Modeling trophic linkages using a multiscale approach

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Trophic hypothesis

- Altered hydrology resulted in reduction in prey and triggered decline in wading birds
- More water → More fish → More birds

What influences wading bird nest abundance?

- Hydrological fluctuations (Botson 2012, Beerens et al. 2015, Petersen 2017)
- Fish density (small herons) vs. habitat availability (GREG, WHIB, WOST; Klassen et al. 2016)

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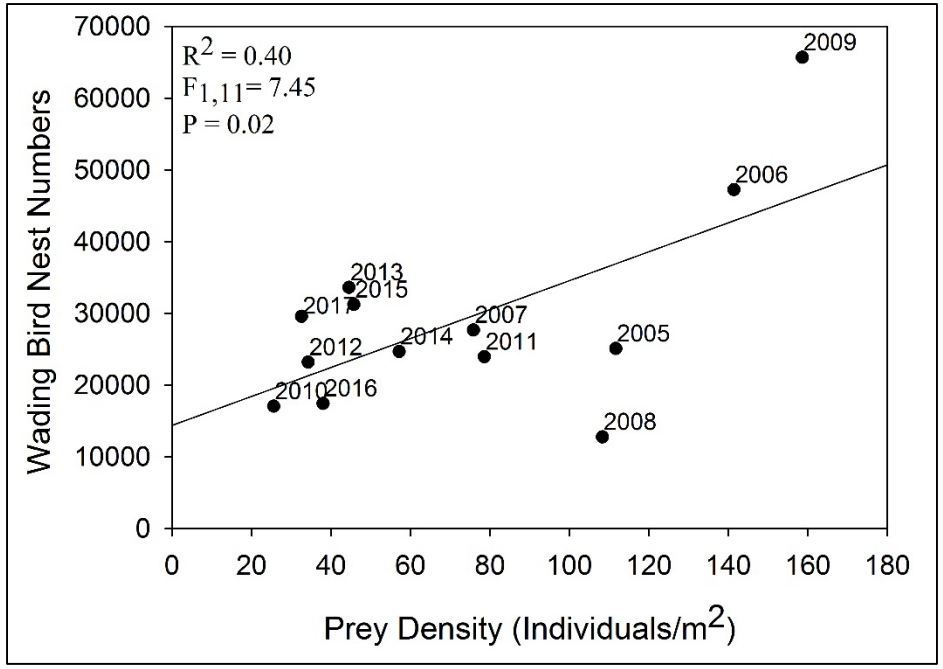
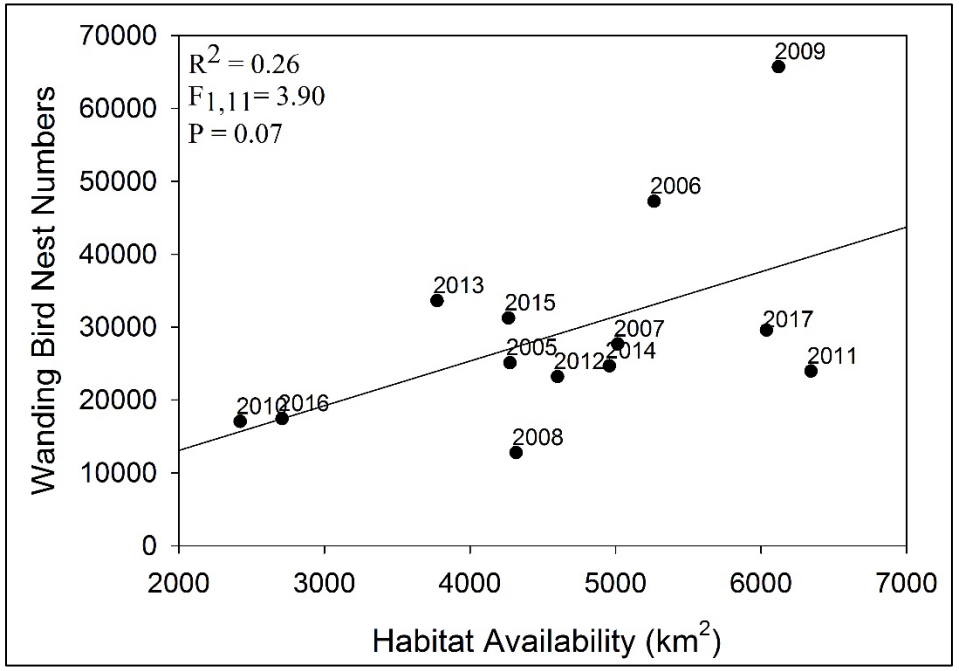




Objective

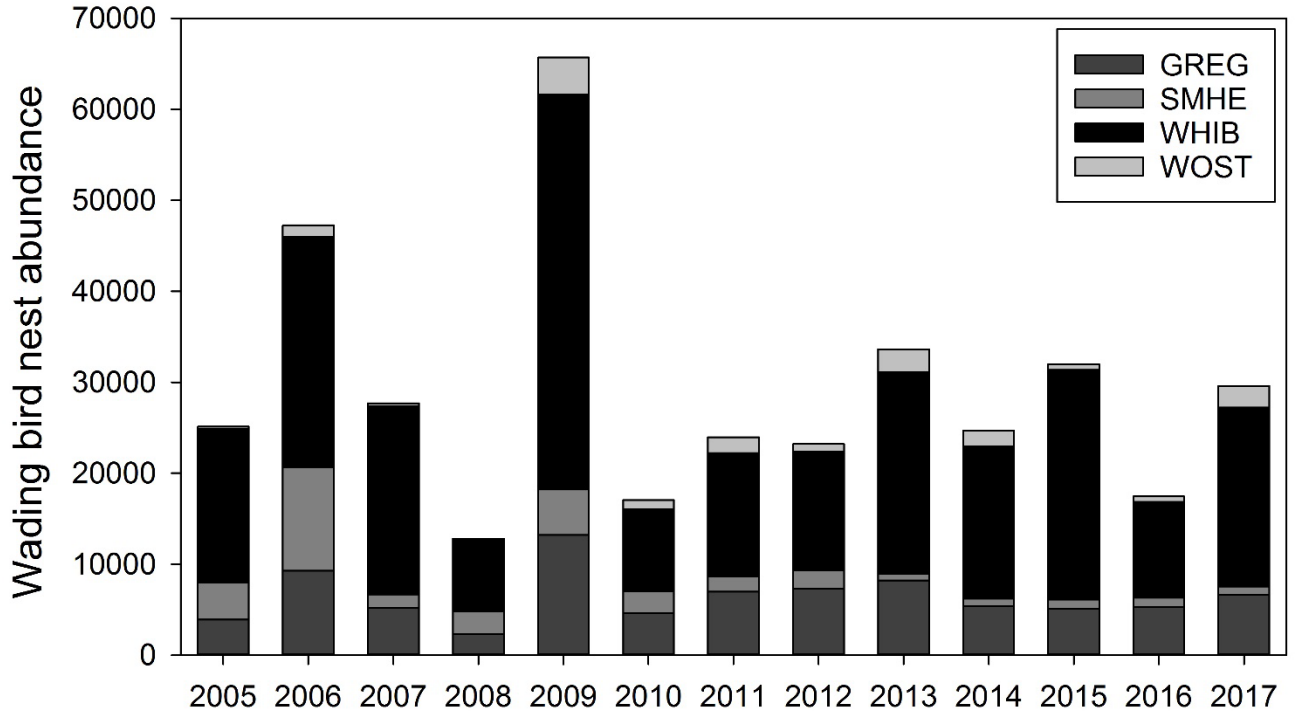
- Explore the relationship between aquatic dry-season prey densities, habitat availability, and annual wading bird nest numbers

