



# Faunal Contributions to P-cycling and their Influence on Restoration of the Everglades

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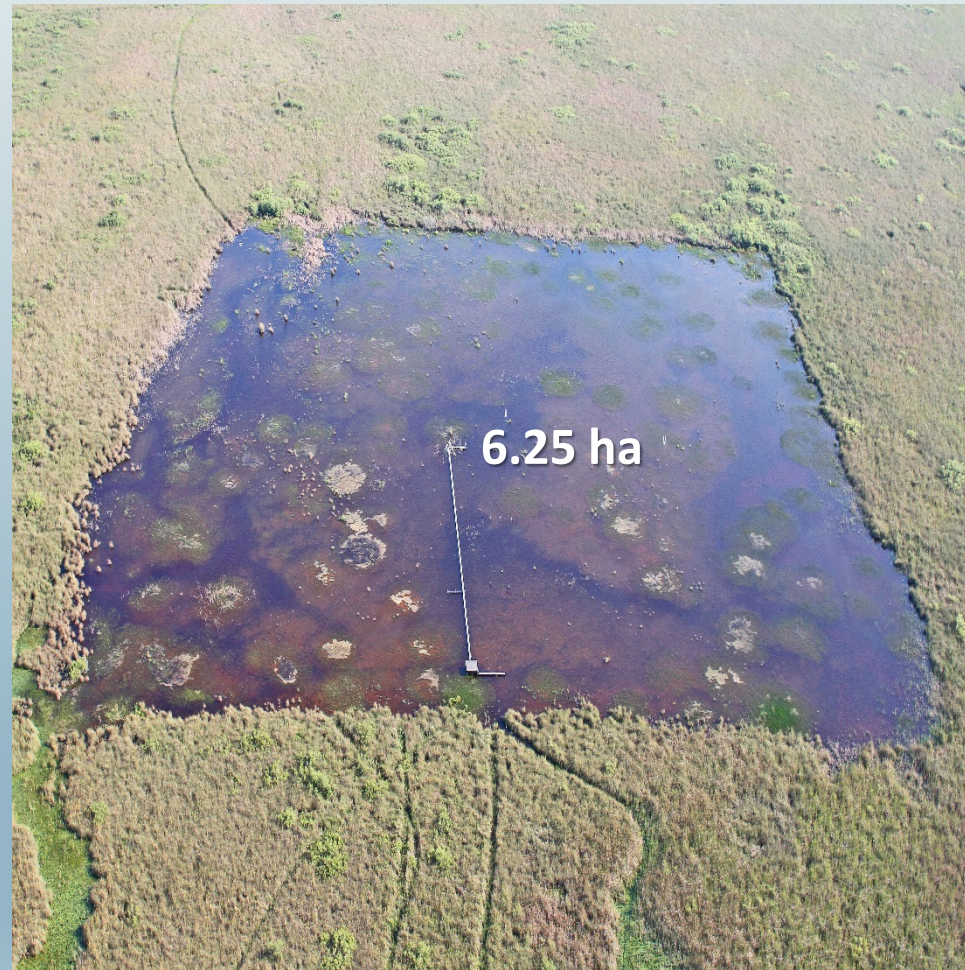
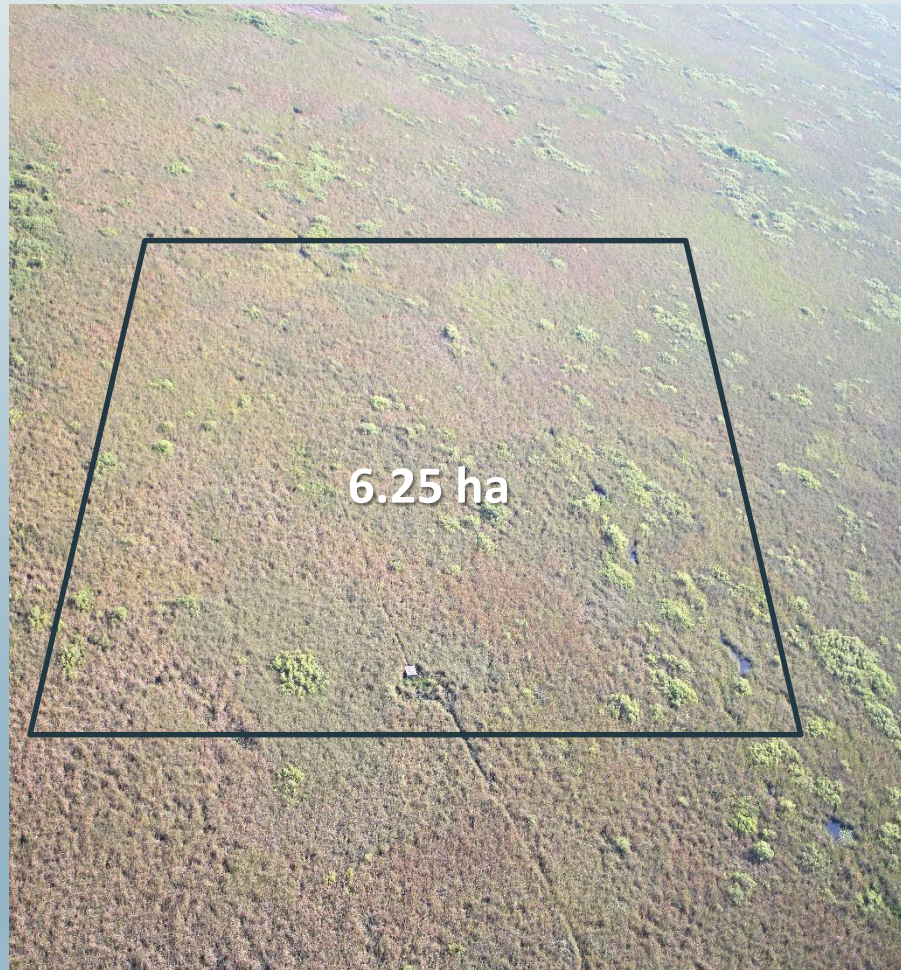
# Part 1. Effects of Eutrophication on Everglades Fauna

