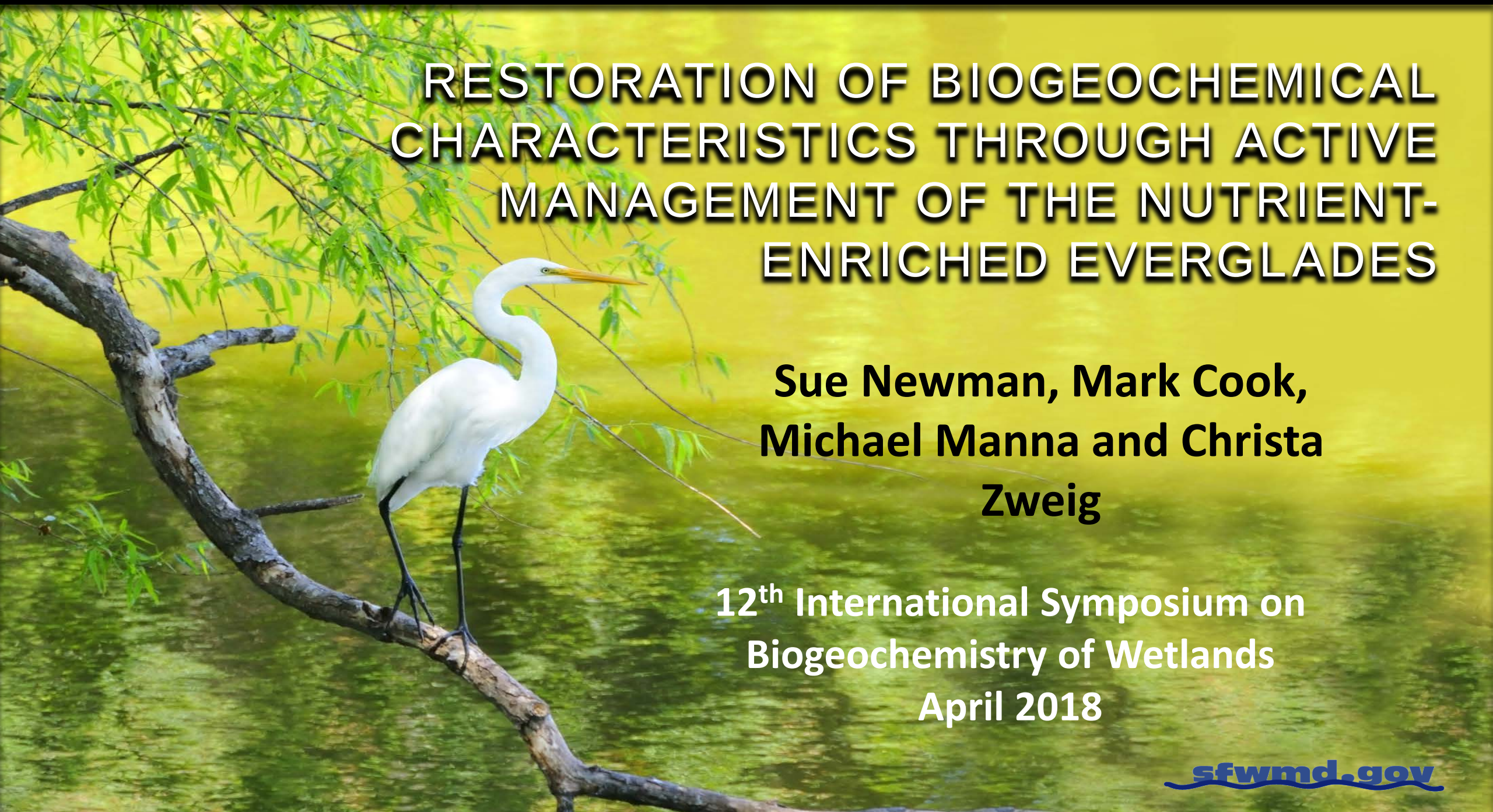

RESTORATION OF BIOGEOCHEMICAL CHARACTERISTICS THROUGH ACTIVE MANAGEMENT OF THE NUTRIENT-ENRICHED EVERGLADES

Sue Newman, Mark Cook, Michael Manna and Christa Zweig

