

The Effects of Hydrological Variation on Seasonal Wading Bird Prey Concentrations in the Everglades



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Introduction

- The relationship among hydrology, prey populations and wading bird populations (Trophic Hypothesis) is one of the primary themes underlying the Everglades restoration
- Knowledge of this relationship has been used to set restoration targets and develop performance measures for the Comprehensive Everglades Restoration Plan (CERP)



Introduction

- A quantitative link between prey abundance and wading bird populations has not yet been established
- Wading birds may not only be responding to prey abundance, but to factors that promote the concentration of prey and their vulnerability to capture (Gawlik 2002)



Objectives

- Identify the spatial and temporal patterns of prey concentrations throughout the Everglades landscape
- Discern the relationship among hydrology, prey concentrations and wading bird nesting



Photo:
Jerome Lorenz



Multistage Sampling Design

(Cochran 1977)

- Landscape units (LSU)
- Primary sampling units
- Sites
- Throw-trap subsamples (1 m²)

Study Area

- Extant Everglades (7919 km²)
- Dry seasons (Dec.-May) of 2005, 2006 and 2007



Methods



Methods

Site Selection

- We target portions of the landscape that serve as wading bird foraging habitat
- Sparse to moderate vegetation with less than 33% of surface covered with water

Sloughs filled to ridges, prey not concentrated in refuges

< 33 % of slough covered with water. Prey concentrated in pools



Methods

- Also sampled at sites with large foraging flocks (> 30 birds) to compare used sites versus available sites

Site Selection

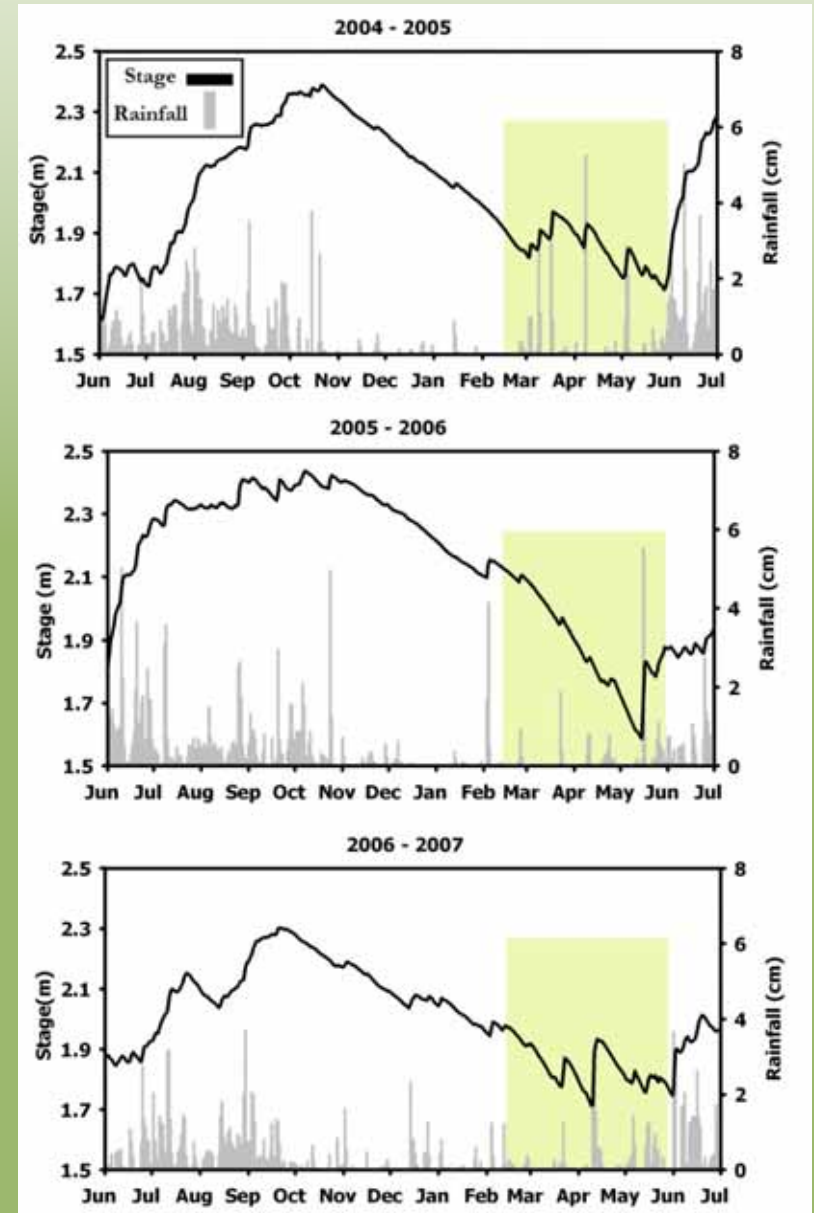
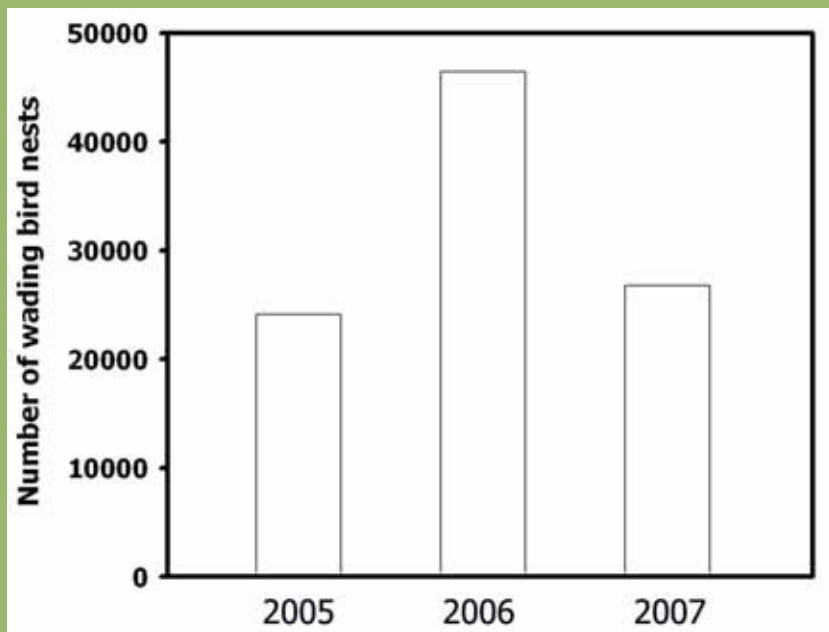
Foraging wading birds in slough that meets target conditions