P enrichment causes a shift from 'ridge and slough' to a *Typha* regime



Loss of wildlife  
habitat

# Rehabilitating Nutrient Impacted Regions with Active Management



Landscape-scale experiment: Cattail Habitat Improvement Project (CHIP)

# CATTAIL PLOT

## Stoichiometrically Unbalanced

low incident solar radiation



# MANAGED PLOT

## Stoichiometrically Balanced

high incident solar radiation



### ECOSYSTEM PROCESSES

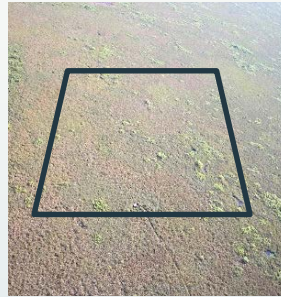
net ecosystem productivity  
sediment respiration  
secondary productivity  
N & P turn over  
Wading bird foraging

P storage and peat deposition



# Summary Results for Enriched Region: Years 1 to 3

(n = 3, means  $\pm$  SD)



	<b>Control</b>	<b>Open</b>
<b>Periphyton (<math>\text{g m}^{-2}</math>)</b>	$3 \pm 8$	$30 \pm 41$
<b>Aquatic prey community</b>	Crayfish (detritivore)	Fish (herbivore)
<b>Prey biomass (<math>\text{g m}^{-2}</math>)</b>	$12.84 \pm 5.79$	$10.83 \pm 7.79$
<b>C:P (Slough Crayfish)</b>	$74.5 \pm 21.2$	
<b>C:P (Sailfin Molly)</b>		$57.0 \pm 12.6$
<b>Wading birds per plot/week</b>	$0.1 \pm 0.4$	$51.3 \pm 39.3$

# Summary Results: Years 1 to 3 (n = 3, means $\pm$ SD)



**Reference**

**Open**

**Aquatic prey community**

Fish  
(herbivore)

Fish  
(herbivore)