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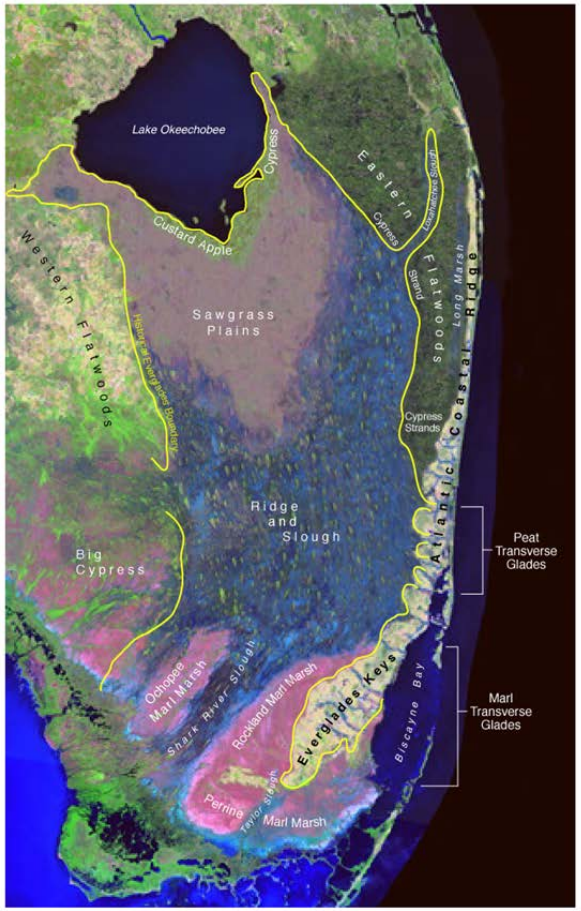
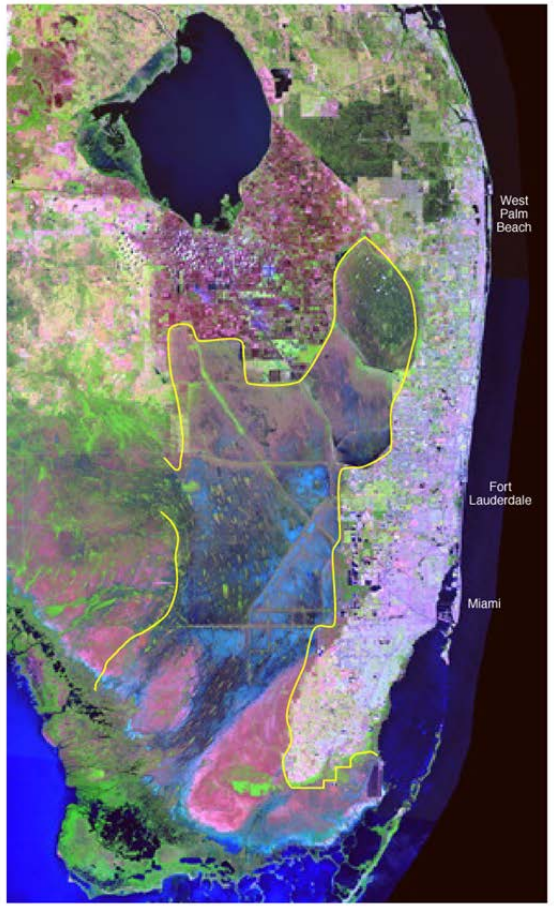
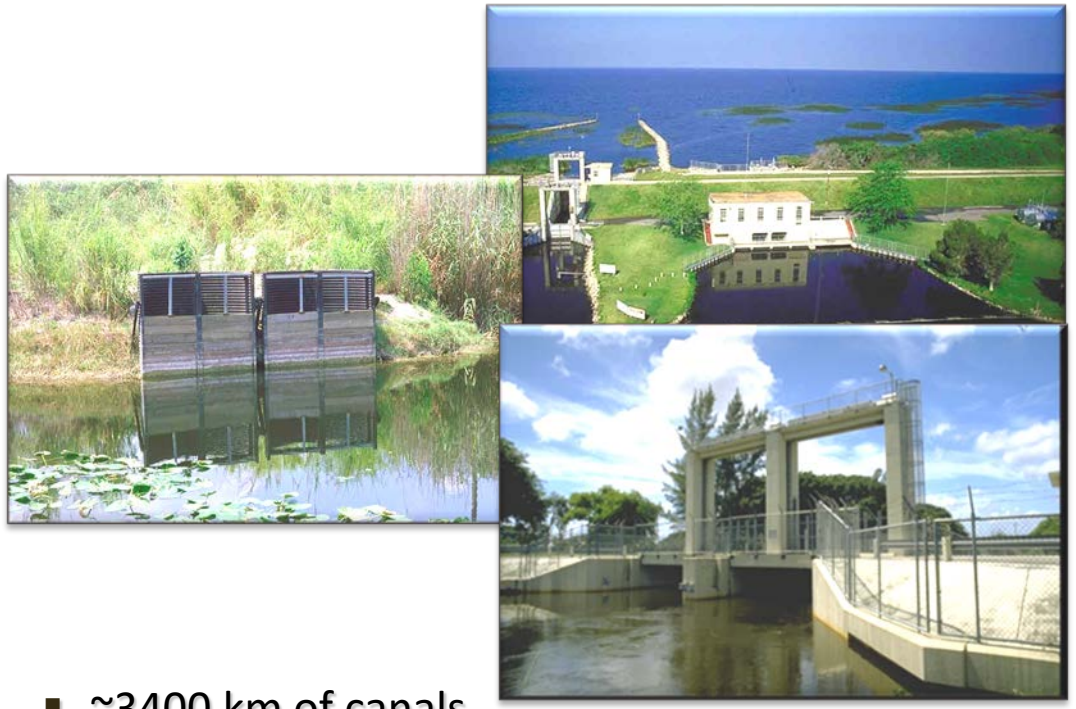
sfwmd.gov

