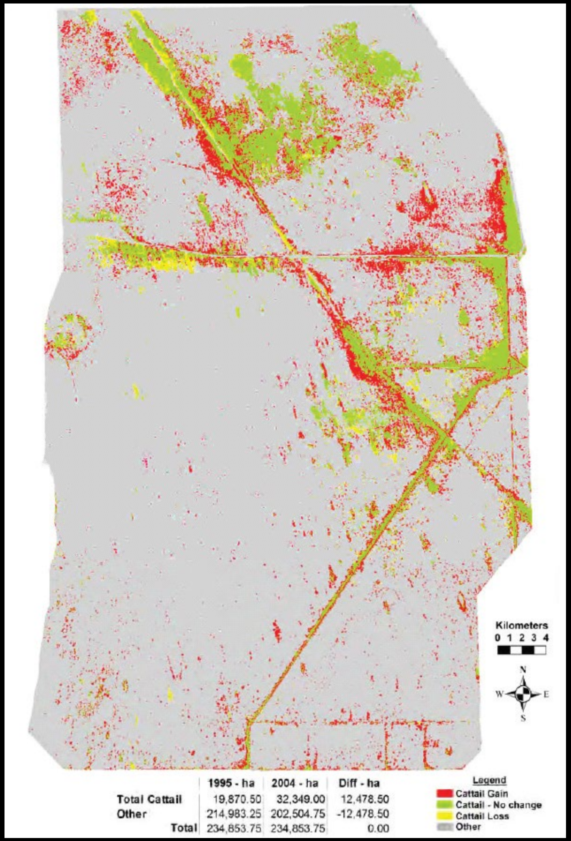
Borkhataria et al (2017) The Synthesis of Everglades Restoration and Ecosystem Services (SERES): a case study for interactive knowledge exchange to guide Everglades restoration. Restoration Ecology 25:S18–S26.

Ecosystem assessment - Soils

- Soils are an integrator of long-term water chemistry conditions
- Nutrient inputs to wetlands primarily stored in soils
- Spatial distribution of soil nutrients can be used to assess long-term nutrient impacts
- Soils = ideal ecosystem component for assessing baseline condition

Eutrophication Metric
Vegetation





	1995 - ha	2004 - ha	Diff - ha
Total Cattail	19,870.50	32,349.00	12,478.50
Other	214,983.25	202,504.75	-12,478.50
Total	234,853.75	234,853.75	0.00

- Cattails (*Typa spp.*) are used as indicator species of eutrophication and disturbance.
- Respond to changes in water quality.
- … and hydrology.

Chen H, Mendelssohn IA, Lorenzen B, et al (2005) Growth and nutrient responses of Eloecharis cellulosa (Cyperaceae) to phosphate level and redox intensity. American Journal of Botany 92:1457–1466.

Sklar F, Dreschel T, Warren K (2011) Ecology of the Everglades Protection Area. 2011 South Fla. Environ. Rep.

Objective

- Evaluate soil nutrient and water quality changes in upper Taylor Slough during hydrologic restoration.

Hypotheses

- Soil nutrient concentrations will decrease due to hydrologic restoration.
- Water quality conditions will improve due to improved hydrology.

Pre 1994

- L-31W canal was constructed (1961 -1968).
- L-31W canal operated for water supply to Taylor Slough via gravity flow (1969-1980).
- S-332 pump stations installed South-Dade Conveyance System operation commenced (1981-1991).

