Statistical guidelines for sampling marine avian populations

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Seabirds in the Atlantic

Where are the birds?

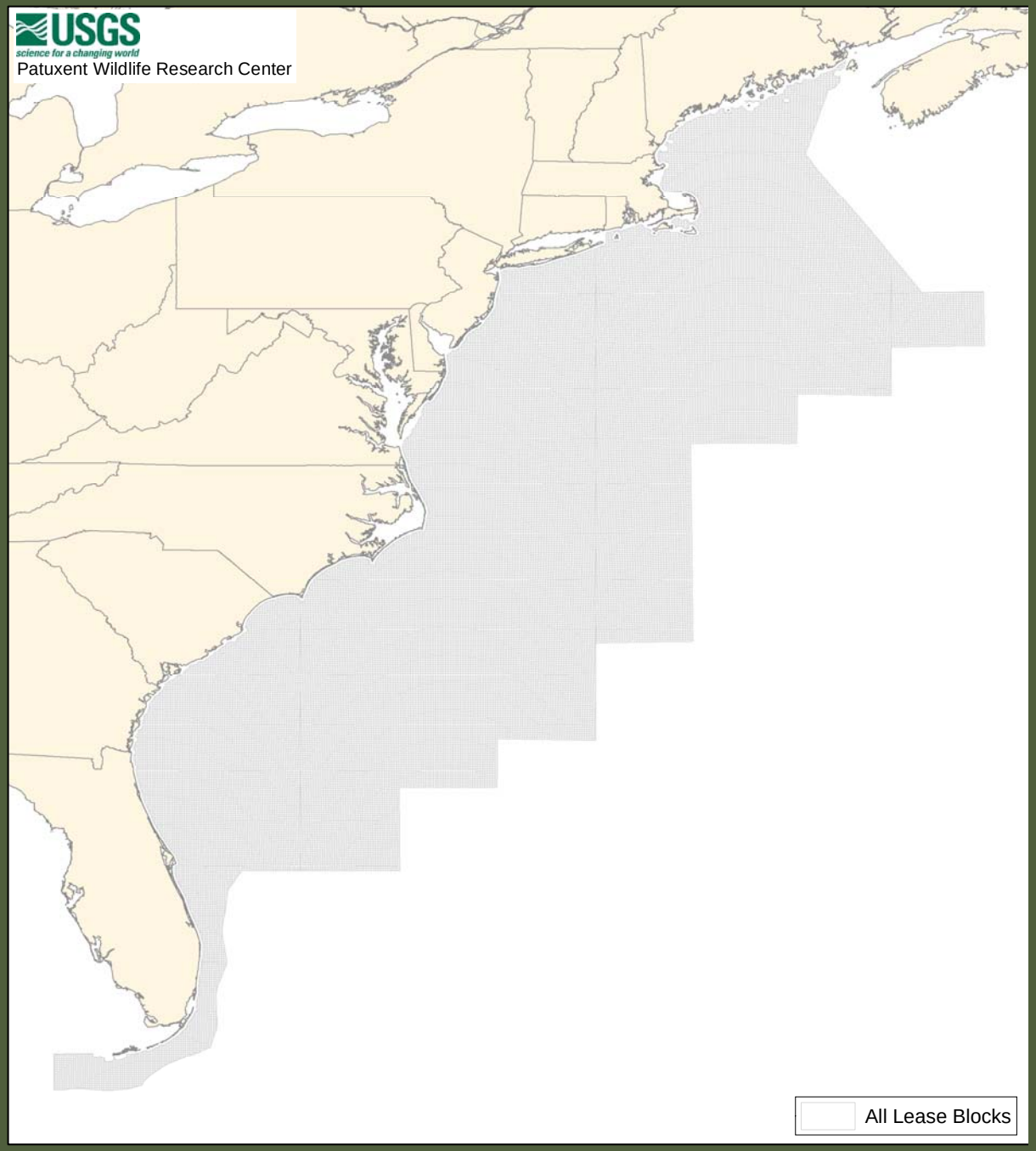
Not a lot known about the distribution and abundances in the Atlantic

- Difficult to survey
- Rough conditions
- Patchily distributed
- Highly mobile

Where are the birds?
Wind development

Off shore wind power garnering lots of interest

- Many states have implemented a 20% renewable energy by 2020 mandate
- Public perception of oil spills is poor



U.S. Bureau of Ocean and Energy Management (BOEM)

- 5km x 5km lease blocks
- Along the Outer Continental Shelf of the Atlantic Ocean

Objectives

Develop a framework for assessing:

1) which lease blocks are “hot spots” and “cold spots”

2) the required surveying effort to guide BOEM and industry in determining wind turbine placement

What is a hot/cold spot?

