Wading bird responses to hydrological variation at Lake Okeechobee

David A. Essian[1], Jennifer Chastant[1,2], Jenna May[3,4], and Dale E. Gawlik[1,3]

1. Department of Biological Sciences, Florida Atlantic University

2. Environmental Resources Management, Palm Beach County

3. Environmental Science Program, Florida Atlantic University

4. Planning and Policy Division, United States Army Corps of Engineers

Quantitative tools for restoration

- Alligator
- Amphibian
- Crayfish
- CSSS Marl Prairie
- Vegetation (ELM and ELVes)
- Snail Kites (EverKite)
- Apple Snails (EverSnail)
- Prey Fish Biomass
- Small Fish Density
- Slough Vegetation
- Roseate Spoonbill
- Great Egret, White Ibis, and Wood Stork (WADEM)

Source: https://www.jem.gov/Modeling/WADEM

https://www.sfwmd.gov/our-work/cerp-project-planning

https://nps.maps.arcgis.com/apps/Shortlist/index.html?appid=fdbe3807f91c4206abeac2ae6fa5573d

National Academies Press, 2018

1. “Improve water levels in Lake Okeechobee…”

2. “Improve the quantity and timing of discharges to the St. Lucie and Caloosahatchee estuaries…”

3. “Restore degraded habitat for fish and wildlife throughout the study area…”

4. “Increase the spatial extent and functionality of wetlands”

https://www.saj.usace.army.mil/LOWRP/

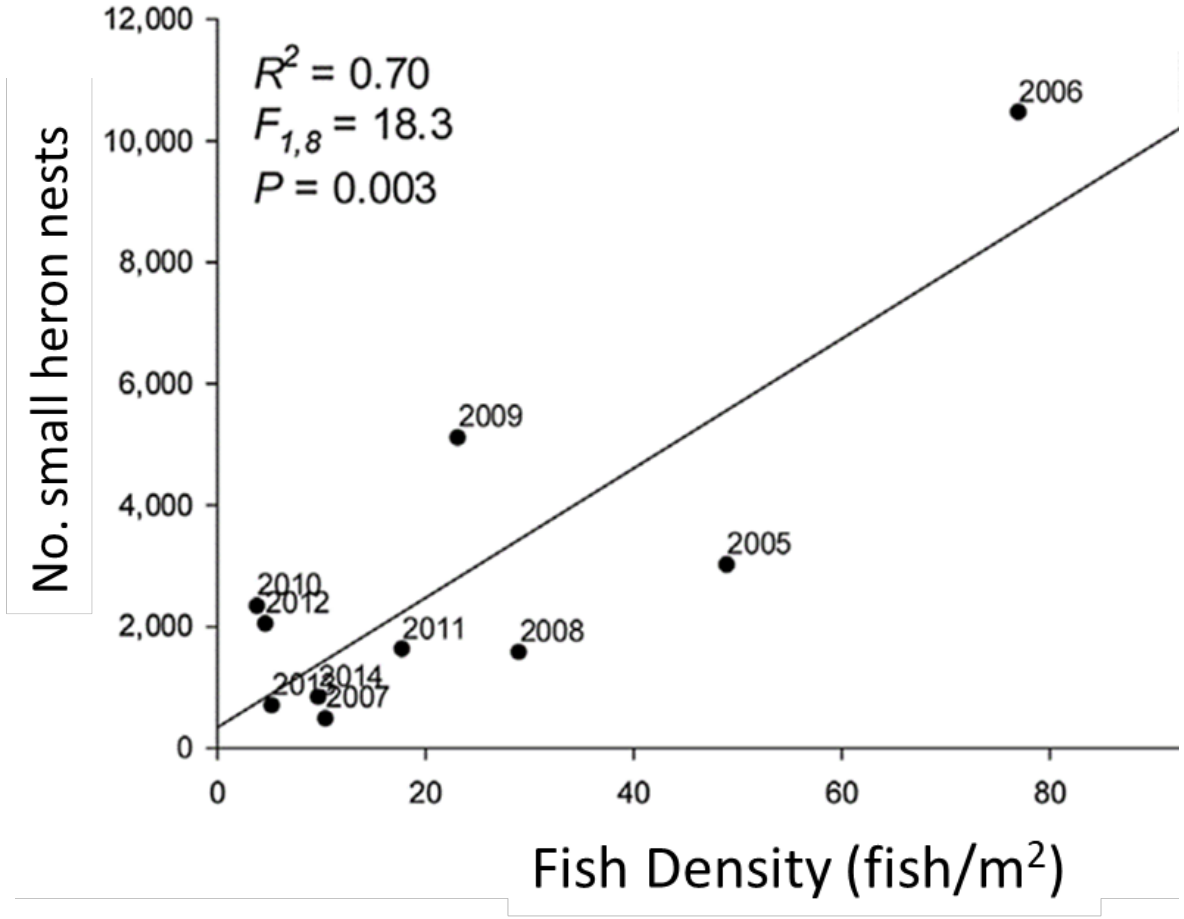
Objective

- To investigate the effect of hydrological variation on wading bird habitat availability and prey densities
- To quantify the effects of hydrological variation on wading bird populations

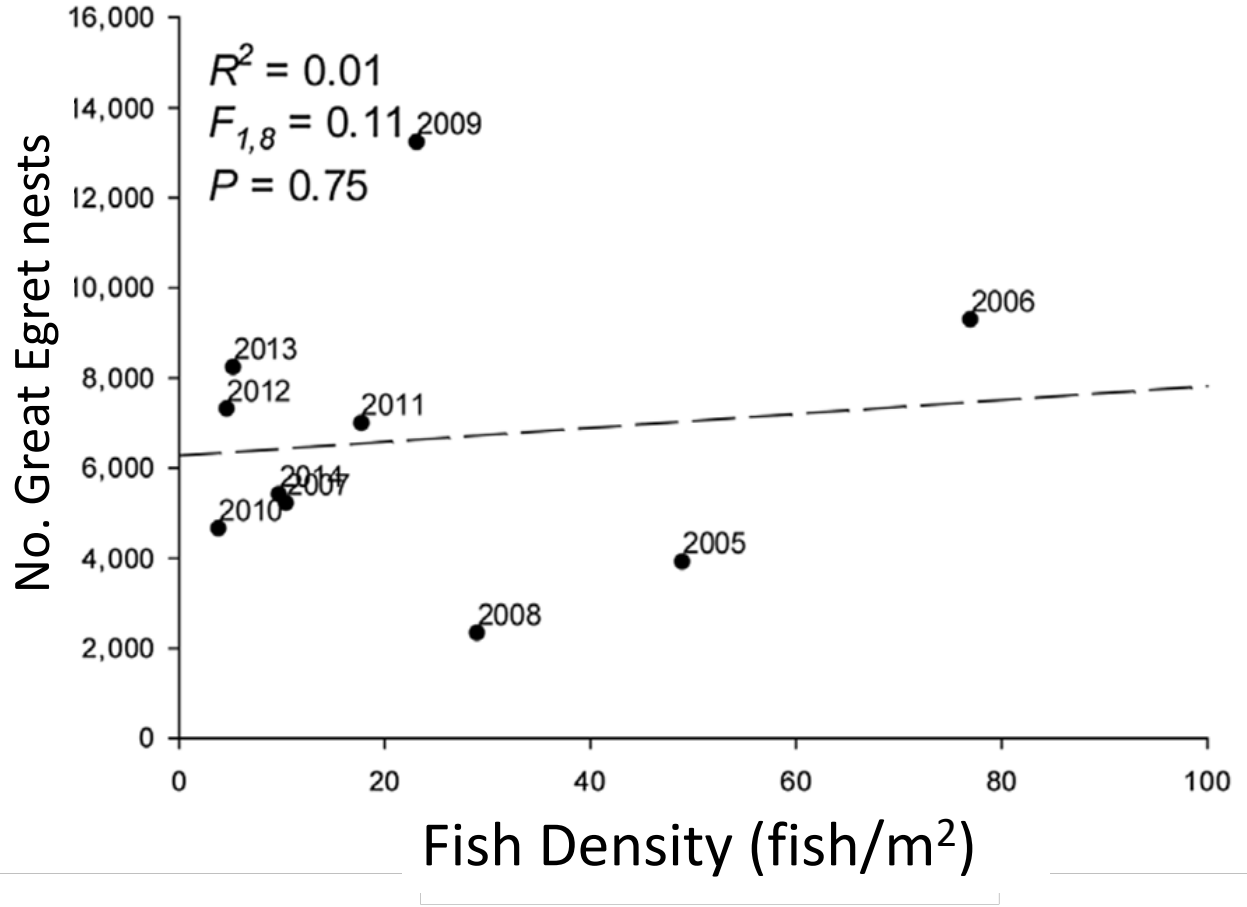
Snowy Egret (*Egretta thula*)

Great Egret (*Ardea alba*)

Small Herons (*Egretta sp.*)