Water Management System Components

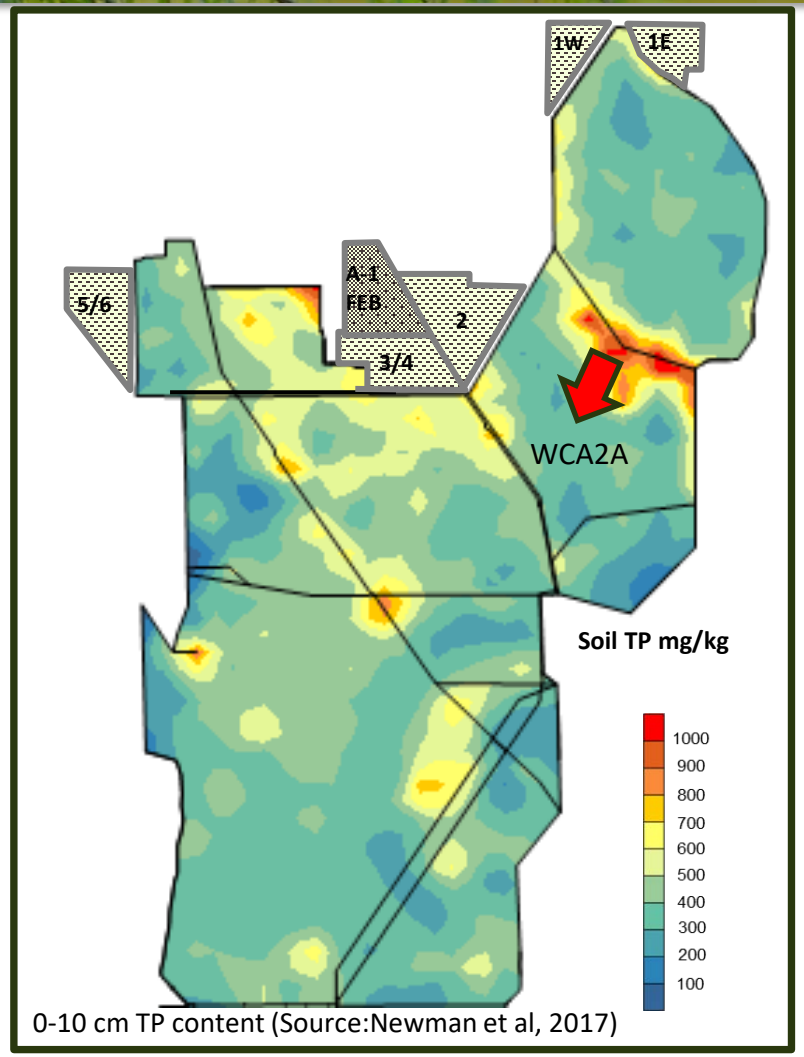






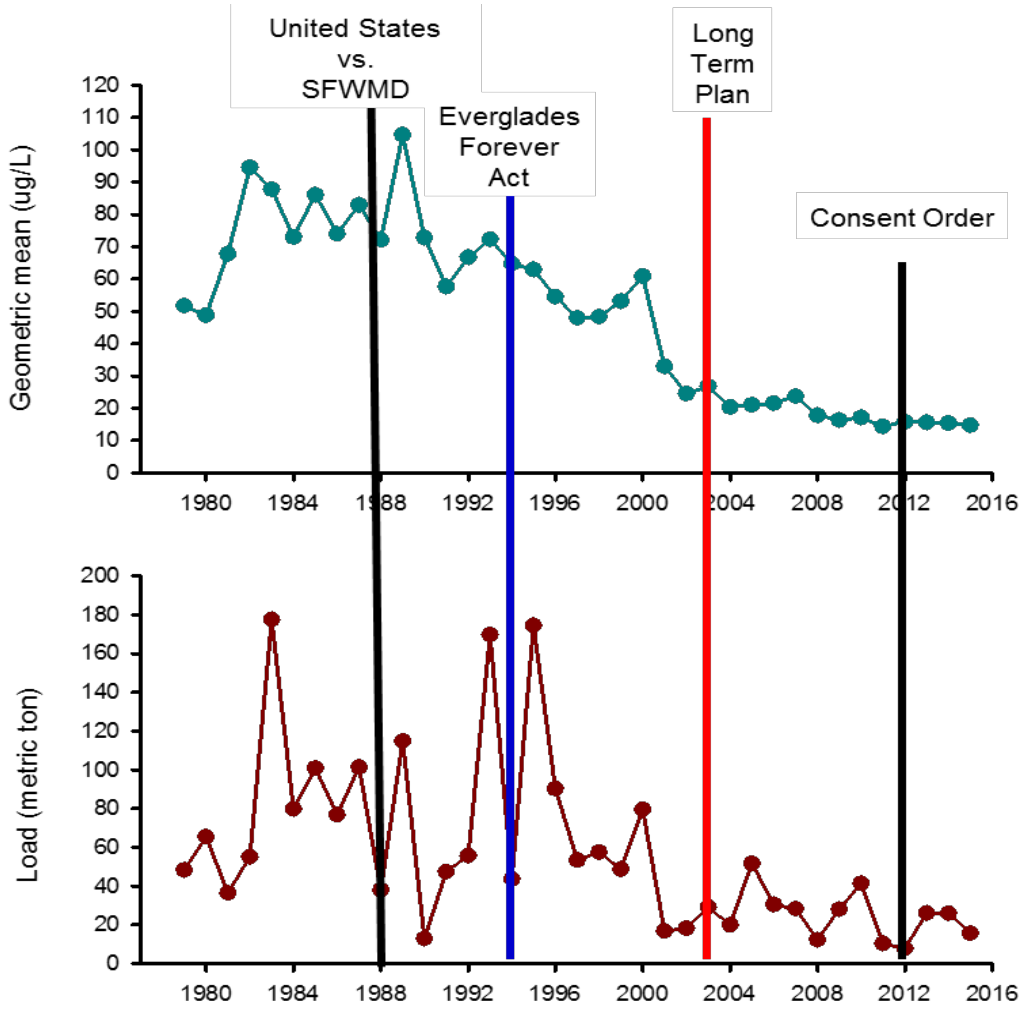
- ~3400 km of canals
- ~3200 km of levees/berms
- > 600 water control structures
- 71 pump stations

Phosphorus Enrichment



0-10 cm TP content (Source:Newman et al, 2017)

Loads and Concentrations into WCA2A



Downstream Resistant to Change

Soil TP > 1000 mg/kg
10% ash content

Unenriched Ridge and Slough

Soil TP 200-400 mg/kg
60-70 % ash content

Location:WCA2A

Active Management of Cattail- Jumpstart Restoration?

Hypothesis: Creating openings in P enriched areas will cause a shift from cattail-detrital dominated system, to one dominated by algae/SAV

