



Kate Goodenough

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My excitement at seeing an AMOY chick just before a nasty storm rolled in. Caper Romain SC June 2007



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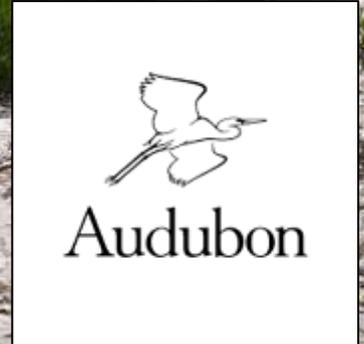
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Tradeoffs used during reproduction by the American Oystercatcher in North Carolina

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General Life Hx Strategies for AMOY



- K-selected: long-lived (> 15 years); delayed reproduction (typically at 3-5 years of age)
- Partial migrant
- Reverse sexual dimorphism with biparental care
- Benthic diet specialist shellfish and marine invertebrates
- Some food specialization depending upon nesting landscape/location (Brown & Nol 2024)

AMOY Nesting Landscape in North Carolina

~400 pairs nest in North Carolina in variable habitat

Barrier island beaches (**45%**),

Natural and marsh islands (**36%**),

Artificial dredged spoils material islands (**19%**)

Spatiotemporal variation in selective threats (Nol 1989; Corbat 1990; Davis et al. 2001; George 2002; McGowan 2004, Sabine et al. 2006)

Mammalian and avian predation

Nest overwash events (tidal and human-derived)

Human disturbance



Behavioral Tradeoffs- Birds have choices



These oysters are tasty! Maybe I will stay longer today...

“...a compromise that an animal makes by engaging in one behavior at the expense of another due to time and energy limitations...”

Some common tradeoffs

- Central place foraging- Alter aspects of their foraging, e.g. distances traveled, time spent foraging, altering forage locations, or type of food consumed (Monaghan et al. 1994, Garthe et al. 2000)
- Partitioning rate of nest and chick attendance, e.g., one sex spending more time defending territories or provisioning offspring more often than their partner (Nol 1985)

AMOY have **spatiotemporal limitations** as benthic foragers



- Constrained by tidal cycle and therefore food availability
- Research in North Carolina suggests the best model for chick survival **predicts lower survival for broods without direct access to foraging habitat** (Schulte & Simons 2015)
- Nest sites adjacent to foraging territories may be very important to brood survival (Ens et al. 1992, Heg & van der Velde 2001, Kersten & Brenninkmeijer 1995, van de Pol 2007, Schulte & Simons 2015)

Possible tradeoffs

- 1- May have differential tradeoffs to mitigate reproductive costs (Alter foraging strategies)
- 2- Differential nest site/territory selection (choose territory with connected food sources)

North Carolina Project Questions

Do AMOY alter their forage strategies during reproduction?

Hyp 1: There will be differences in forage distance and location during reproduction compared to the non-nesting period

Do foraging tradeoffs vary across the nesting landscape?

Hyp2: There will be differences in foraging behavior across breeding location and nesting habitat type

Is forage adjacency an important factor in chick/brood survival?

Hyp3: There will be differences in chick survival when comparing locs with or without adjacent foraging grounds



Methods



GPS telemetry

- 31 AMOY deployed with GPS dataloggers (<3% of body mass) using three nesting substrates and with or without adjacent foraging habitat
- GPS tags were set to collect data every 60-120 minutes
- Tag deployment planned for 12 months
- Data used to develop foraging parameters