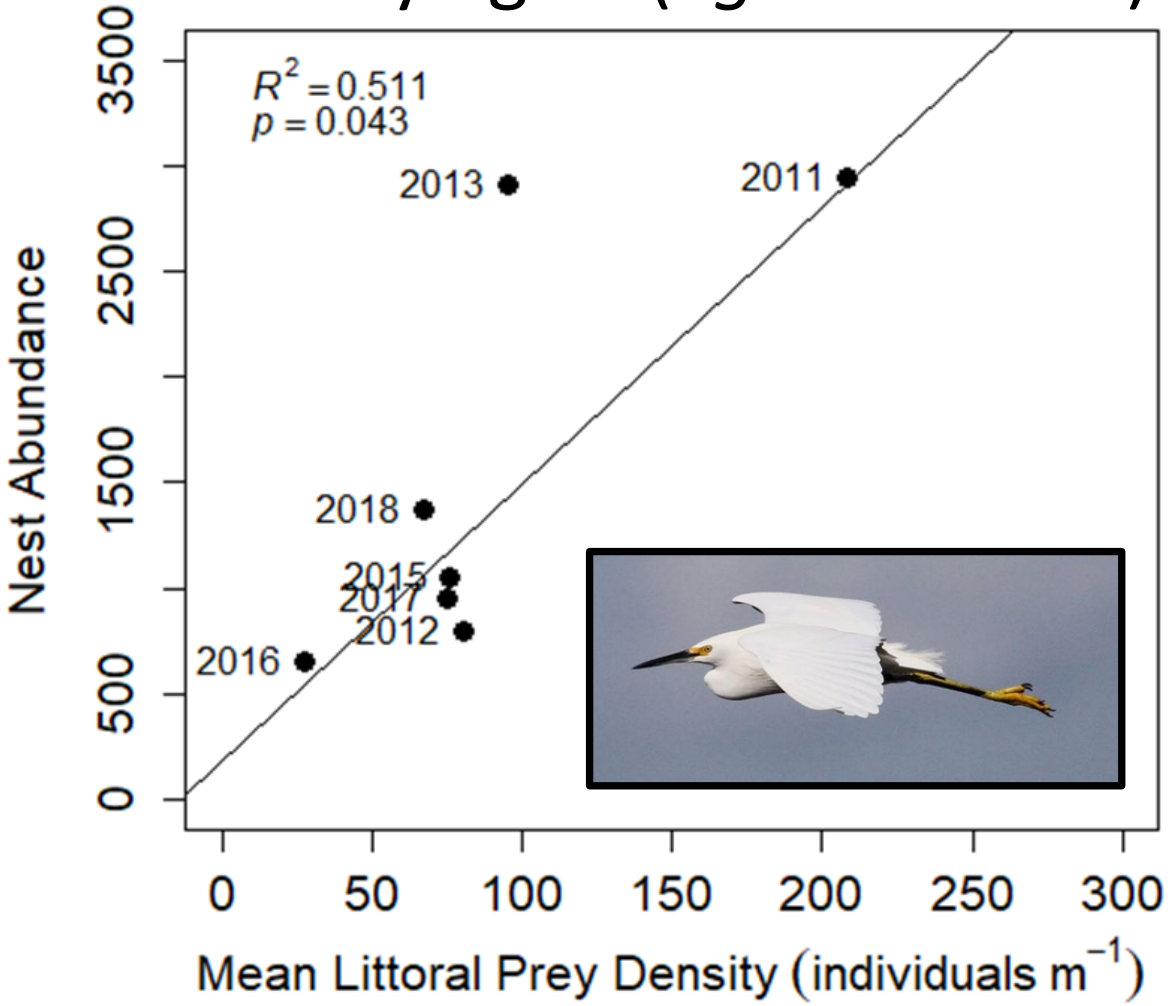


Great Egret (*Ardea alba*)