A priori Hypotheses

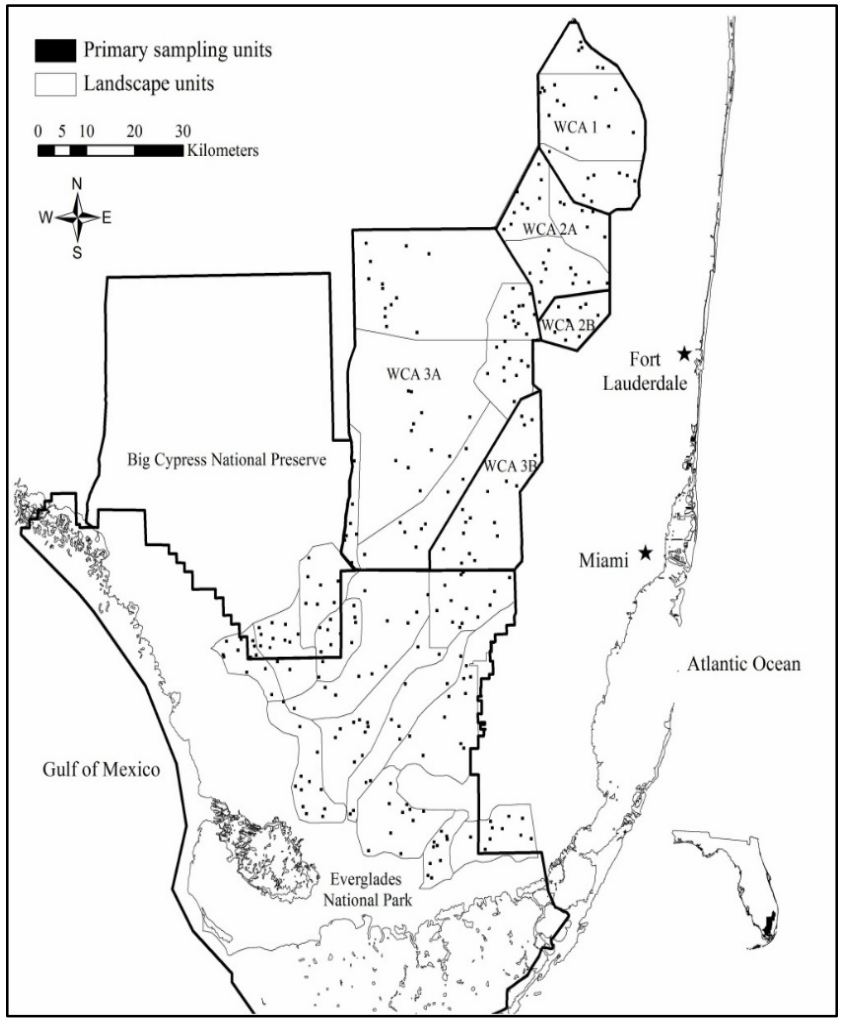
Hypothesis	Models
Regional Prey Density	Y = BICY-PD
	Y = ENP-PD
	Y = WCA-PD
Timing Regional Prey	Y = BICY-MonthAvail
	Y = ENP-MonthAvail
	Y = WCA-MonthAvail
Foraging Habitat Availability	Y = HabAvail
Regional Prey/Regional Timing	Y = PD + MonthAvail
	Y = PD*MonthAvail
Regional Timing/Habitat	Y = MonthAvail + HabAvail
	Y = MonthAvail*HabAvail