1994

Increase in S-332 discharge capacity

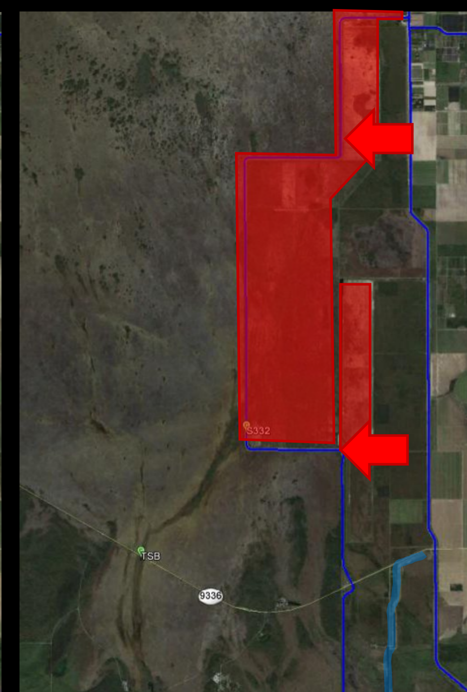
2001/2002

S-332 stopped ops.
D- Detention basin constructed

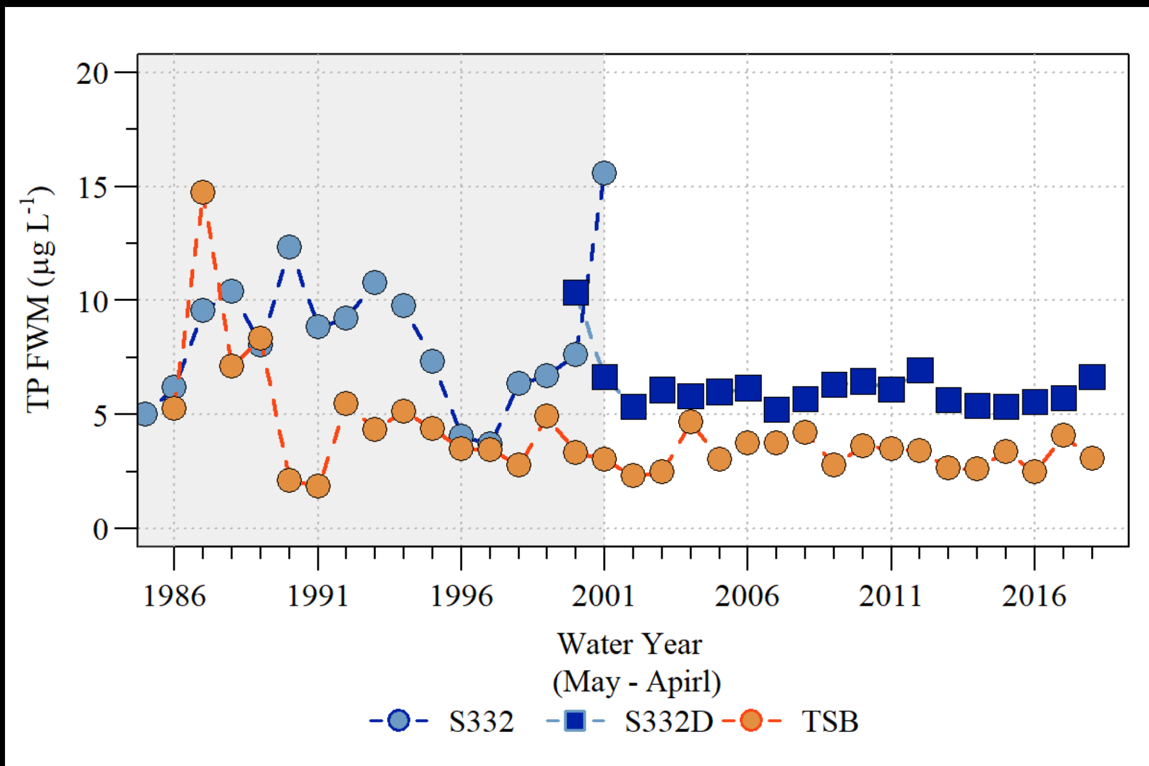
2014

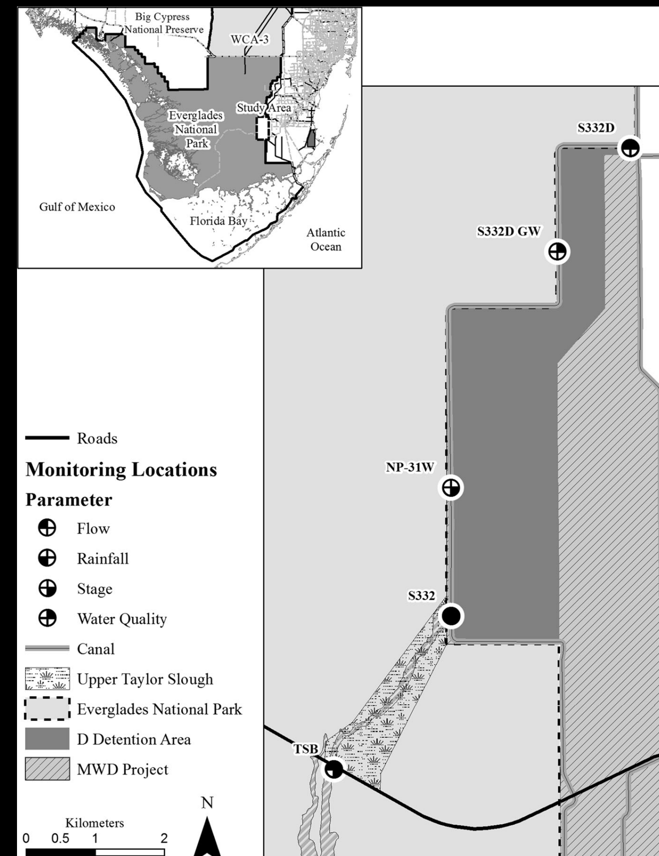
Improved Conveyance and storage

2016

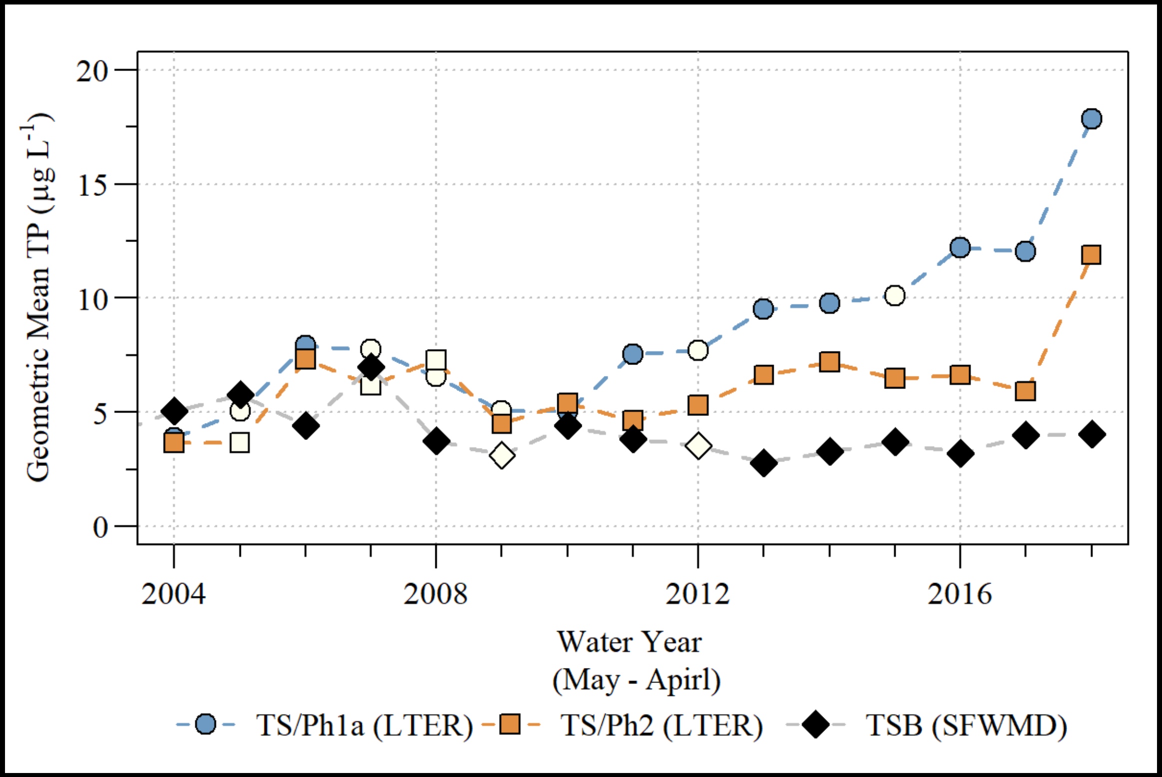


Canal plugging and structure construction and ops.





- Julian P (2017) Assessment of Upper Taylor Slough water quality and implications for ecosystem management in Everglades National Park. Wetlands Ecology and Management 25:191–209.
- Julian, *Unpublished Data*



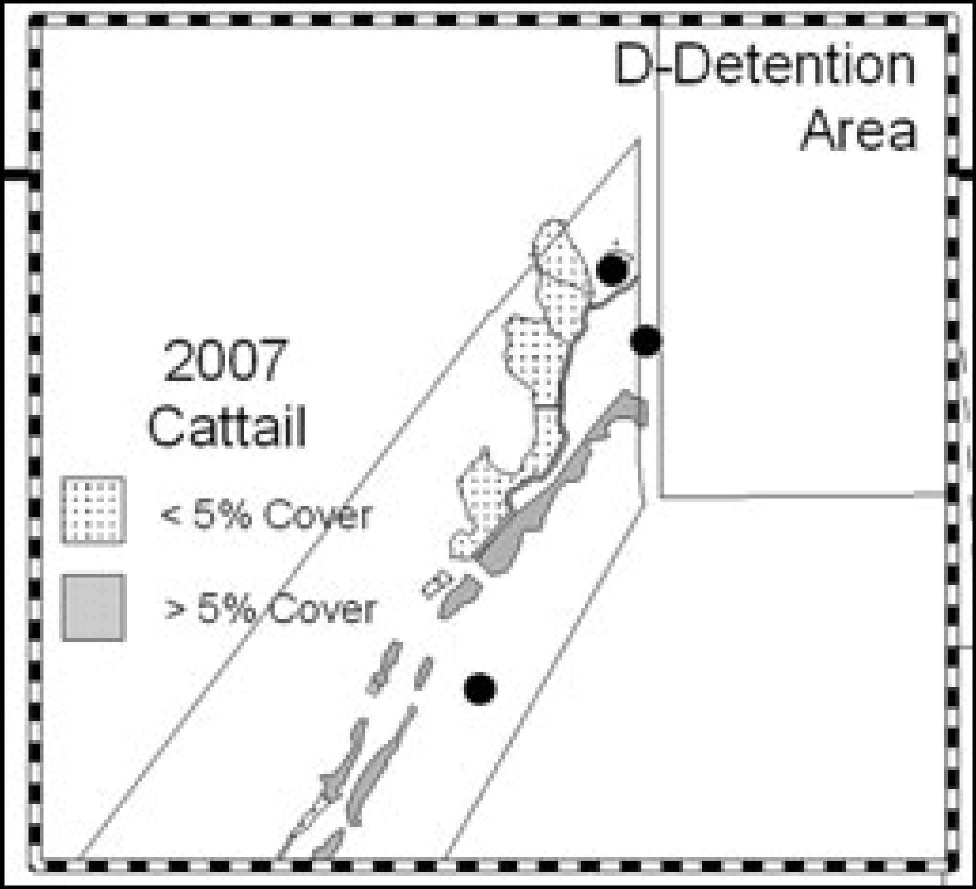
Solid points: >6 Samples Per Year (samples in wet and dry season)

Empty Points: <6 Samples Per Year (unequal samples between seasons).

Julian, *Unpublished Data*

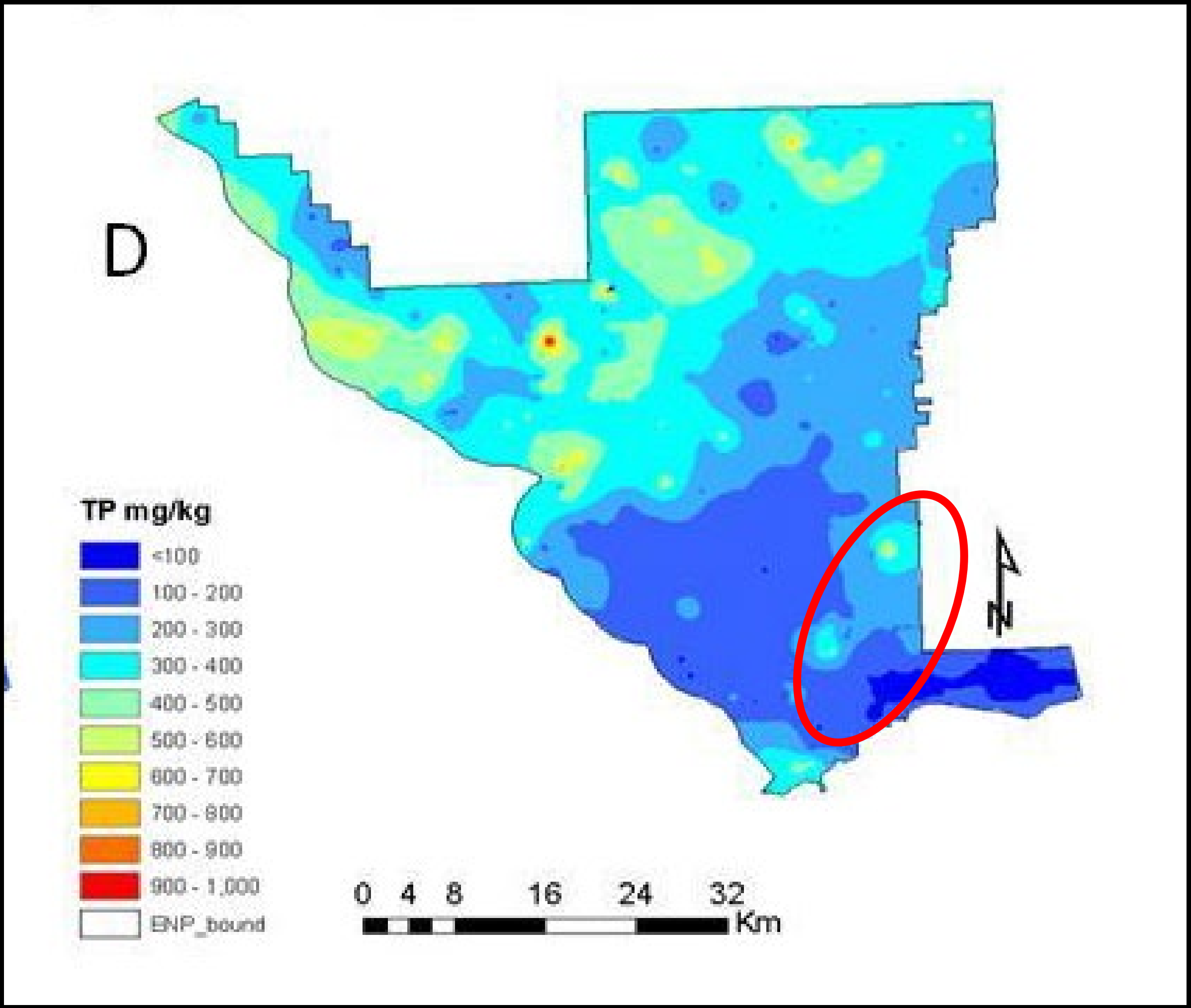
Year	Aerial Imagery Coverage
1994	No cattail detected
1999	No cattail detected
2004	~ 8.1 ha
2007	~ 5.7 ha (field data)
2009	~ 7.9 ha