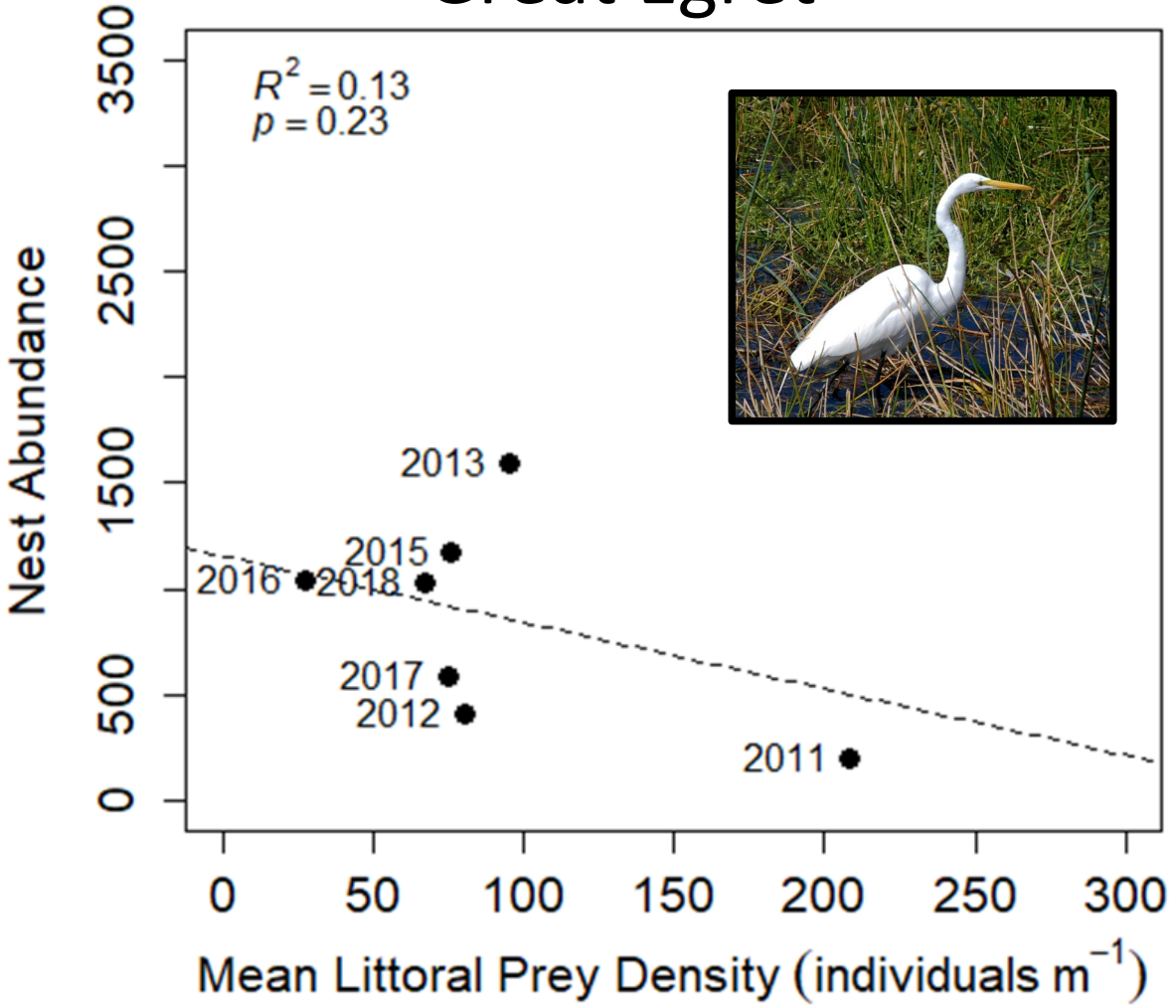


Klassen et al. 2016

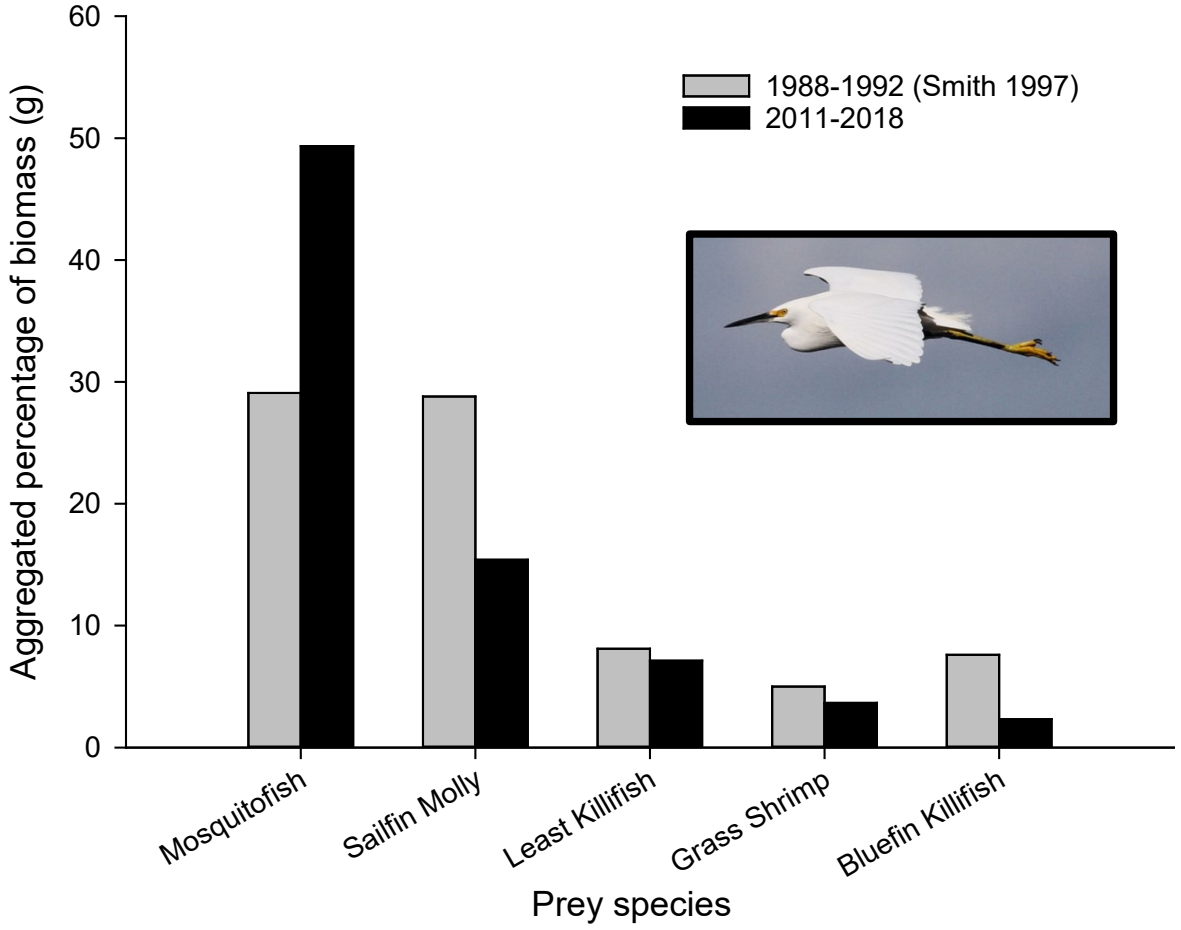
Snowy Egret (*Egretta thula*)