Response variable data source

- Annual nest abundance
- 2005-2017
- N = 12

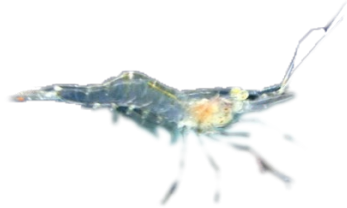


Explanatory variable data source



Fauna Concentration Project

- 2005-2017
- Regional Timing of Availability – BICY, ENP, & WCAs



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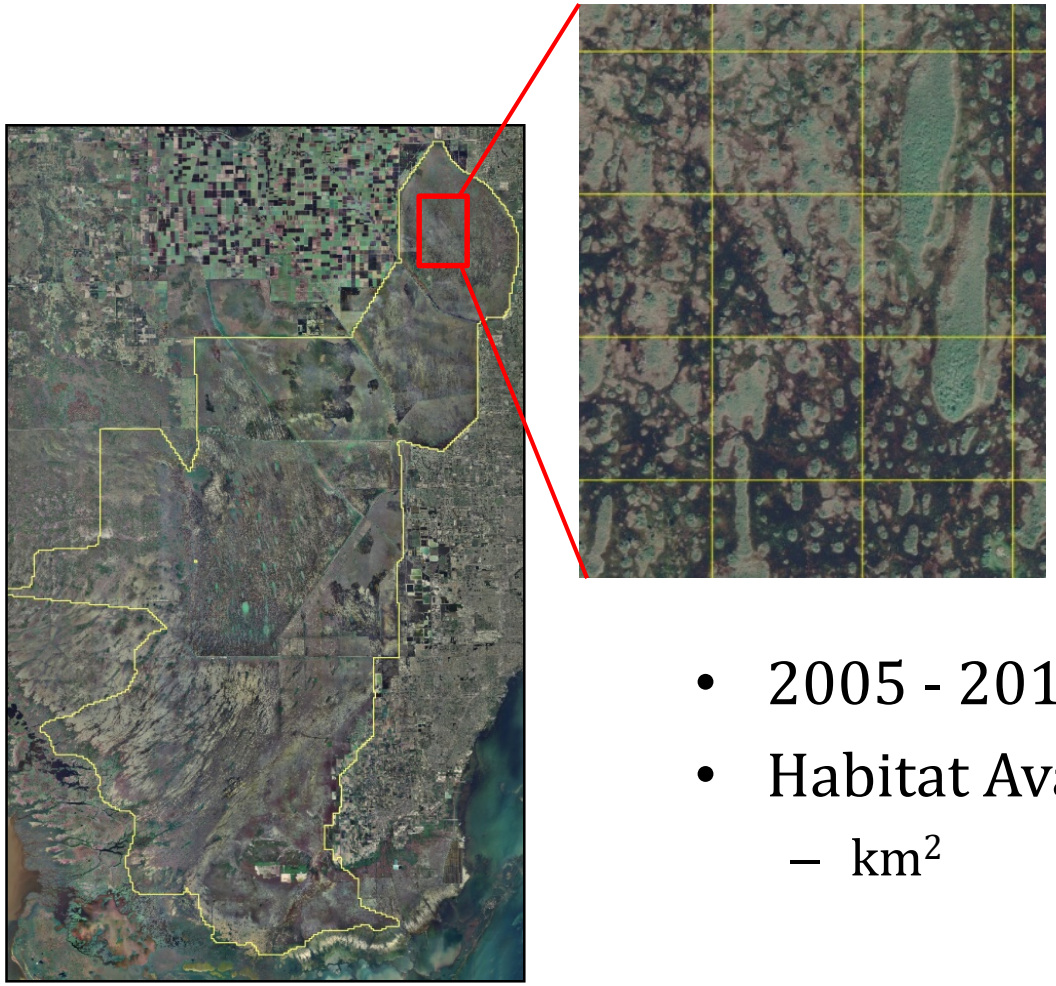
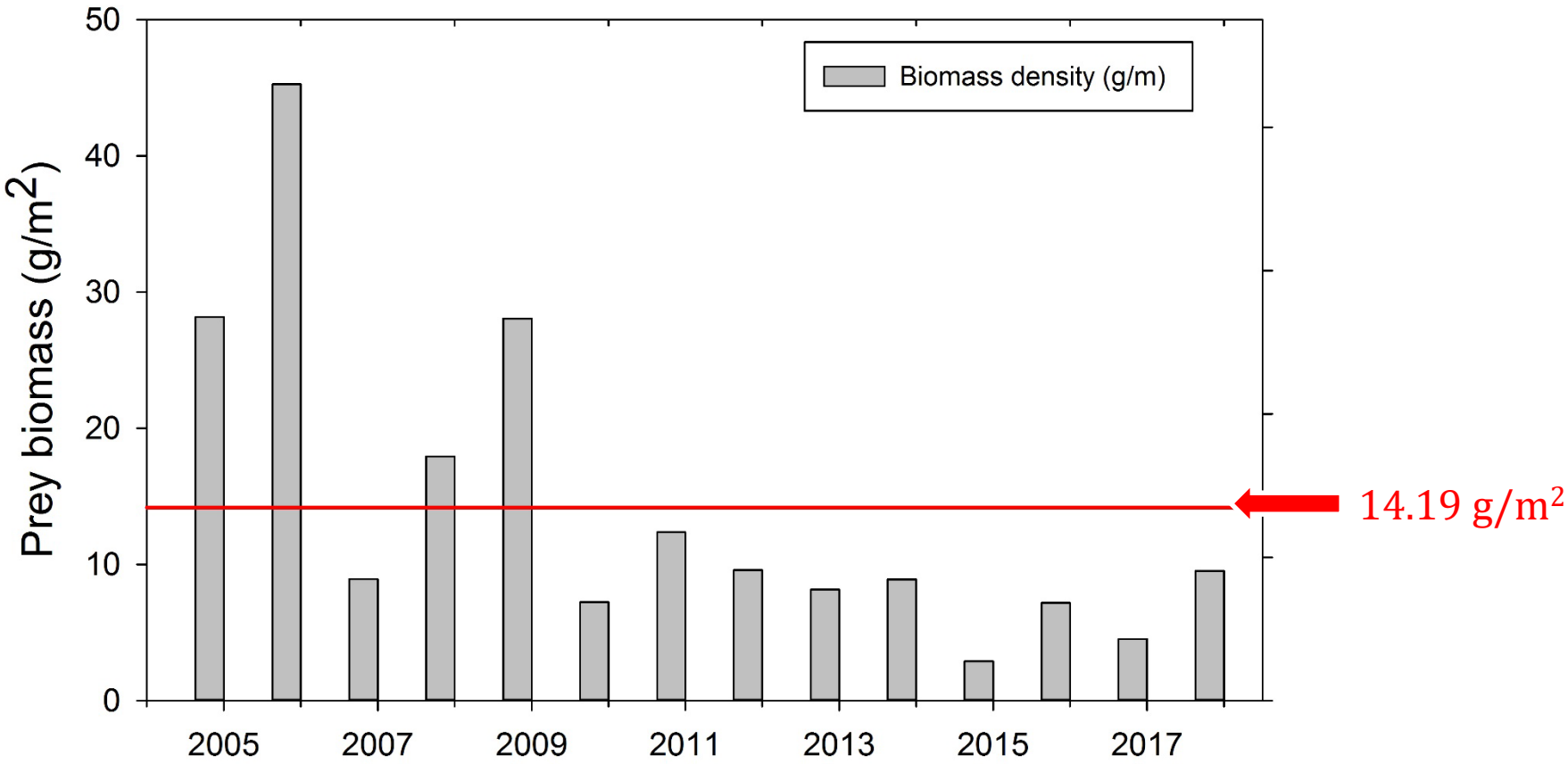