**Prey biomass (g m<sup>-2</sup>)**

1.6  $\pm$  1.7

10.8  $\pm$  7.8

**C:P (Sailfin Molly)**

126.4  $\pm$  19.7

57.0  $\pm$  12.6

**Mass (mg dry wt; S. Molly)**

51  $\pm$  56

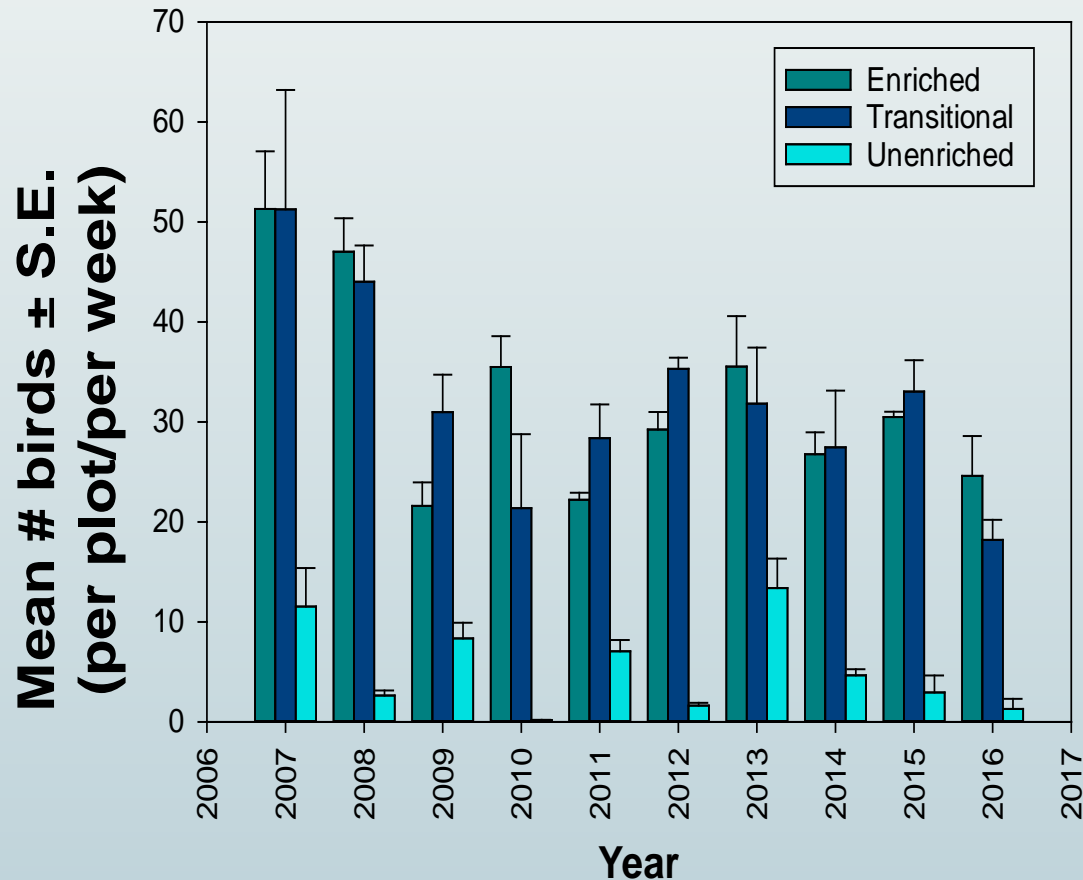
70  $\pm$  73

**C:P (Periphyton)**

3027

660