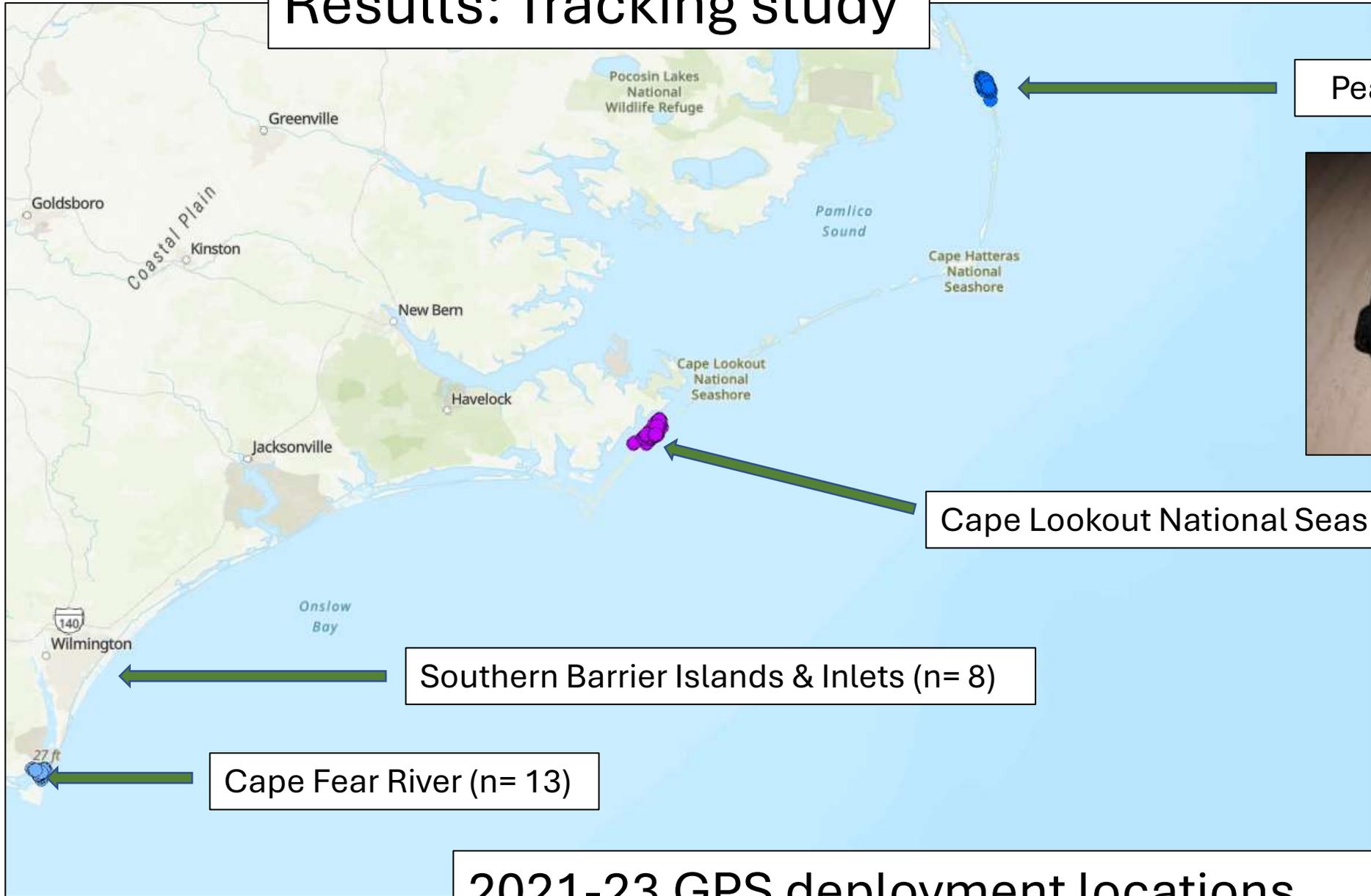
Annual Productivity Surveys

- Data used to develop information on nesting phenology, nest outcome, and brood survival

LMM Analyses

- Linear mixed effects models used test the influence of reproductive stage on foraging distance and duration and brood survival

Results: Tracking study



Pea Island NWR (n= 4)



Cape Lookout National Seashore (n= 6)

Southern Barrier Islands & Inlets (n= 8)

Cape Fear River (n= 13)

2021-23 GPS deployment locations

- Over 70,000 data points were generated for the project (n= 28)
- Tracks ranged in length from 5- 30 months