- 2005 - 2017
- Habitat Availability
  - km^2

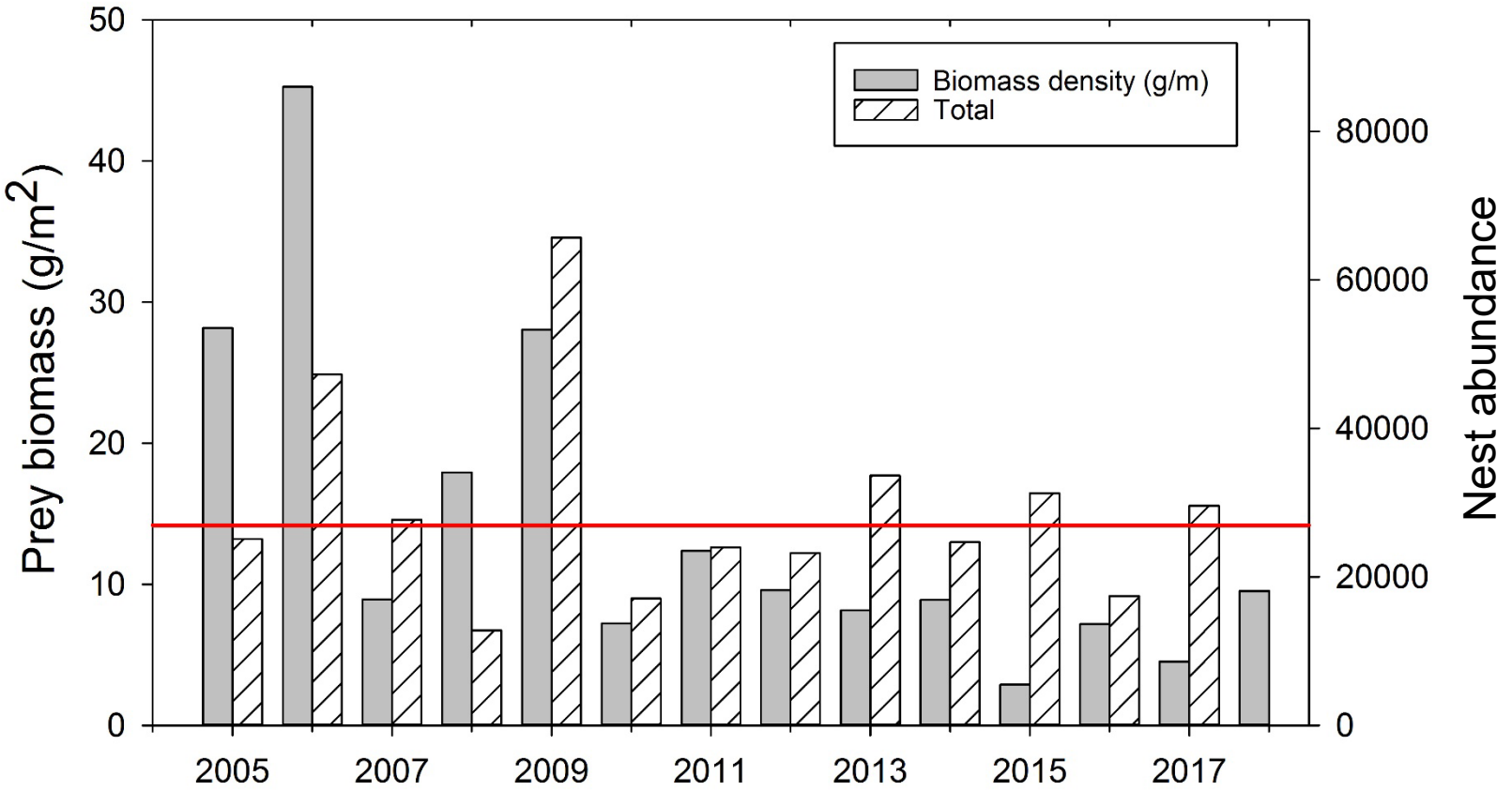
Statistical methods

- Model selection approach
- Generalized Linear Models
  - PROC GLIMMIX (SAS 9.3)
  - Response: nest abundance
    - negative binomial distribution
  - Fixed effects: prey density and habitat availability

Prey concentrations



Prey concentrations & nest abundance



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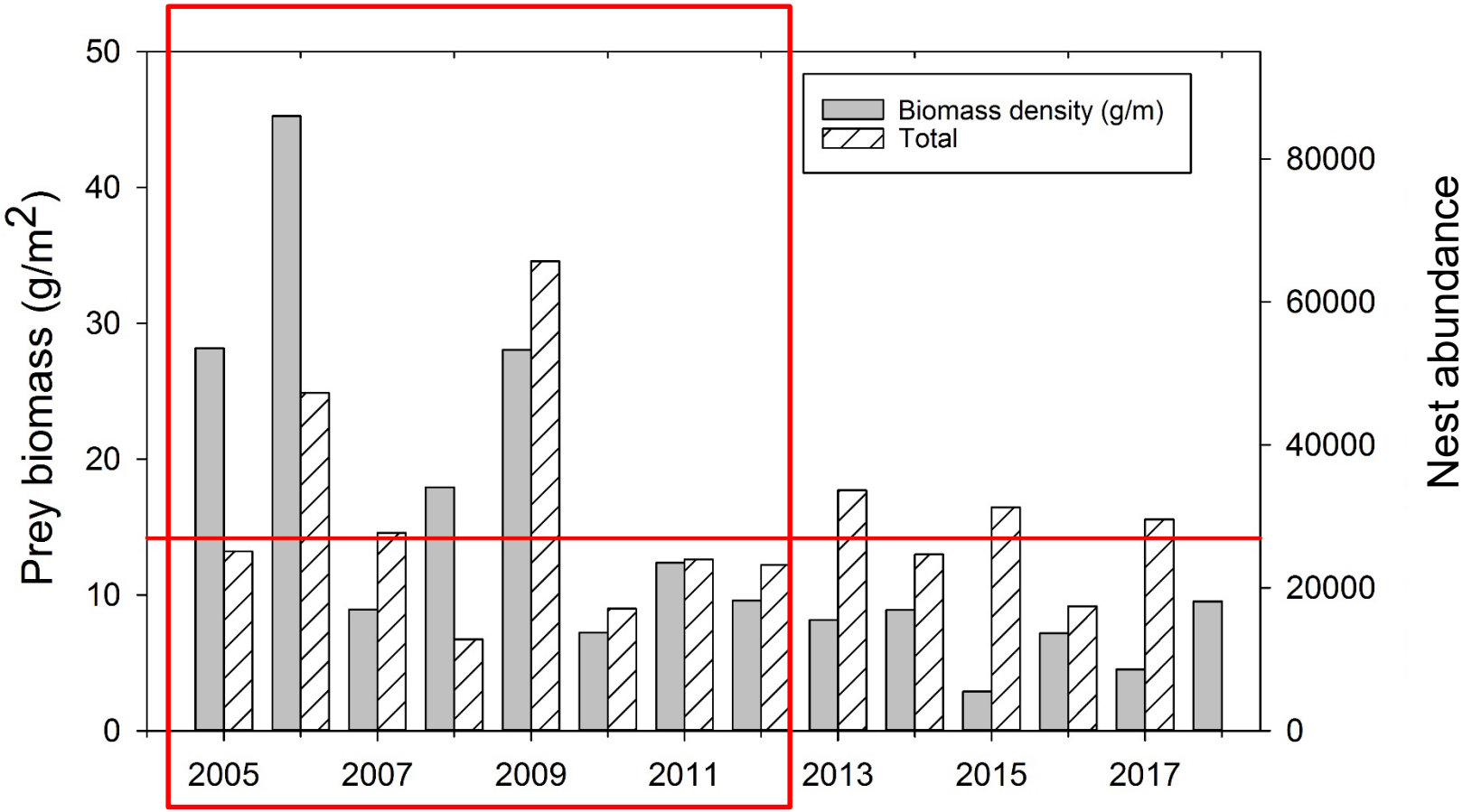