# Wading Bird Use of Open Plots was Consistently Greater than in the Unenriched Reference Region

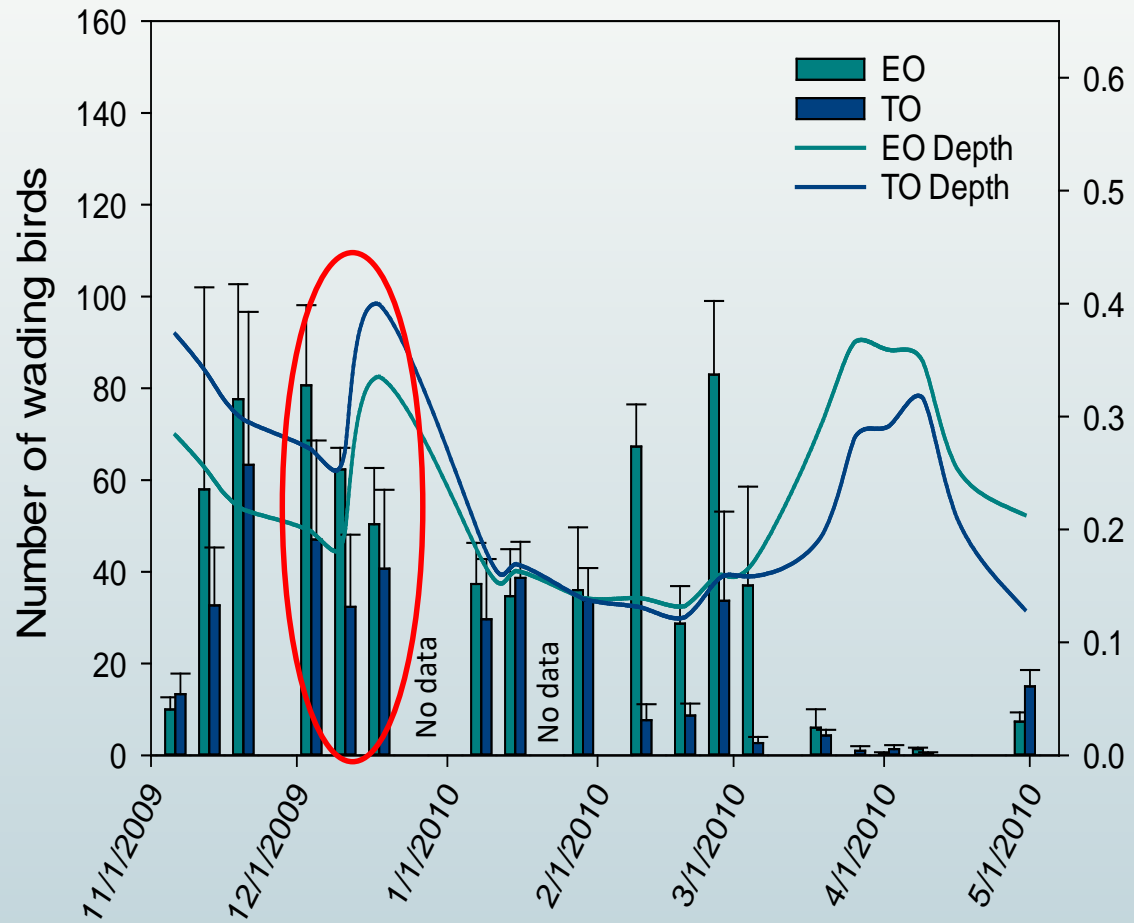


Open Plots-WCA2-A

# Eutrophication has changed the Mechanisms driving Wading Bird Prey Availability



Typical foraging in ridge & slough relies on water level recession to concentrate prey