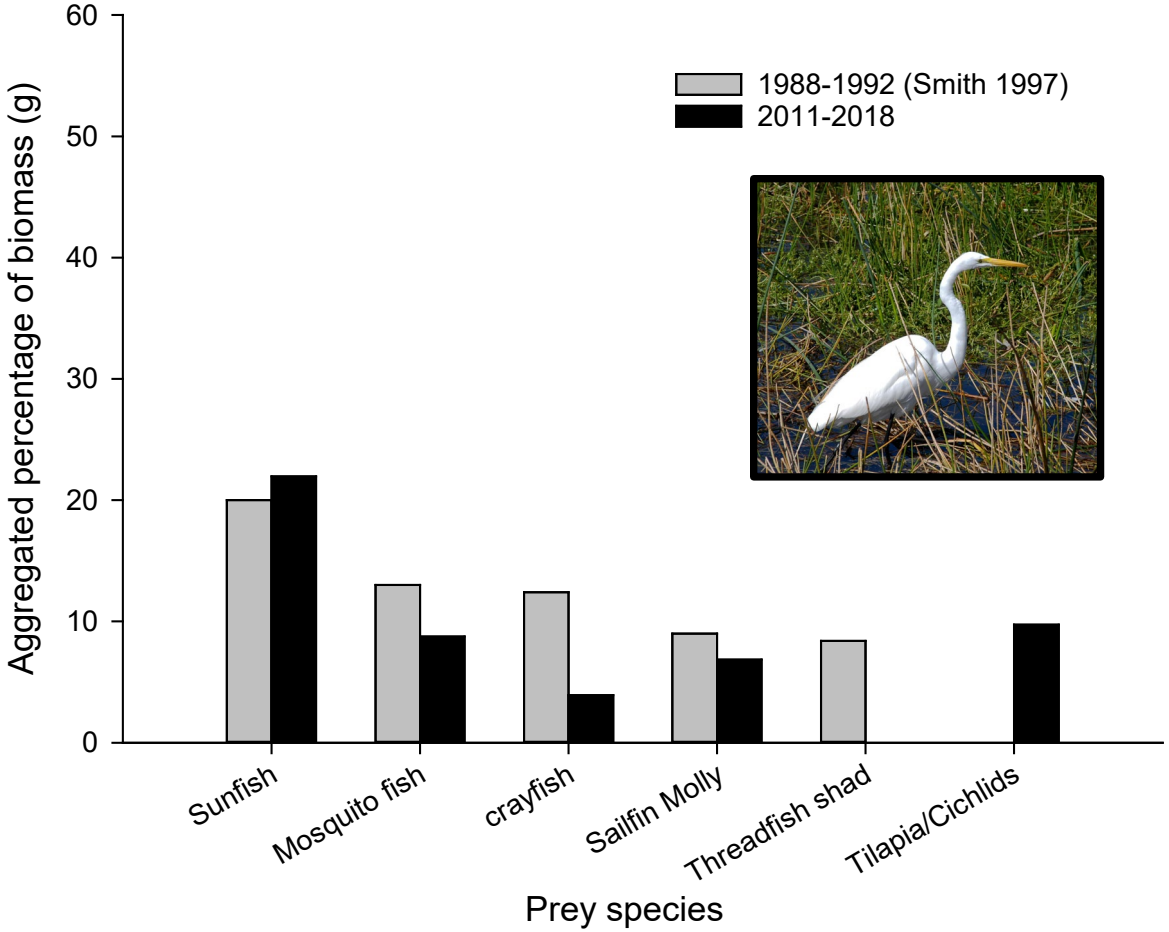
Great Egret

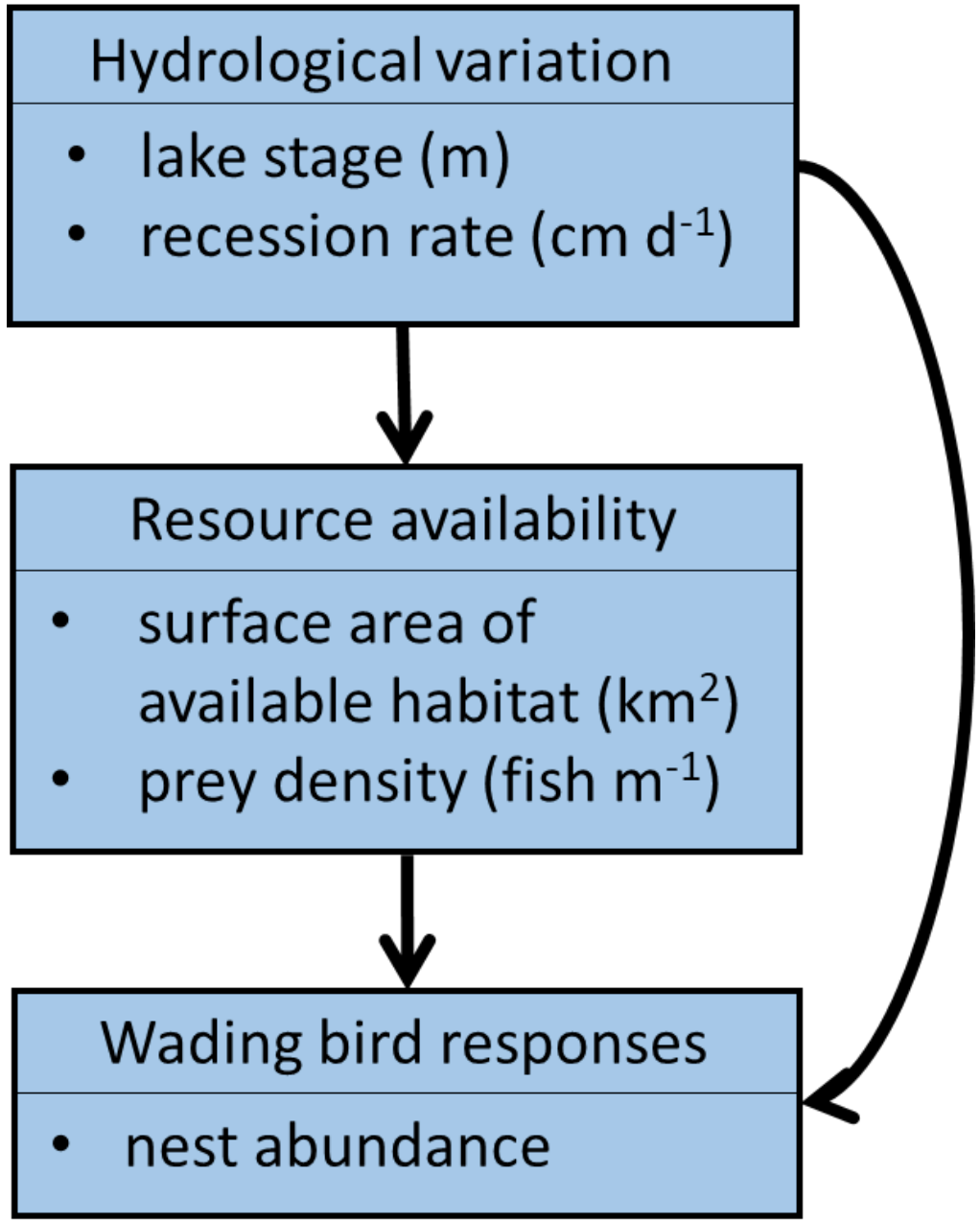


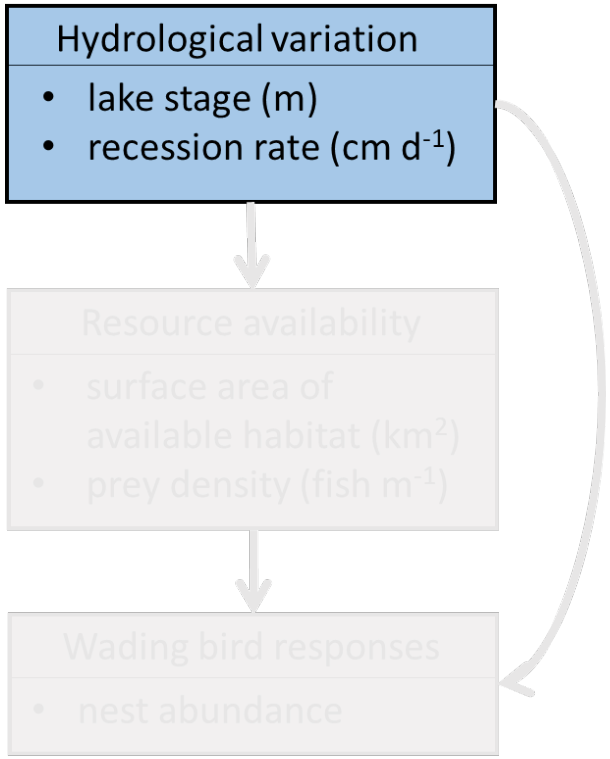
Snowy Egret



Great Egret

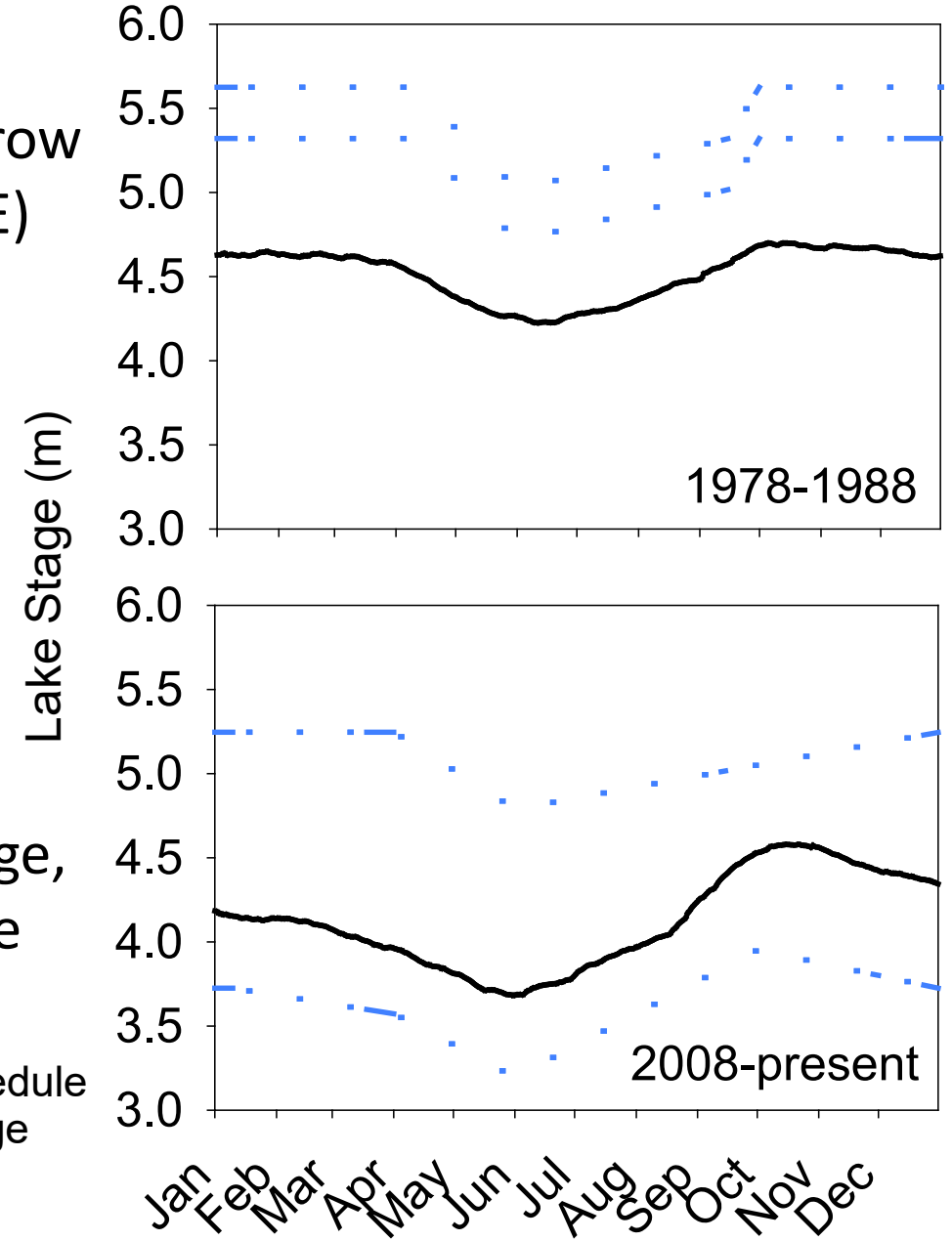



Hydrological variation
• lake stage (m)
• recession rate (cm d-1)
Resource availability
• surface area of available habitat (km2)
• prey density (fish m-1)
Wading bird responses
• nest abundance



High stage, narrow envelope (HSNE)

Moderate stage, wide envelope



DBHYDRO (SFWMD)

Trimble and Marban, 1988 & 1989; SFWMD, 2010

Hydrological variation

- lake stage (m)
- recession rate (cm d^{-1})

↓

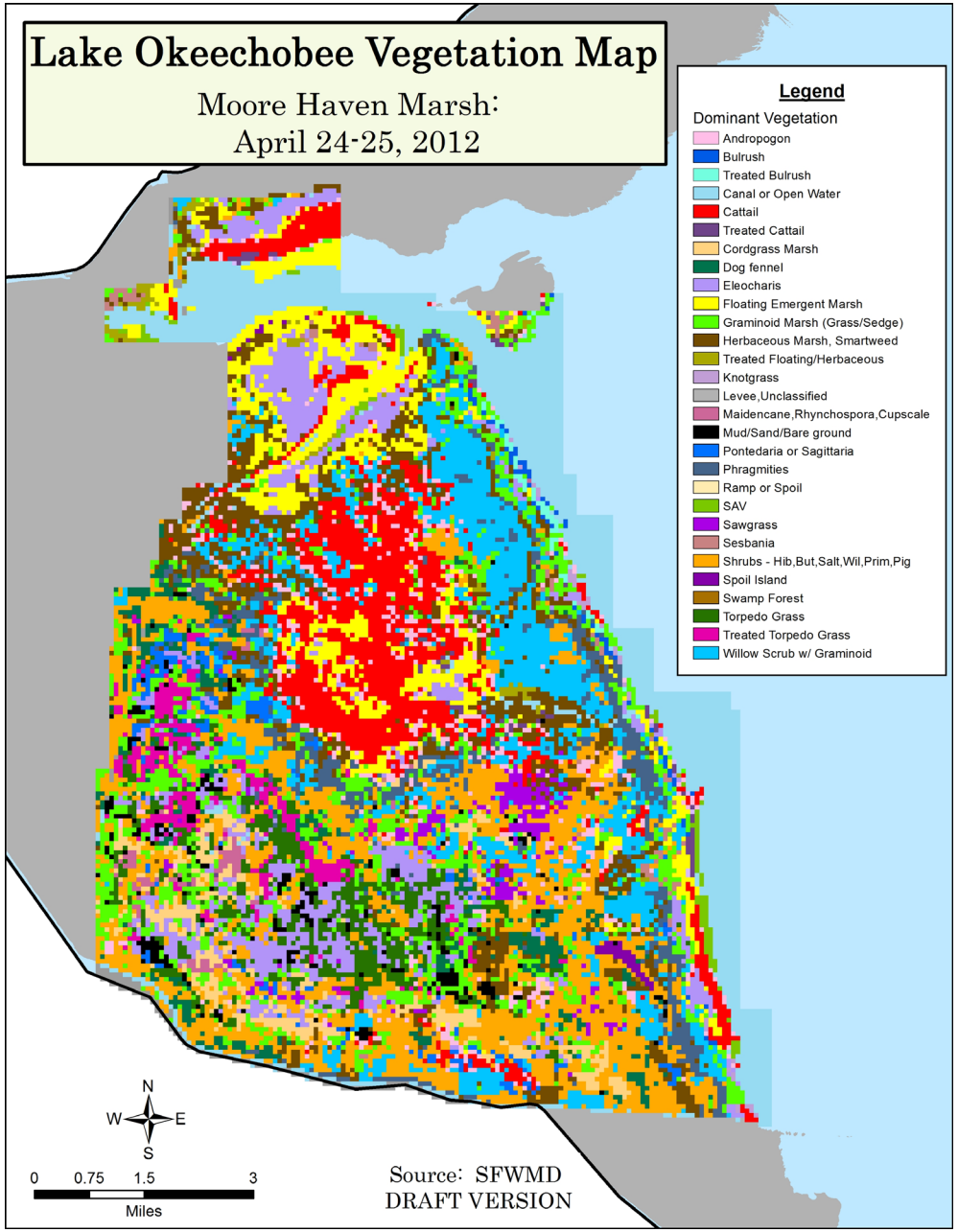
Resource availability

- surface area of available habitat (km^2)
- prey density (fish m^{-1})