Results

Hydrology and wading bird nesting

- Differed considerably among 2005, 2006 and 2007

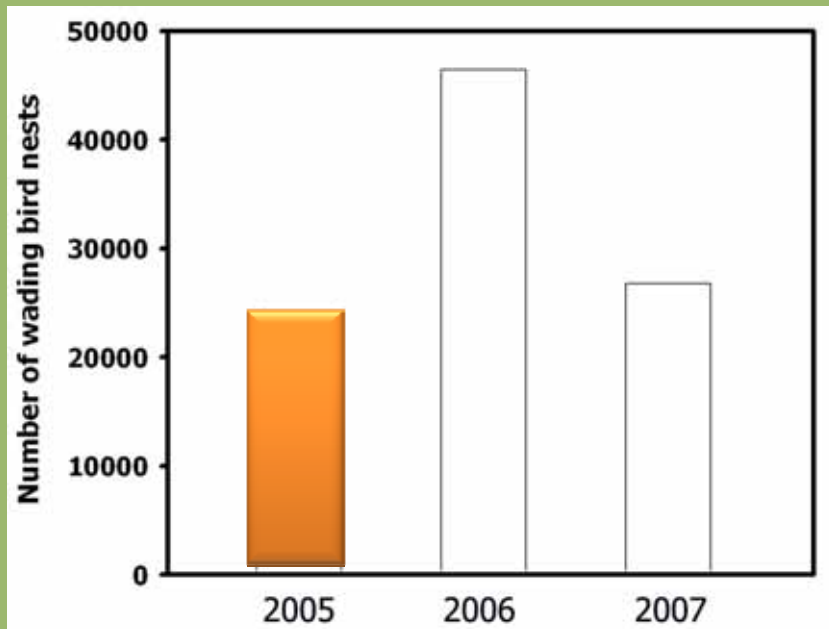
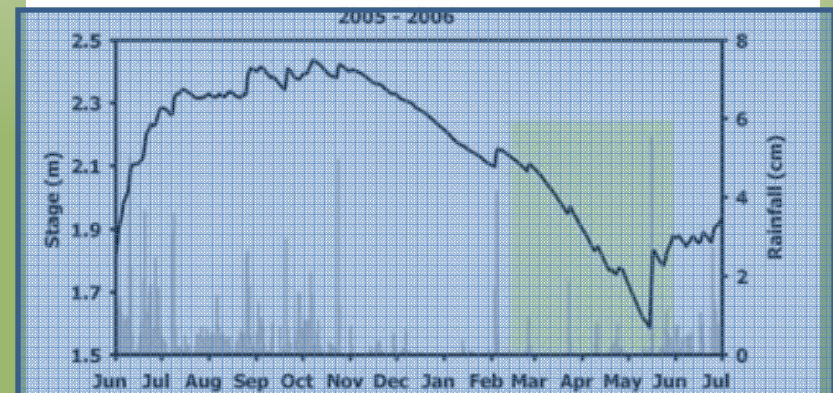
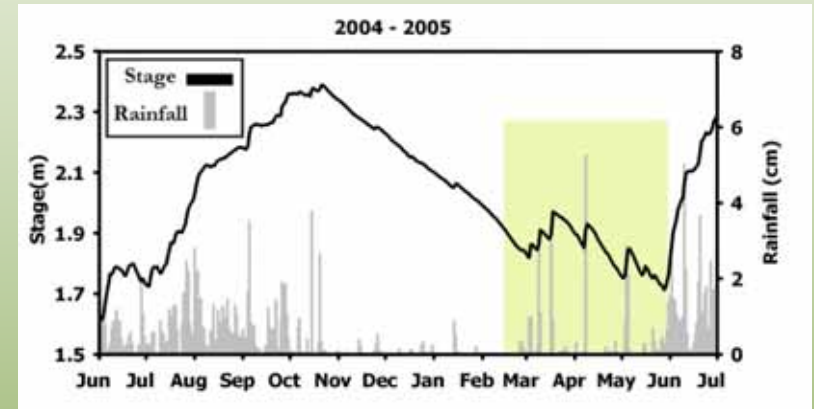