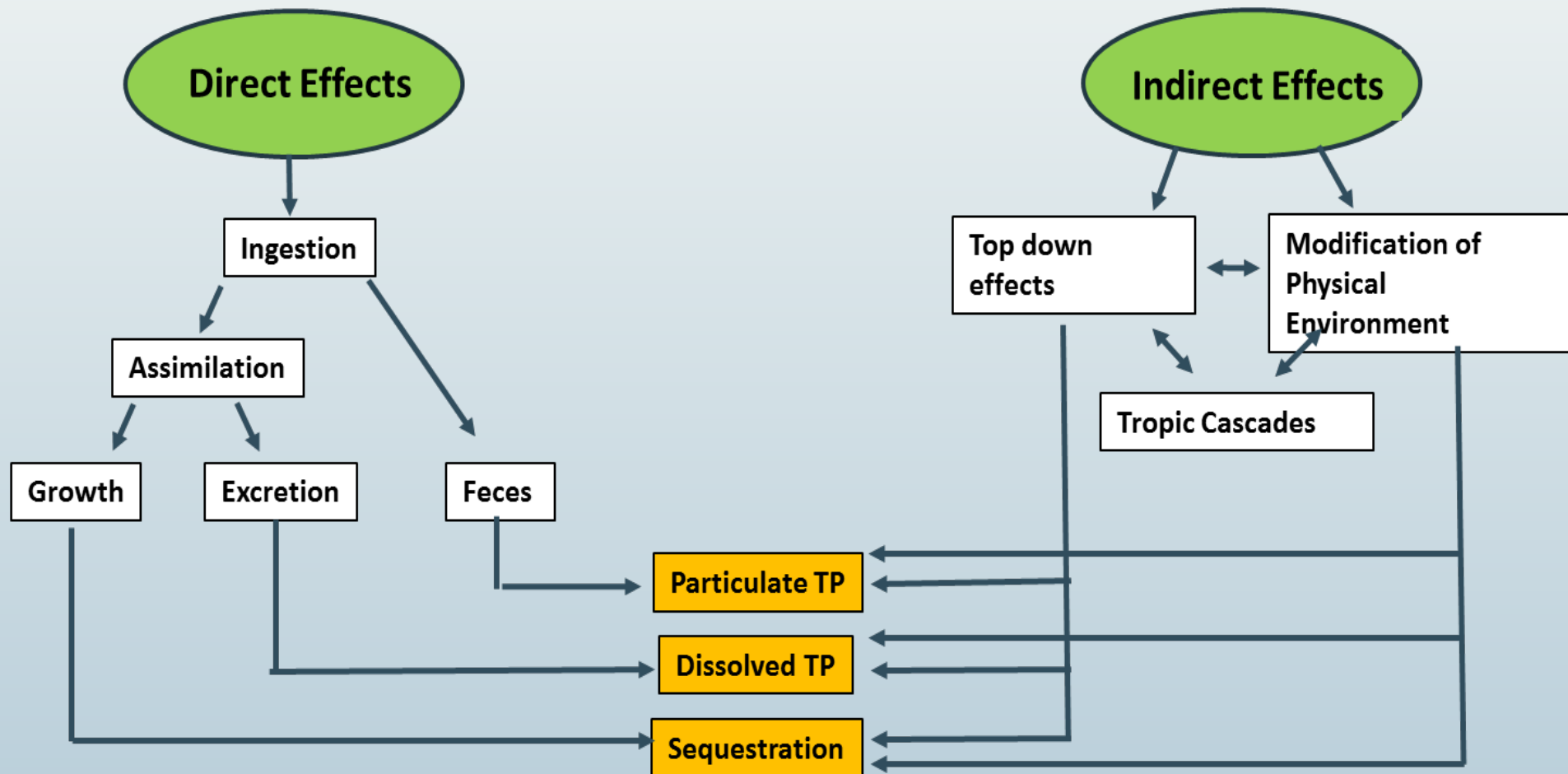
Foraging occurs at greater depths and is less reliant on water-level recession



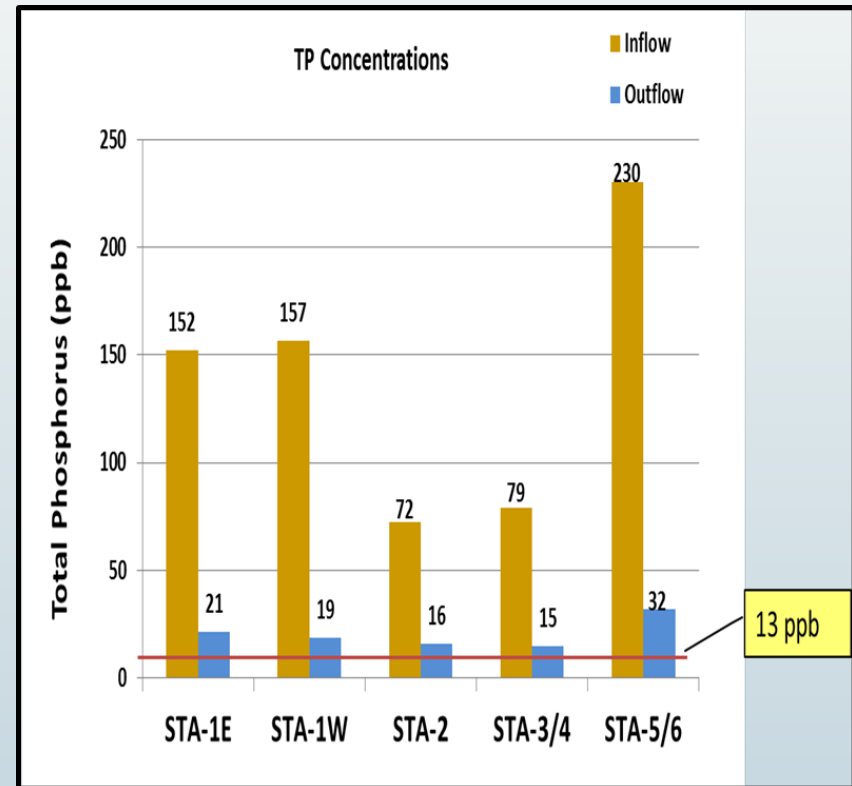
# Summary of CHIP

1. The management technique improves ecosystem function in nutrient impacted Everglades.
2. Nutrients can impact fauna at multiple levels from individual elemental composition to community and food web responses.
3. Studying faunal responses led to greater insights into the role of P in Everglades food webs, with potential implications for restoration