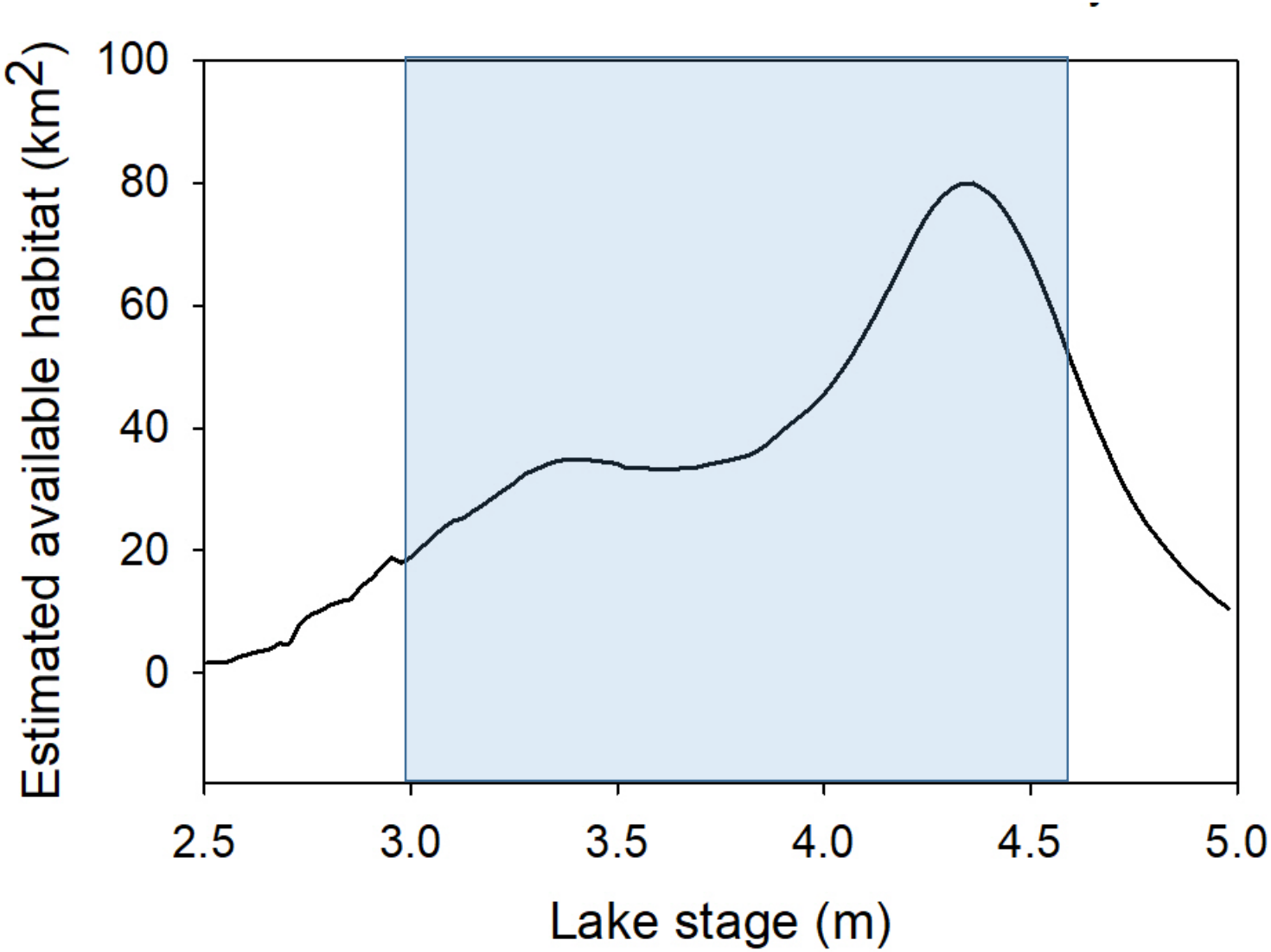
↓

Wading bird responses

- nest abundance



https://www.sfwmd.gov/document/lake-okeechobee-moore-haven-marsh-vegetation-map-2012



- Habitat availability peaks when lake stages are between 4.0-4.5 m

Hydrological variation

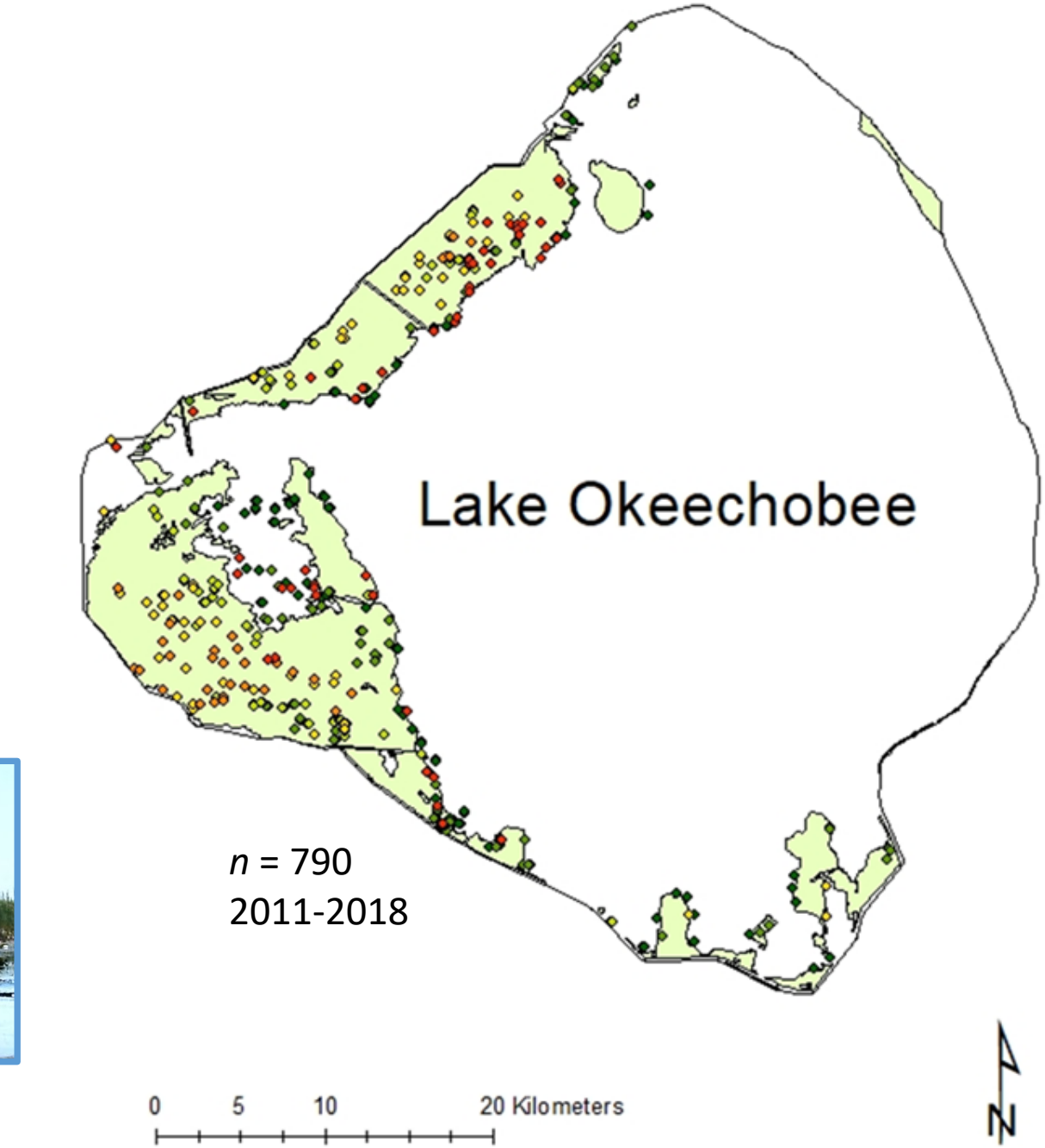
- lake stage (m)
- recession rate (cm d^{-1})