Hot spot = A lease block with an average species specific abundance that is **three** times the mean of the region

Cold spot = A lease block with an average species specific abundance that is **one third** the mean of the region

The Atlantic Seabird Compendium

- >250,000 seabird observations from U.S. Atlantic waters
- Collected from 1978 through 2011
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We used:

- 32 scientific data sets – 28 ship-based, 4 aerial
- Transects were standardized to 4.63km
- 44,176 survey transects representing 463 species

Two part approach

1) Determine the best statistical distribution to model the count data for each species in each season

2) Use the best fitting distribution to produce power analyses

The rest of the talk

1) Describe the broad two part approach

2) Integrate an example using Northern Gannets

Two part approach

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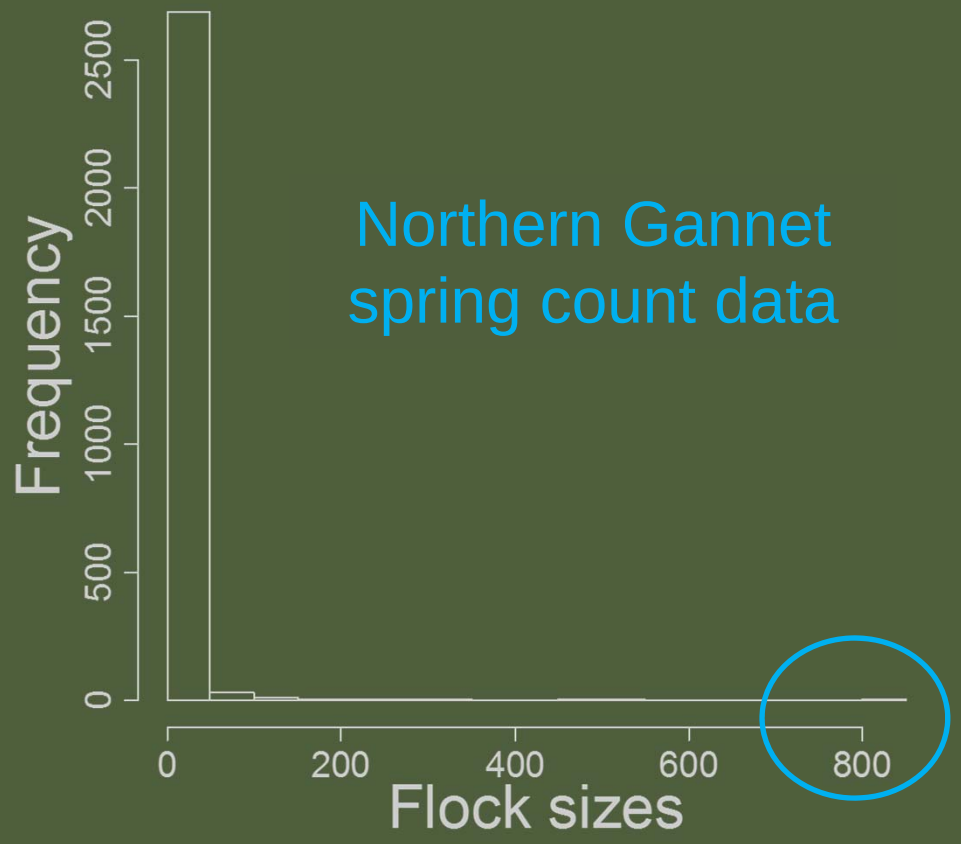
Part 1: Model the data

