The effects of vegetation and water depth on wading bird foraging habitat selection and foraging success in the Everglades

Samantha Lantz
Dale E. Gawlik
Mark I. Cook

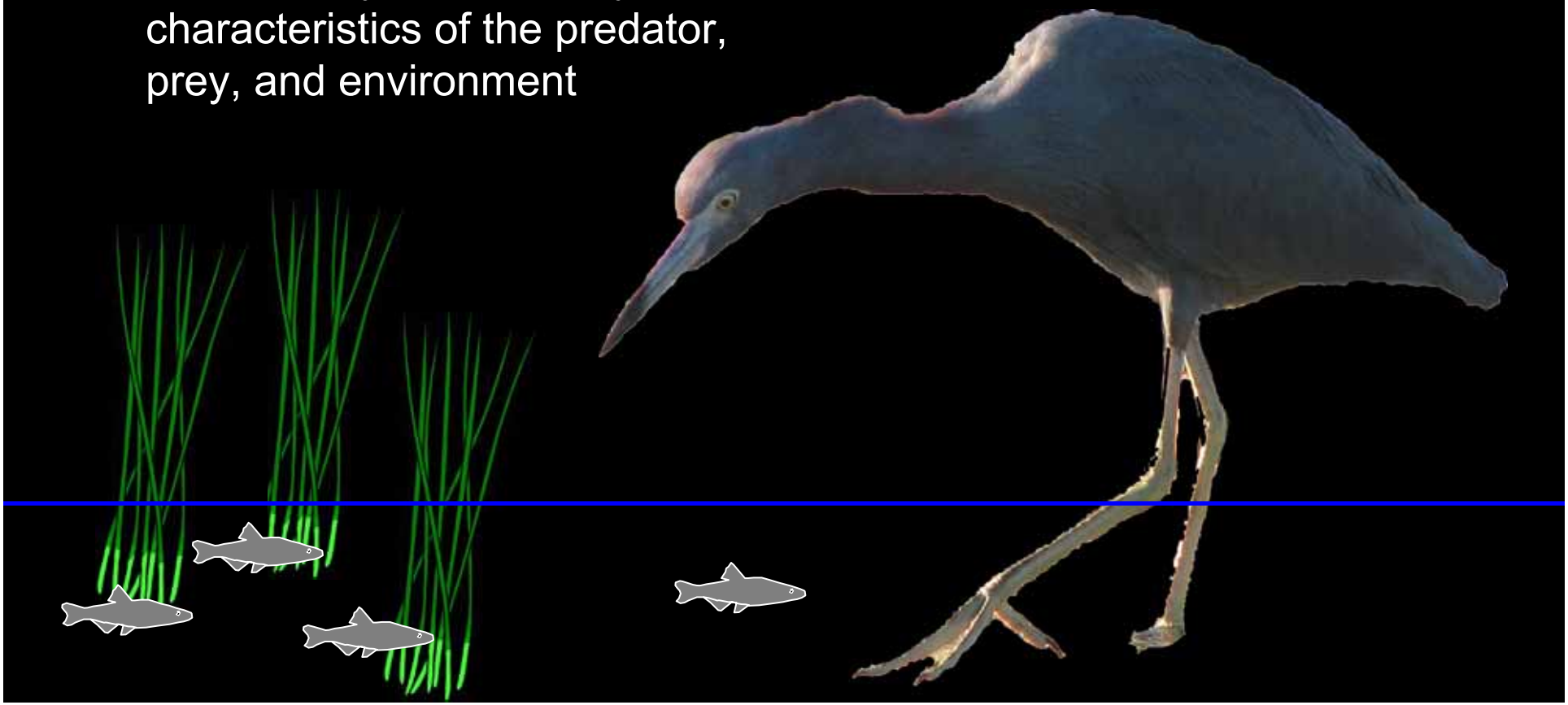
Prey Availability

- Prey availability limits the success of avian populations
- Decreases in prey availability have had detrimental effects on wading bird populations worldwide (Butler 1994, Hafner 1997)
- Little research on specific aspects or mechanisms

Prey Availability

- Prey density is often used as a surrogate for prey availability
- Availability is a combination of prey density and vulnerability to capture

- Vulnerability: Affected by characteristics of the predator, prey, and environment



Objectives

- Quantify the effects of environmental features on prey availability by measuring foraging habitat selection and foraging success

1. 2007: water depth and submerged aquatic vegetation

2. 2008: water depth and emergent vegetation

Study Site

A.R.M. Loxahatchee National Wildlife Refuge
Loxahatchee Impoundment Landscape Assessment project (LILA)

- Experimental facility simulates a landscape response
- Physical features mimic the Everglades

Study Site

- 10 × 10 m enclosures
- Allows for controlled prey and vegetation
- Replication:
  - Two macrocosms
  - Two replicates/experiment

Treatment variables

- Water depth
  - Shallow slough (10 cm)
  - Deep slough (25 cm)