Results

Hydrology and wading bird nesting

2005

- Natural dry season recession was interrupted by several reversals
- Poor year for wading bird nesting

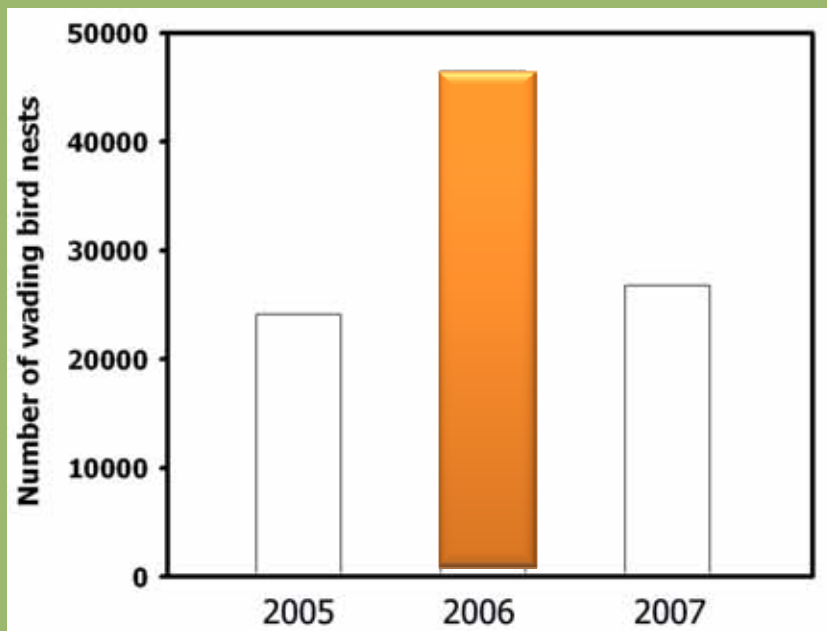
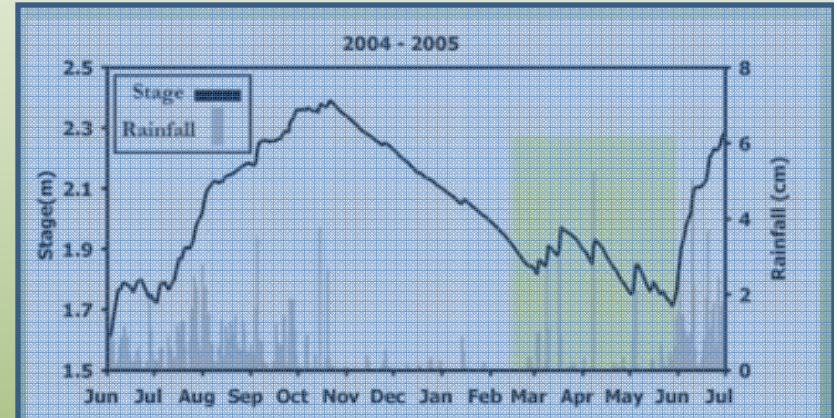


Results

Hydrology and wading bird nesting

2006

- High water levels at the start of the dry season and a steady recession created near optimal conditions for wading birds
- High nesting effort