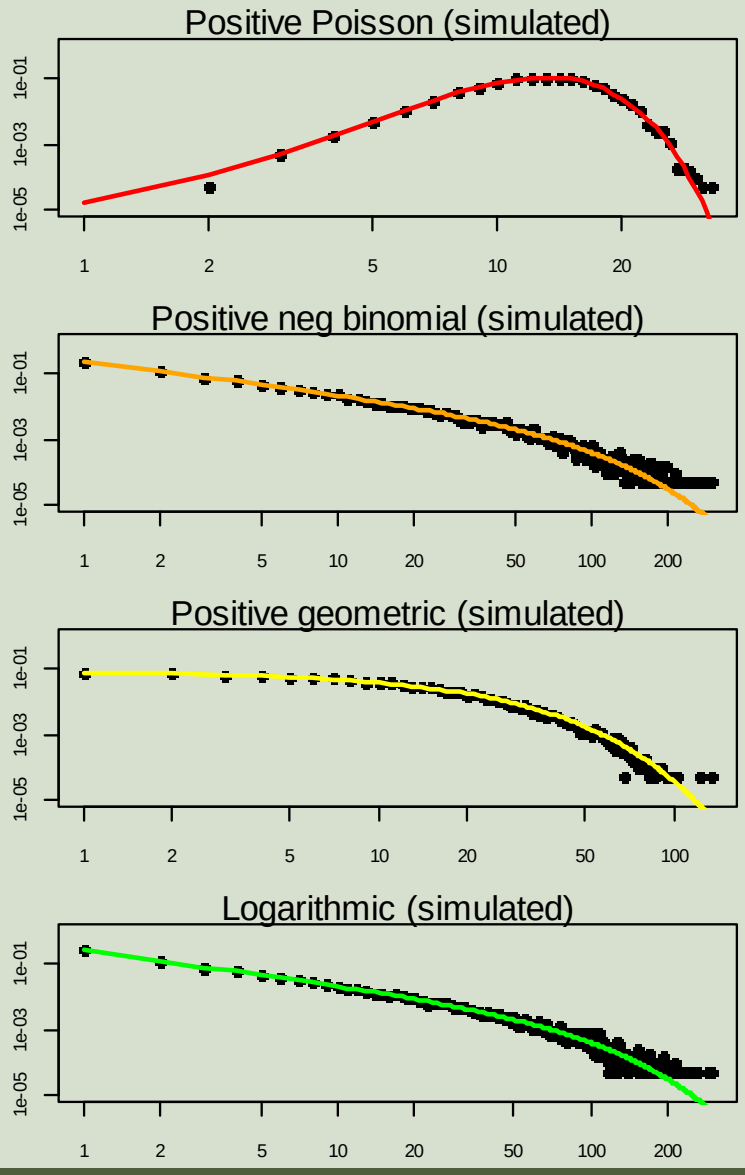
Test eight statistical distributions:

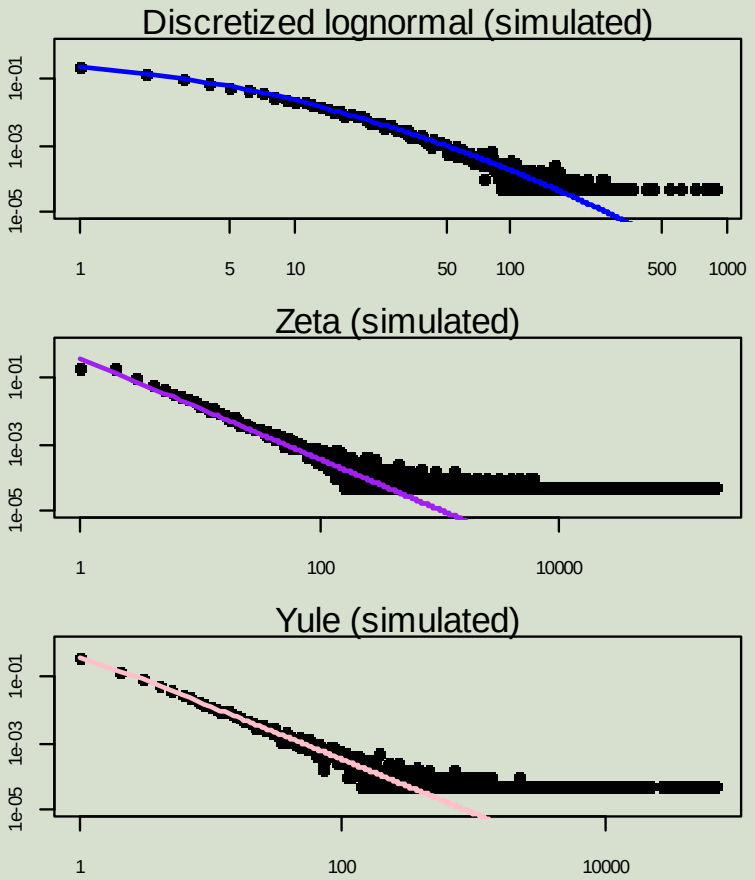
Poisson
Negative binomial
Geometric
Logarithmic
Discretized lognormal
Zeta decay
Yule
Zeta (power law)



Northern Gannet spring count data

Examples of the distributions





Part 1: Results

	Spring	Summer	Fall	Winter	Total
Number species with >500 observations	12	10	15	11	48

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	Spring	Summer	Fall	Winter	Total
Number species with >500 observations	12	10	15	11	48
Discretized lognormal	7 (4*)	4 (3*)	8 (3*)	8 (2*)	27 (12*)
Yule	1*	3*	1*	1	1 (5*)
Negative binomial Logarithmic Zeta decay			3*		0 (3*)