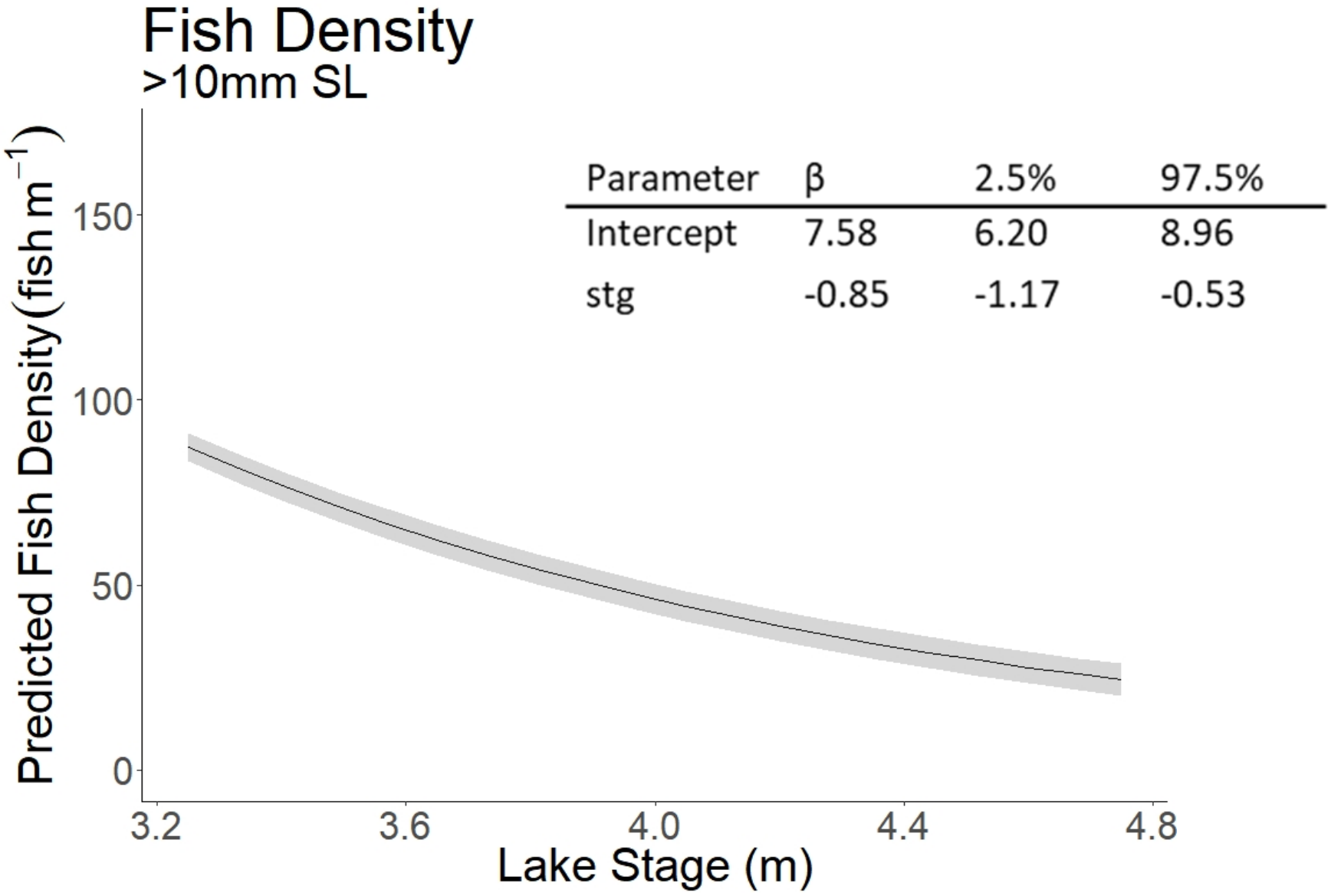
Resource availability

- surface area of available habitat (km^2)
- prey density (fish m^{-1})