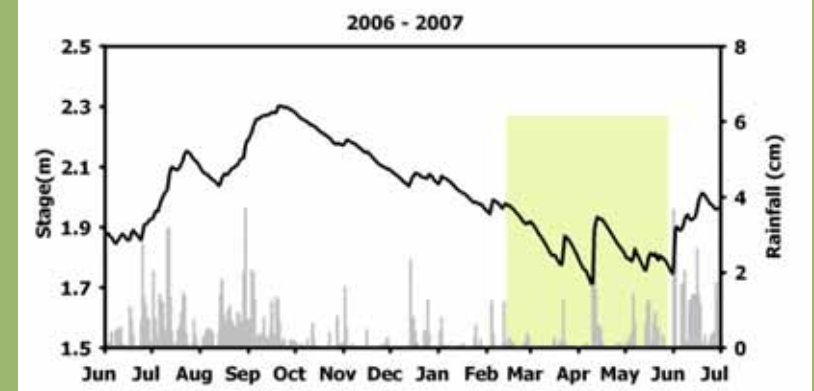
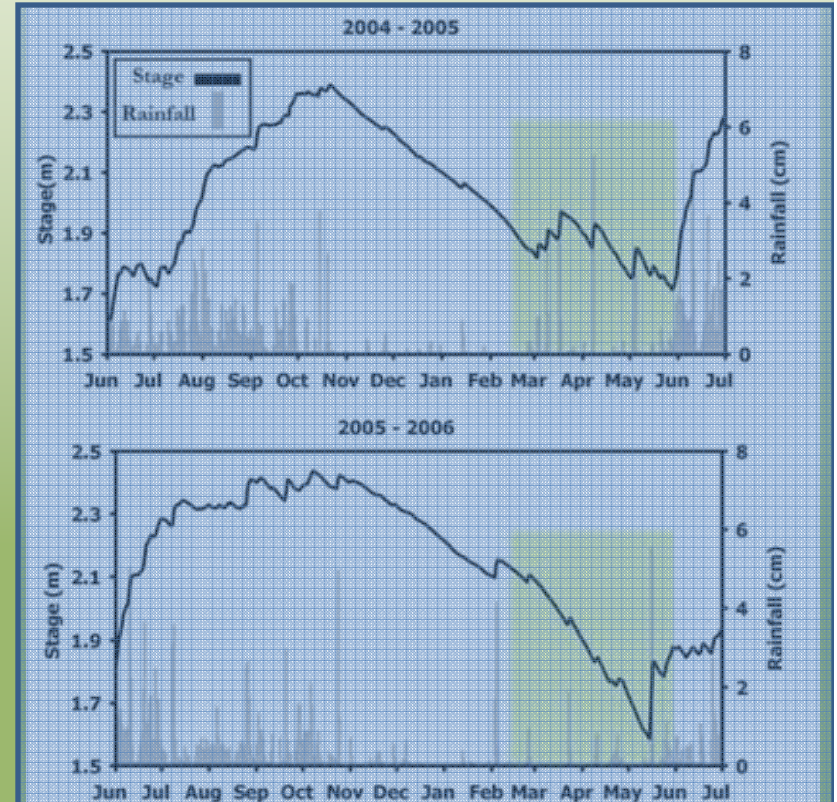
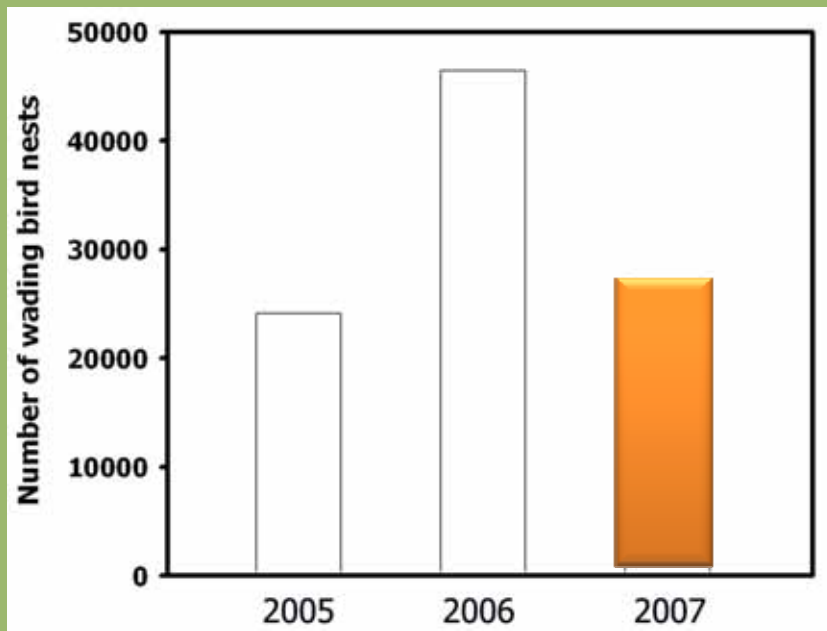