Results- Overall



- No difference in movements when comparing locations
- Sex was not a factor in movements- males and female moved were similarly
- Foraging distance varied according to nesting habitat- Barrier Island nesters traveled farthest
- Night movements occurred more often during the non-breeding and incubation stages and was influenced by moon phase, tidal stage, and Julian Day
- Variation also evident in the timing of forage across reproductive stage- birds not on nest foraged at various times during a 24hr cycle
- Forage adjacency important to forage strategy- if food nearby then less time spent away from nesting territory

Results: Foraging Distance

Full Model

Foraging distance ~ sex + Reproductive stage + Julian Day + Day Length + 24hr Cycle + Nesting habitat + Nesting location + Forage adjacency + Tidal cycle + (1|animal_id) + (1|year)

Best fit Model

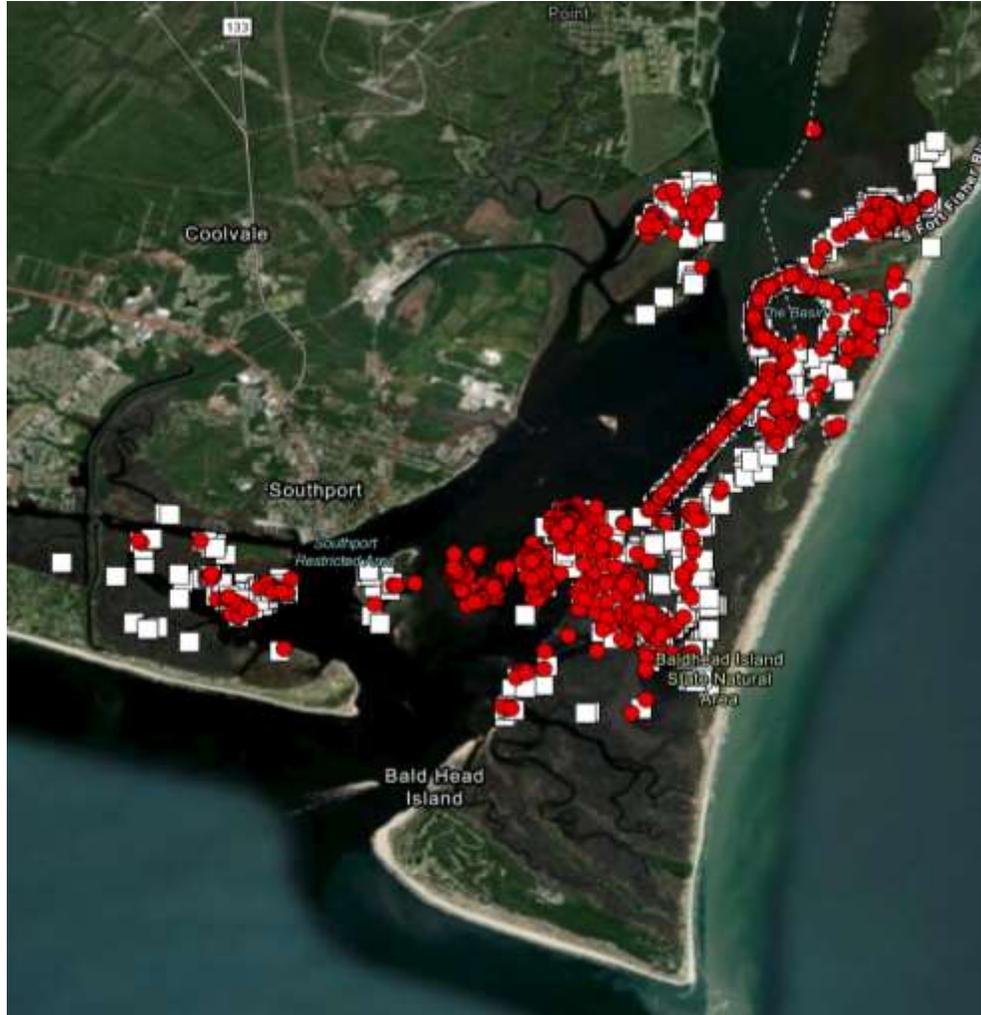
Foraging distance ~ Reproductive stage + Julian Day + 24hr Cycle + Nesting habitat + Forage adjacency + Tidal cycle + (1|animal_id)