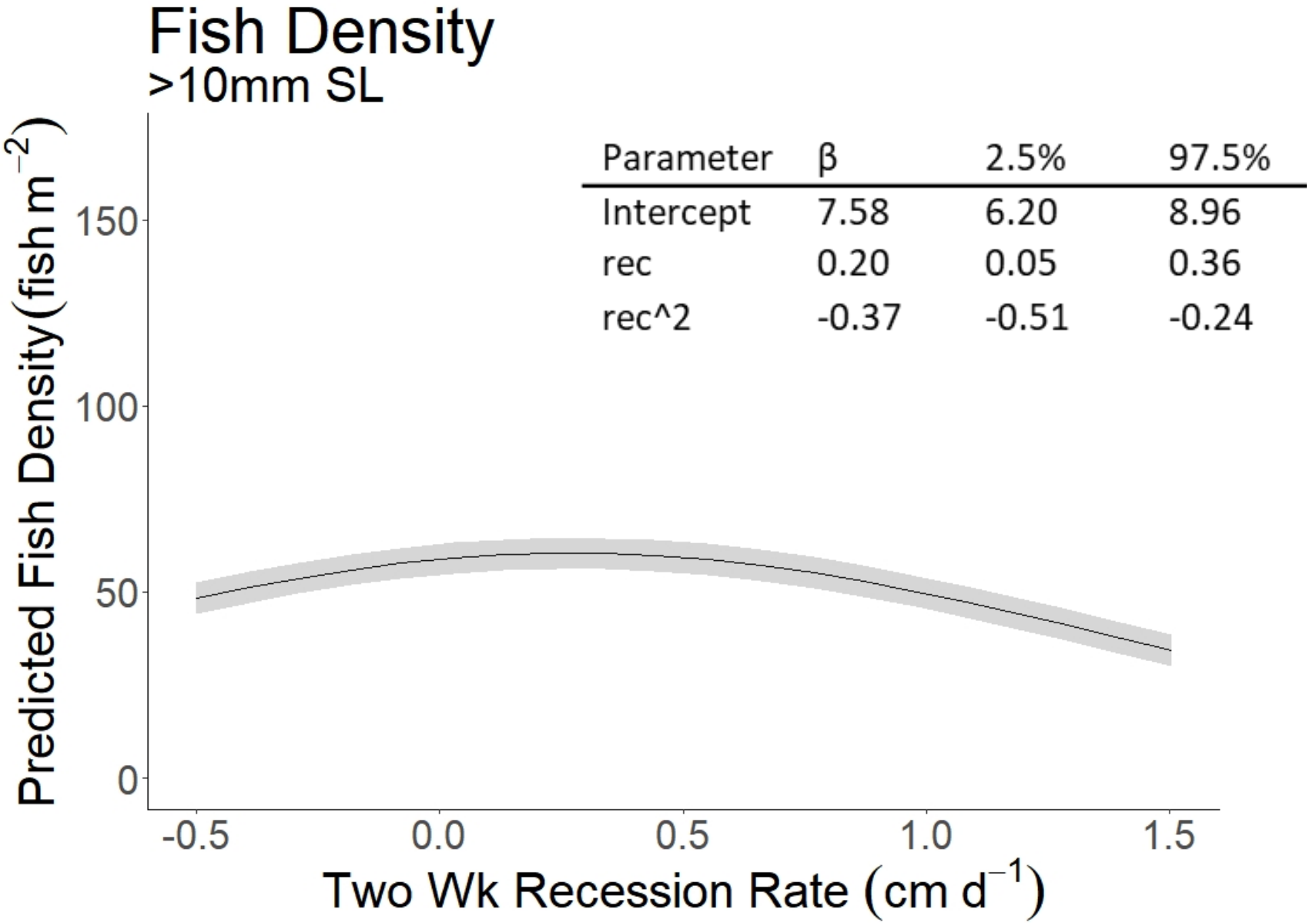
Resource availability

- nest abundance
- survival



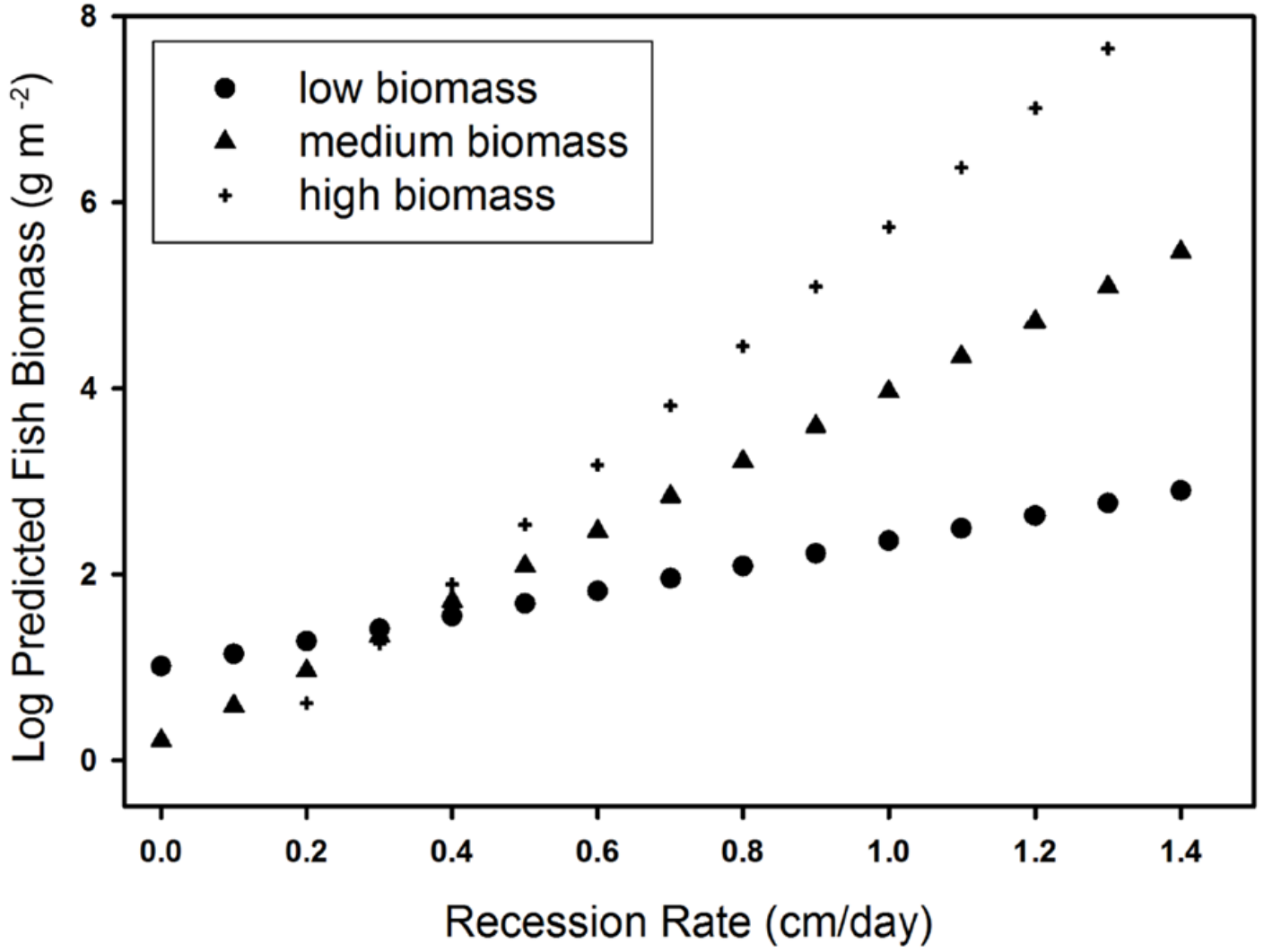


- Predicted fish densities decline with lake stage



Parameter	β	2.5%	97.5%
Intercept	7.58	6.20	8.96
rec	0.20	0.05	0.36
rec^2	-0.37	-0.51	-0.24

- Fish densities are only weakly affected by recession rate



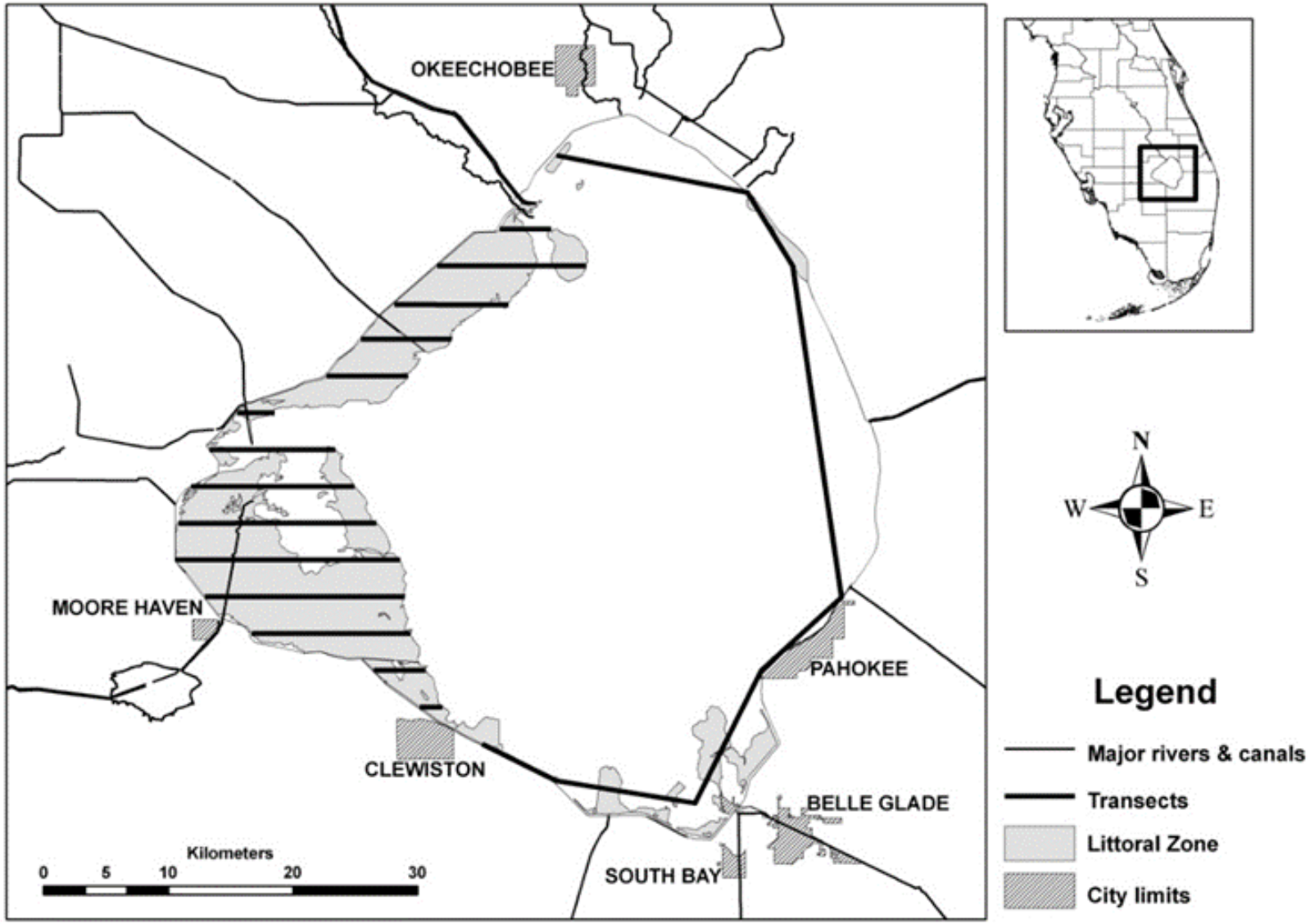
Botson et al. 2016

Why is recession rate not important in predicting fish densities at the lake?

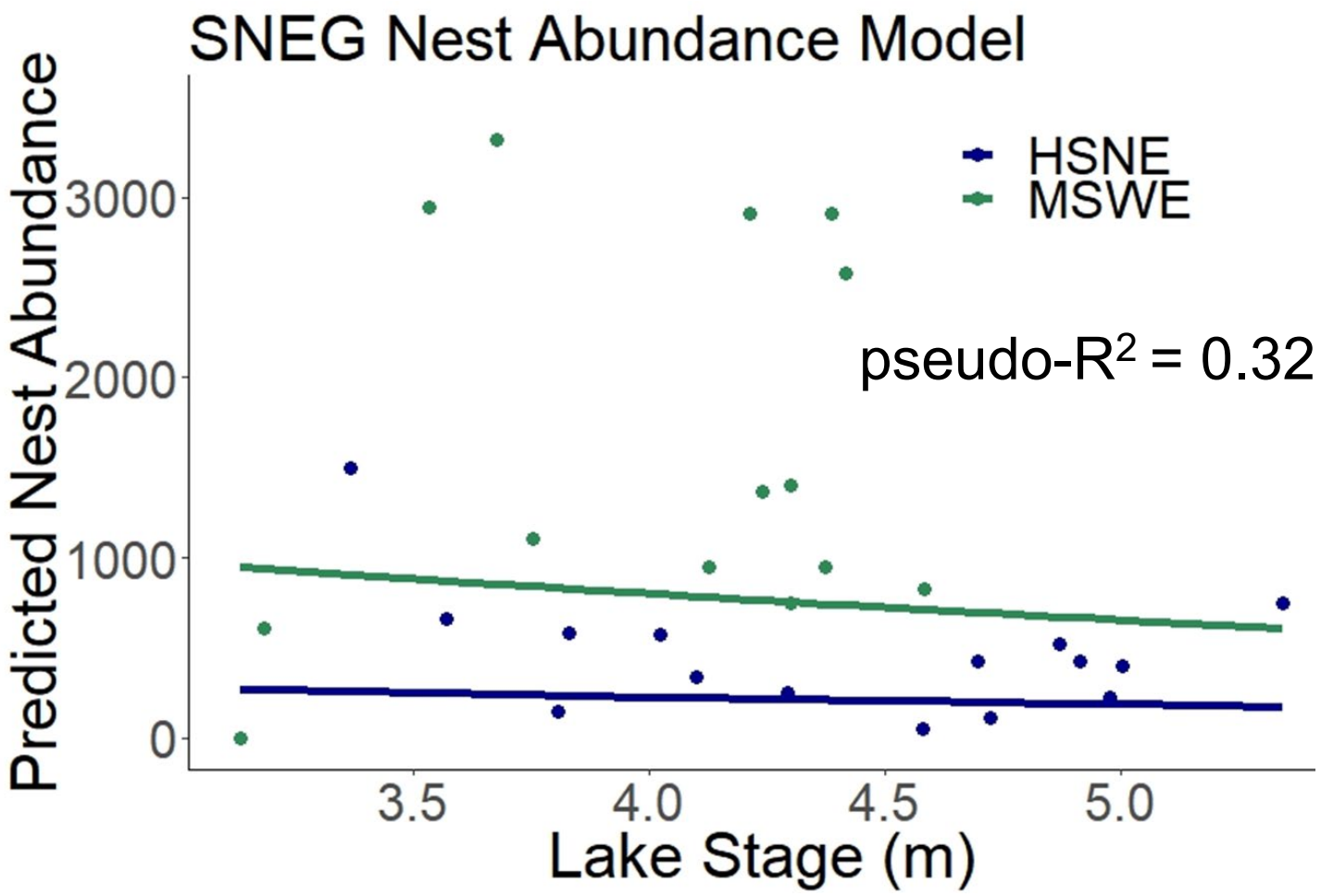
Hydrological variation
- lake stage (m)
- recession rate (cm d^{-1})