Results

Hydrology and wading bird nesting

2007

- Below average wet season rainfall and drought conditions
- Low wading bird nesting effort

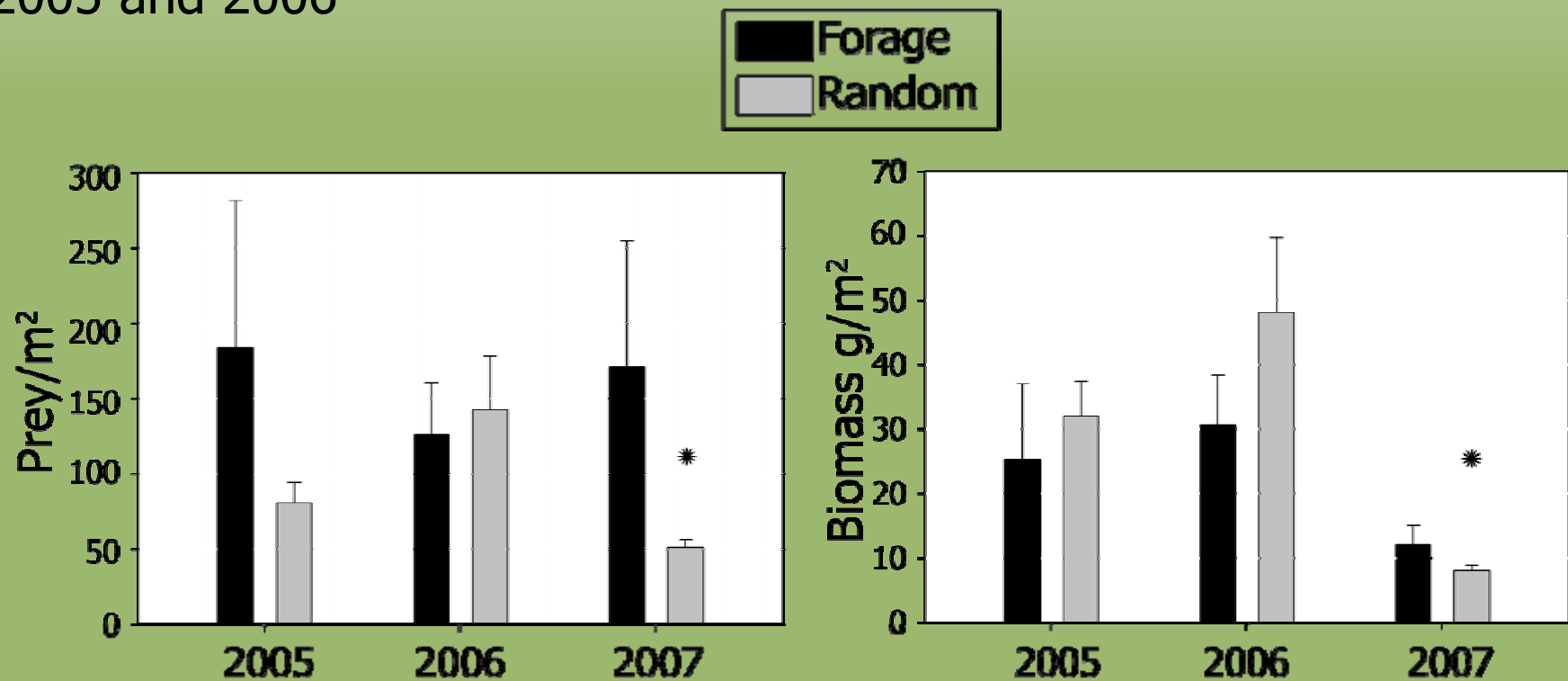


Results

Prey Concentrations

- Averaged across the entire landscape, prey density and biomass were highest in 2006 and lowest in 2007