Sadle 2008; Surratt et al 2012



- Surratt et al. (2012) Recent Cattail Expansion and Possible Relationships to Water Management: Changes in Upper Taylor Slough (Everglades National Park, Florida, USA). Environmental Management 49:720–733
- Sadle J (2008) Summary of cattail encroachment in Taylor Slough. South Florida Natural Resource Center, Homestead, FL

2003



Soil TP (mg kg^{-1}) Everglades National Park

Statistic	Value
Mean	362
Min	54
Max	628
SD	87
N	310
>500 mg kg^{-1}	7%

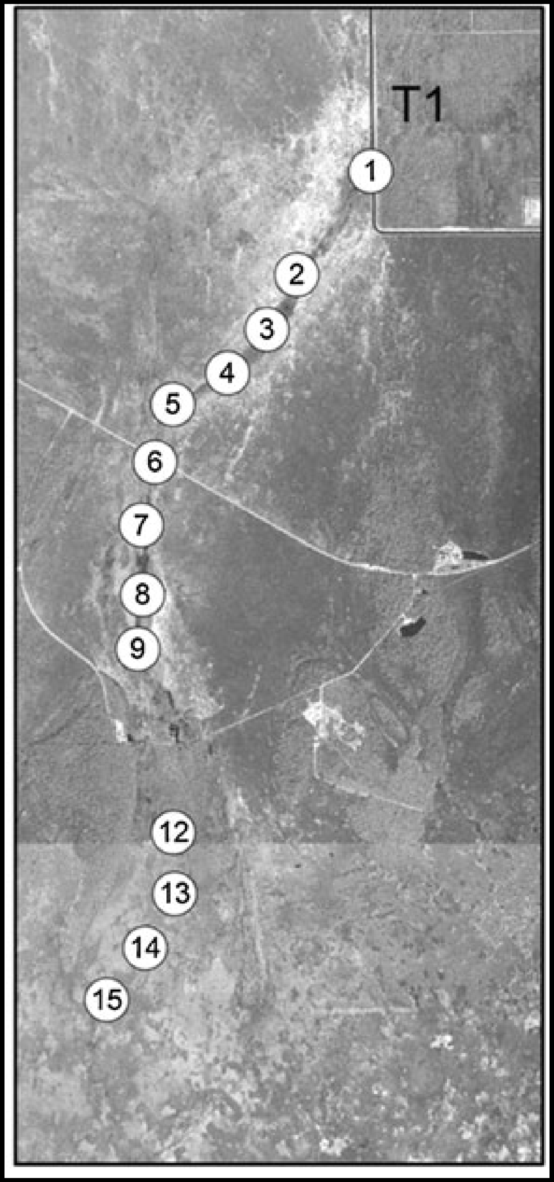
Osborne et al (2011) Spatial distributions and eco-partitioning of soil biogeochemical properties in the Everglades National Park. Environmental Monitoring and Assessment 183:395–408.

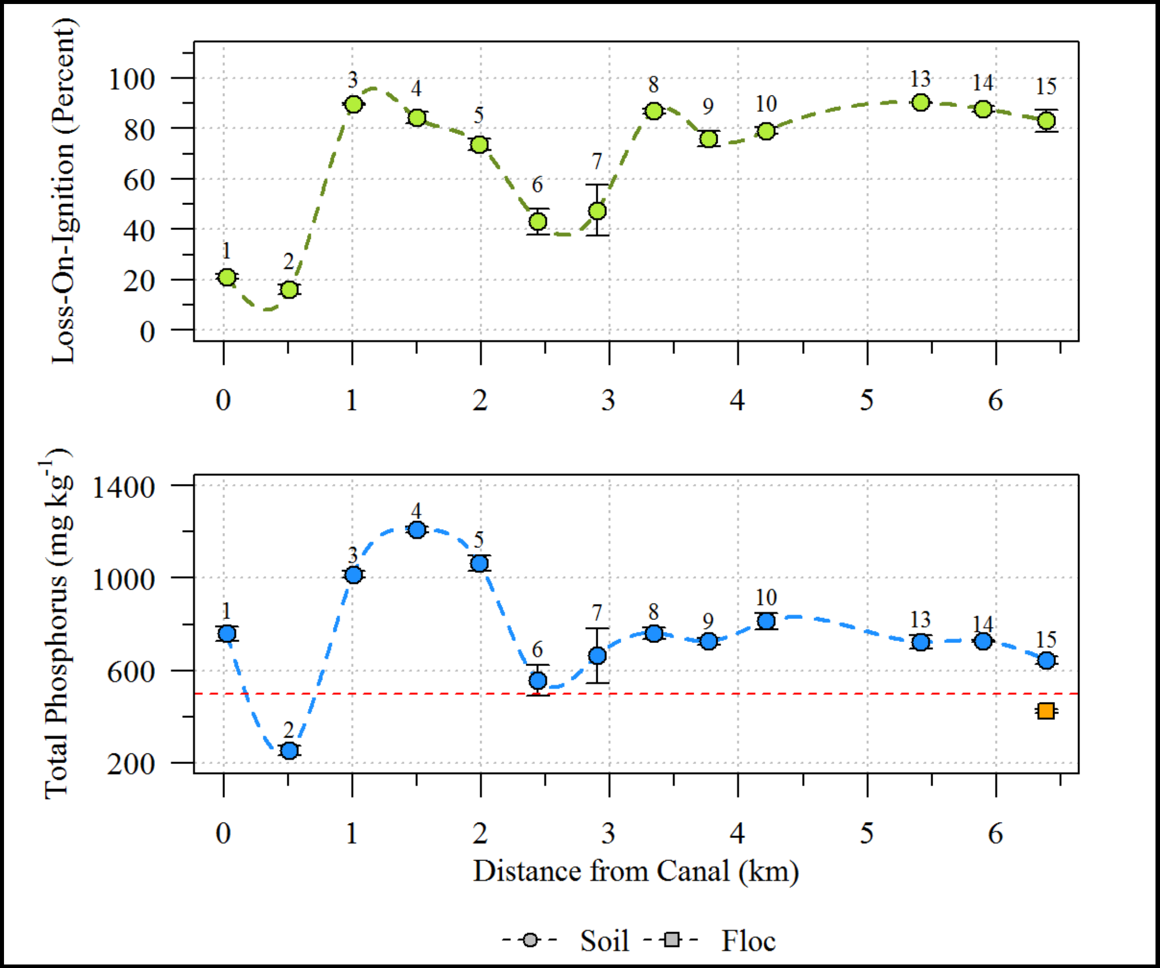
- Numerous regional monitoring efforts did not detect eutrophication and cattail occurrence in UTS.

- First cattail observation in UTS approx. 2004

- Surface water TP concentrations in UTS are relatively low.
  - Inflow annual FWM < 10 $\mu g\ L^{-1}$ for the last 15 years
  - Downstream marsh (i.e. TSB and TS/Ph2) < 10 $\mu g\ L^{-1}$