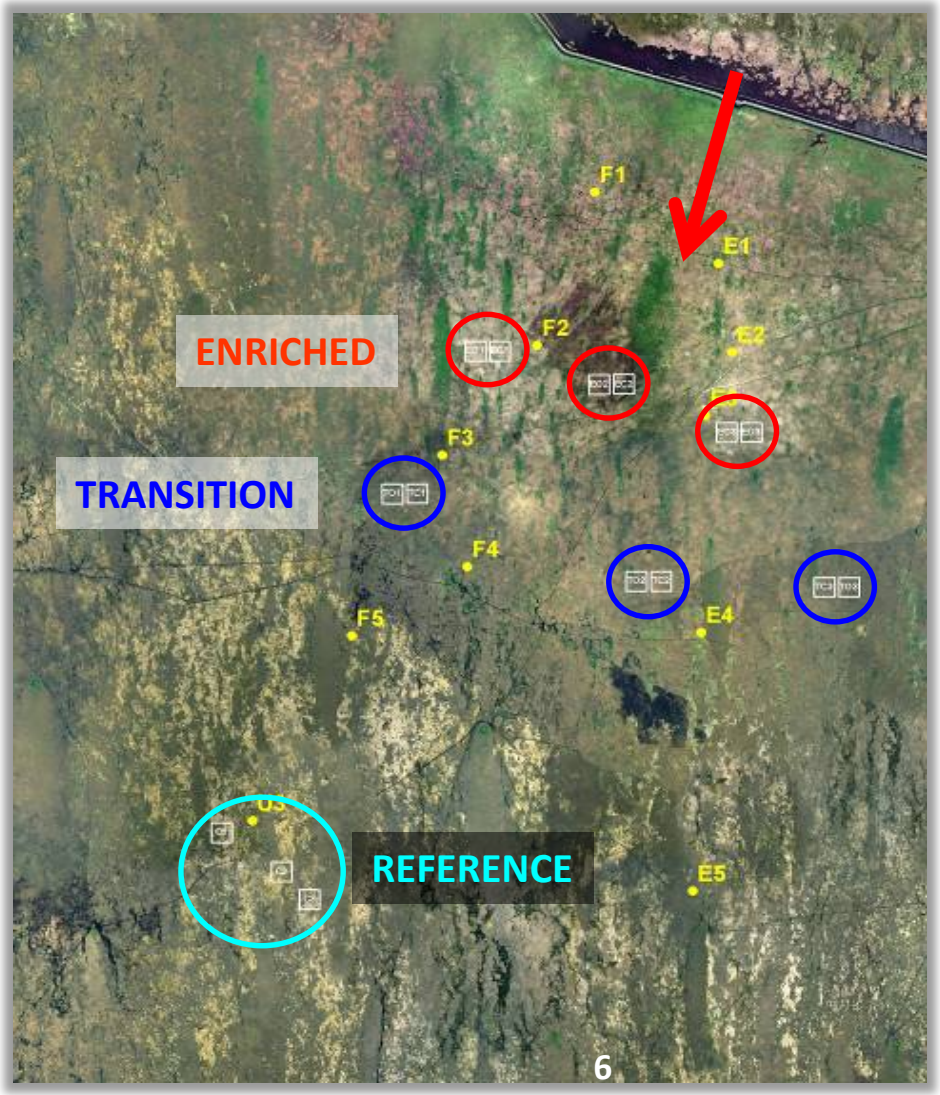
Location: WCA2A

Cattail Habitat Improvement Project (CHIP)

Timeline

May 2006 - glyphosate
Jul 2006 - burn
Aug 2006 - glyphosate + imazapyr
Mar 2007- glyphosate + imazapyr
Nov 2007- glyphosate + imazapyr
Apr 2011 - imazamox
Jan 2013 - imazamox
Sep 2016- imazamox

Each plot 6.25 ha (250x250 m)

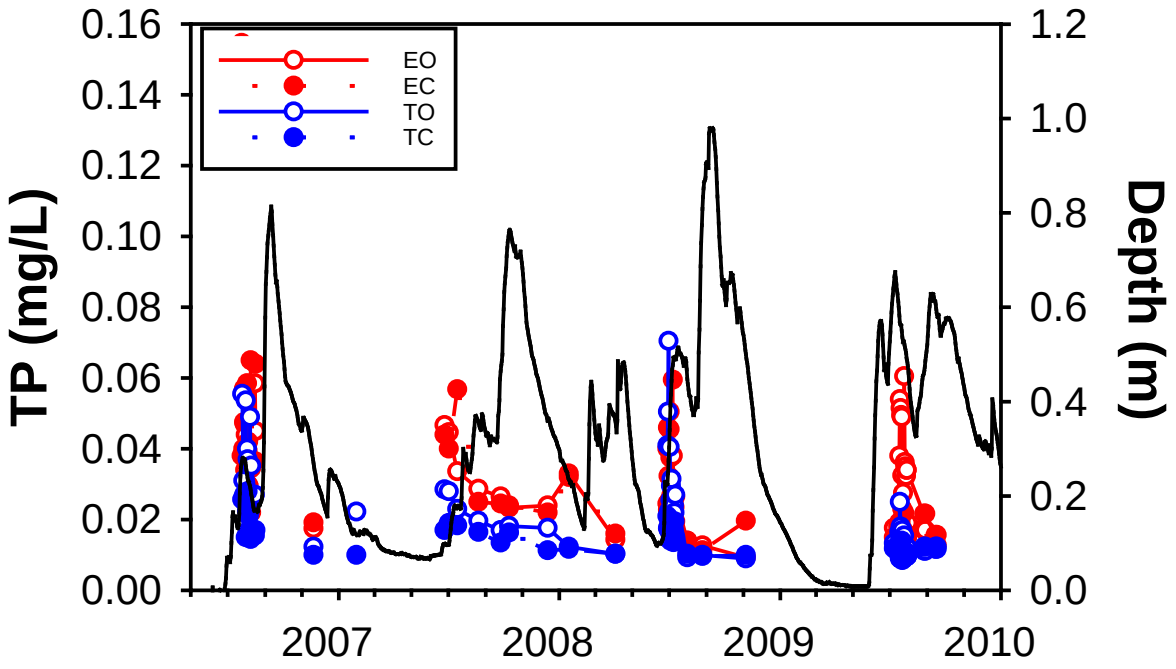


Project Objective and Hypotheses

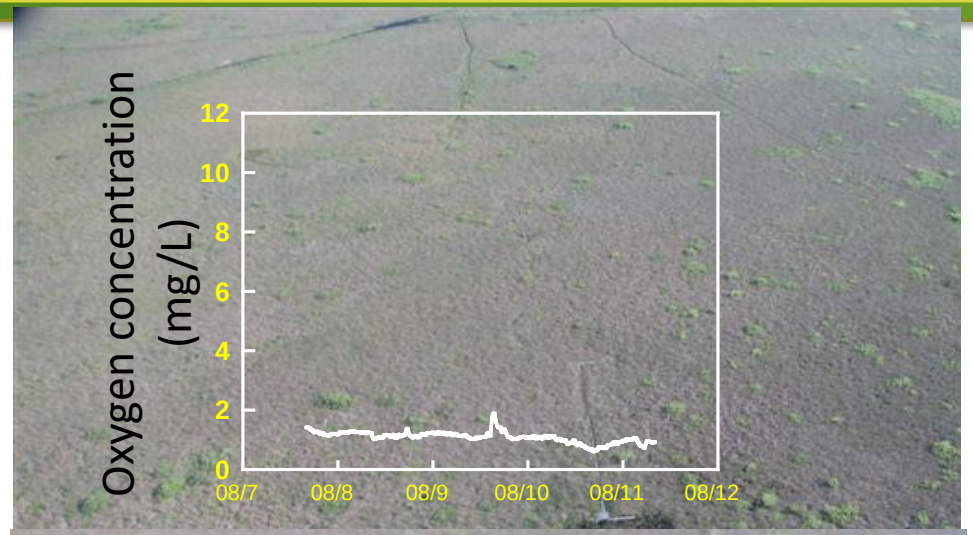
- Primary objective to restore habitat function and access by wading birds
- Hypothesis: Switch from *Typha* to openwater/SAV will fundamentally alter biogeochemical cycling-
  - treatment plots will experience greater nutrient fluxes
  - be comprised of more nutritional plants (i.e. algae)
  - aquatic productivity will drive nutrient cycling and storage