# Part 2. Effects of Fauna on Nutrient Cycling in Freshwater Ecosystems



# Investigating Effects of Fauna on P-Cycling in the Everglades Storm Water Treatment Areas (STAs)



Reduce P in runoff water prior to discharging to the Everglades Protection Area

# Do American Coots Affect P Cycling?



Estimated wintering population in STA-1W: **87,000 Coots**

Assuming: coots eat 90 g plants/day and excrete 54 g guano/day (dry wt), then:

Daily consumption: = **7,830 kg (dry wt) vegetation**

Daily excretion: = **4,698 kg (dry wt) guano**

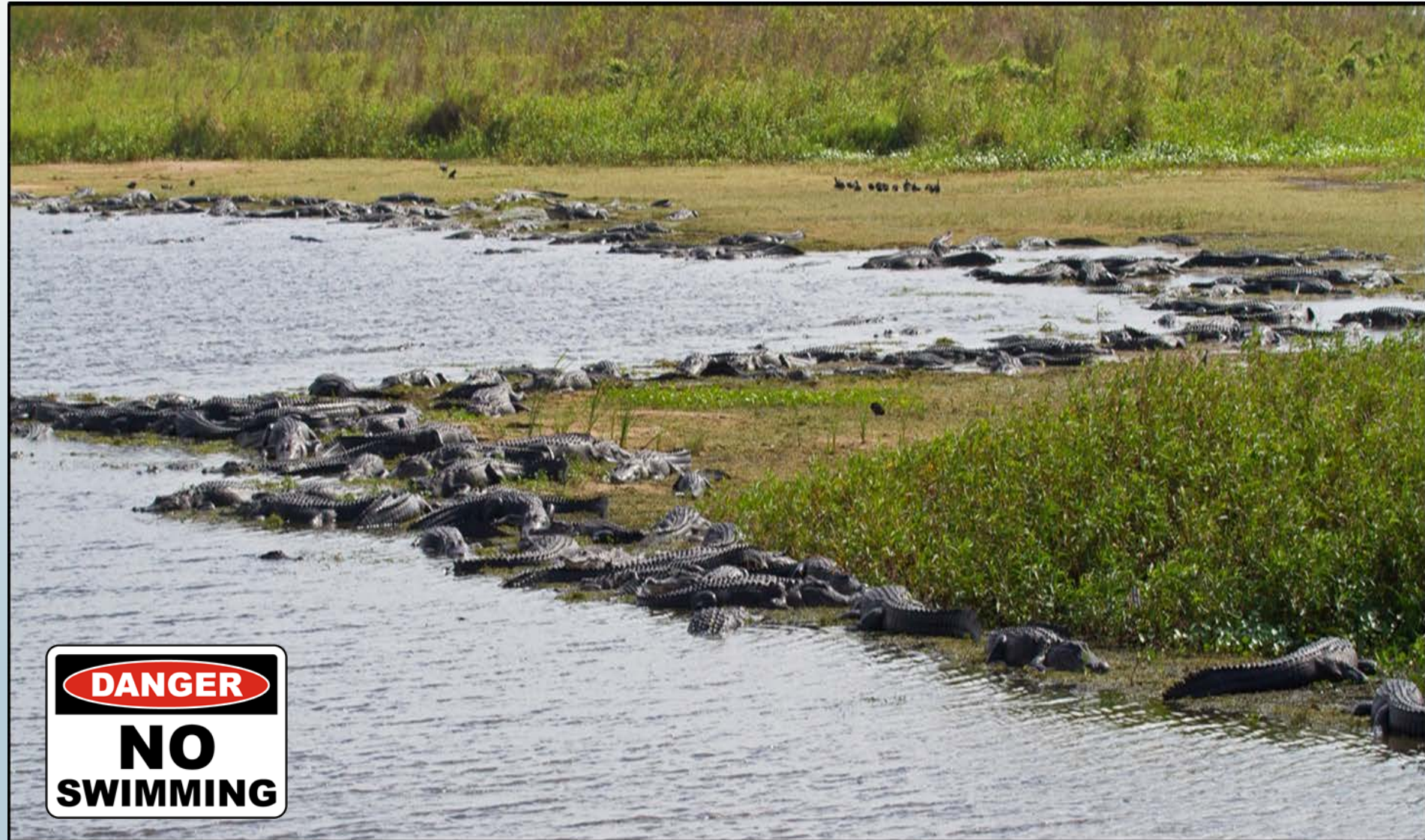
How much of the external P loading are Coots recycling in STA1-W?