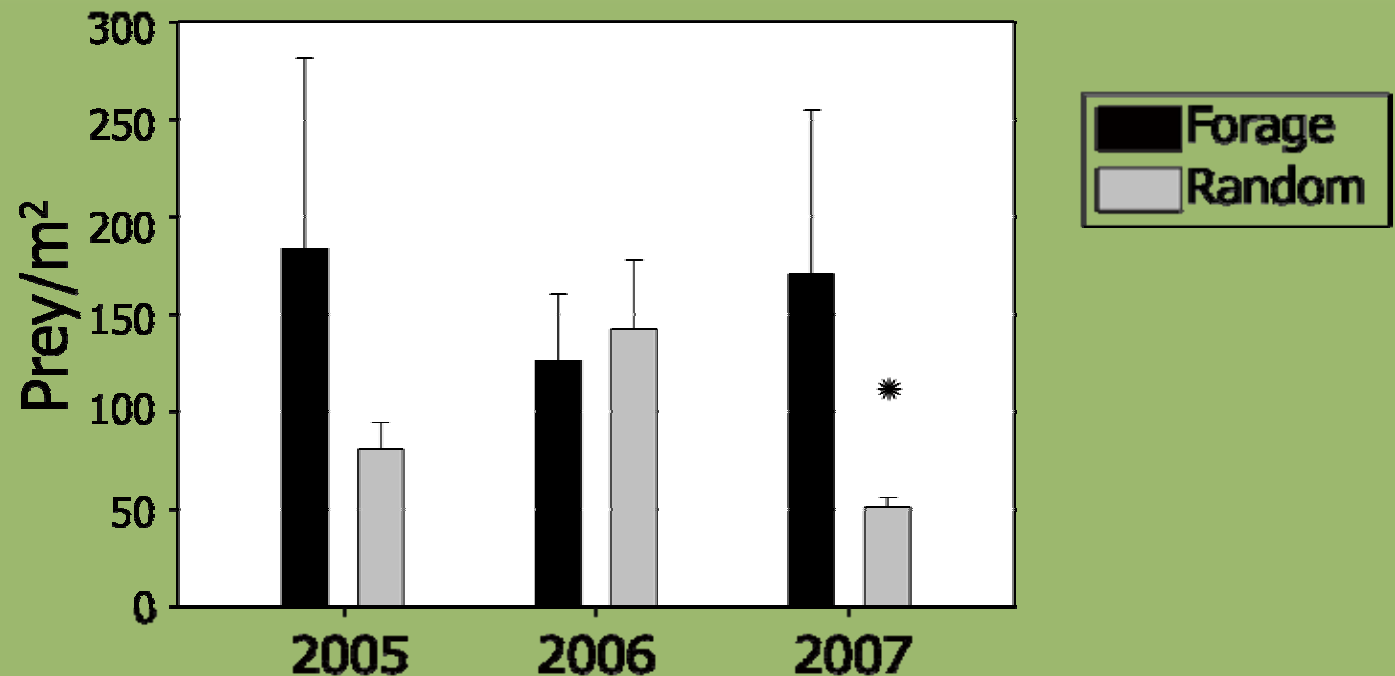
- Biomass at random sites was significantly lower in 2007 than both 2005 and 2006



Results

Random sites vs. foraging sites

- 2005 & 2007 – prey density tended to be greater at foraging sites than random sites
- 2006 – no discernable difference in prey density between random and foraging sites



Results

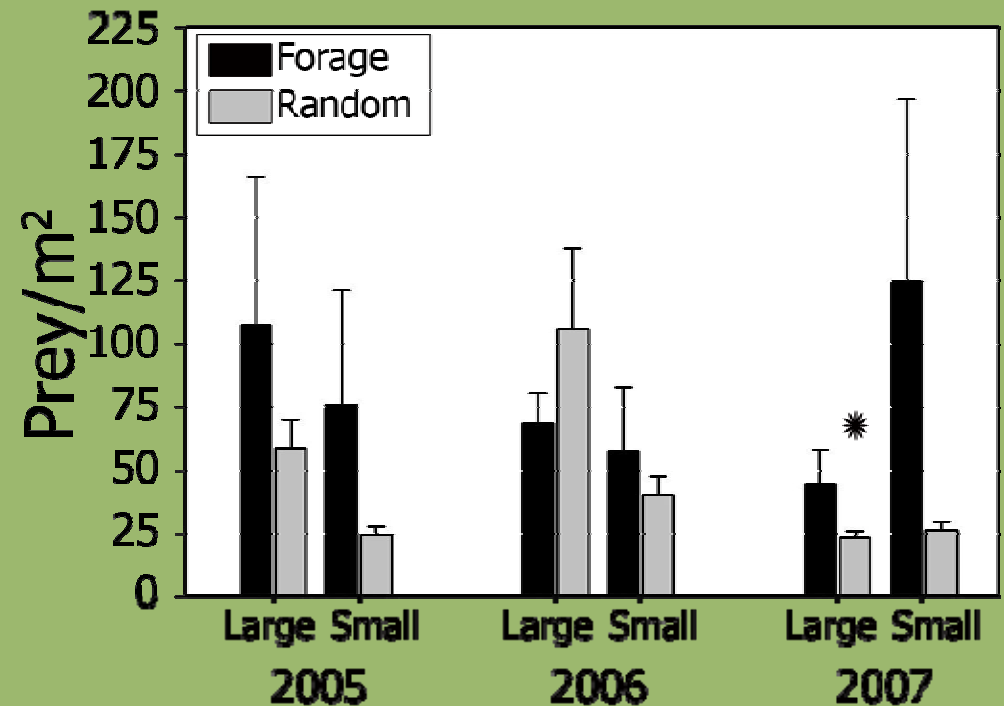
Prey Size

2005 & 2006

- Samples were comprised of a higher proportion of large prey (>2cm) than small prey
 - May be typical of samples taken as marsh is going dry but not typical of wet season samples