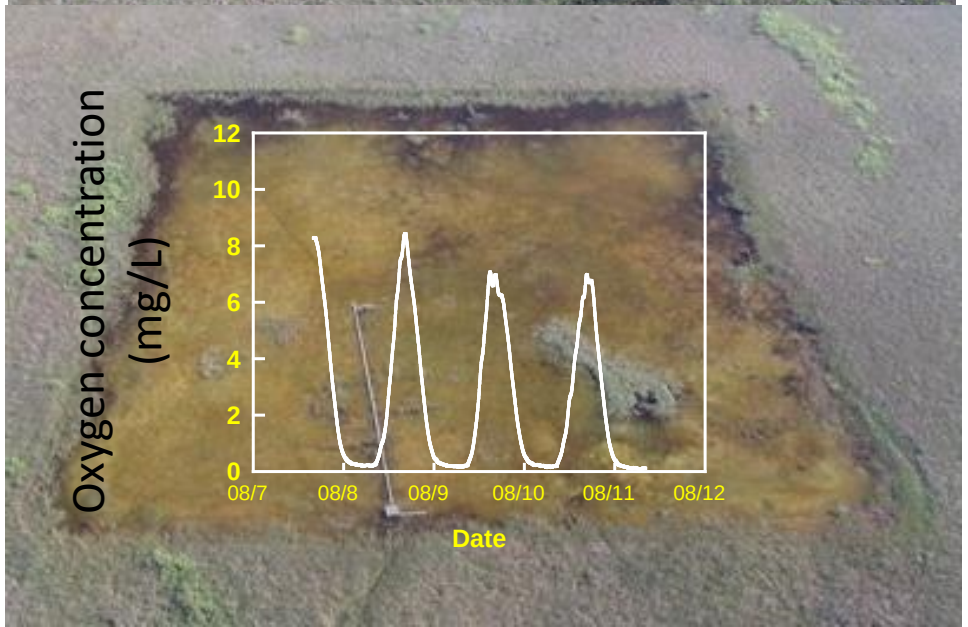
  as a result, open plots will store less carbon and nutrients

Immediate Effects of Treatment



Short duration spike in TP concentrations in open and control plots following rewetting





Succession of an Ecosystem- TO1

Evolution of the Plots- TO1

September 2015

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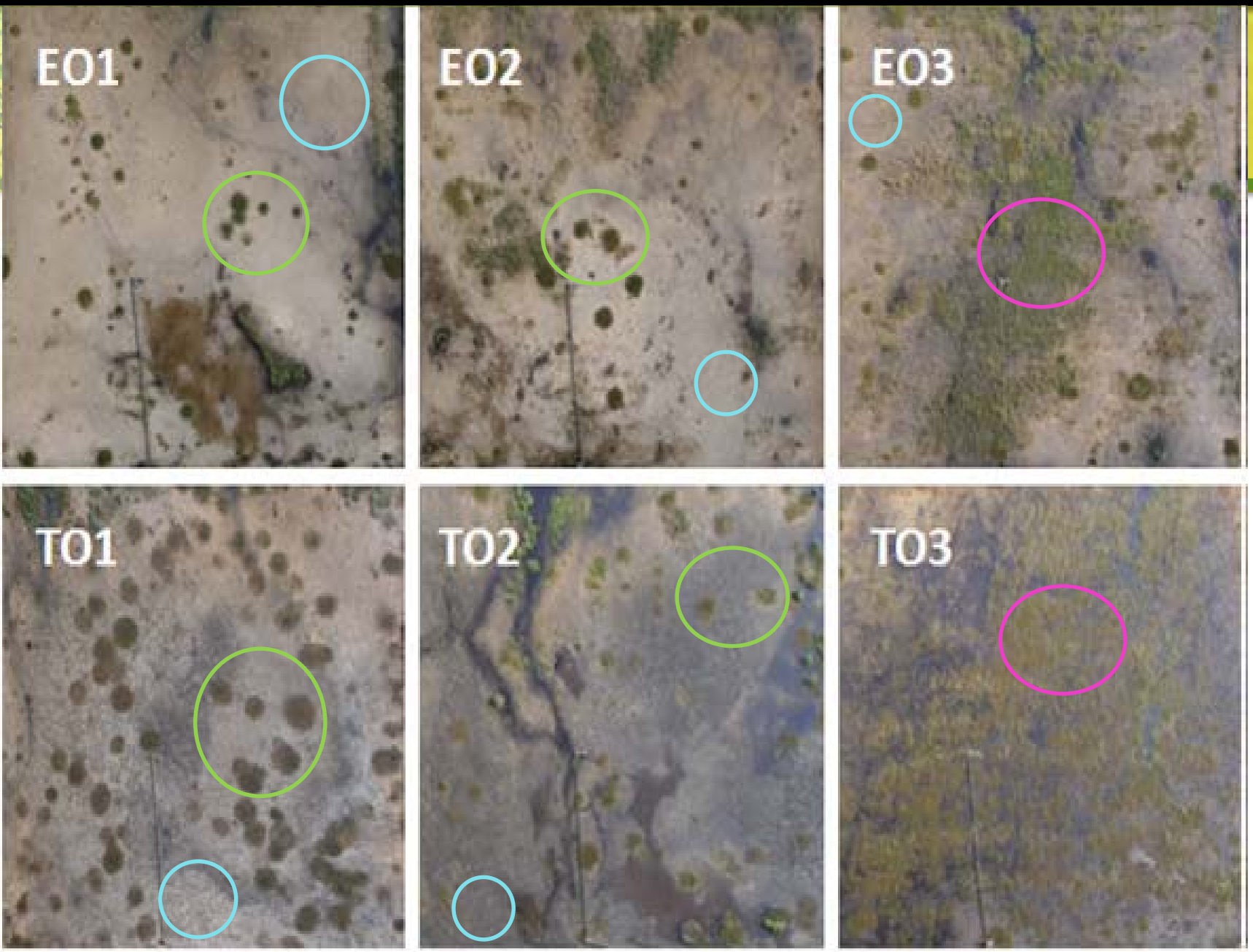