2007

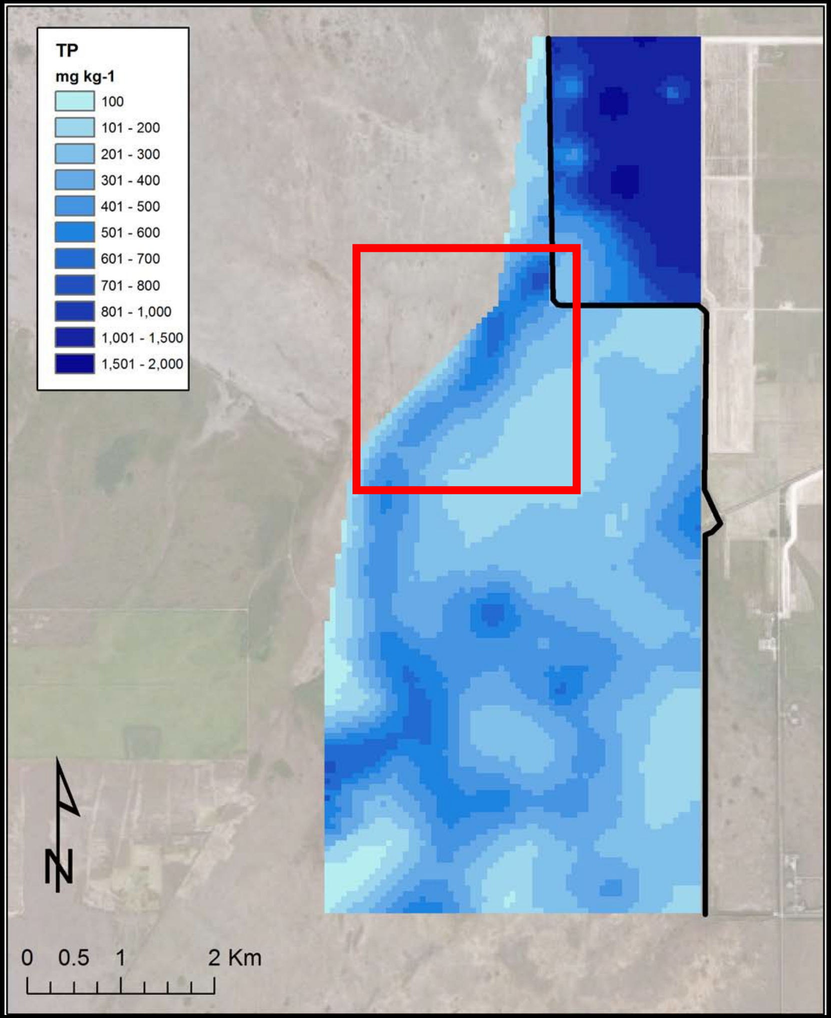




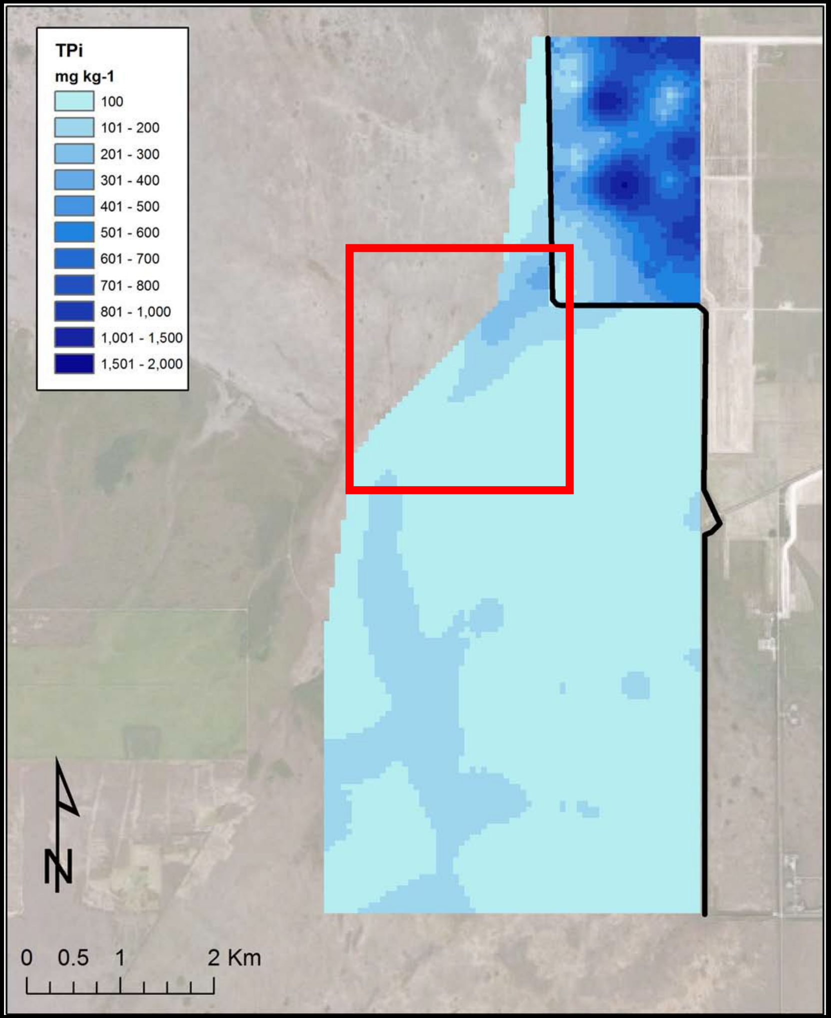
Osborne et al (2014) Evidence of Recent Phosphorus Enrichment in Surface Soils of Taylor Slough and Northeast Everglades National Park. Wetlands 34:37–45.

2012

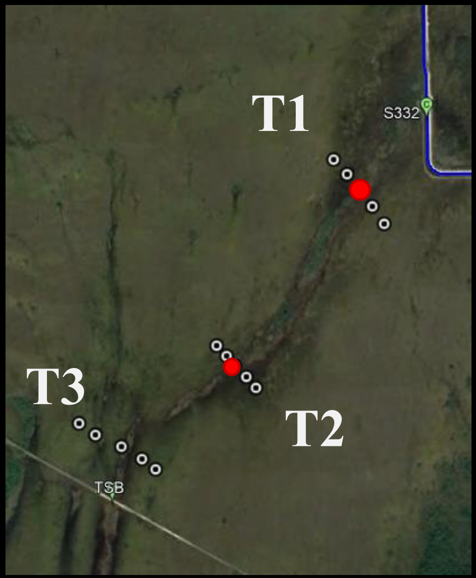
Total Phosphorus

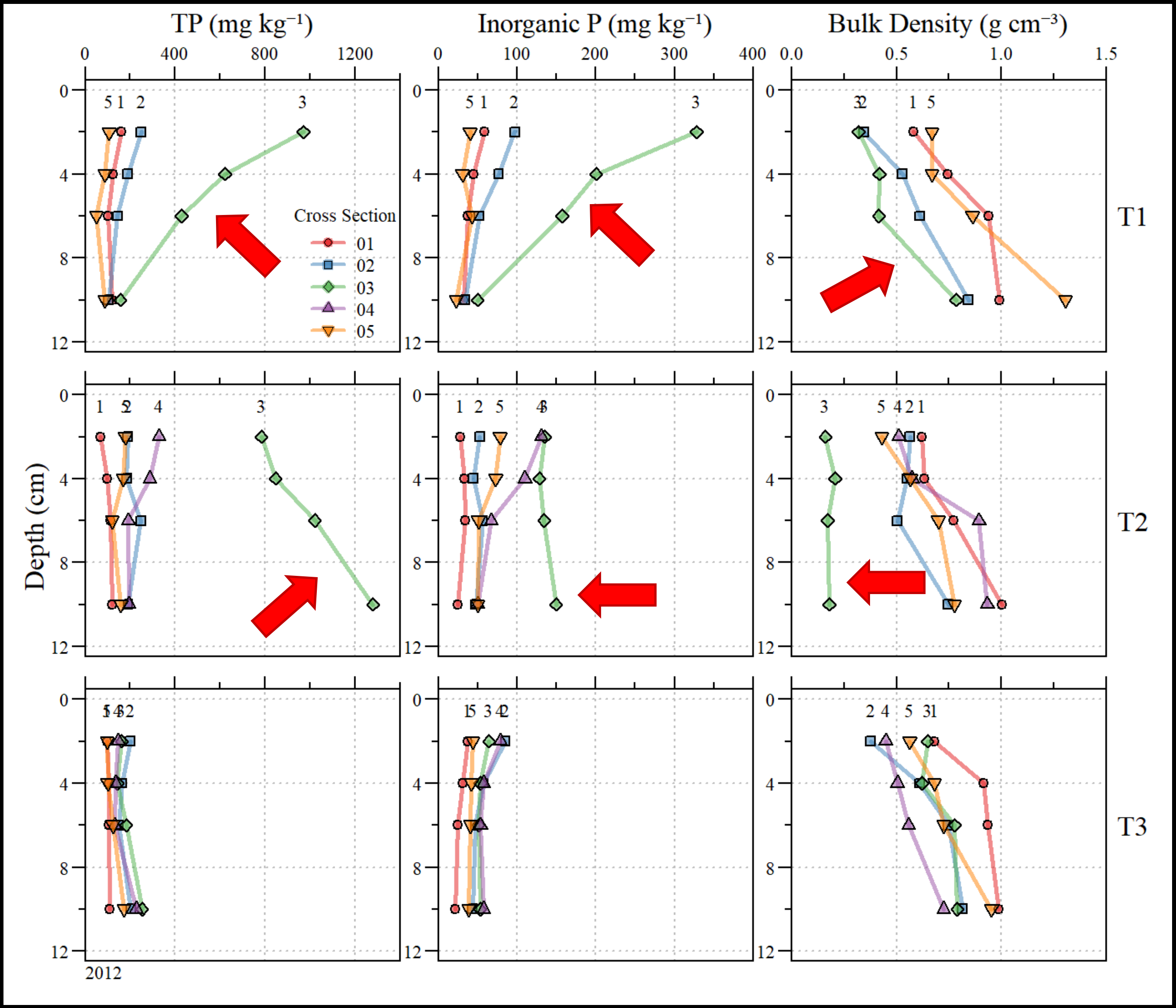


Inorganic Phosphorus



Osborne and Ellis (2015) Monitoring of Phosphorus Storage in Park Marsh Land Sediments: An assessment of the C-111 Spreader Canal Project. National Park Service, Everglades National Park





