Estimating American Oystercatcher Abundance: Spatially and Temporally Replicated Counts



Nathan J. Hostetter

PhD Student
North Carolina State University
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Co-authors and Collaborators

- Ted Simons (NCSU-USGS)
- Sara Schweitzer, Matt Abraham (NCWRC)
- Ruth Boettcher (VDGIF)
- Beth Gardner, Ken Pollock, Tracy Borneman (NCSU)
- Alex Wilke (TNC)
- Lindsay Addison, Walker Golder (NC Audubon)
- Randy Swilling, Britta Muiznieks (Cape Hatteras NS)
- Jon Altman, Michael Rikard (Cape Lookout NS)

Outline

- Estimating abundance
- Pilot study
- Preliminary findings
- Topics for future work

Why Assess AMOY Abundance

- Focal species for coastal shorebird conservation
- Under threat from habitat loss, human interactions, predation, …
- Provide reliable information for management and conservation planning

Methods of Assessing Abundance

- Census: count all individuals
- Sampling: count animals in sampling units and adjust for unobserved individuals

Methods of Assessing Populations

- Census:

$$\widehat{N} = C$$

*Every individual in the entire population (*N*) was counted (*C*)

Methods of Assessing Populations

- Sampling:

$$\widehat{N} = \frac{C}{\alpha\,\hat{\beta}}$$

Methods of Assessing Populations

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Fraction of area sampled

Methods of Assessing Populations

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Fraction of area sampled

Estimated fraction of individuals observed

Methods of Assessing Populations

$$\widehat{N} = \frac{C}{\alpha\ \hat{\beta}}$$

C = count statistic
α = fraction of area sampled
β = estimated fraction of individuals observed
N = ?