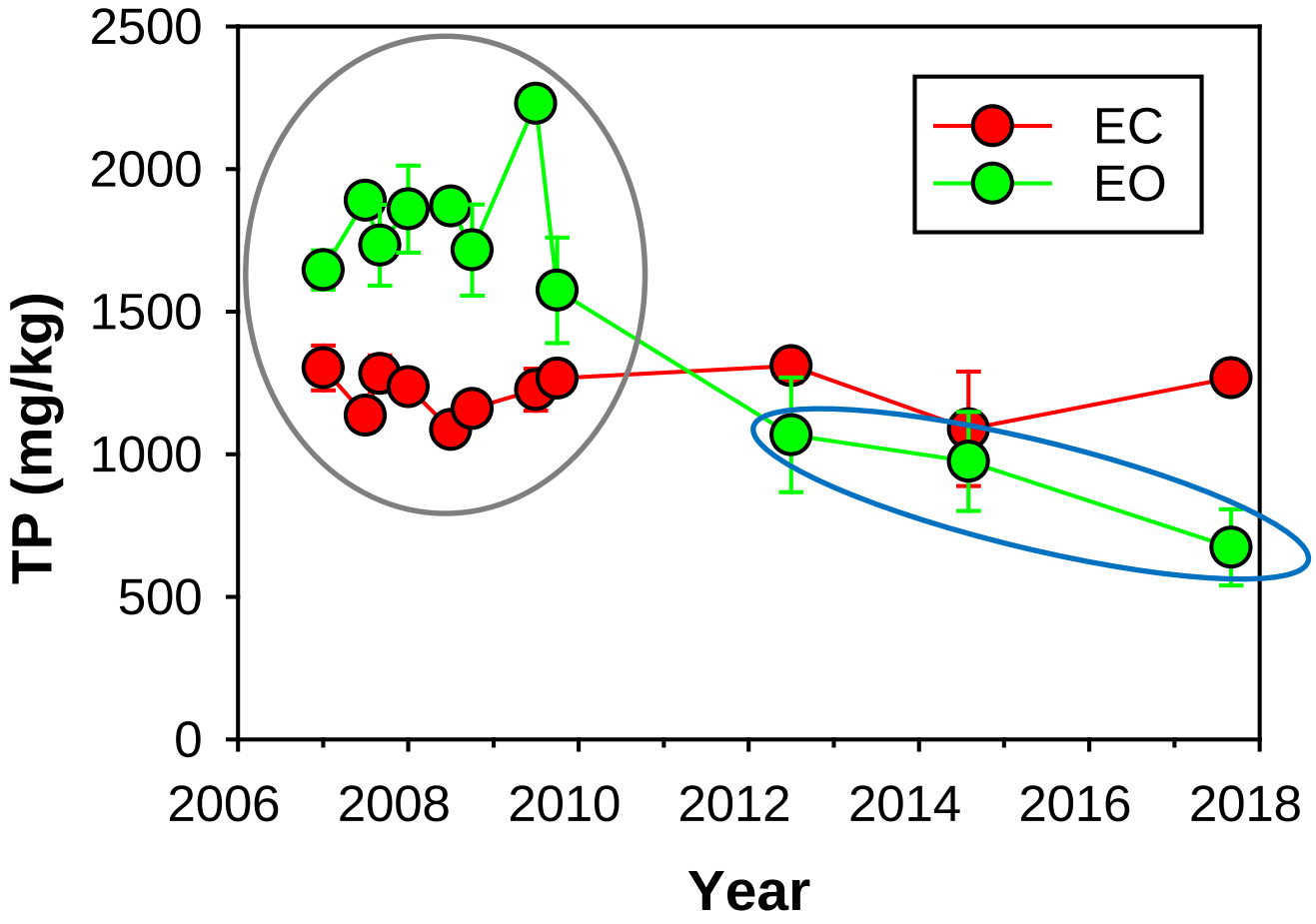
Open plots in April 2012- during dry out

Dominant Vegetation

- Open water/*Chara*
- *Eleocharis*
- Diffuse *Eleocharis*, *Sagittaria*, *Typha*, and other emergents

Distinct West-East Response

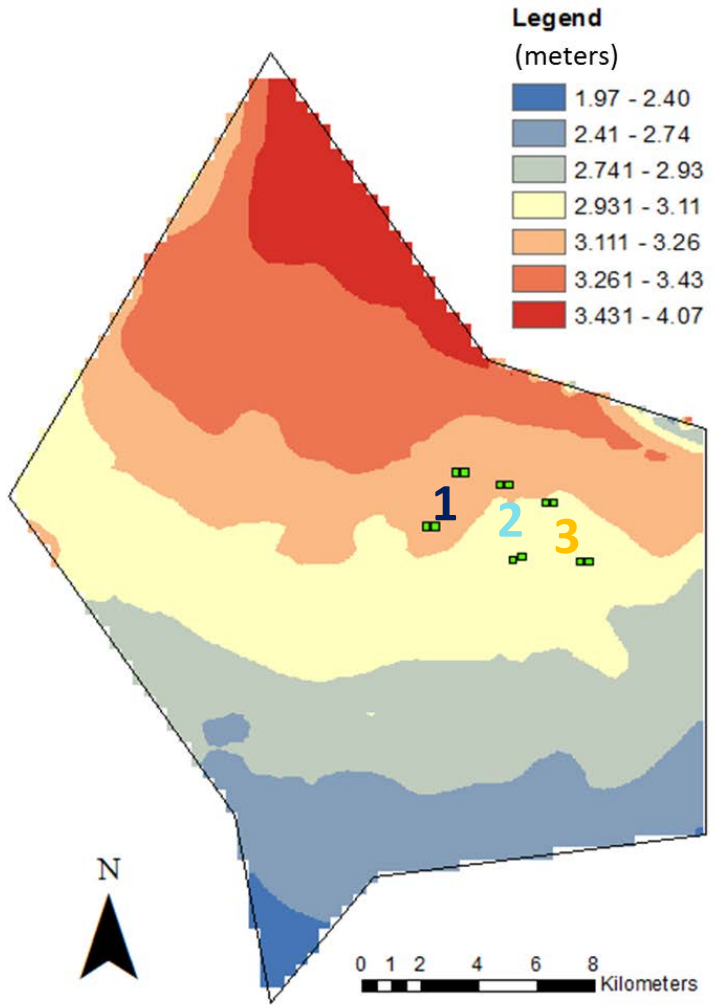
Change in P over Time (Floc)