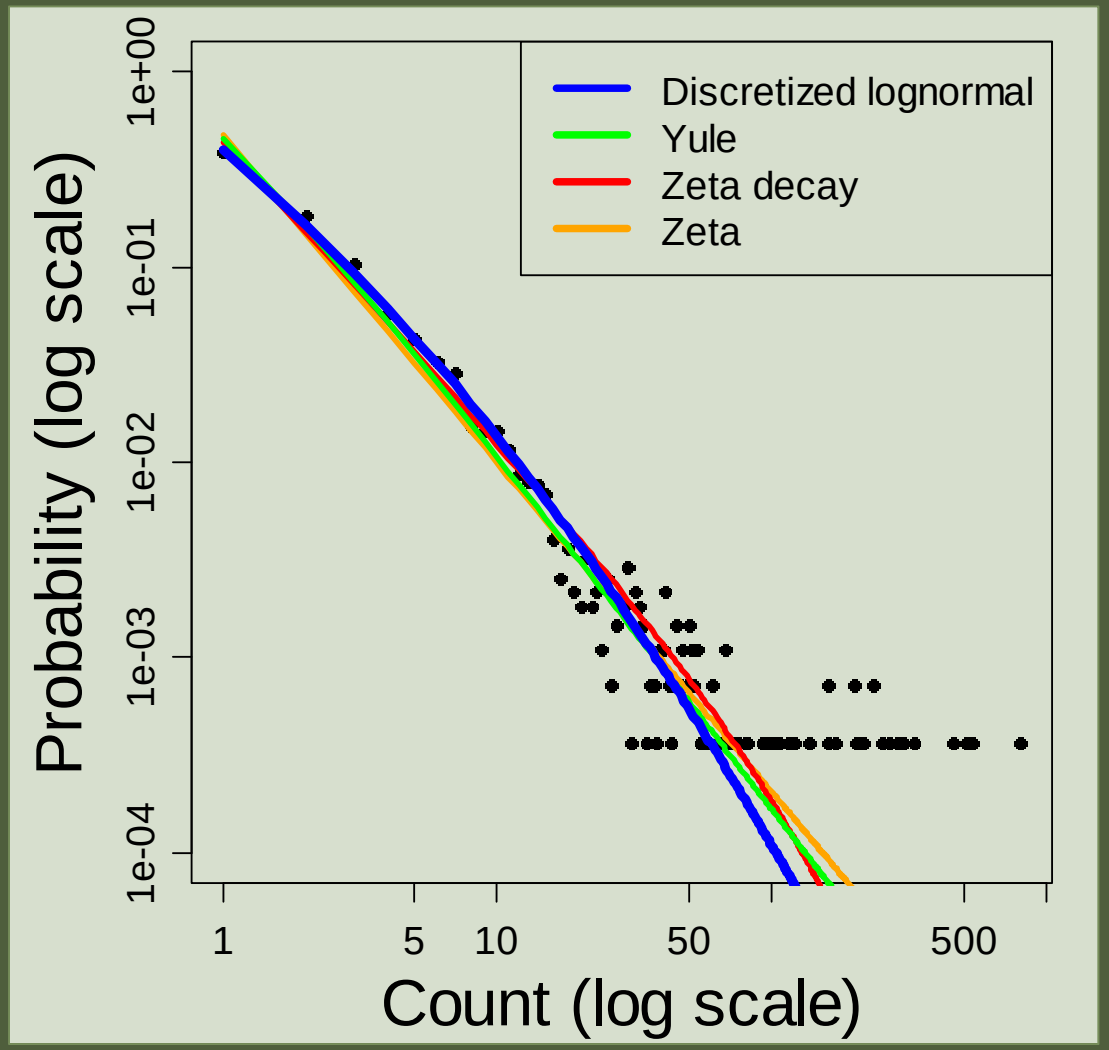
*Not significantly better for $\alpha = 0.05$