Notes here:

- Sex not an important influence on foraging distance
- Movements were shorter in distance during incubation and no-nest periods
- Nesting habitat and Location were slightly important

Model: Best Fit Foraging Distance	P-value
Sex	0.681
Reproductive Stage	<0.001 Inc, < 0.001 No Nest
Julian Day	< 0.001
24hr Cycle	< 0.001
Tidal Stage	< 0.001
Nesting Habitat	0.027 SI, 0.144 MI
Forage Adjacency	0.005
Nest Location	0.0847 NBII, 0.066 SBII

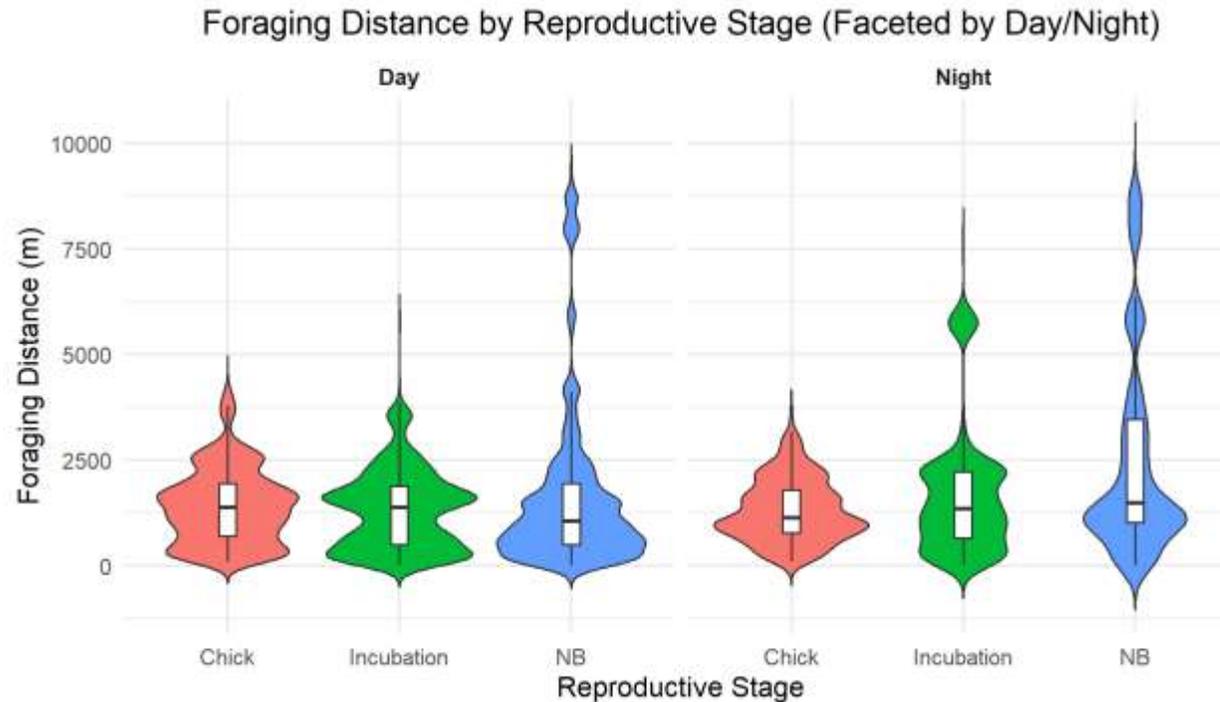
Timing, and Location



- Forage locations remained similar across the breeding season
- Timing of forage varied according to reproductive stage
- More foraging during the day and closer to territory for pairs raising chicks
- More night foraging at longer distances for non-nest birds

White = day foraging locations, Red = night foraging locations.