Assuming: Guano = 1.4% P; Coots present for 150 days/yr; STA-1W = 2648.3 ha, then:

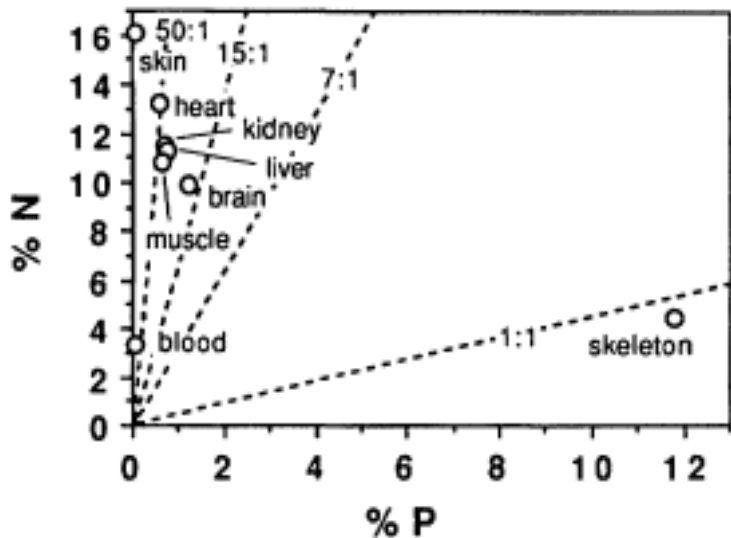
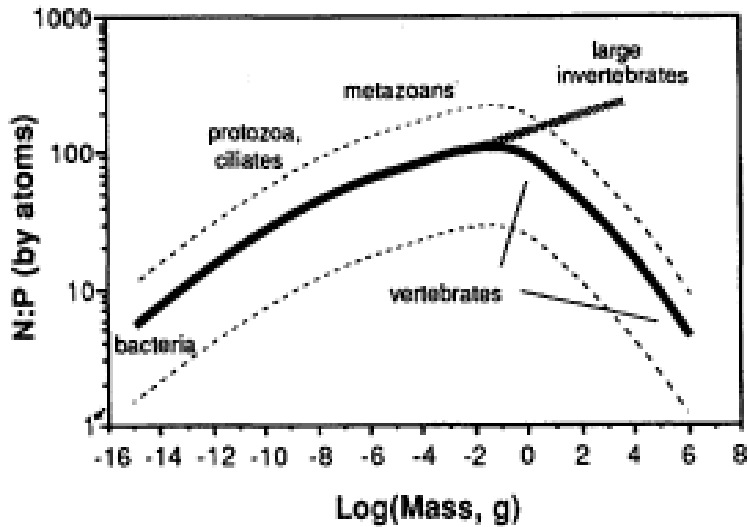
Coot P cycling in STA-1W = **0.37 g/m<sup>2</sup>/y<sup>-1</sup>**

Coot P cycling is **20 % of external TP loading** (1.9 g/m<sup>2</sup>/y<sup>-1</sup> )

# Are Alligators Acting as Nutrient Sinks (P Storage in Body Tissues)?

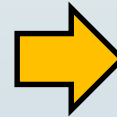


N:P ratios in vertebrates are thought to decrease with increasing body size.....



...because bone has low N:P, and percent skeletal mass increases with body size.