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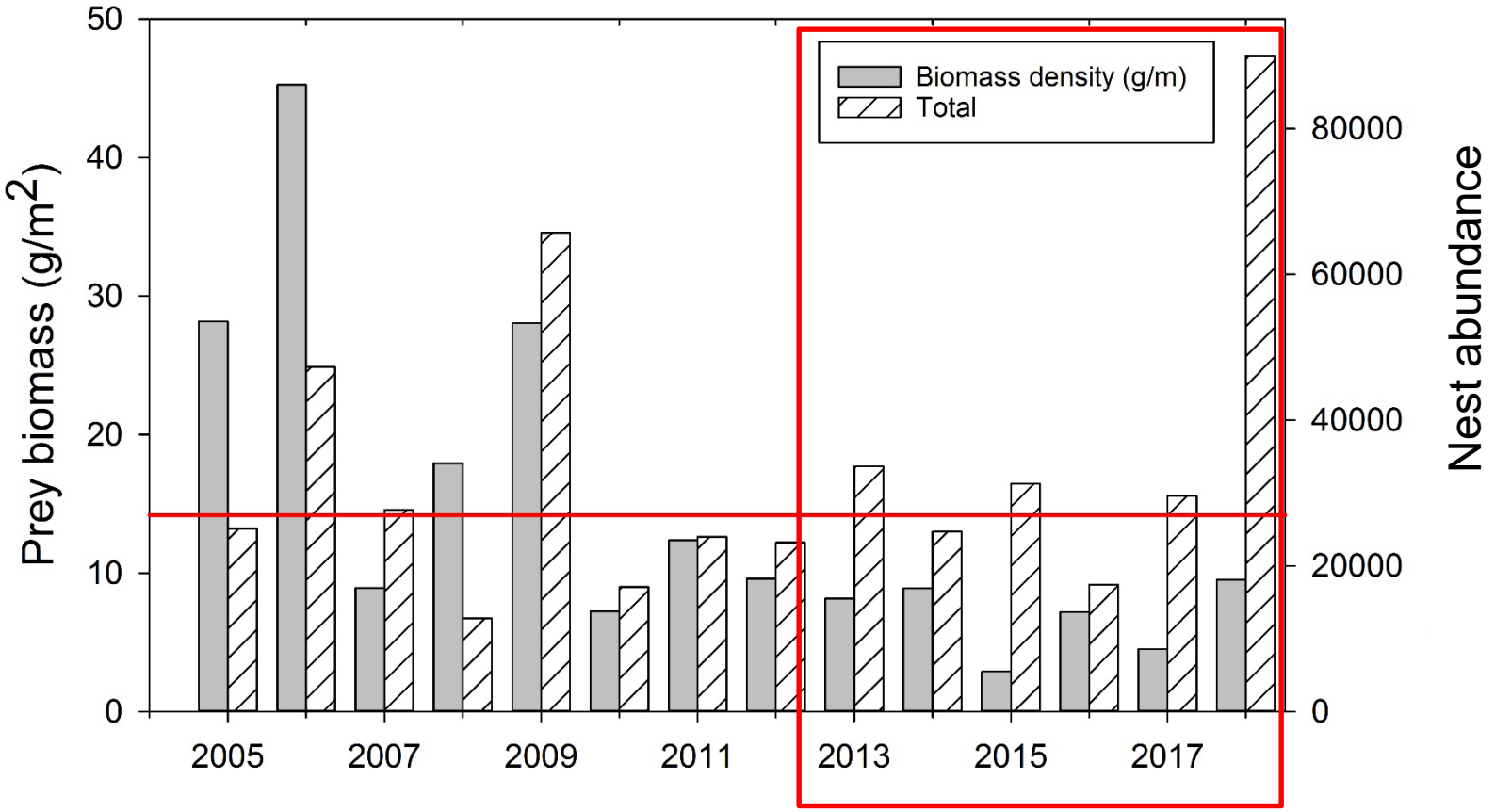