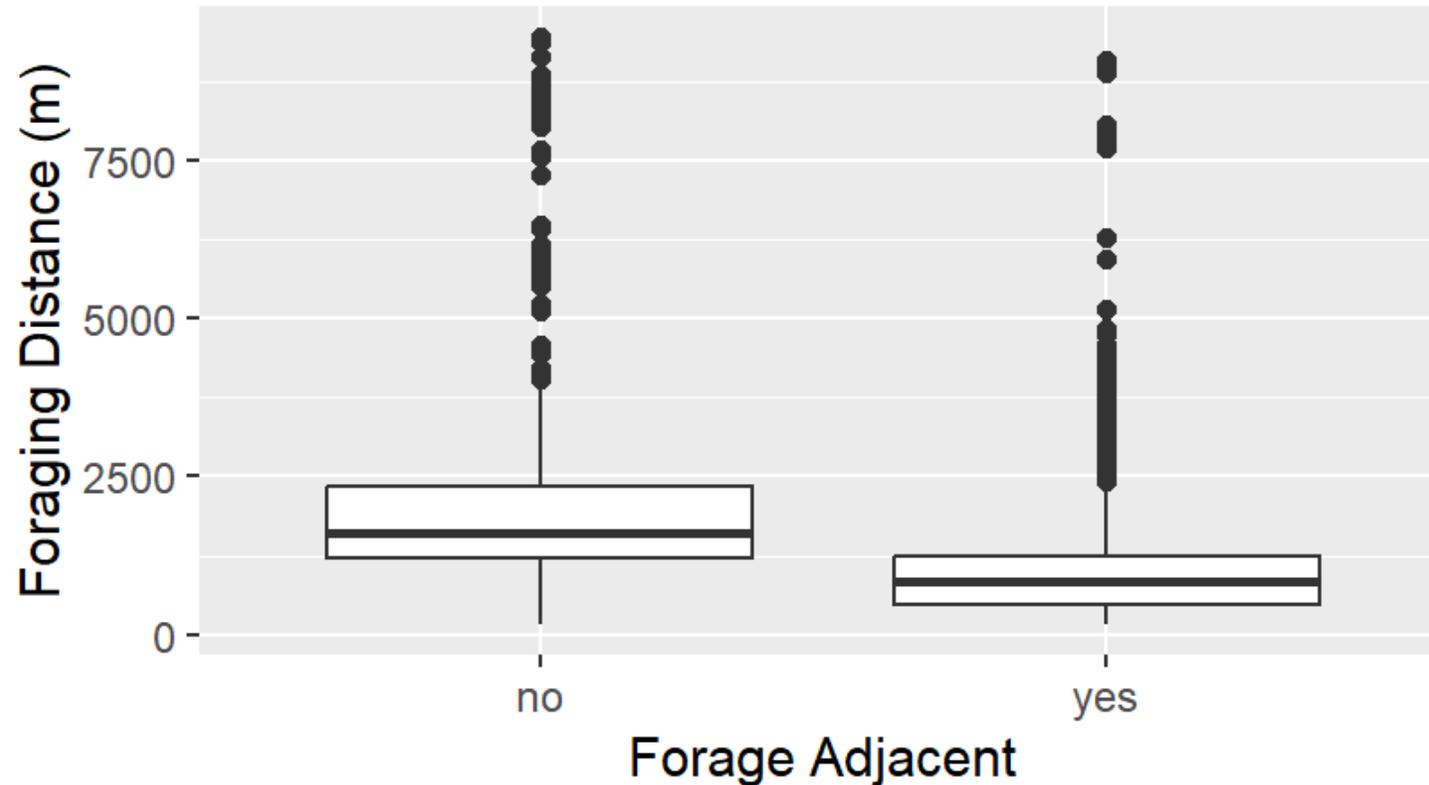
Day vs Night Movements



- Day/night locations strongly correlated ($r^2= 0.82$) and overlapping (87%)
- Mixing model suggests an interaction between night foraging and moon phase < 25% moon illumination [on these nights non-breeding AMOY were foraging farther from nesting territory]

Does foraging adjacency matter?