Part 1: Results

Northern Gannet

Discretized lognormal top distribution for fall and spring

Discretized lognormal and Yule fit equally well in winter and summer



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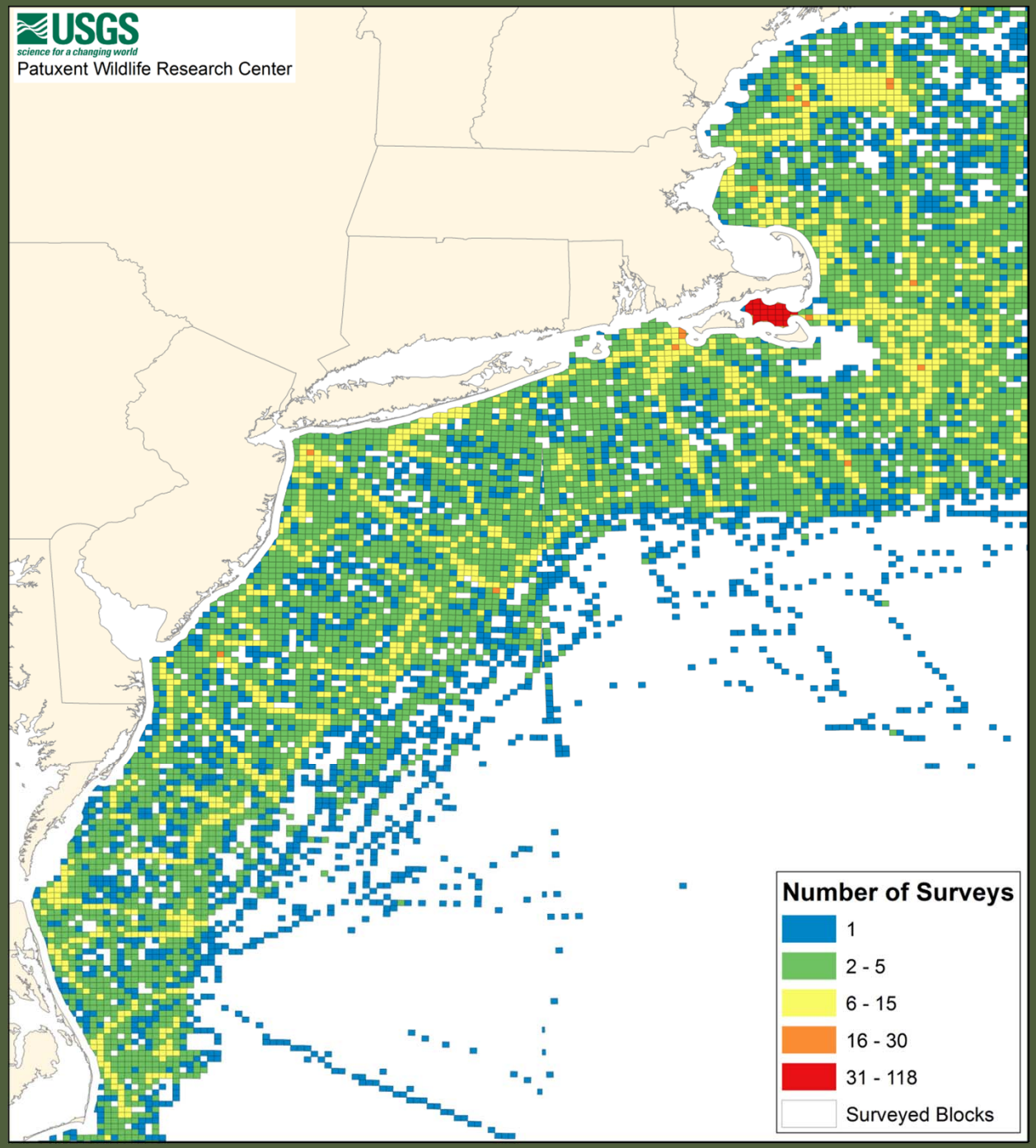
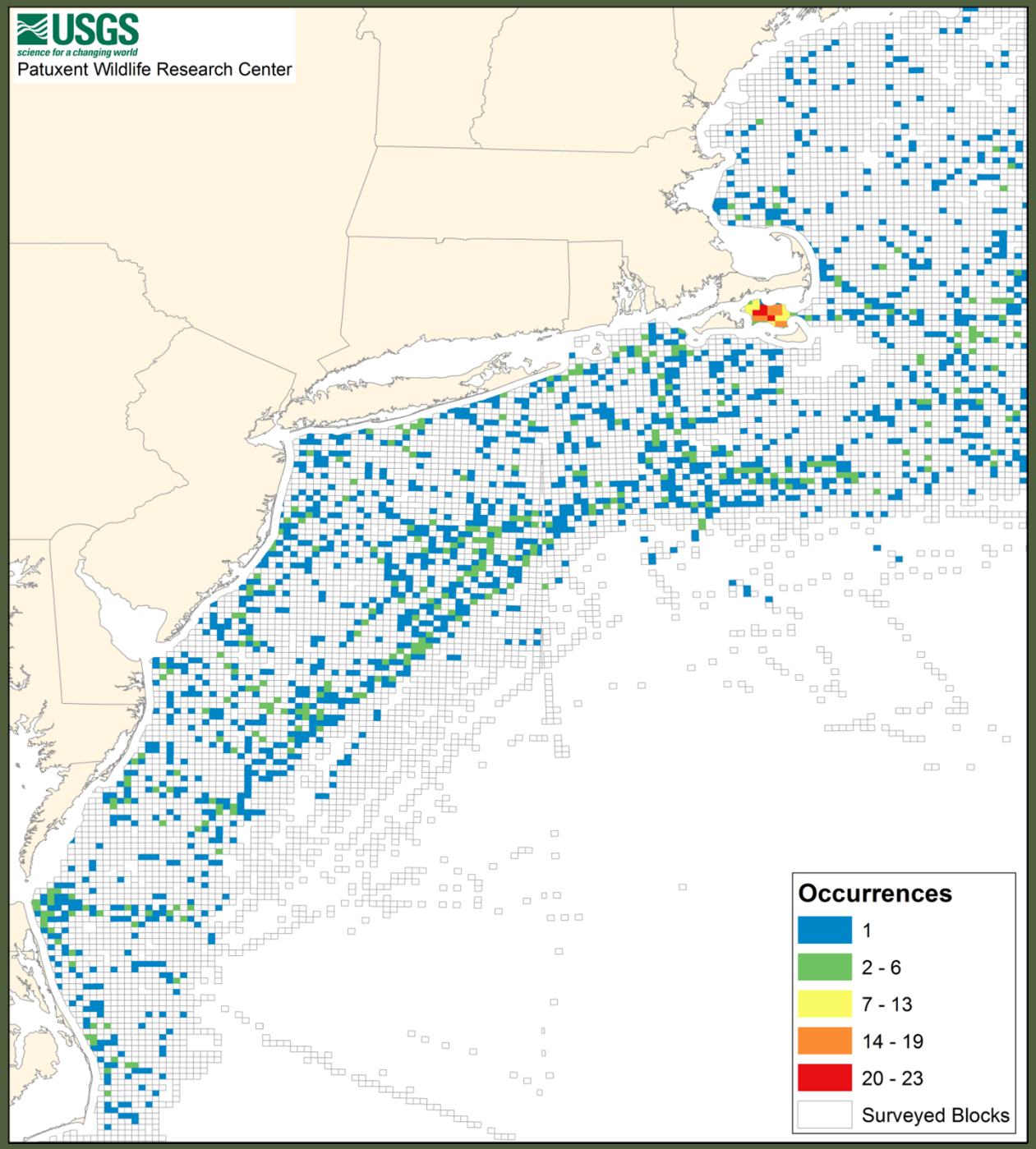