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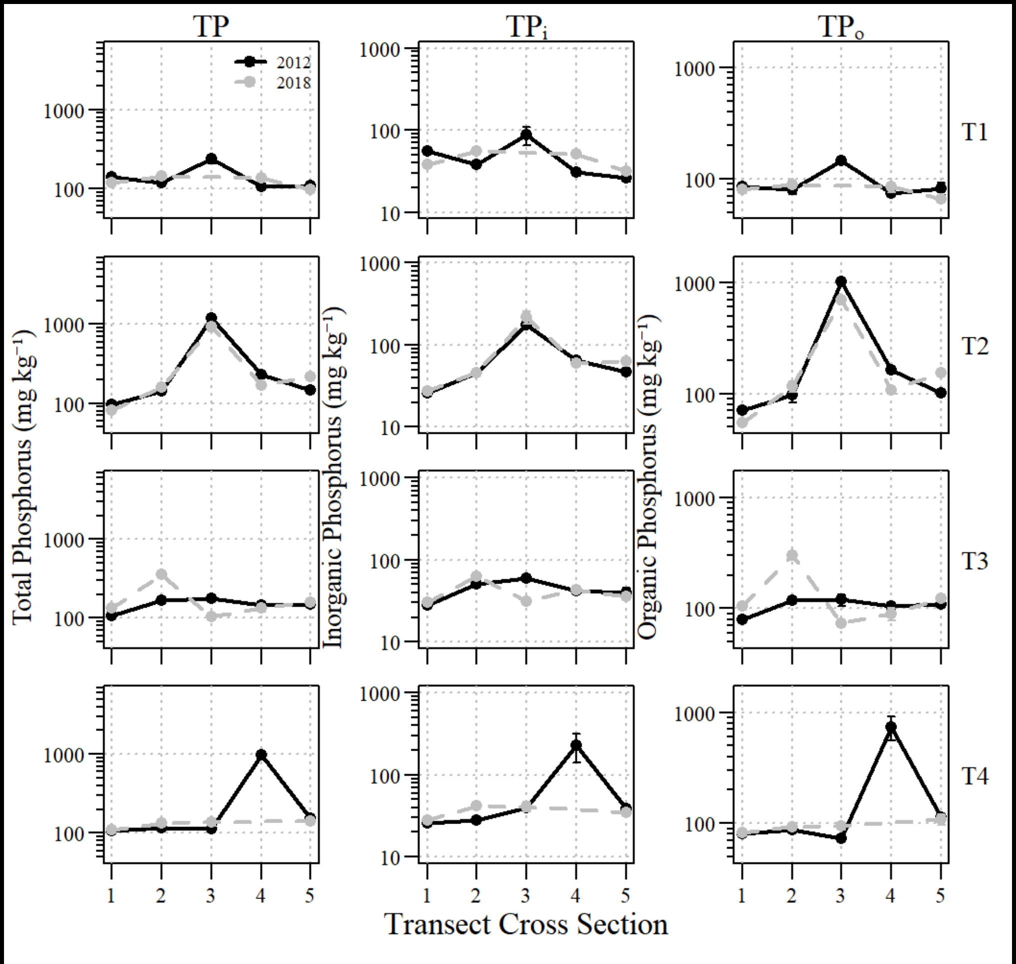
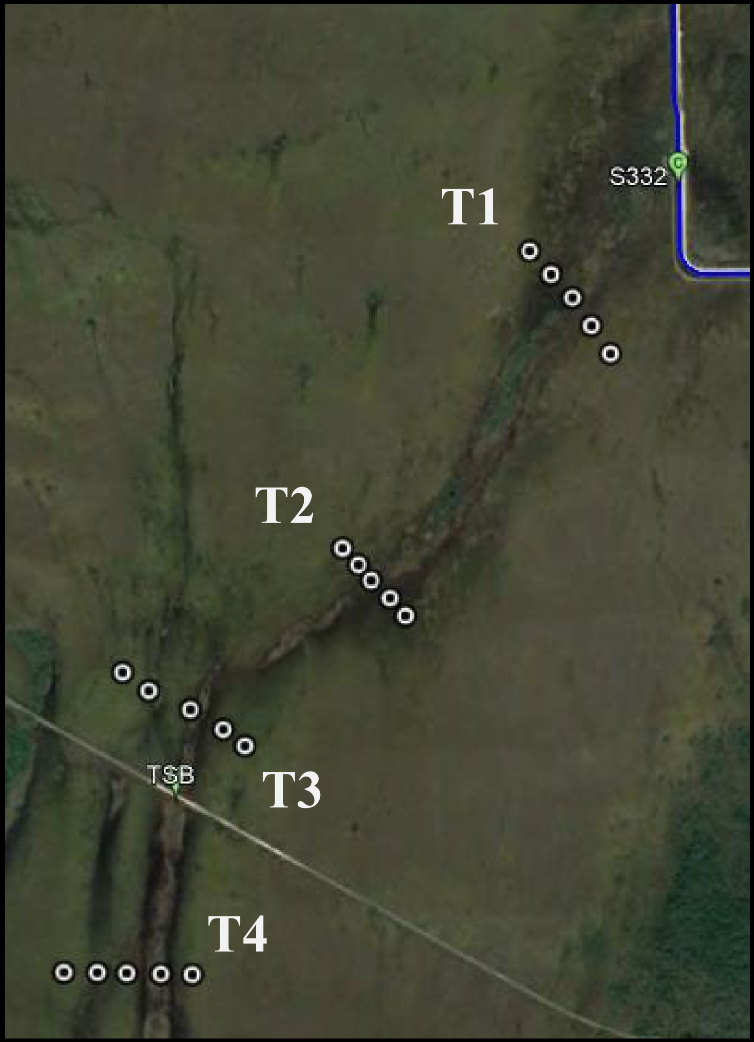
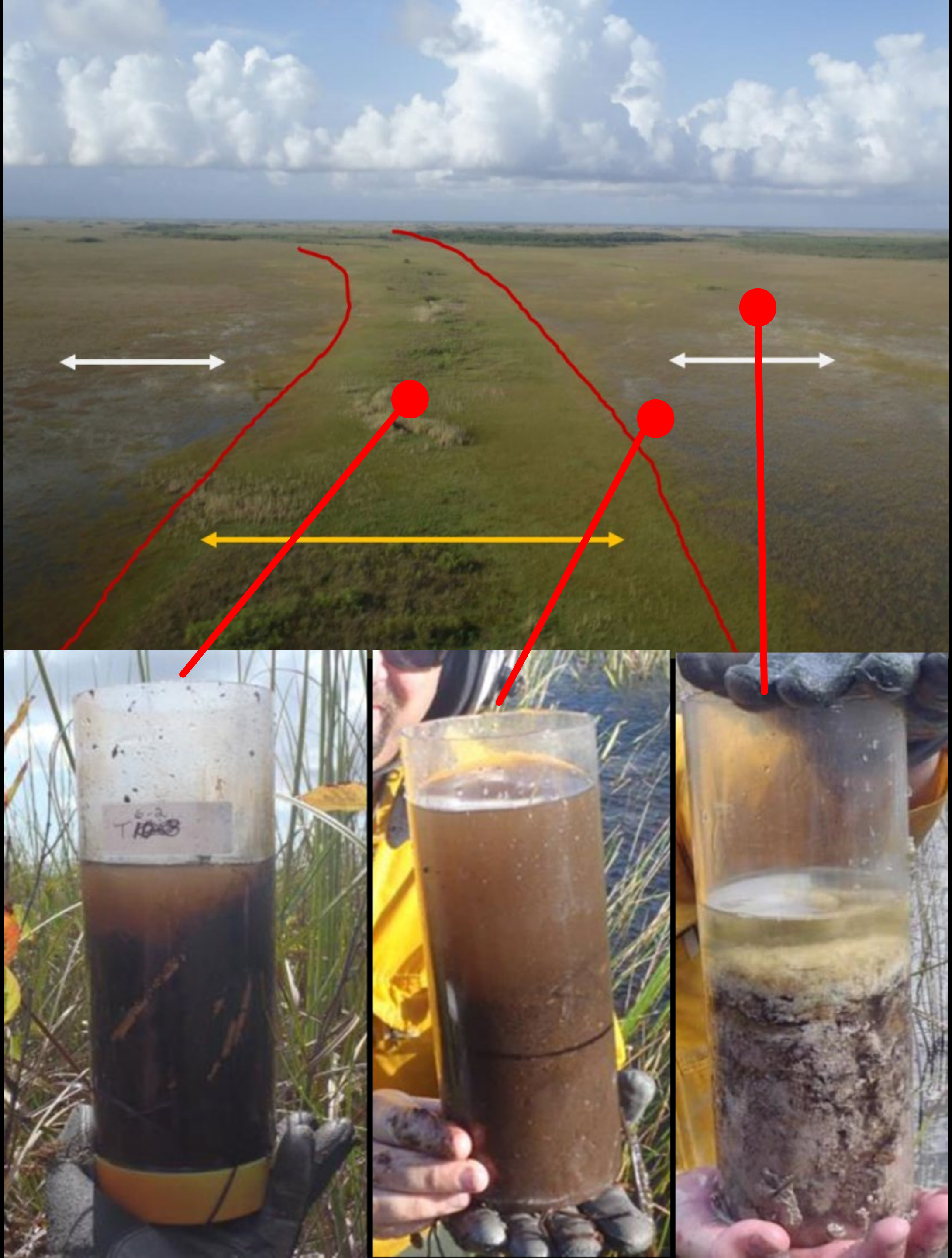


