The factors affecting nest and brood survival and chick body condition of American oystercatchers

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Introduction

Daily survival rates (DSR)
There are several factors that influence DSR

1. Seasonality
    - Nest initiation date has been found to influence DSR

2. Nest and brood age
    - As nests' and broods' age, studies have found DSR increases

3. Others – Predators, weather, temperature

(Dinsmore *et al*. 2002 Ruthrauff and McCaffery 2005; Tjorve and Underhill 2008; Murphy 2010; Smith and Wilson 2010)

Introduction

Chick body condition

- Body condition is a measure of energetic reserves available for use by individuals for daily processes
  - Condition indices are calculated to reflect the health of an animal

- Chick fledgling weights are positively related to juvenile survival
  - Poorer body condition may reduce the probability of juvenile survival for oystercatchers

- Environmental stressors and food availability also influences body condition

(Tella *et al*. 2001; Virzi 2008; Peig and Green 2009; Smith and Wilson 2010)

Research Objectives

1. I examined various factors that may influence daily nest and brood survival

2. I determined if chick body condition was influenced by laughing gulls (*Leucophaeus atricilla*)

Methods: Daily nest and brood survival

- I used Program MARK to model DSR

<u>Models</u>

1. Constant daily survival
2. Temporal– linear and quadratic time trend
3. Top temporal model + covariates

Covariates: nest and brood age, number of gulls, A-P of nesting gulls, territory size

- 27 day incubation period and chick survival to 35 days

- Used Akaike's information criterion for small samples
- ΔAIC_c values < 2 to be top competing models
- Significant results: 95% confidence limits did not include zero

Methods: body condition

Calculated scaled mass indices instead of using the traditional method

- Traditional method– many studies have scrutinized the validity of using OLS residuals as indices

Scaled mass indices: a method developed by Peig and Green (2009)

$$M = M_i \left[\frac{L_o}{L_i}\right]^{b_{sma}}$$

M_i and L_i are the body mass and linear body measurements of individual I

b_{sma} is the scaling exponent = slope of OLS regression / Persons R coefficient
L_o is the arithmetic mean value of L for the study population

<u>Analysis</u>
Determined if gulls significantly effected mass indices using two-tailed T-tests in Minitab 17
Gull variables:

1. Absent (0) and Present (> 0)
2. Low (0-40)
3. High (41-140)
4. A-P of nesting gulls

Results: Daily nest survival

N = 142
Constant DSR = 0.968 (SE 0.003)
Probability of nest survival = 0.418 (0.003)

Model	AIC_c	ΔAIC_c	W*i*	K	Deviance
LT + Age	459.9068	0	0.62989	3	453.8973
LT + Age + NTSz + gulls + Nesting	461.4848	1.578	0.28616	6	449.4517
LT	465.8507	5.9439	0.03225	2	461.846
LT + nesting	467.4673	7.5605	0.01437	3	461.4579
LT + gulls	467.6204	7.7136	0.01331	3	461.6109
LT + NTSz	467.6204	7.7136	0.01331	3	461.6109
QT	468.0935	8.1867	0.01051	2	464.0888
S(.) constant	476.0657	16.1589	0.0002	1	474.0641

Daily nest survival beta results

Covariate	Beta	SE	Lower	Upper
Linear trend	-0.012	0.003	-0.018	-0.005
Age	-0.043	0.015	-0.072	-0.012
Number of gulls	-0.085	0.170	-0.419	0.248
A-P nesting gulls	0.178	0.286	-0.384	0.739
Territory size	-0.085	0.170	-0.419	0.248

Results: Daily brood survival

N = 56
Constant DSR = 0.985 (SE 0.003)
Probability of fledging = 0.591 (0.003)

Model	AICc	Δ AICc	W*i*	K	Deviance
QT + gulls	171.7211	0	0.49586	3	165.7039
QT + nesting	174.0411	2.32	0.15545	3	168.0239
QT + gulls + NTSz + Nesting + Age	174.7293	3.0082	0.11019	6	162.669
QT + Age	175.5541	3.833	0.07295	3	169.5369
QT	175.8318	4.1107	0.06349	2	171.8232
QT + NTSz	176.1367	4.4156	0.05452	3	170.1195
LT	176.4824	4.7613	0.04586	2	172.4738
S(.) Constant	183.0931	11.372	0.00168	1	181.0903

Daily brood survival beta results

Covariate	Beta	SE	Lower	Upper
Quadratic trend	-0.001	0.000	-0.002	-0.001
Age	0.033	0.022	-0.010	0.076
Number of gulls	-0.007	0.002	-0.011	-0.002
A-P nesting gulls	-0.839	0.434	-1.690	0.011
Territory size	0.628	0.622	-0.591	1.847