Methods of Assessing Populations

$$\widehat{N} = \frac{C}{\alpha\ \hat{\beta}}$$

N = Individual AMOY
Pairs
Territories
Nests

C = count statistic

α = fraction of area sampled

β = estimated fraction of individuals observed

Topics to discuss

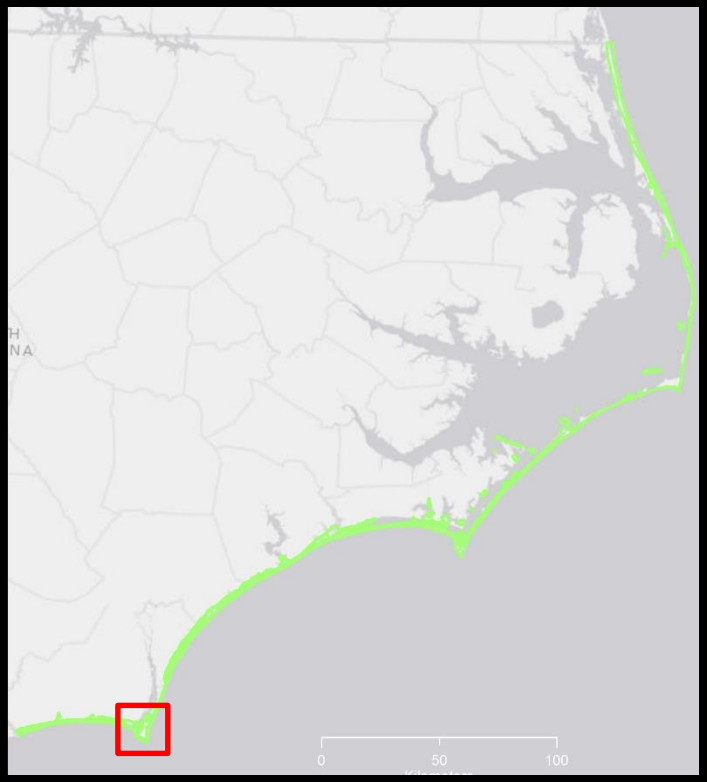
1. Metric of interest

Pilot Study

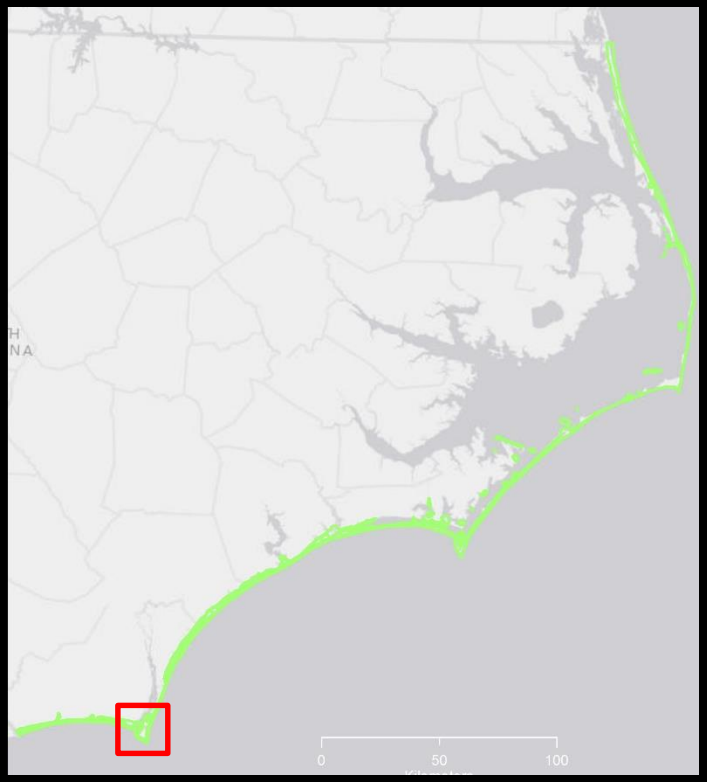
- Multi-agency effort across NC and VA
- Spatially and temporally replicated counts
- Evaluate:
  1. Logistics of conducting replicated multi-agency surveys
  2. Census assumptions
  3. Analysis options
  4. Possibilities to expand the study

Why Count Data?

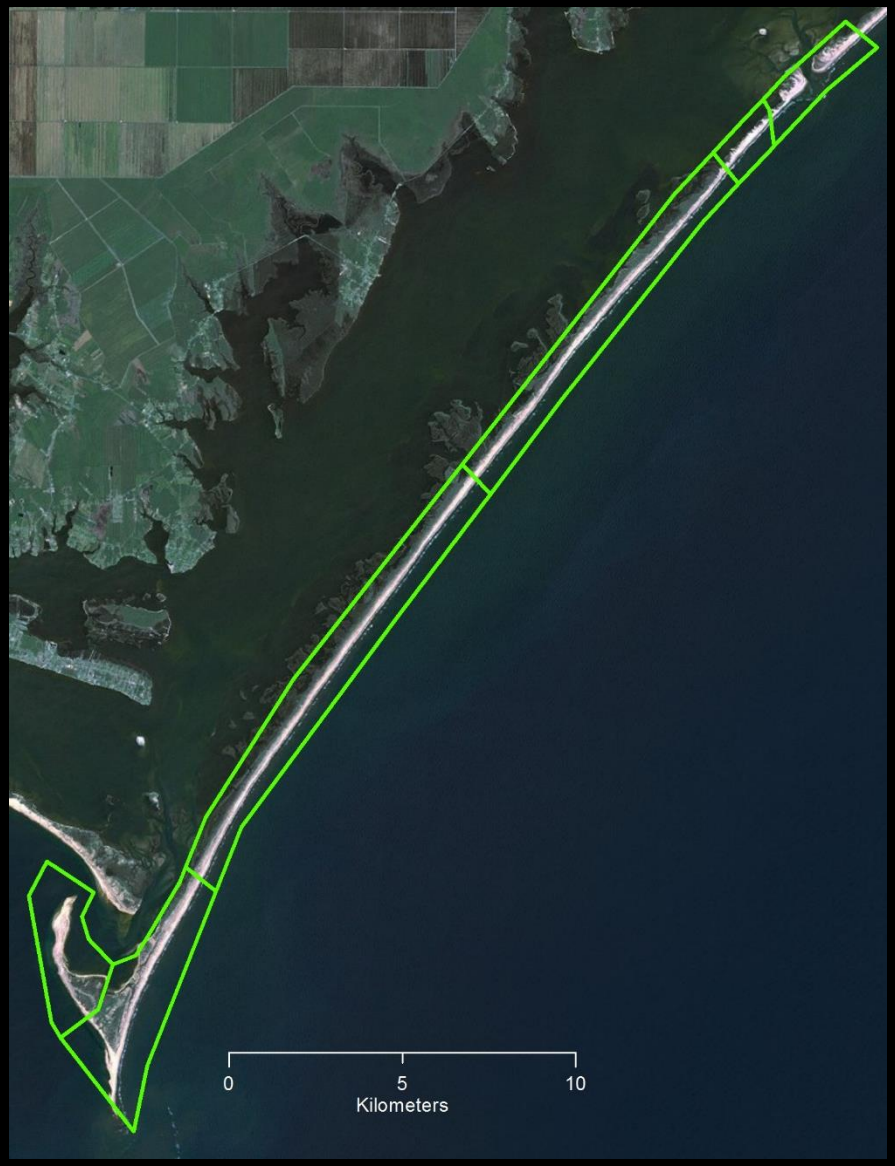
- Estimate abundance (N) from relatively “cheap” data
- More data can be collected
  - e.g., more sites, more replicates
- Replicated surveys allow for estimation of detection probability