Hyp3: There will be differences in chick survival when comparing locs with or without adjacent foraging grounds



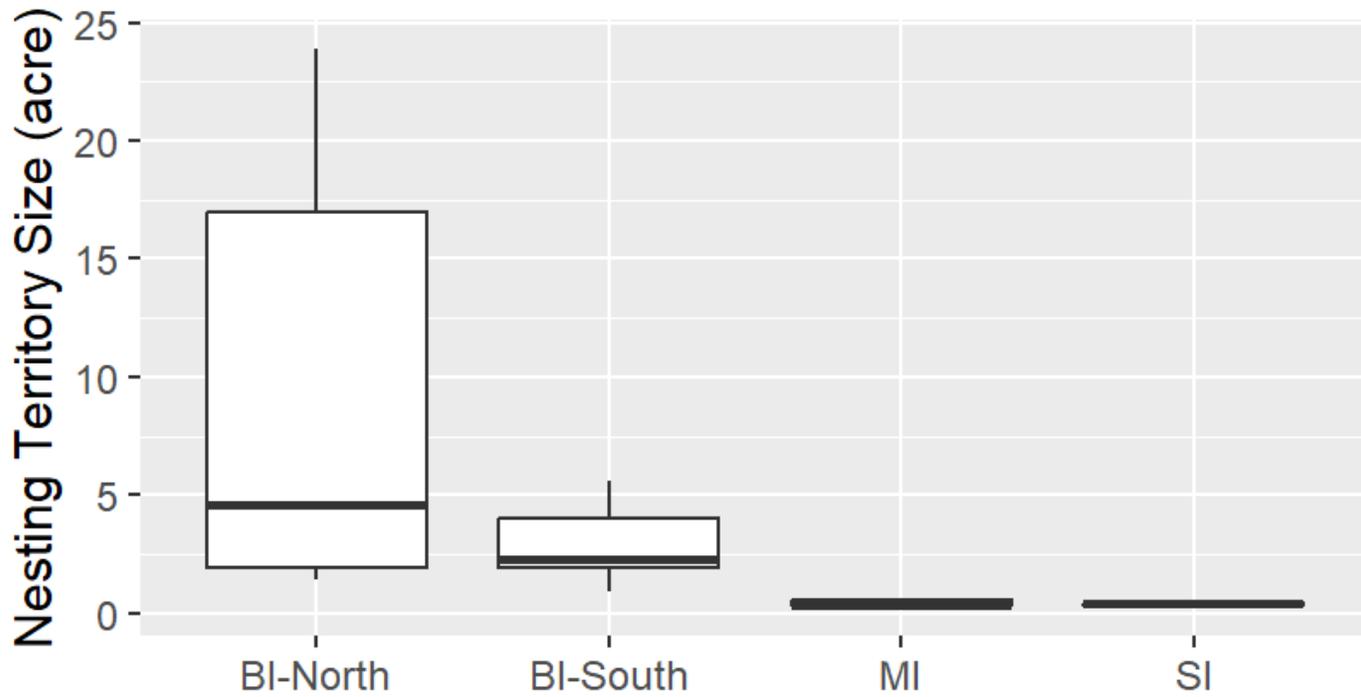
- Foraging distances tended to be larger for nesting areas with no forage adjacent to the nesting territory
- Not a direct impacts, but there may be indirect influences

F-statistic: 1127 , DF _{1,15062} p-value: < 0.001

Do foraging tradeoffs vary across the nesting landscape?