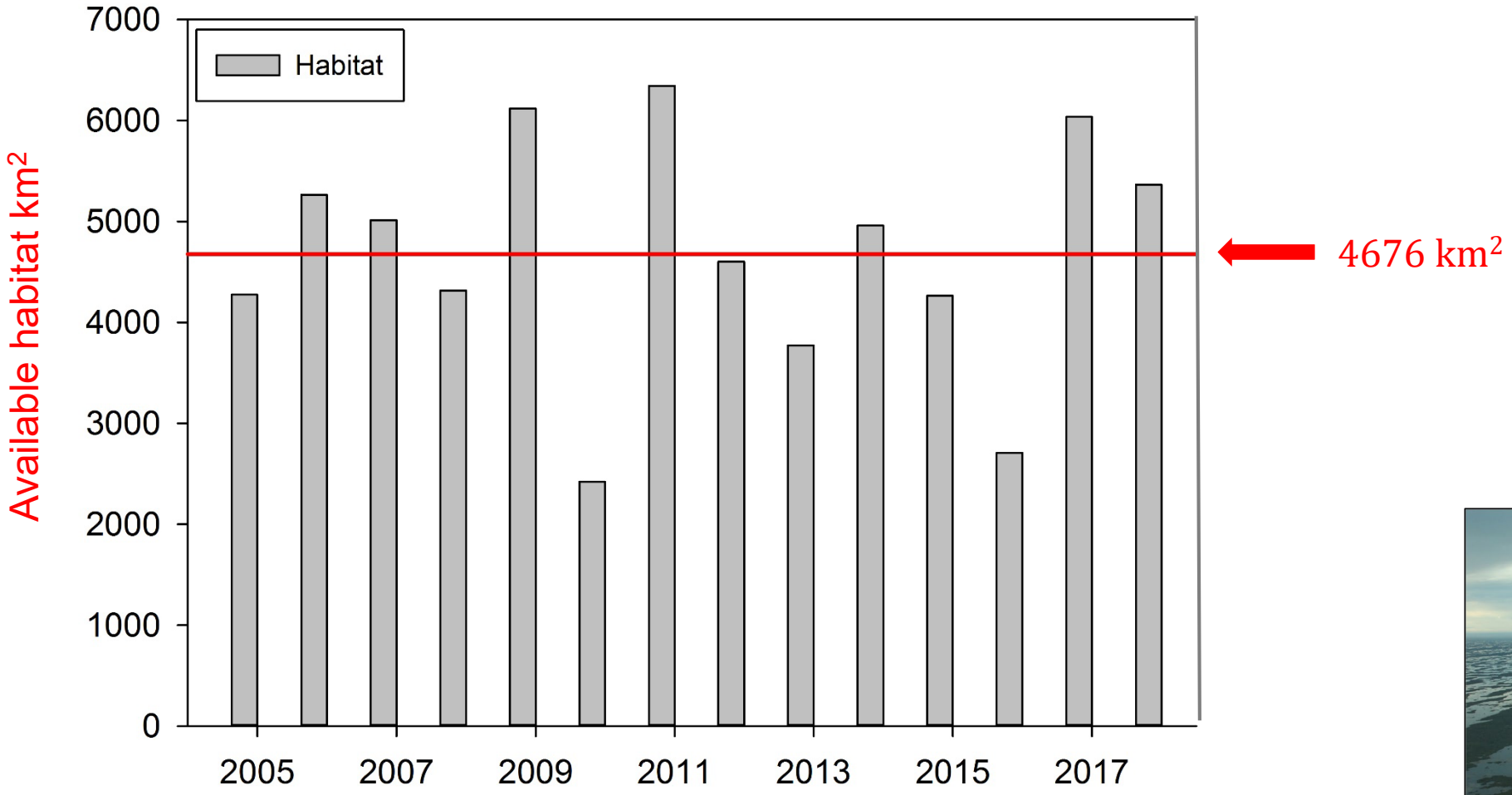
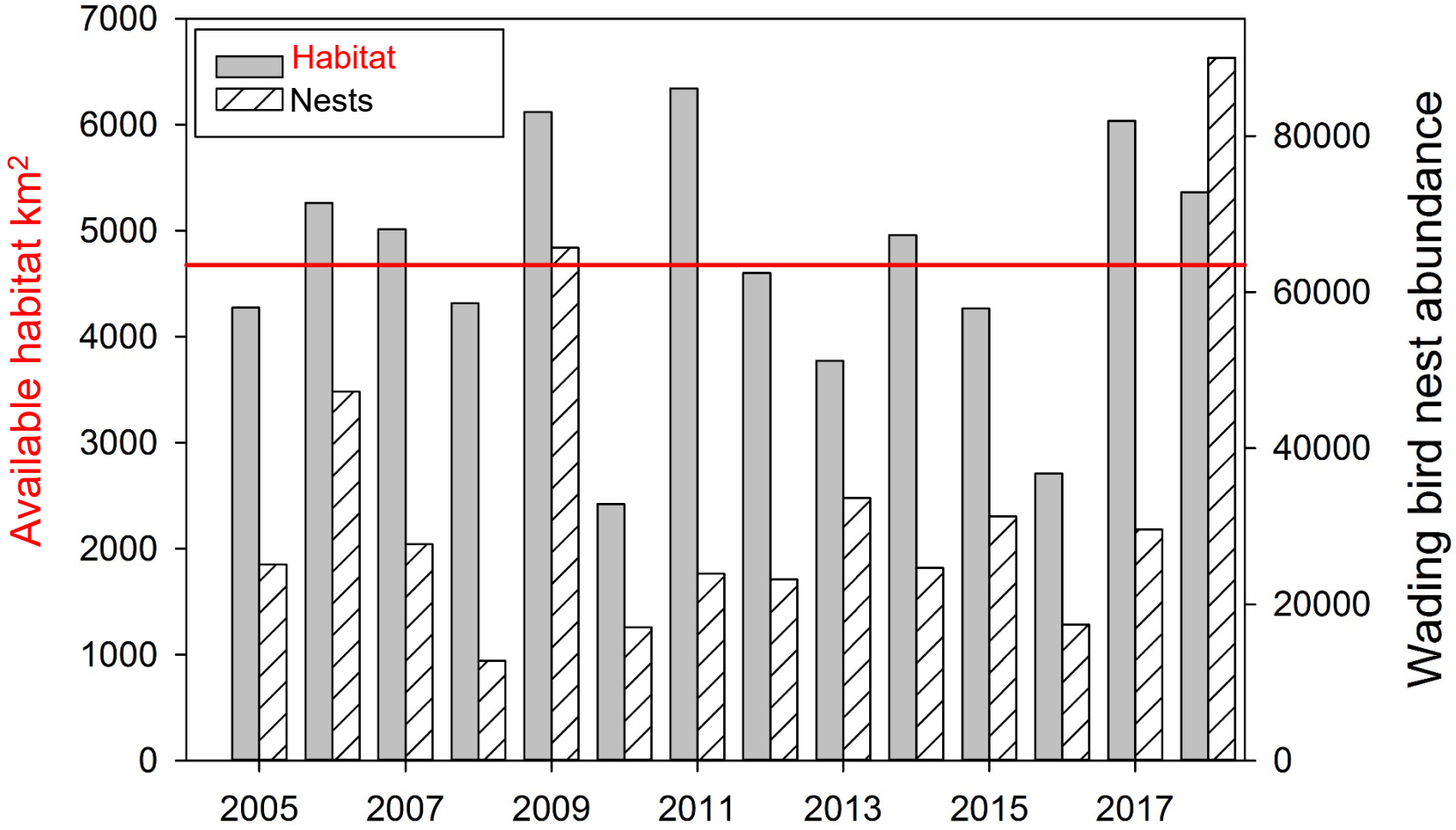