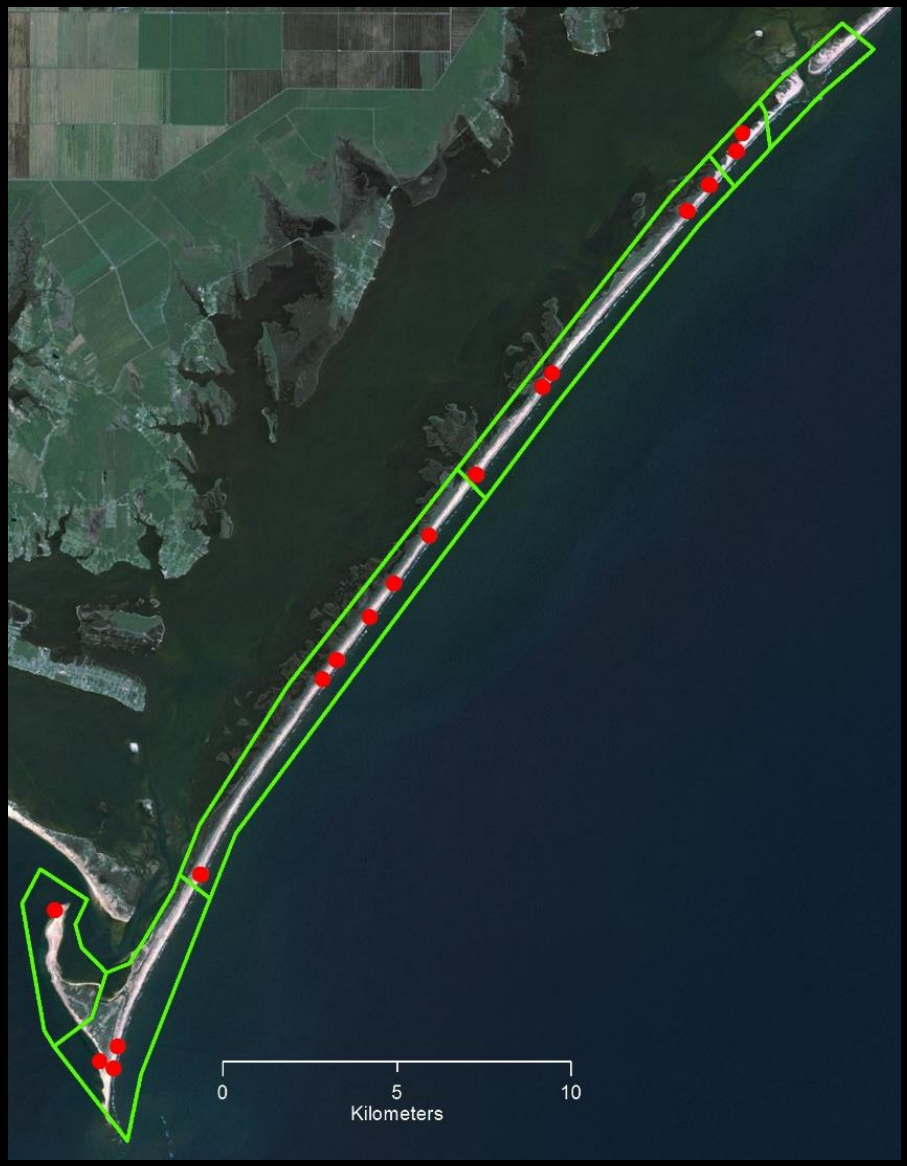
- 171 plots in NC
- 67 plots surveyed (NC), 3 in VA
- 30 plots surveyed on multiple occasions