Part 2: Power analysis

Part 2: Power analysis for Northern gannets in the spring

*Focusing only on lease blocks where individuals were observed



Part 2: Northern gannet results

Reference mean = 6.9 individuals per lease block conditional on presence

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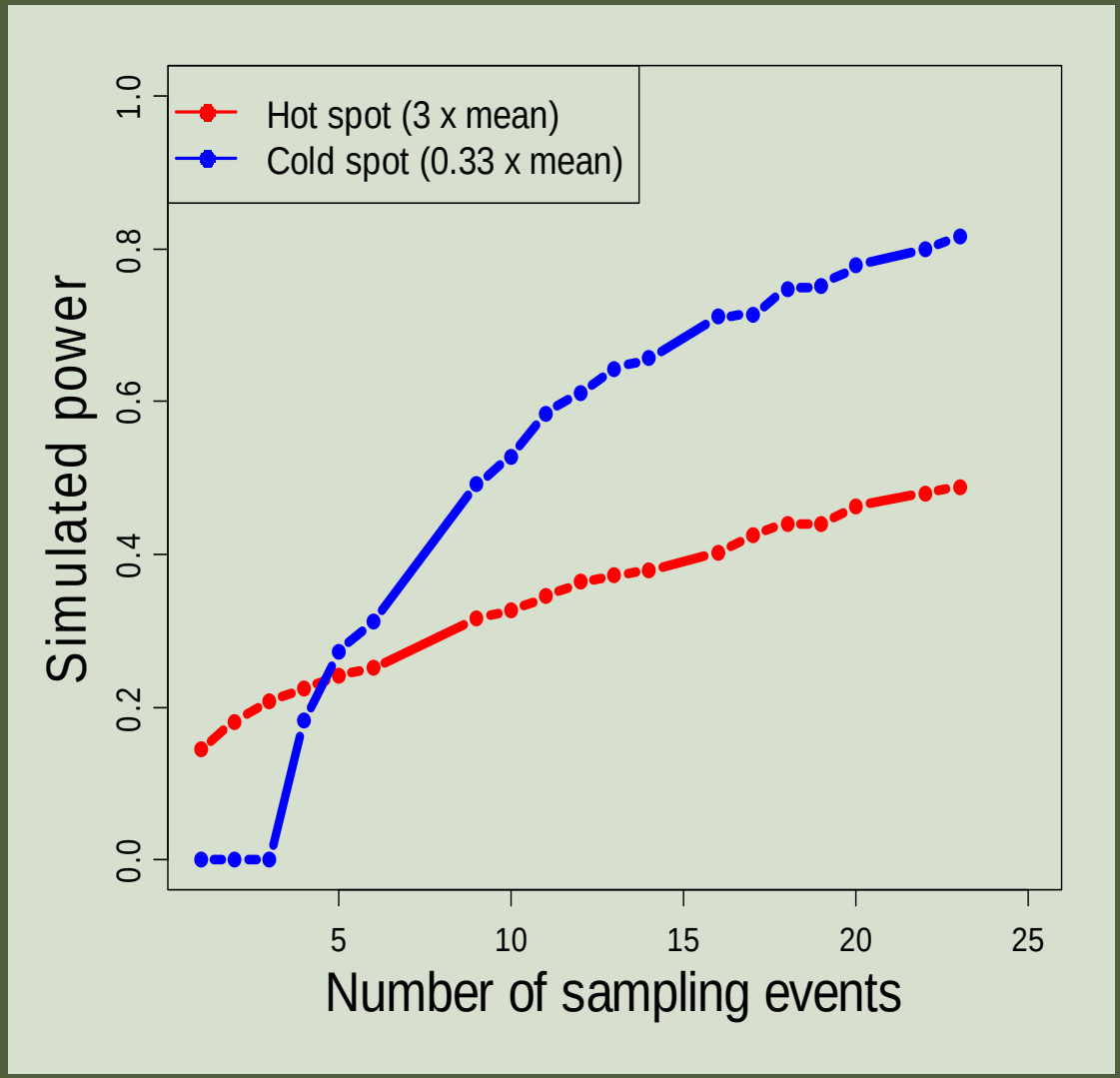