2007

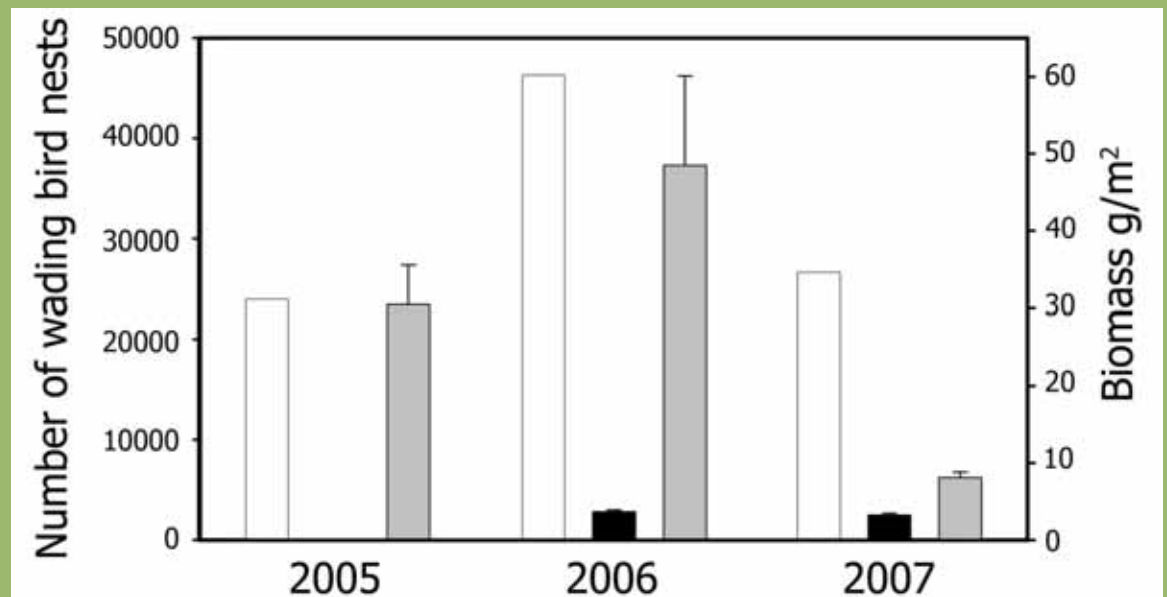
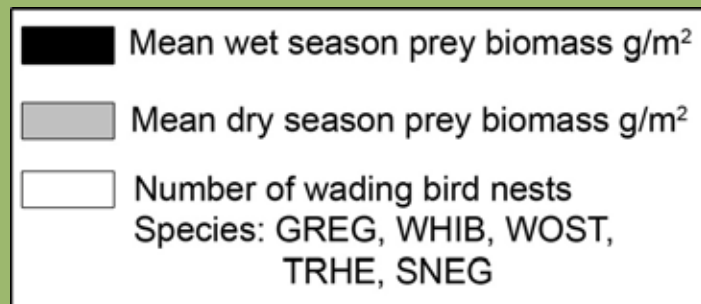
- No difference in the proportion of prey sizes
- Decline in large fish



Results

Wet season prey vs. dry season prey

- Mean biomass of prey collected during the dry season was significantly higher than mean biomass of prey collected during the wet season, especially in 2006
- Dry season biomass declined markedly from 2006 to 2007
- Wet season biomass declined only marginally
- Corresponds to a decrease in wading bird nesting effort



Results

Year	Hydrology	Prey	Nest Effort
2005	Poor Good wet season water levels, dry season marked by reversals	Low	Low
2006	Optimal Long and high wet season water levels, steady recession	High	High
2007	Poor Low wet season water levels, drought	Very low	Low