South Core Banks
Cape Lookout NS



South Core Banks Survey #1
34 individuals (9-May)



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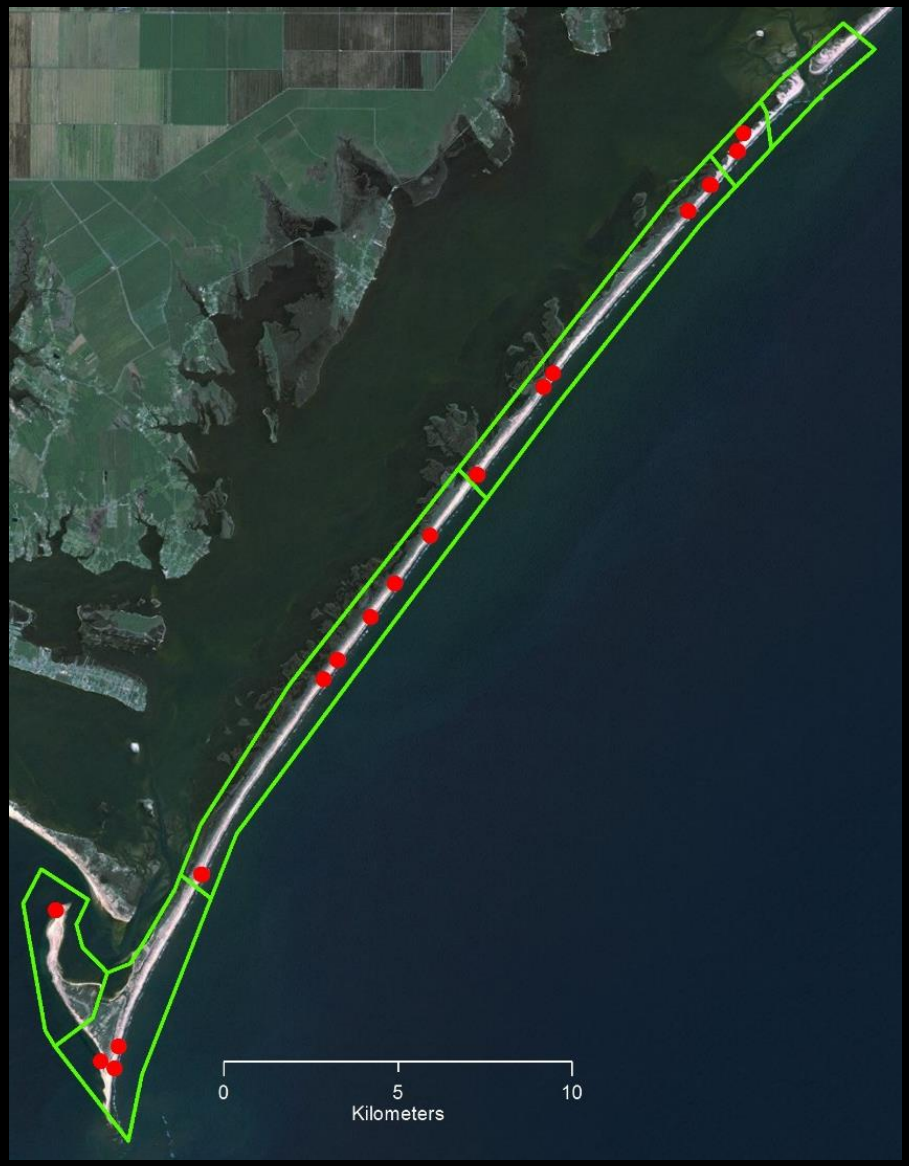