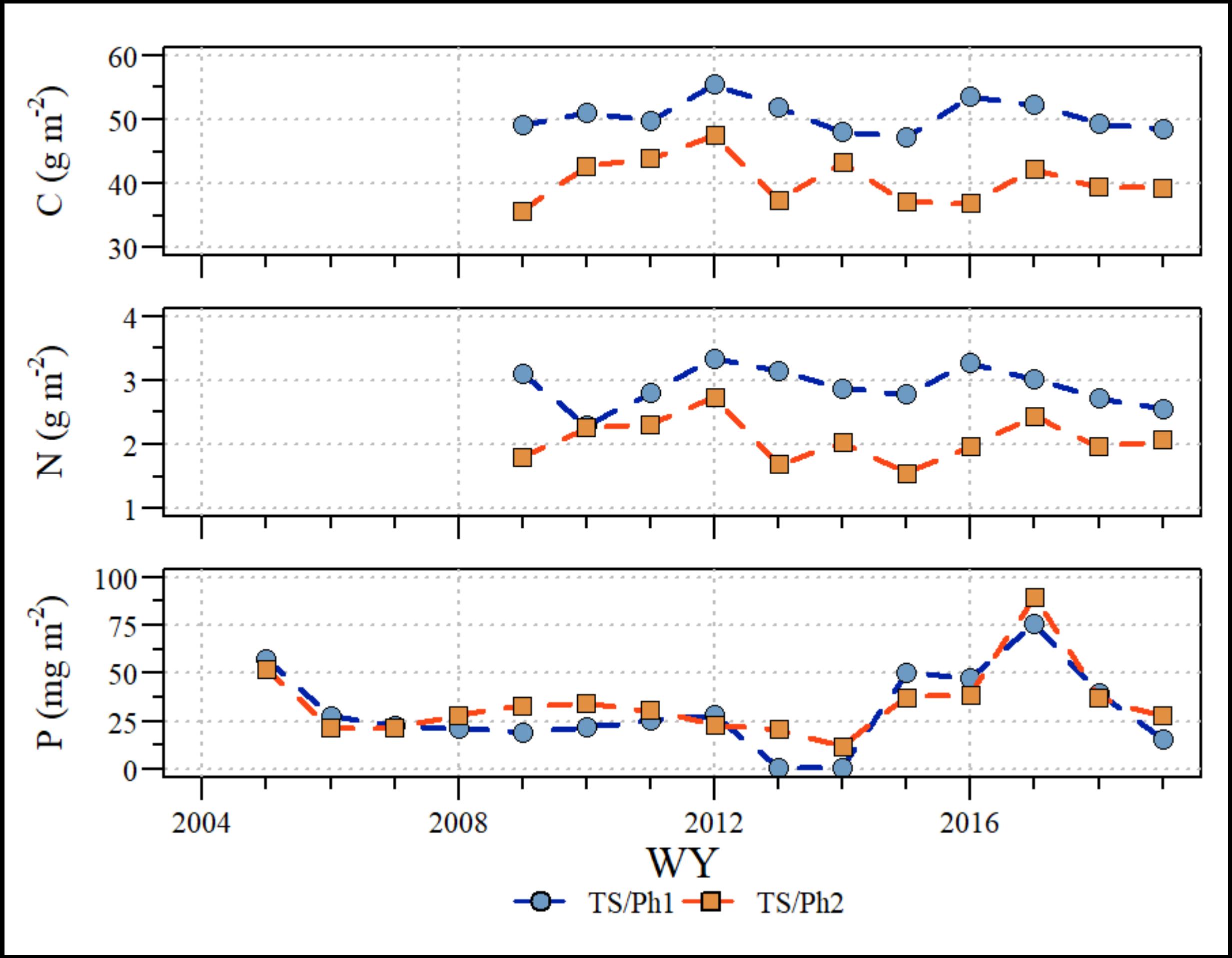


*Note change in scales between TP, TP$_i$ and TP$_o$.

August, *Unpublished Data*



FCE LTER Soil Time-series

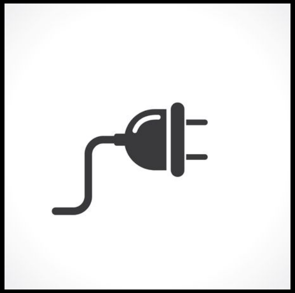


Date Sources:

- Chambers R, Russell T (2018a) Percentage of Carbon and Nitrogen of Soil Sediments from the Shark River Slough, Taylor Slough and Florida Bay within Everglades National Park (FCE) from August 2008 to Present.
- Chambers R, Russell T (2018b) Physical and Chemical Characteristics of Soil Sediments from the Shark River Slough and Taylor Slough, Everglades National Park (FCE) from August 2004 to Present.

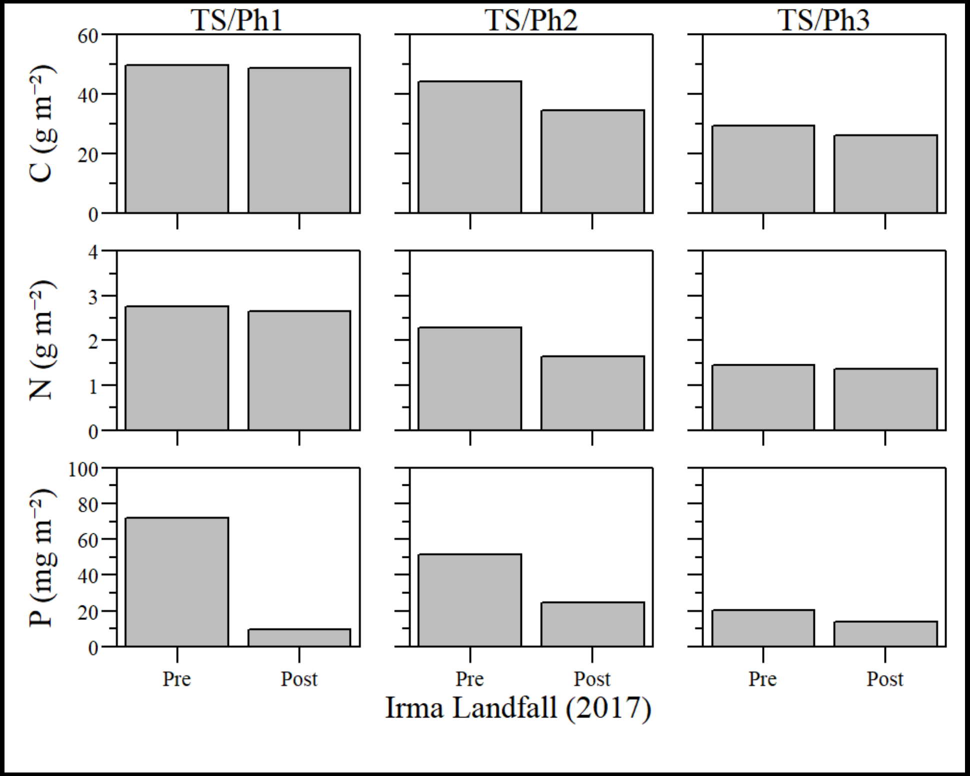
FCE LTER

FCE LTER Soil Time-series



Ongoing work

Data collected pre- and post- Irma landfall by FCE staff.