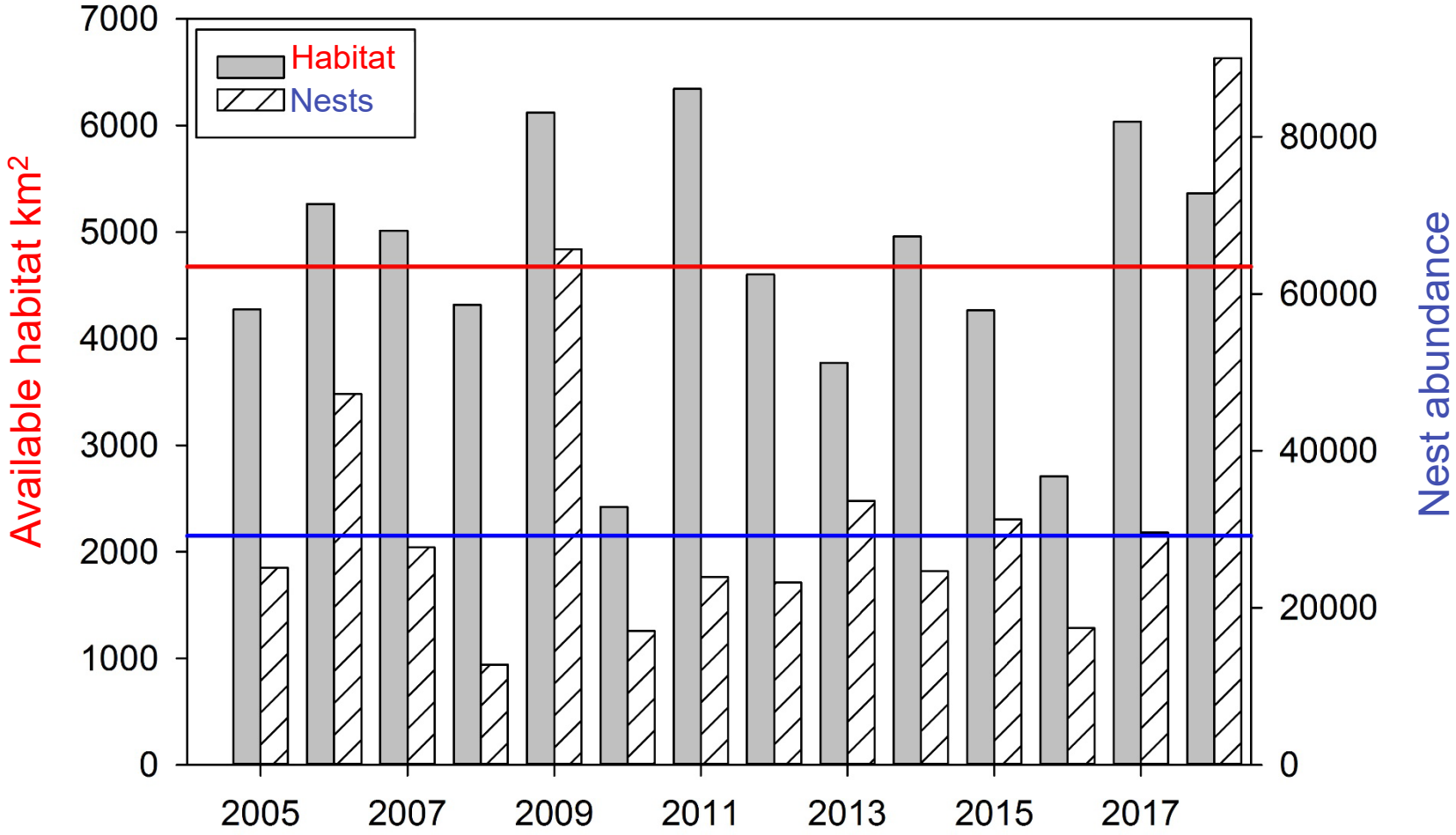
Available foraging habitat



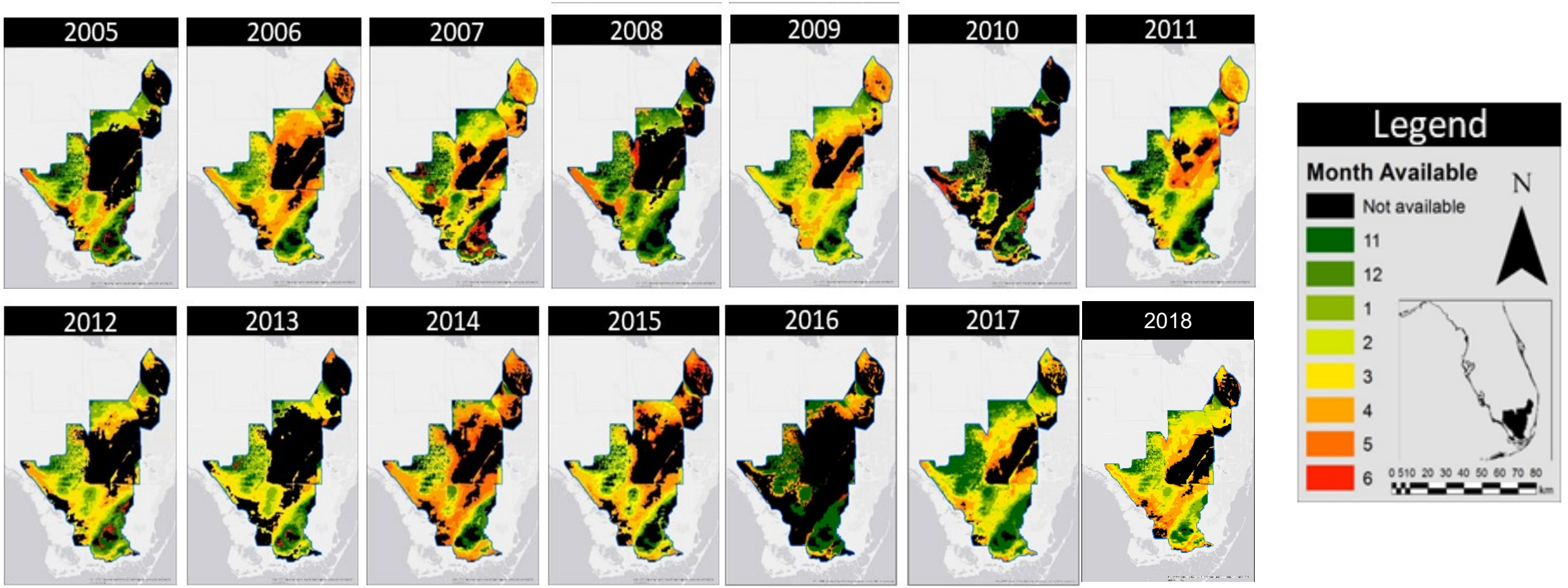
Foraging habitat & nest abundance



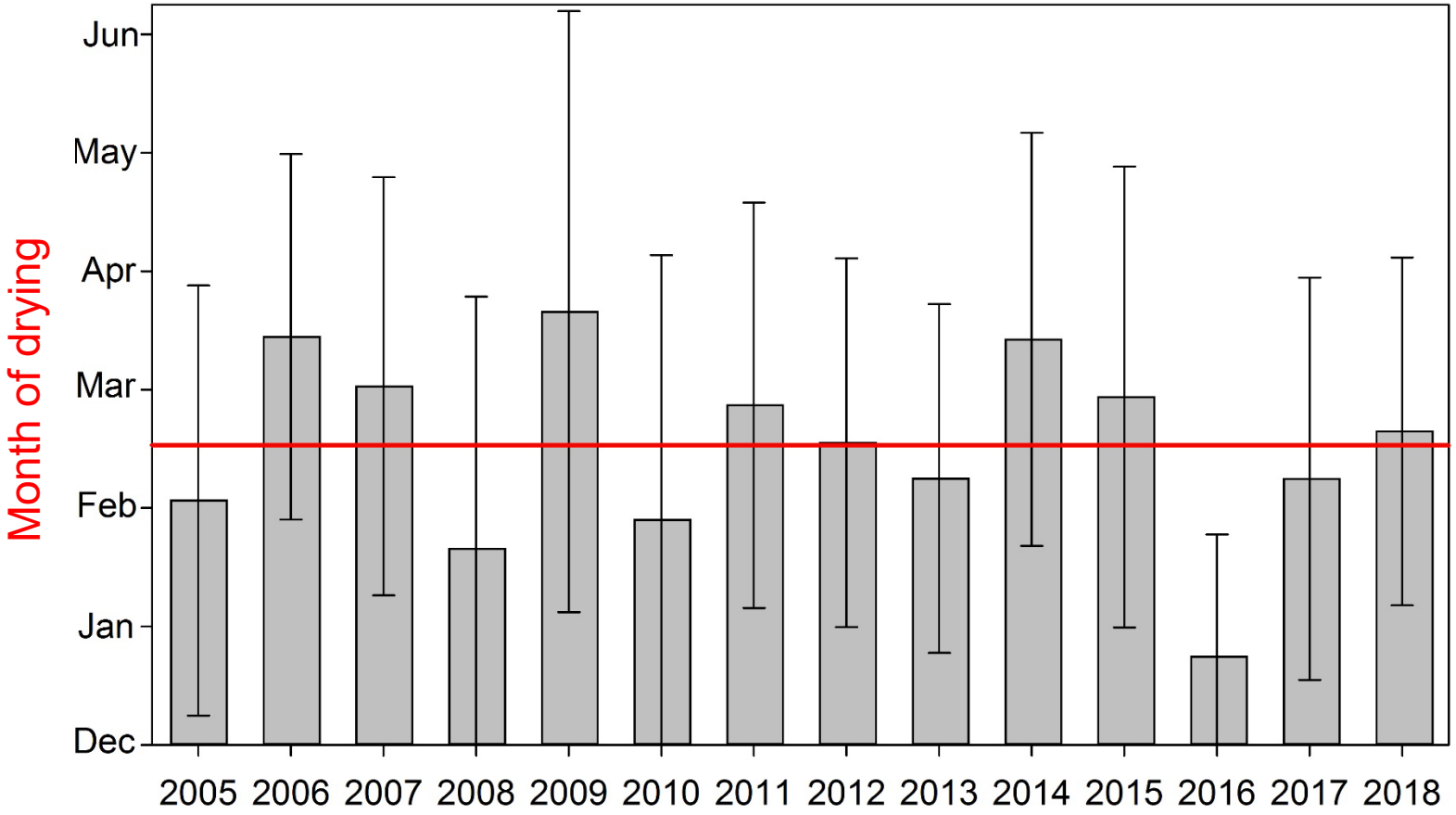
Foraging habitat & nest abundance



Timing of available foraging habitat

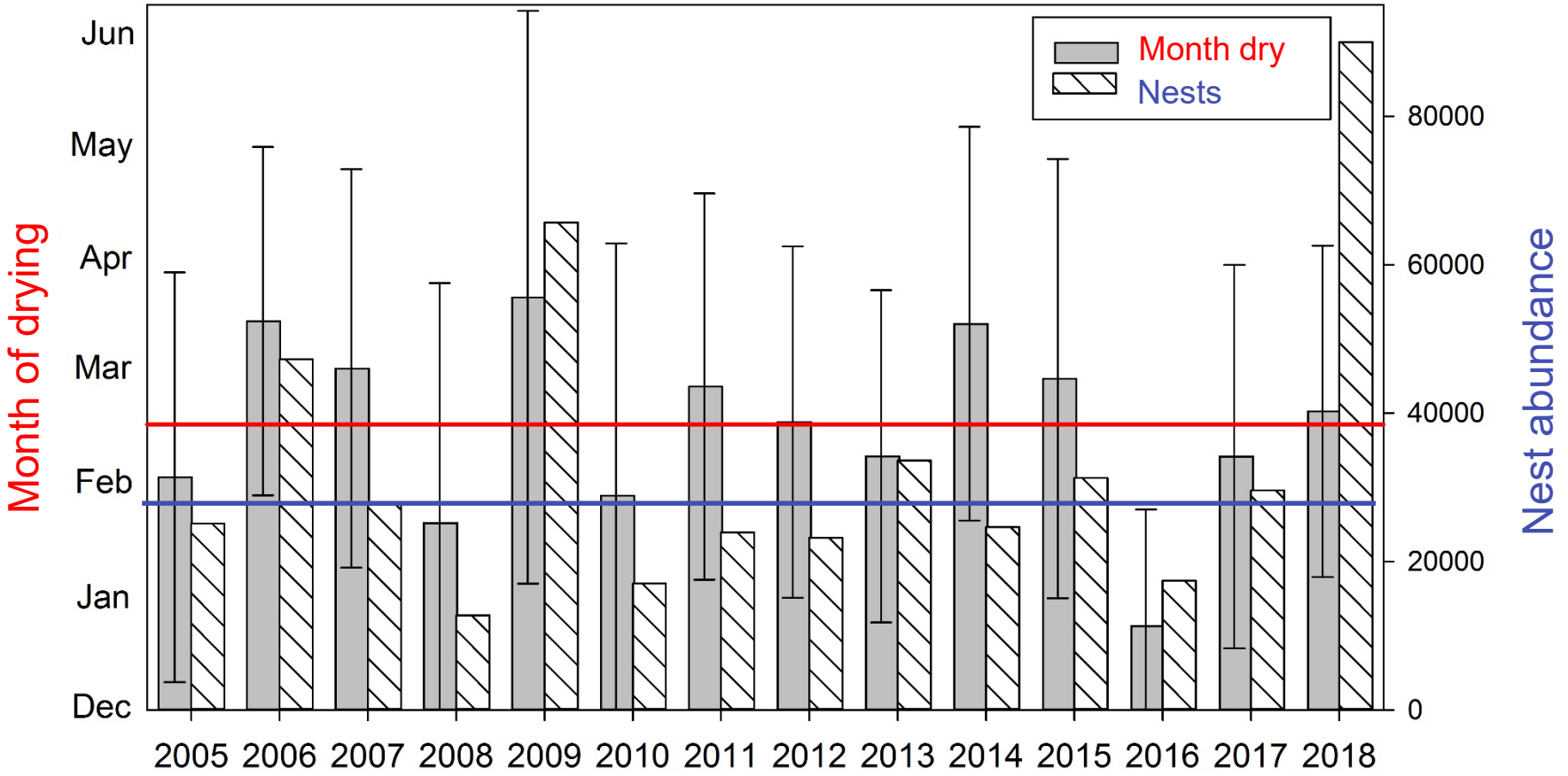


Timing of habitat availability



Mid-Feb

Timing of availability and nest numbers



Top nesting models

- Regional Density/Habitat Availability
  - ENP prey density + habitat availability (w_i = 0.94, R^2 = 0.61)

Model	**-2Loglike**	**k**	**AIC_c**	**ΔAIC_c**	**w_i**	**R^2**
ENP-PD + HabAvail	8.1	4	6.60	0.00	0.94	0.61
	:	:	:	:	:	:
Null	14.7	2	20.20	13.60	0.00	0.00

Parameter estimates

Parameter	β	SE	LCL	UCL
Intercept	8.0797	0.25	7.496	8.8663
ENP-PD	0.2017	0.29	0.128	0.275
HabAvail	0.0003	$4.0E^{-4}$	$2.2e^{-4}$	$4.1e^{-4}$

Prey density and habitat availability influence wading bird nest abundance

Discussion