South Core Banks Survey #2
18 individuals (16-May)

South Core Banks Example

	9-May	16-May	24-May	5-June	14-June
Individuals	34	18	34	38	52
Pairs	17	8	17	19	21
Territories	13	8	17	18	18

Maximum individual count: 52
Maximum pair count: 21
Maximum territory count: 18

Actual number of breeding pairs: 27 (separate productivity monitoring study)

Pilot Study

- Evaluate:
  1. Logistics of conducting replicated multi-agency surveys
     - Spatial and temporal counts
  2. Census assumptions
     - Detection probability <1.0
  3. Analysis options
  4. Options for expanding the study

Analysis Options

1. N-mixture models (Royle 2004)
    - Data: spatially and temporally replicated counts
    - Metric: abundance and detection probability
    - Assumptions:
        1. Closed population
        2. Constant detection probability
            - Can add covariates
        3. Constant per plot abundance
            - Can add covariates
        4. Independence among plots

Example N-mixture

	9-May	16-May	24-May	5-June	14-June
Individuals	34	18	34	38	52
Pairs	17	8	17	19	21
Territories	13	8	17	18	18

Per plot rate: 5.89 territories per plot (SE = 1.39)

N-mix est. of territories on SCB: 29 (95% ci: 16-43)

Detection probability: 0.38 (SE=0.08)

Analysis Options

2. Spatial models (Chandler and Royle 2013)
   - Data: replicated spatially referenced count data
   - Metric: density and detection probability
   - Assumptions:
     1. Closed population
     2. Individuals occupy a home range
     3. Individuals are detected independently

Spatial models

- Uses spatial correlation in count data
- Metric: density and detection probability
  - ‘activity centers’

Spatial models

- Red dots are locations of observed ‘territorial birds’

Spatial models

- Red dots are locations of observed ‘territorial birds’
- Blue stars are known nest locations from separate productivity study

Pilot Study

- Evaluate:
  1. Logistics of conducting replicated multi-agency surveys
     - Spatial and temporal counts
  2. Census assumptions
     - Detection probability <1.0
  3. Analysis options
     - N-mixture models
     - Spatially referenced models (?)
  4. Options for expanding the study

Expanding the Pilot Study

1. Incorporate re-sighting data
2. Record effort
3. Covariate data

Topics to discuss

1. Metric of interest
2. Standardized data collection
3. Spatial extent
4. Time and effort

References

N-mixture models

Royle, J.A. 2004. N-mixture models for estimating population size from spatially replicated counts. Biometrics 60: 108–115.

Lyons, J.E., Royle, J.A., Thomas, S.M., Elliott-Smith, E., Evenson, J.R., Kelly, E.G., Milner, R.L., Nysewander, D.R., and Andres, B.A. 2012. large-scale monitoring of shorebird populations using count data and n-mixture models: black oystercatcher (*Haematopus bachmani*) surveys by land and sea. The Auk 129: 645–652.

Spatial models

Chandler, R.B., and Royle, J.A. 2013. Spatially explicit models for inference about density in unmarked or partially marked populations. Ann. Appl. Stat. 7: 936–954.

Sollmann, R., Gardner, B., Parsons, A.W., Stocking, J.J., McClintock, B.T., Simons, T.R., Pollock, K.H., and O'Connell, A.F. 2013. A spatial mark–resight model augmented with telemetry data. Ecology 94: 553–559.