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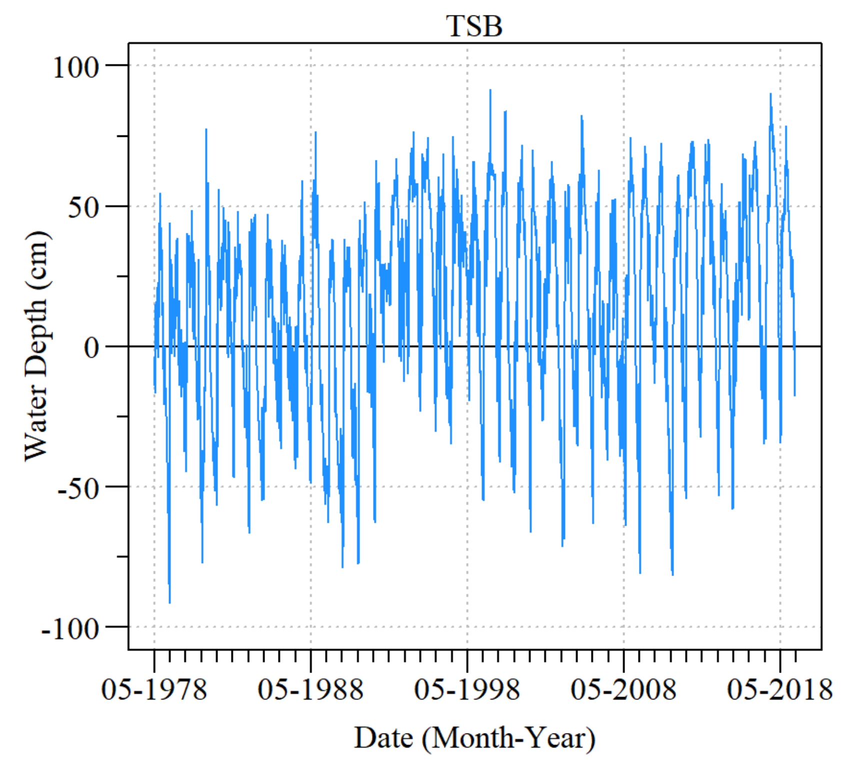
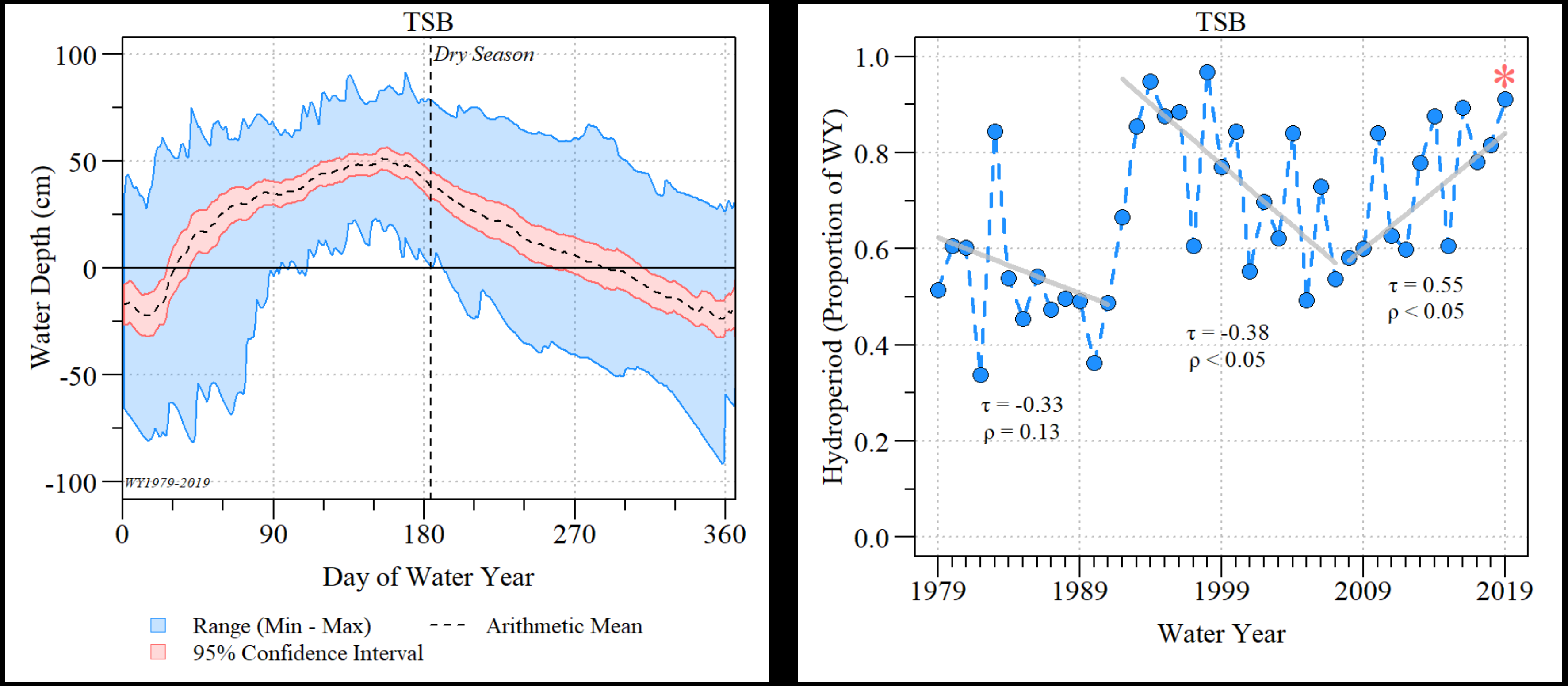
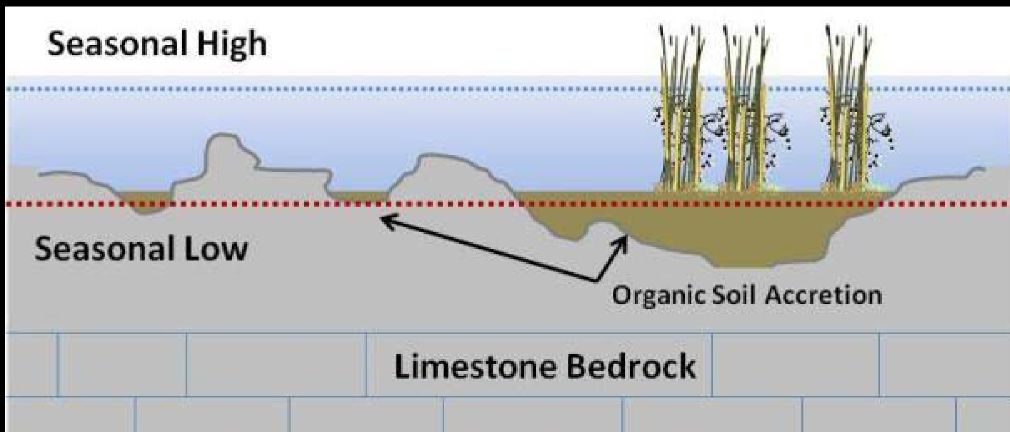
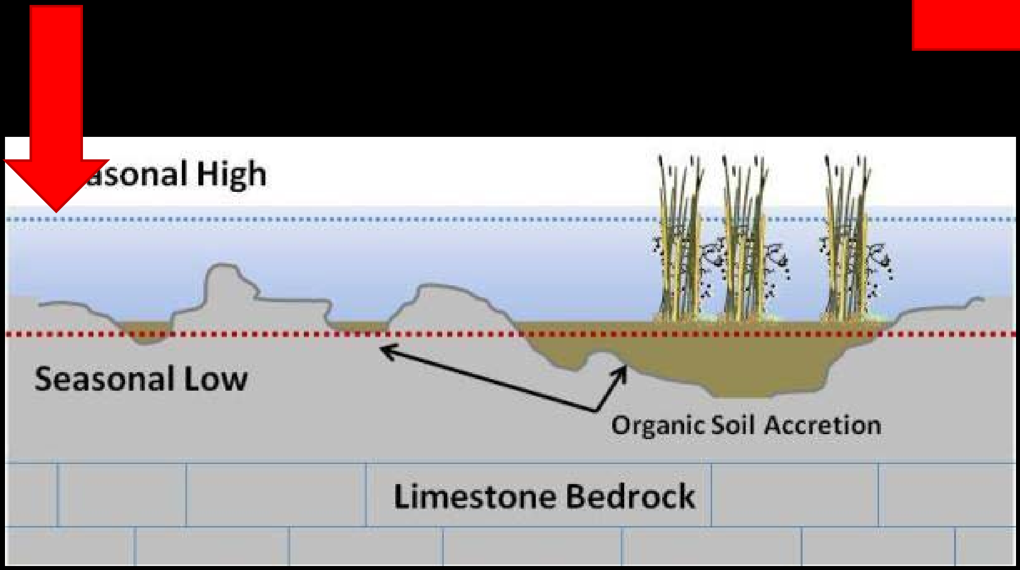
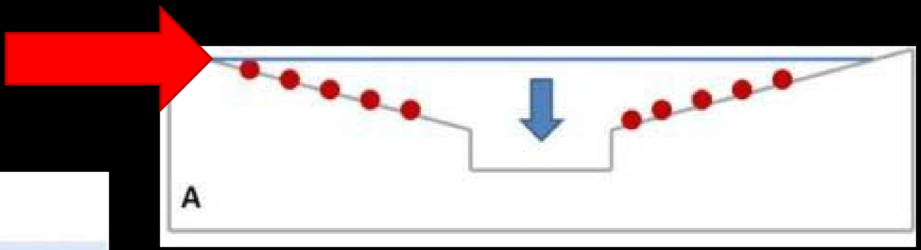
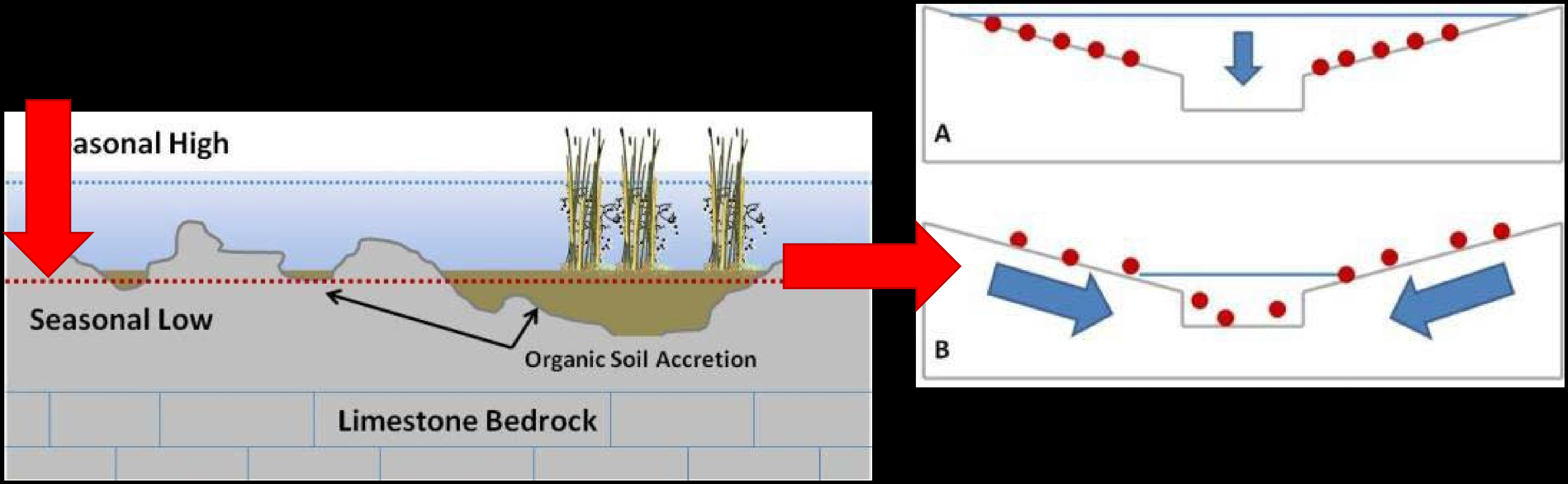