- Vegetation

- 2007: Submerged Aquatic Vegetation
  - Bladderwort (*Utricularia* sp.)
  - 0, 2, 5 L/m^2

- 2008: Emergent vegetation
  - Spikerush (*Eleocharis* sp.)
  - None, Sparse, Moderate densities

Fixed variables

Decoys


Great Egrets


Snomingos

Fish

- *Gambusia affinis*
- 20 fish/m^2
- Used mark-recapture with VIE to estimate fish populations and restock daily

Data collection

- Foraging habitat selection
    - Use vs. availability measured using Manly's standardized selection index
- Foraging success
    - Foraging birds were videoed and time-activity budgets were conducted using Etholog 2.2 (Ottoni 2000)
    - Capture rates and efficiencies analyzed in SAS using ANOVA

Foraging habitat selection

Tricolored Heron

White Ibis

Great Egret

Little Blue Heron

Snowy Egret

Glossy Ibis

Roseate Spoonbill

Wood Stork

SAV Results: Foraging Habitat Selection

- Birds prefer shallow water
- Trend exaggerated throughout the season

Depth	January	April
10 cm	0.58	1.0
25 cm	0.42	0.0

SAV Results: Foraging Habitat Selection

- Birds selected enclosures with SAV

SAV	January	April
0 L/m^2	0.19	0.32
2 L/m^2	0.36	0.48
5 L/m^2	0.45	0.20

SAV results: Foraging success

- Significant differences based on the season (Jan or April replicate)
- Environmental factors had little affect on foraging success

Capture Rate	**P**
Season	<0.0001
Water depth	0.99
SAV density	0.28

Capture Efficiency	**P**
Season	0.057
Water depth	0.046
SAV density	0.20

SAV results: Foraging success

- Great Egrets had higher foraging success in deeper water
- Great Egrets may prefer deeper water (Moreno et al. 2004)
- Great Egrets have a lower GUD than other species (Gawlik 2002)

Emergent vegetation: Foraging habitat selection

- Birds selected enclosures with shallow water and sparse vegetation

Water Depth	Emergent Vegetation Density	Standardized Selection Index
Shallow	None	0.302
Shallow	Sparse	0.404
Shallow	Moderate	0.208
Deep	None	0.037
Deep	Sparse	0.030
Deep	Moderate	0.019

Emergent vegetation: Foraging success results

- Because of strong selection for shallow water, vegetation was the only treatment variable
- Vegetation density had little affect on foraging success

Capture Rate	**P**
Vegetation Density	0.19

Capture Efficiency	**P**
Vegetation Density	0.29

Discussion: SAV and Emergent vegetation

- In both years, birds showed a preference for shallow water and intermediate levels of vegetation density
- Differences between 2007 and 2008
    - 2007: Seasonal differences
    - Increased foraging success in April
        - Change in needs of birds
            - Pre-breeding vs. breeding season birds
            - Higher foraging success during breeding season

Discussion

- Selection for shallow water is consistent with other studies
- Prior studies show mixed results regarding vegetation
- Kersten et al. (2001) found that fish were pushed into open patches during early morning hours because of overnight respiration by macrophytes
- Vegetation may calm the water surface, thus increasing visibility
- Vegetated areas may have higher prey densities

Discussion

- Birds showed strong selection patterns but treatments did not appear to affect foraging success
- Contradicts studies of piscine predators foraging in vegetation
- Why select for shallow water and vegetated habitat?

Why select for shallow water and vegetated habitat?

- Anticipated elevated prey densities
    - Dry season recession in the Everglades may concentrate prey in shallow water
    - Prey densities often higher within vegetation (Dvorac and Best 1982, Diehl 1988, Rozas and Odum 1988)
    - No difference here because of controlled fish densities
- Other possibilities: ecological trap theory (Battin 2004), high prey density may have resulted in a threshold response (Holling 1959), intra- and interspecific differences between birds (age, relative satiation, etc.)

Applications to Everglades Restoration

- One of the first studies to investigate the linkages between wading birds, fish, and habitat features
- Understanding how upper trophic level animals respond to hydrologic manipulations is essential in using these species to set targets or track restoration progress

Applications to Everglades Restoration

- CERP has an emphasis on getting the water right, and changes to hydrology are known to affect vegetative communities
- Changes in hydrology and vegetative communities could affect the attractiveness of habitat to foraging birds
- Remains uncertain how this may affect wading bird population dynamics
- There is a wide gradient of habitat features that provide suitable foraging habitat for wading birds

Acknowledgments

Gawlik lab: Tyler Beck, James Beerens, Bryan Botson, Garth and Heidi Herring, Rachael Pierce, Phil Heidemann, Damion Marx, Rebecca Stanek

Technicians and volunteers: Juliet Lamb, Angela Sjollema, Kristen Simpson, Tia Anderson, Meghan Weaver

A.R.M. Loxahatchee National Wildlife Refuge: Eric Cline, Ryan Desliu

South Florida Water Management District: Fred Sklar

Dedicated in memory of Gareth Akerman, Phil Heidemann, and Damion Marx