# Wading Bird Transportation of P across Ecosystem Boundaries

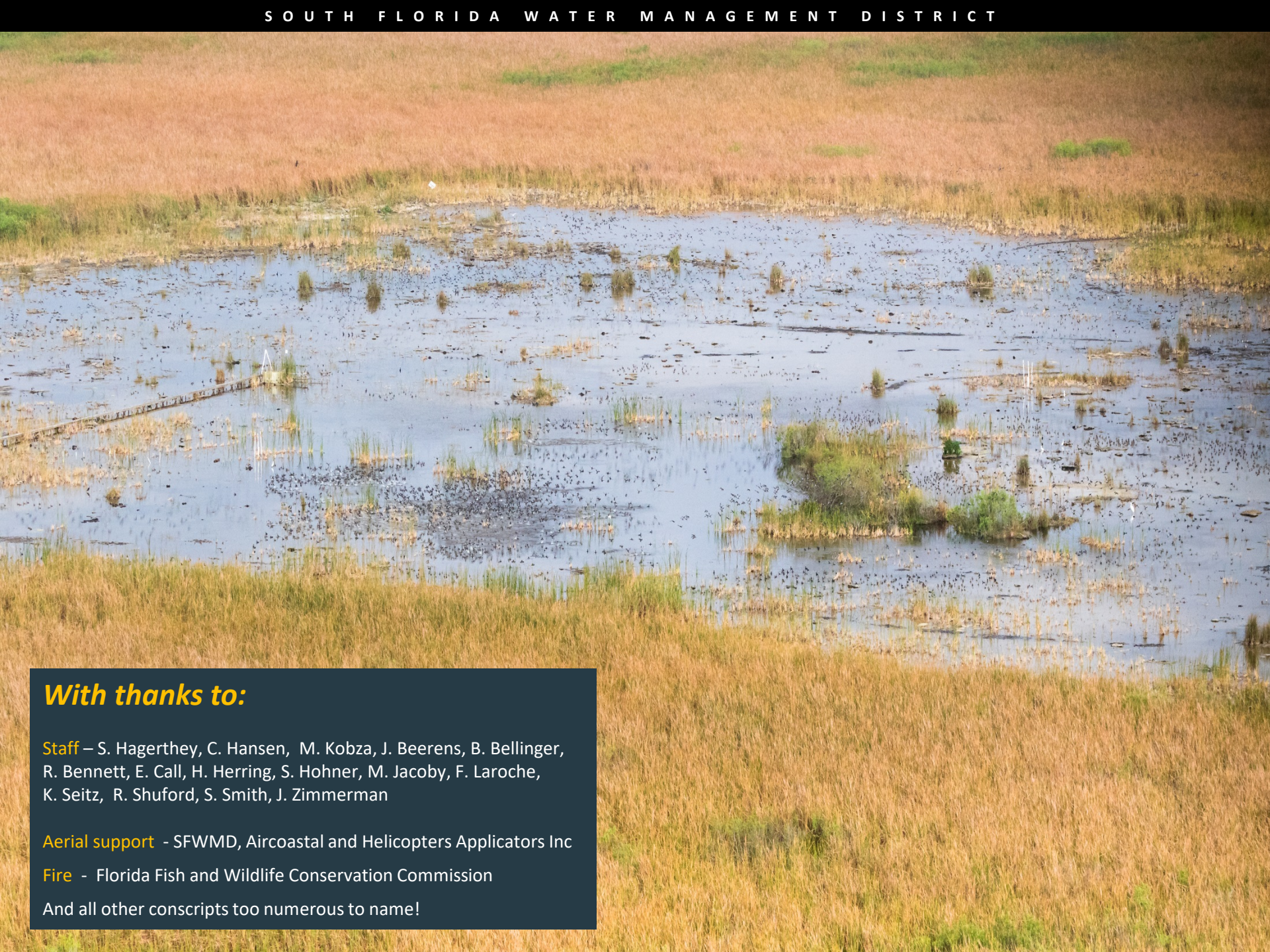


Wading birds feed in the STAs and transport prey to nesting colonies

# Potential Relevance of Fauna to Everglades Ecology and Restoration

1. Have the considerable reductions in faunal populations (fish, crayfish, coots, wading birds, crocodilians) affected nutrient dynamics in the current system and if so, how?
2. Can wildlife accelerate restoration of nutrient impacted regions?
3. How will restoration of these populations impact future nutrient dynamics?





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**Fire** - Florida Fish and Wildlife Conservation Commission

And all other conscripts too numerous to name!