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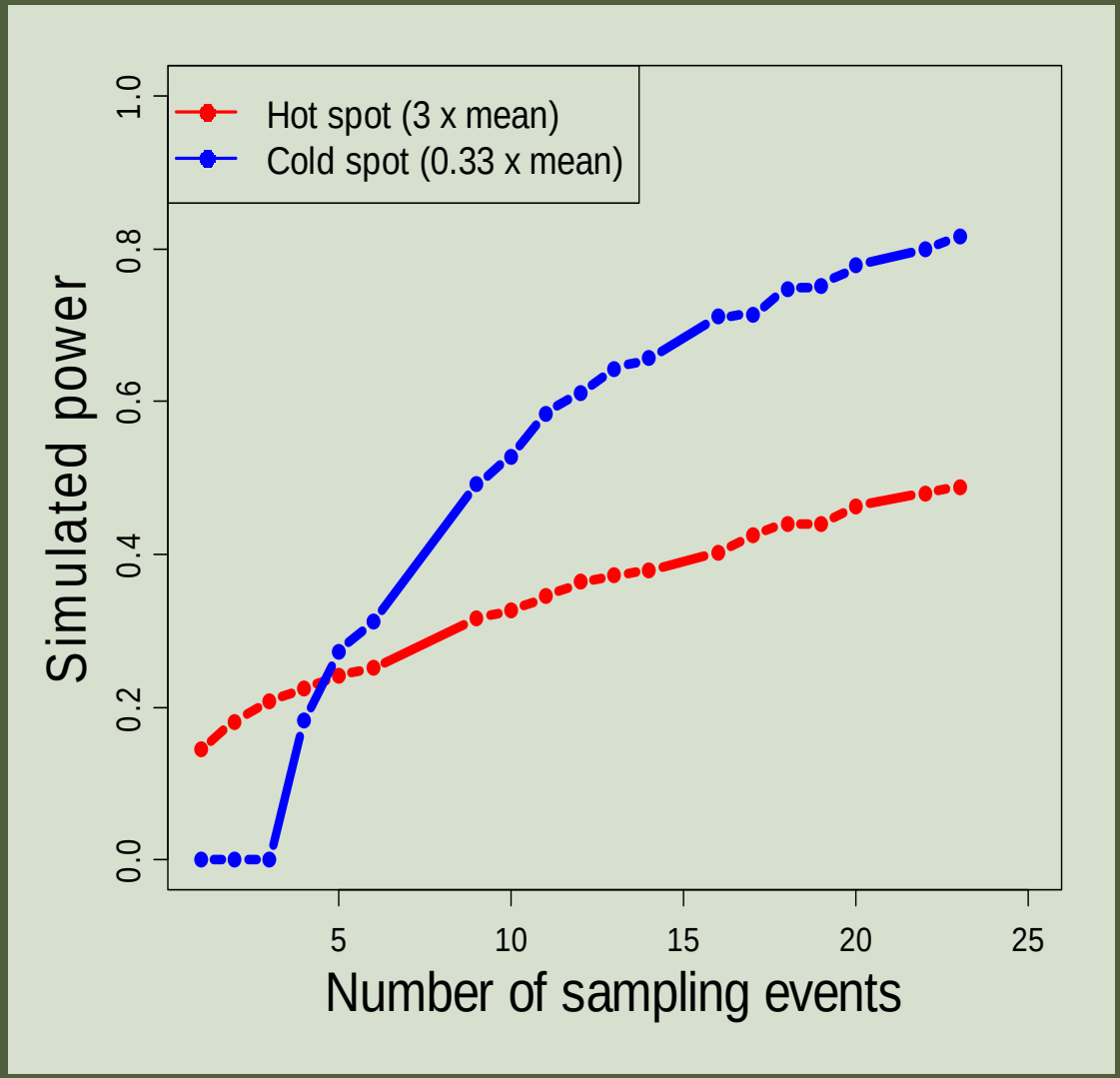