Discussion

Hydrology and wading bird nesting

2005

- many reversals
- limited by the concentration of prey



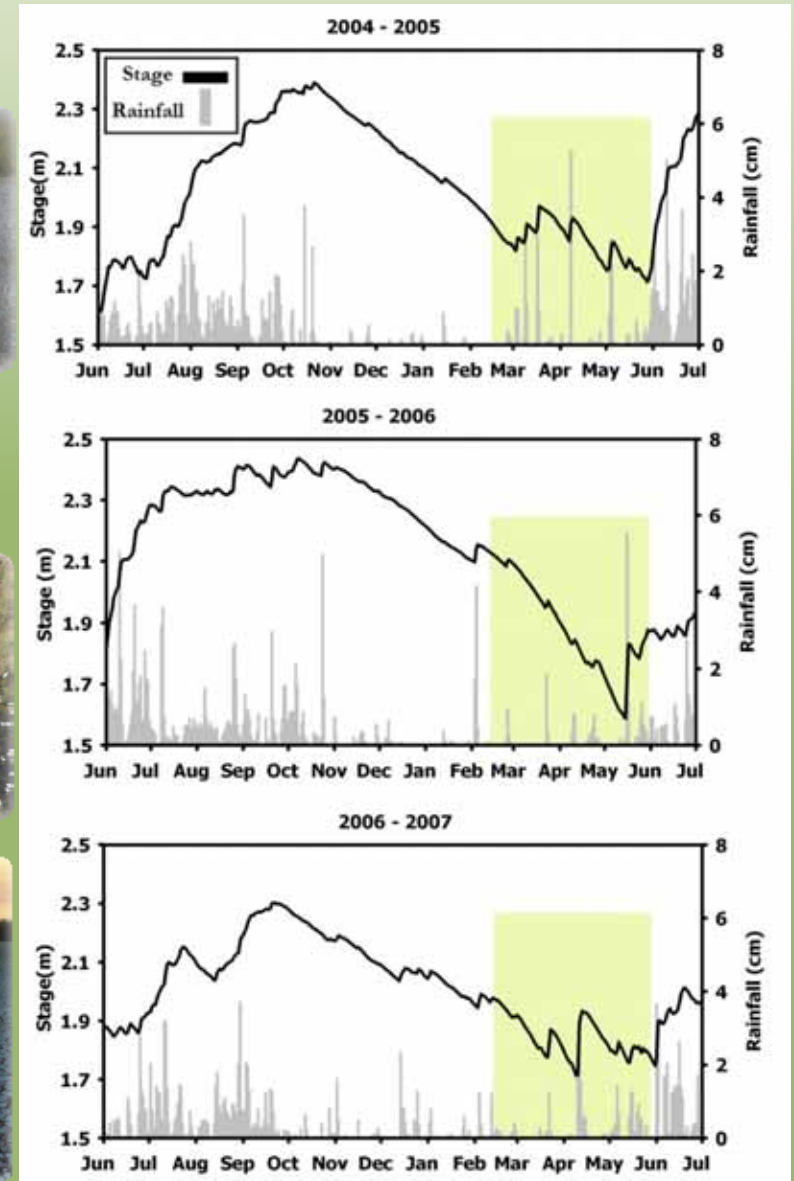
2006

- Steady drydown, high wet season water levels
- not limited



2007

- drought conditions
- limited by prey production



Discussion

Food limitation experiment
(Cook and Herring 2007)

2006

- White Ibis nestling growth not food limited

2007

- White Ibis nestling growth was food limited



Discussion

Random vs. Foraging sites

2005 & 2007 – poor hydrology, low wading bird nesting

- Despite poor conditions, birds able to find some sites with high prey densities

2006 – optimal conditions

- High quality foraging patches more common in the landscape



Discussion

Prey Size

- 2005 & 2006 – fish community in drying pools is dominated by large prey (>2cm)
- This novel pattern is opposite of what is typically seen when sampling in deeper water
- Pattern did not persist in 2007, calling into question whether the major impact of a drought on wading birds is in reduced prey population size or smaller body size
- Decline of large prey items reduces quality of prey patches

Discussion

Wet season prey vs. dry season prey

- Difference between dry season and wet season biomass more pronounced in 2006, when hydrological conditions were best for wading bird foraging
- Difference in the magnitude of the decrease in prey biomass between wet and dry season samples from 2006 to 2007 may in part be a function of birds feeding in different portions of landscape



Conclusion

- Hydrological disparities among years were associated with differences in prey concentrations and wading bird nesting effort
- Supports key trophic hypothesis: restored water → higher prey availability → higher wading bird nesting effort



Conclusion

- Evidence that wading birds are limited by prey production and concentration
- Knowledge of how these factors operate will help us more clearly define the fundamental linkage among hydrology, prey populations, and wading birds
- Refine targets for Everglades hydrological restoration



Acknowledgements

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Dedicated in memory of my friends and colleagues,
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