Results: chick body condition

1. Absence and presence of gulls
   $t_{42} = 2.62$, $P = 0.012$

Absent	$\bar{x} = 407.6$, SD = 48.8
Present	$\bar{x} = 364.3$, SD = 60.4

2. Number of gulls
   $t_{42} = 2.33$, $P = 0.025$

Low	$\bar{x} = 399.28$, SD = 50.74
High	$\bar{x} = 357.30$, SD = 65.40

3. A-P of nesting gulls
   $t_{42} = -2.2$, $P = 0.033$

Absent	$\bar{x} = 398$, SD = 52
Present	$\bar{x} = 357.2$, SD = 65

Discussion: Daily nest survival

DSR

- Findings were similar to Koczur (2013) for Texas oystercatchers
- Atlantic coast
  - 0.979 and 0.966 (Sabine *et al*. 2006 and Borneman 2013)
  - 0.928 and 0.950 (Davis *et al*. 2001 and Schulte 2012)

Top model included a linear time trend and nest age

- DSR decreased significantly with time and age

1. Weather – High tide events later in the season resulted in synchronous nest loss
2. Colonial nesting birds – predict their arrival in mid April strongly affected reproductive success
   - 49% hatching success for birds nesting near mean initiation date (March 25) vs. 32% nesting after
   - Renesting attempts in mid season were also less successful (30%)
   - Other studies have found higher hatching success for early season nesters
3. Recreationalists – nests were left unattended when boaters and fisherman were present
4. Predators increased

(Johnson and Walters 2008; Tjorve and Underhill 2008)

Discussion: Daily nest survival

<u>Territory size</u>

- DSR decreased with territory size but not significantly
  - ➢ Many larger territories were on the large islands, large dredge spoils or the mainland
  - ➢ Similar results found by Koczur (2013) and Atlantic coast studies

1. Mammalian predators – mainland and islands connected to mainland
2. Colonial nesting birds – large islands and large dredge spoils supported colonies

<u>Number of laughing gulls</u>

- DSR decreased as the number of gulls increased, but not significantly
- Only 1 predation event was camera verified, but other evidence suggested gulls are a major threat

1. Adults frequently flushed nests to chase off gulls
2. Found eggs with small holes or presence of yolk near cracked eggs

- I predict egg predation occurred when nests were left unattended

(Harris and Wanless 1997; Magella and Brousseau 2001; Hazlitt 2001; O'Connell 2003; McGowan *et al*. 2005; Virzi 2008)

Discussion: Daily nest survival

<u>Nesting laughing gulls</u>

- Conversely, DSR slightly increased in the presence of nesting gulls but not significantly

- The size of colonies and proximity to nesting gulls may explain these findings
  - Dredge spoils typically supported ≤ 20 breeding gull pairs
  - Oystercatcher pairs may be capable of defending against several gulls versus a large aggregation of gulls.

Discussion: Daily brood survival

<u>Top model included quadratic time trend and number of laughing gulls</u>

- Top model and DSR decreased significantly with time and as gulls increase

1. Colonial nesting birds – gull predation of young chicks
   - I hypothesize that young chicks (< 2 weeks) were predated by gulls
   - I documented several instances of gulls harassing or attempting to predate young chicks
2. Weather – influenced food availability
   - Northerly storms early in the season cause extreme low tide events and result in great reef exposure over a long period of time
   - Southerly storms later in the season cause prolonged high tide events. There were several instances of older chicks dying and I predict it was starvation.

Discussion: Daily brood survival

<u>Nesting laughing gulls was the next best model</u>

- DSR decreased when nesting gulls were present but not significantly
  - When nesting gulls were absent more pairs (n = 26) fledged a chick than when nesting gulls were present (n = 6)
  - Predation of young chicks
  - Parents allocating less to chick attendance and more towards vigilance and agonistic behaviors

<u>Brood Age</u>

- DSR increased with age but not significantly
  - Chick mortality for precocial young typically occurs within the first week of hatching
  - As chicks grew larger, I observed little interspecific interactions when they were near gulls

(Ens *et al*. 1992; Hazlitt and Butler 2001; Colwell *et al*. 2007; and Schulte 2012)

Discussion: Chick body condition

I found evidence of laughing gulls negatively affecting body condition

- Breeding near gull colonies did affect parental behavior
  - Foraging – although not significant, foraging decreased in the presence of gulls
  - Vigilance – adults were significantly more vigilant as gulls increased
  - Study on colonial penguins found higher breeding densities affected offspring condition and adults invested in more nest defense (Tella *et al*. 2002)

- Poor body condition can affect juvenile survival

- Intraspecific competition may force poorly conditioned juveniles to disperse to lower quality habitat (Barbraud *et al*. 2003)

Considerations for body condition

1. Unverified indices must be used with caution
2. I cannot assume a causal relationship between gulls and lower body condition
   - Foraging – did not include tide levels, foraging rates and area of location of reefs
   - Brood size – sibling rivalry may explain variation in body condition

Conclusions

My study, along with Koczur (2013) study has identified several main factors that explain reproductive success for Texas oystercatchers

- As predicted, early nesters had higher reproductive success than late season nesters
- Colonial nesting species may strongly affect seasonal trends in DSR
- Territory size influences reproductive success
- Northerly and Southerly fronts influence overwash events and food availability

The results supported my hypothesis that laughing gulls are negatively affecting reproductive success and chick body condition

- Management implications: culling, habitat manipulation or both?

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Questions or Comments?