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
Methods

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

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

Site Selection

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

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Hydrology</th>
<th>Prey</th>
<th>Nest Effort</th>
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</thead>
<tbody>
<tr>
<td>2005</td>
<td>Poor</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td></td>
<td>Good wet season water levels, dry season marked by reversals</td>
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<tr>
<td>2006</td>
<td>Optimal</td>
<td>High</td>
<td>High</td>
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<td></td>
<td>Long and high wet season water levels, steady recession</td>
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<tr>
<td>2007</td>
<td>Poor</td>
<td>Very low</td>
<td>Low</td>
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<td></td>
<td>Low wet season water levels, drought</td>
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</tbody>
</table>
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
Food limitation experiment
(Cook and Herring 2007)

2006
• White Ibis nestling growth not food limited

2007
• White Ibis netling 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
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