Hyp2: There will be differences in foraging behavior across breeding location and nesting habitat type

The answer is yes and no



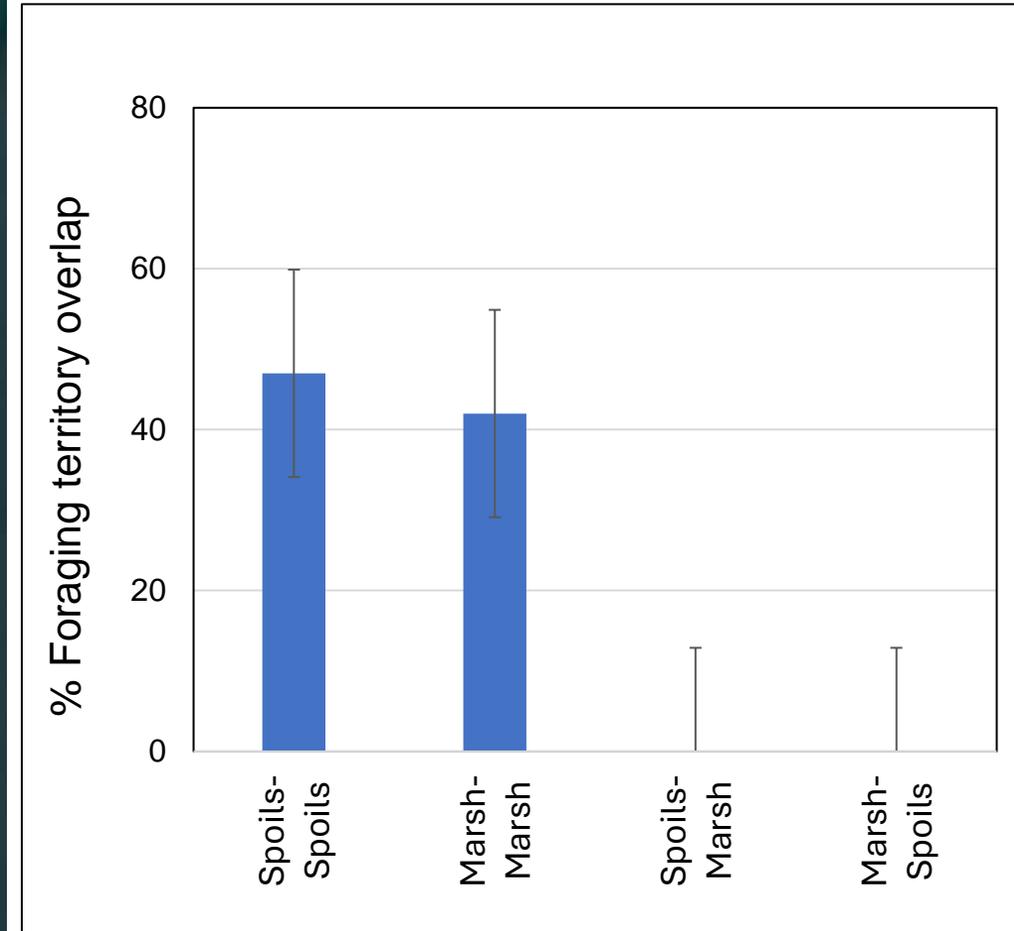
	Mean territory Size (acre)	SD	Range (acre)
Barrier Island-North	9.78	9.05	1.44- 23.9
Barrier Island-South	2.95	1.53	0.93- 5.62
Marsh island	0.44	0.15	0.26-0.64
Spoils island	0.40	0.07	0.3-0.47

- Nesting Territory size is significantly larger for AMOY nesting on barrier islands.
- The spoils islands have the lowest nesting territory size.

One-way ANOVA with a Tukey HSD

Results F statistic = **4.487261**,
p = 0.0152639, **df = (3,19)**

Tukey HSD found significant differences in nesting territory size of the Northern Barrier Islands compared to Marsh and Spoils Islands.



- Individuals nesting in similar habitat (CFR) had greater foraging range overlap than individuals nesting in different habitats.
- Support for foraging territories

Takeaways

- Adults change their foraging strategies to accommodate reproduction; less distances travelled during incubation and chick rearing compared to non-breeding
- Having foraging grounds linked to nesting territories allows adults more time to defend nesting territory and care for young
- Night foraging is important for adults to balance energy budgets (we think)



Photo by Jean Hall 2023

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