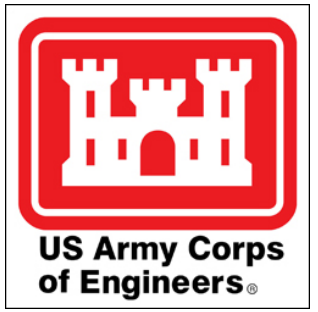
- Wading bird nest numbers track prey biomass 2005 – 2012 but not 2013 – 2018. Possible explanations:
  - 1. Alternative foraging habitats (i.e. urban areas) unaccounted for
  - 2. Does 2013-2018 correspond with a decline in bird productivity?
- Higher than average wading bird nesting years occur when:
  - 1. Habitat availability greater than mean
  - 2. System dry-down occurs after mid-February
- Total nest numbers influenced by:
  - Regional prey-densities
  - System-wide foraging habitat

Future directions

- Species-specific models
  - Regional
- Fine-scale availability
  - LSU-level prey
  - Habitat
    - Do short hydroperiod areas or marl prairies become available earlier in above average nesting years?
- Explore wading bird productivity

Acknowledgements

- Gawlik lab members
- Field technicians
- Undergraduate volunteers



Hydrologic conditions

- Depth – mean of 46,818 cells
- 13-year average – 22.97 cm