TSB
Water Depth (cm)
100
50
0
-50
-100
05-1978
05-1988
05-1998
05-2008
05-2018
Date (Month-Year)

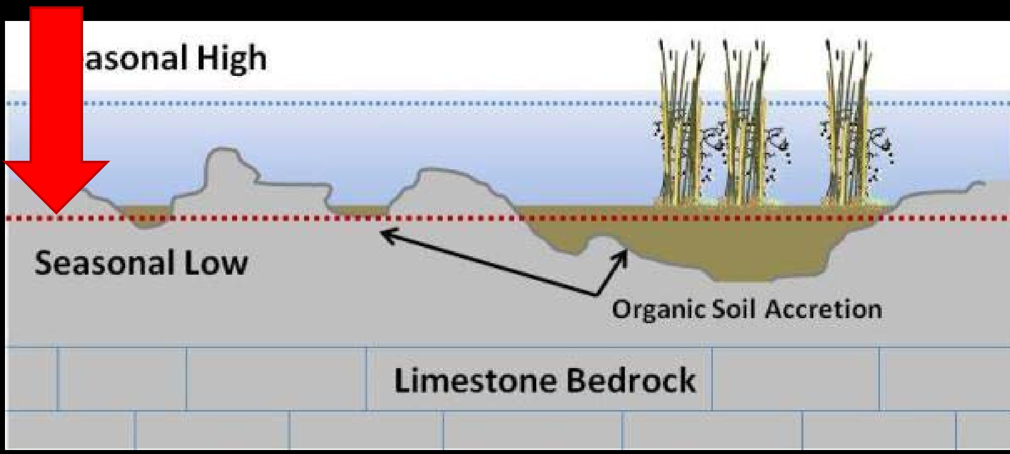

TSB
Dry Season
Water Depth (cm)
100
50
0
-50
-100
WY1979-2019
0
90
180
270
360
Day of Water Year
Range (Min - Max)
95% Confidence Interval
Arithmetic Mean
TSB
Hydroperiod (Proportion of WY)
1.0
0.8
0.6
0.4
0.2
0.0
τ = -0.33
ρ = 0.13
τ = -0.38
ρ < 0.05
τ = 0.55
ρ < 0.05
1979
1989
1999
2009
2019
Water Year


Seasonal High
Seasonal Low
Organic Soil Accretion
Limestone Bedrock

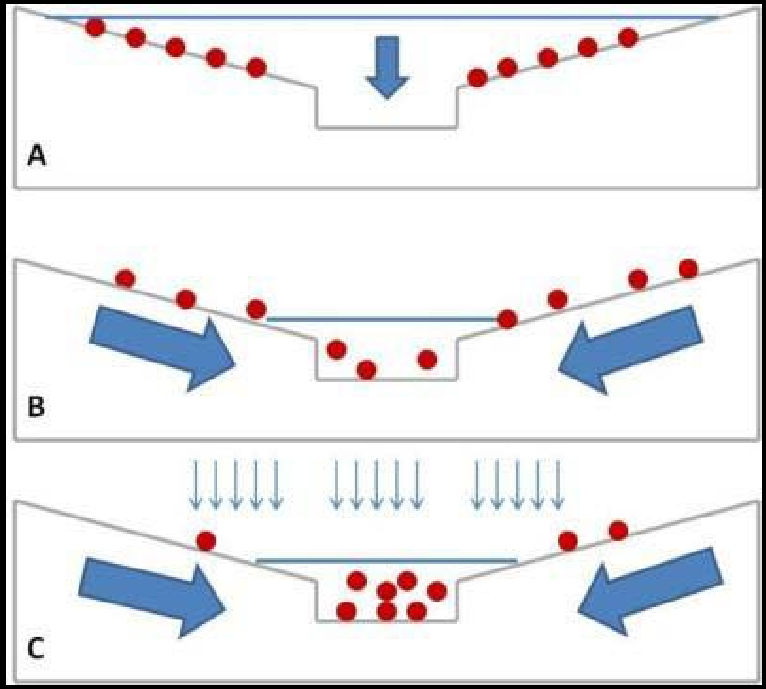

asonal High
Seasonal Low
Organic Soil Accretion
Limestone Bedrock


A

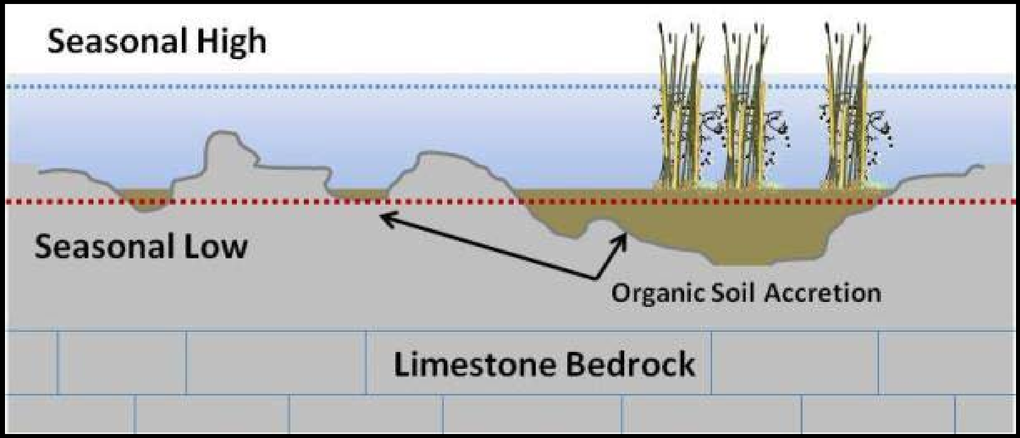

asonal High
Seasonal Low
Organic Soil Accretion
Limestone Bedrock
A
B

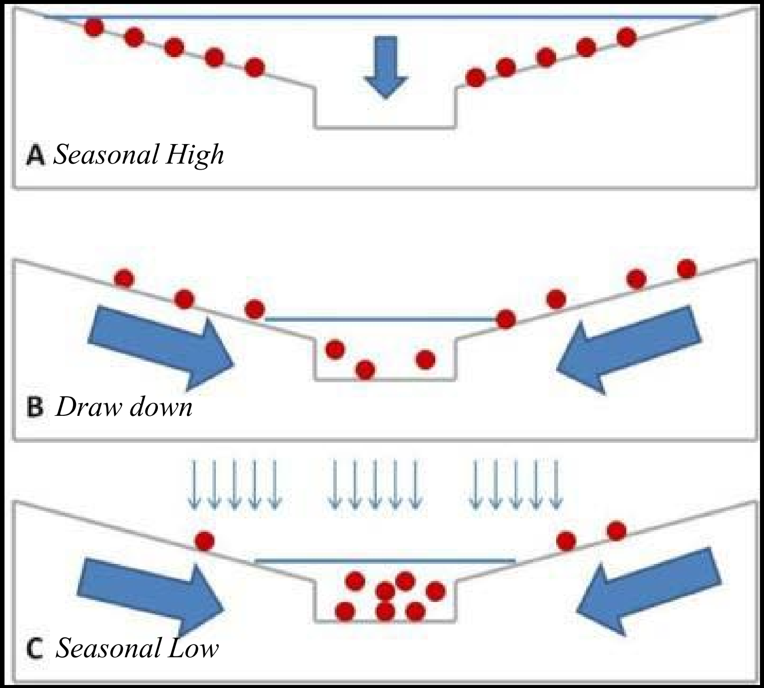


asonal High
Seasonal Low
Organic Soil Accretion
Limestone Bedrock



A
B
C


Seasonal High
Seasonal Low
Organic Soil Accretion
Limestone Bedrock


A Seasonal High
B Draw down
C Seasonal Low

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