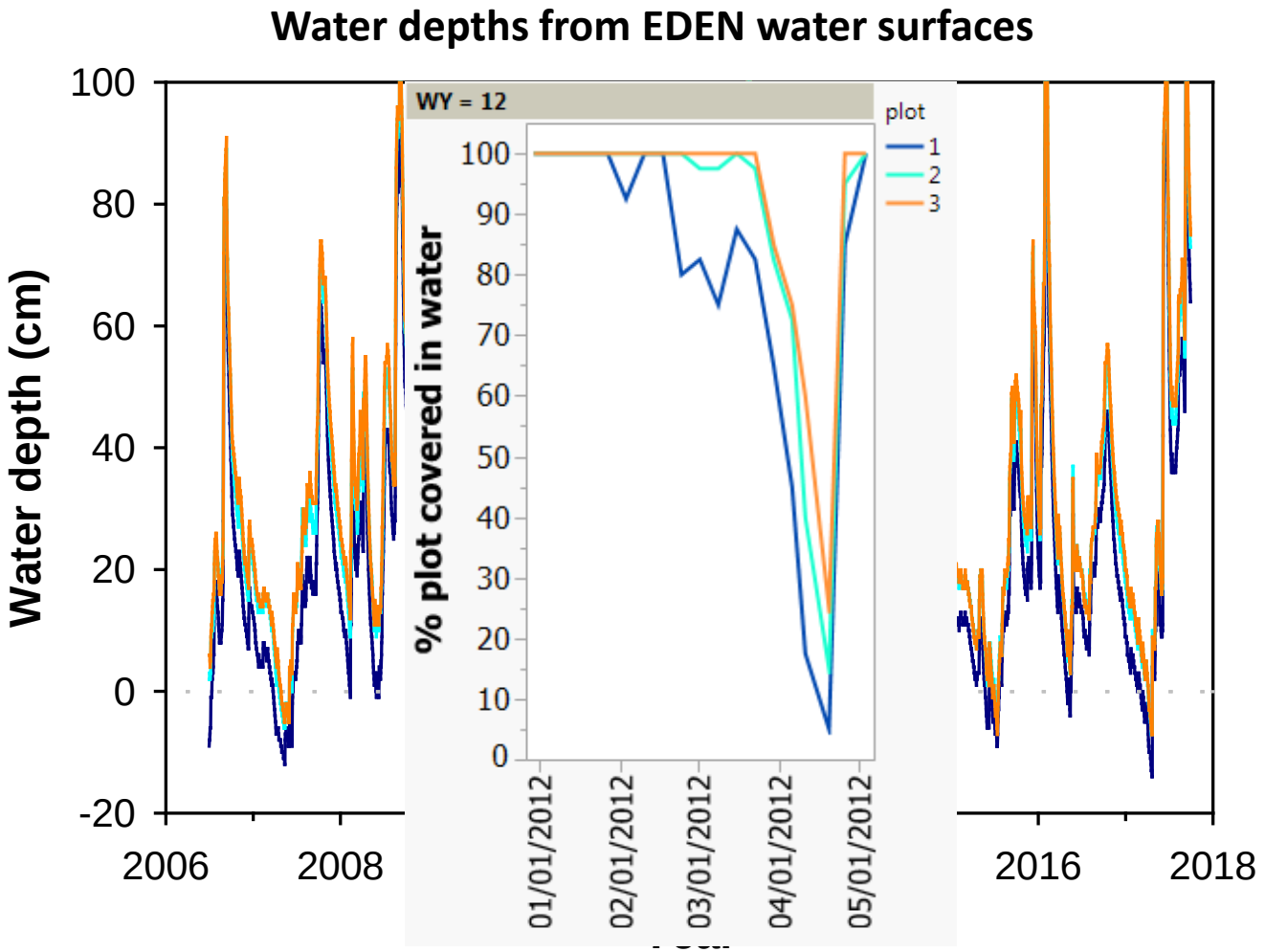


Parameter	Plot	2012	2014	2017
	EO1	891	799	540
TP (mg/kg)	EO2	843	803	
	EO3	1470	1322	807
Ash content (%)	EO1	68	66	61
	EO2	60	58	
	EO3	12	18	40

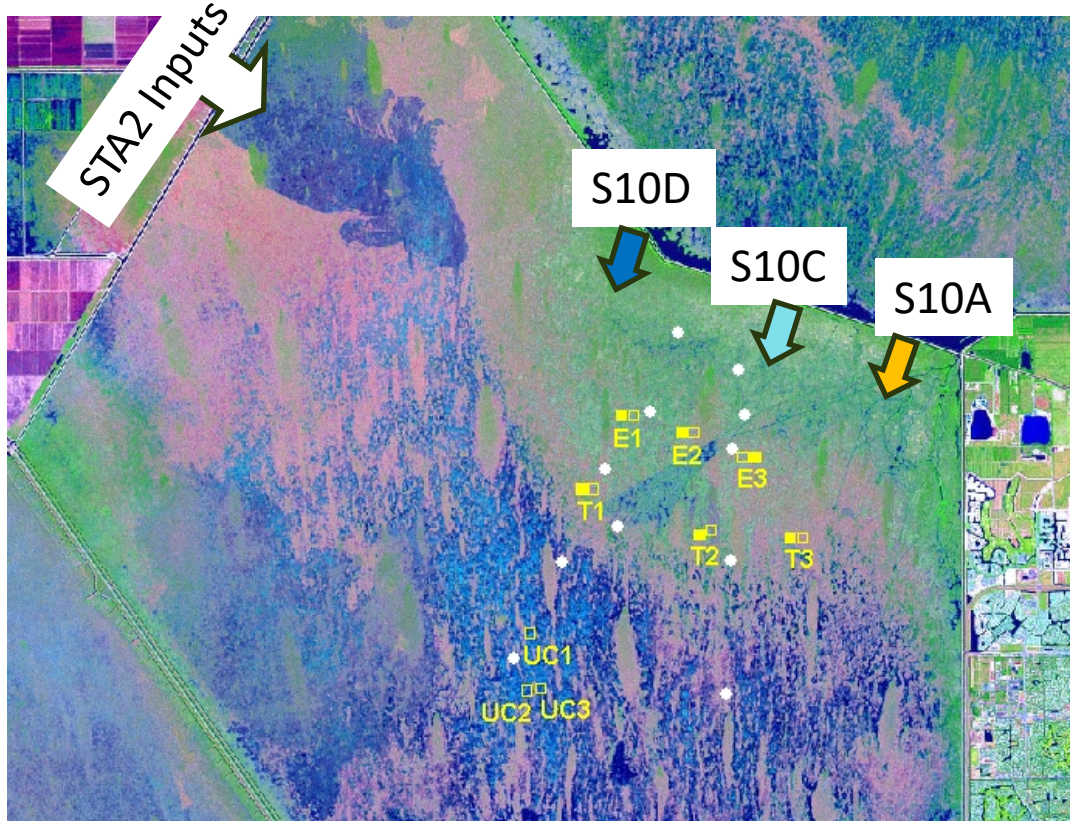
Distinction between enriched and unenriched= top 10 cm soil TP concentration of 500 mg/kg