Resource availability
- surface area of available habitat (km^2)
- prey density (fish m^{-1})

Wading bird responses
- nest abundance



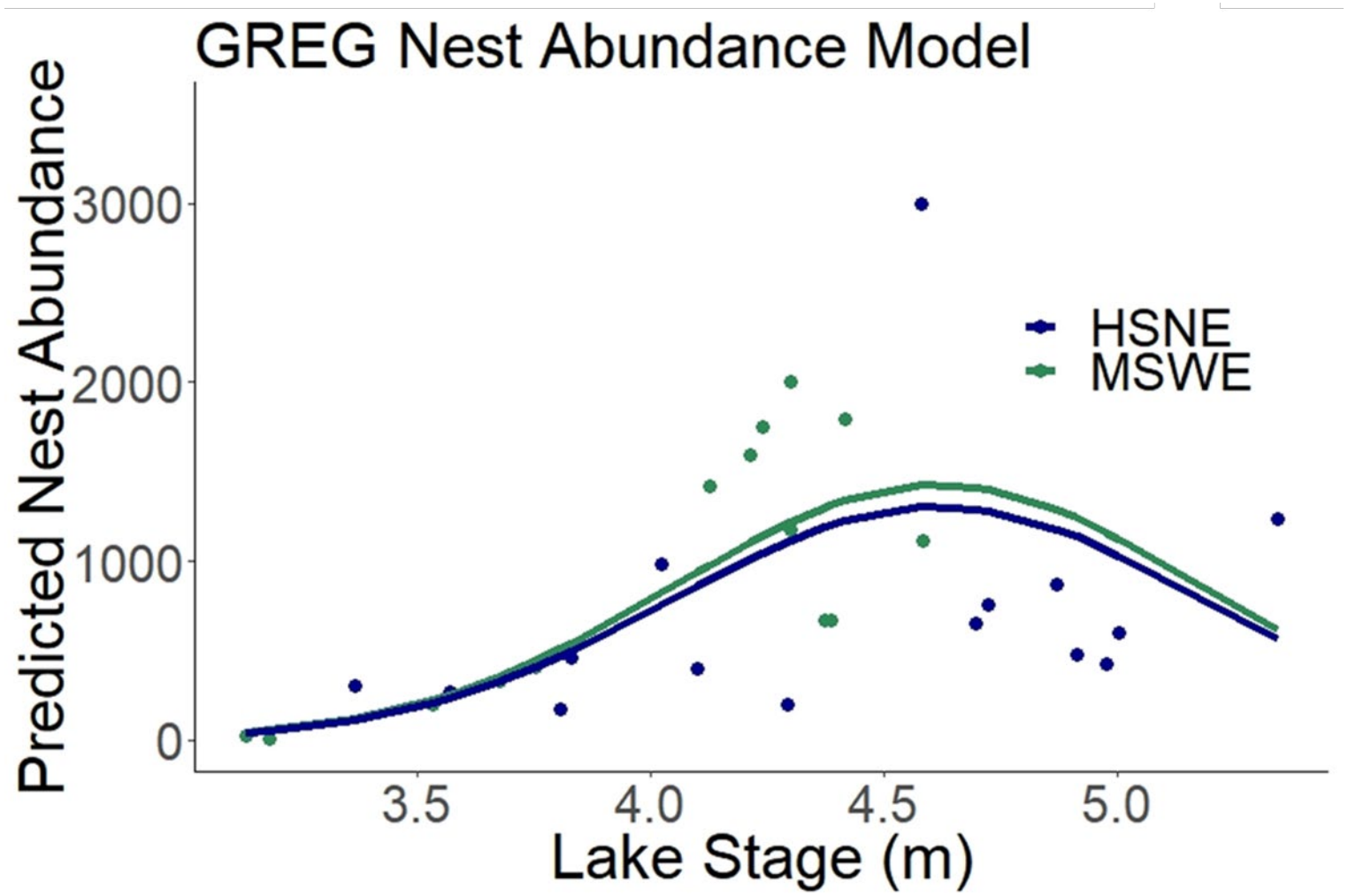
- Aerial surveys (1977-1992; 2005-2018)
- *n* = 29



Parameter	β	2.5%	97.5%
Intercept	6.32	4.80	7.85
MSWE	1.25	0.55	1.94

- Lake stage and recession rate had no effect on lake-wide annual nest abundance
- Snowy Egrets are potentially sensitive to changes in management

model	K	logLikelihood	AICc	delta	weight
mgmt	3	-224.20	455.40	0.00	0.55
global	6	-215.14	446.30	7.13	0.02
null	2	-221.50	4.47.5	8.32	0.01

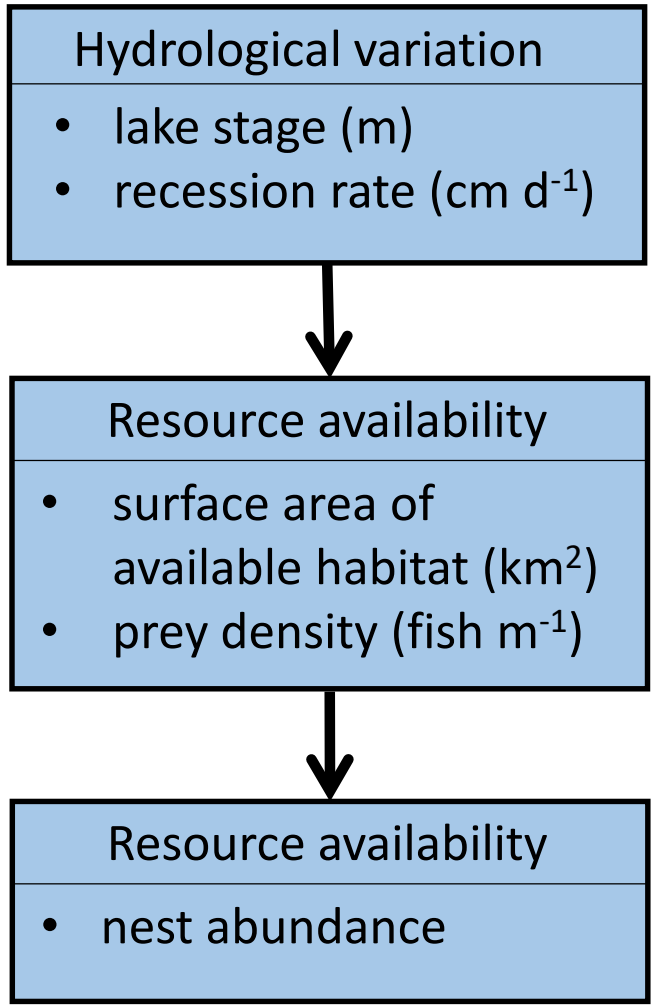


Parameter	β	2.5%	97.5%
Intercept	-26.46	-38.47	-14.46
stg	14.58	8.78	20.37
stg^2	-1.58	-2.27	-0.89

- Management had no effect
- Lake stage was the most informative parameter

model	K	logLikelihood	AICc	delta	weight
stg + stg^2	4	-211.11	431.90	0.00	0.66
global	6	-217.22	437.90	6.04	0.03
null	2	-223.56	451.60	19.70	0.00

Conclusions



- Little effect of recession rate on prey availability, or wading bird productivity
  - Suggests differences between wading bird responses in the two regions
- Differences between species highlight the need for species-specific models
- First generation of models that can be used to inform management, with potential to develop further

Acknowledgements

- U.S. Army Corps of Engineers
- South Florida Water Management District
- Florida Ornithological Society
- Florida Atlantic University Graduate and Professional Student Association
- Gawlik Avian Ecology Lab
  - Jacquie Evans
  - Brian Eachus

@FAUAvianEcology