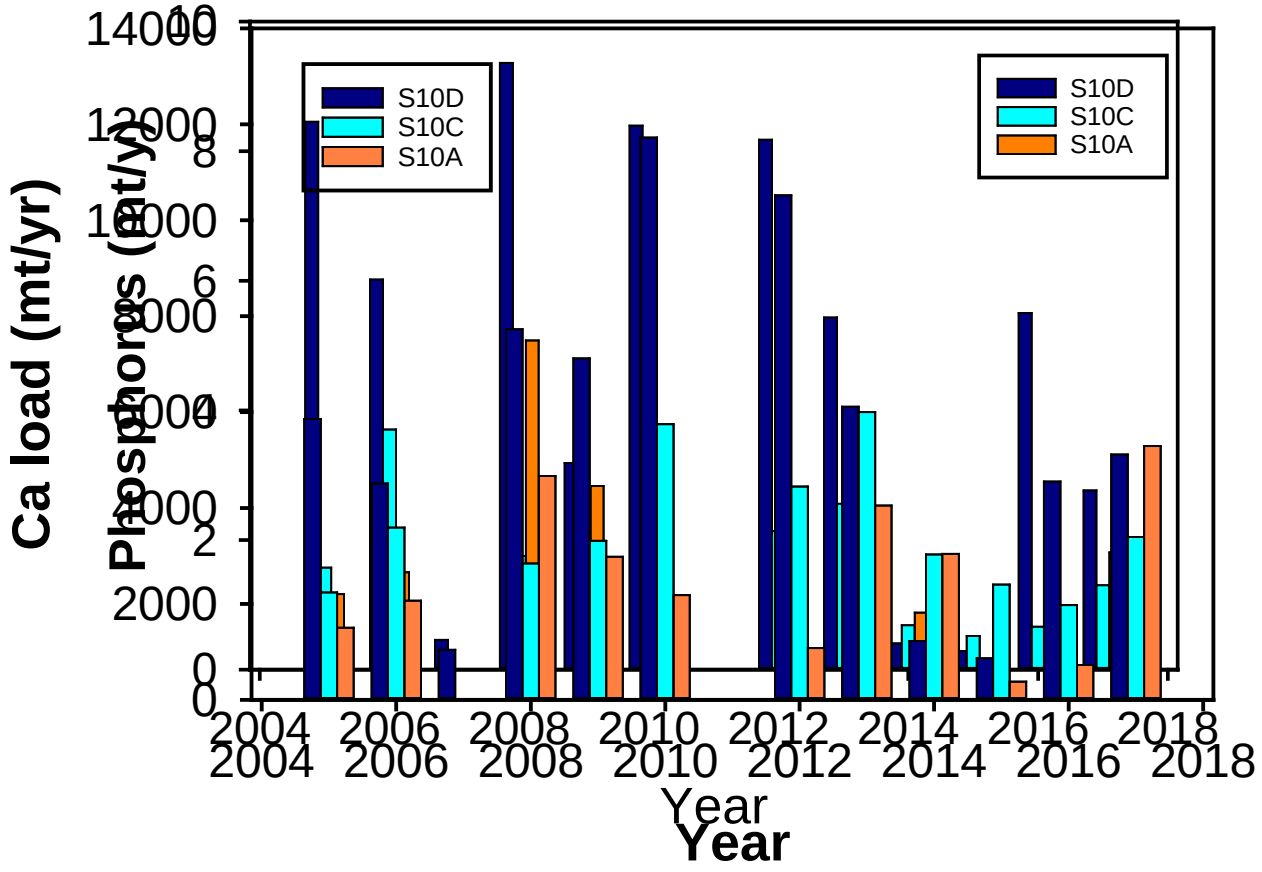
Factors Affecting West-East Response





West v East Loads





Biogeochemical Response (West-East Gradient

(TP mg/kg & Ash % in Sept 2017)

Floc

1268 mg/kg
10%

1078 mg/kg
10%

0-5 cm

Core from *Typha* plot

540 mg/kg
61%

576 mg/kg
73%

West Open Plot- EO1

807 mg/kg
40%

1139 mg/kg
16%

East Open Plot-EO3

P reduction and mineral enrichment is more advanced in western plots

Project Objective and Hypotheses

- Primary objective to restore habitat function (see Cook- this session)
- Hypothesis switch from *Typha* to openwater/SAV will fundamentally alter biogeochemical cycling-
  - treatment plots will experience greater nutrient fluxes –short-term
  - be comprised of more nutritional plants (i.e., algae)- yes (Hagerthey et al, 2014)
  - aquatic productivity will drive nutrient cycling and storage-yes (see Tate-Boldt and Zweig-this session)

  as a result, store less carbon and nutrients - yes

Summary and Conclusions

- 10 years post project implementation, there is evidence of the reversal of legacy P effects in the floc and surface 0- 5cm sediments
- The extent of oligotrophication is more rapid from west to east
- We hypothesize that the prescription for oligotrophication is-
  - Areal flow patterns which create:
    - Local hydroperiod- with sufficient days of dry out for marl consolidation
    - Local hydrology sufficient to minimize *Typha* invasion, and maximize presence of periphyton and SAV
    - Local loading of mineral-enriched water to support $CaCO_3$ precipitation
- Actively managing *Typha* in nutrient and mineral enriched areas for several years, if it results in SAV/openwater environments, is a tool that used incrementally may result in reversal from eutrophication

Next Steps

- Quantify the extent the mineral layer has reduced P flux to overlying water column during rewetting
- Assess whether transition to wet prairie will result in root mining of deeper, legacy P enriched soils
- Development of budget models

Acknowledgements

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