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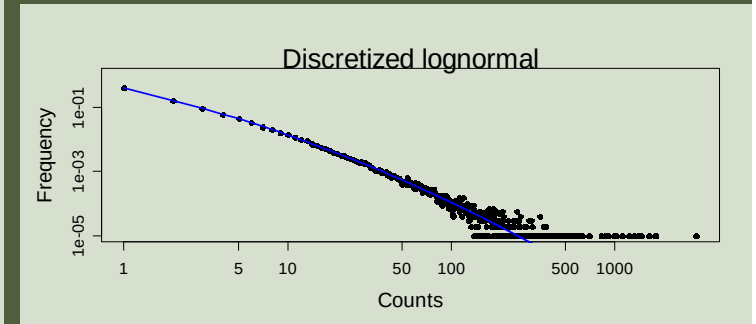

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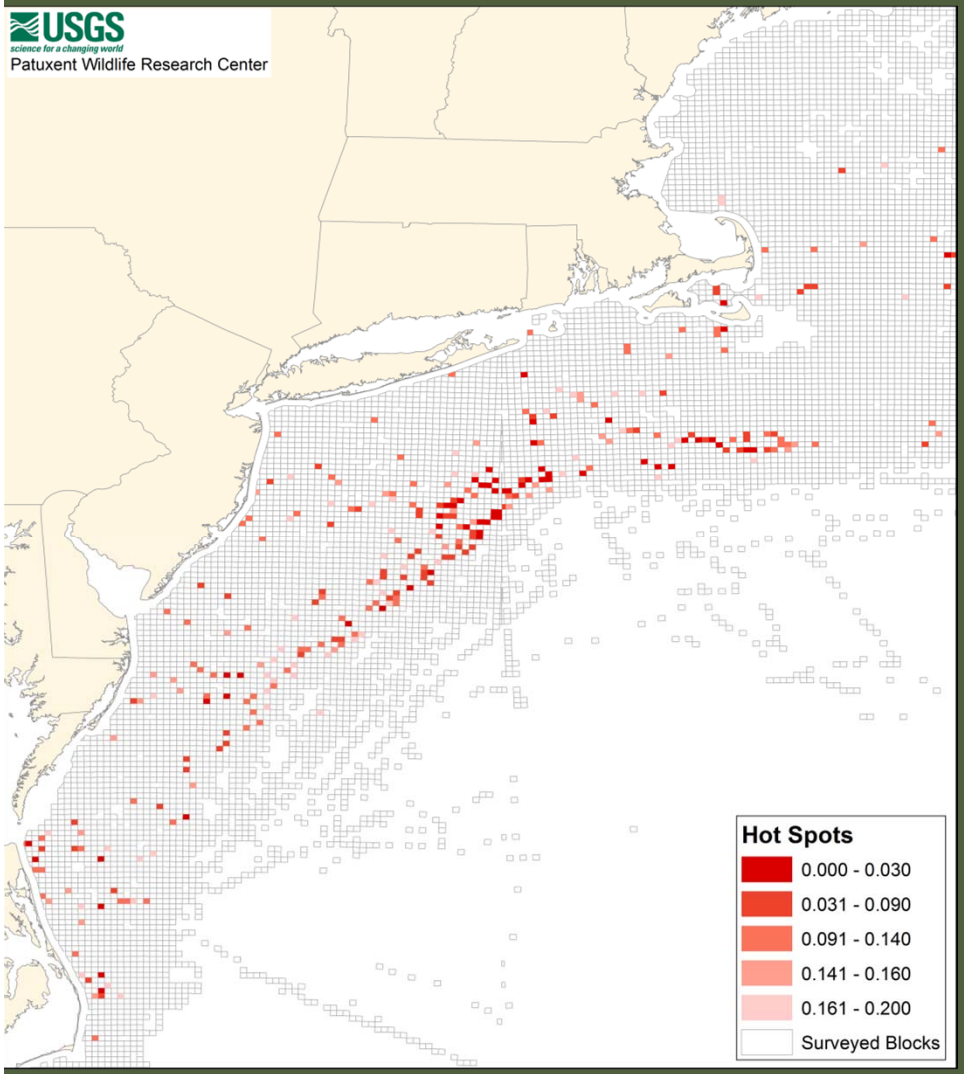

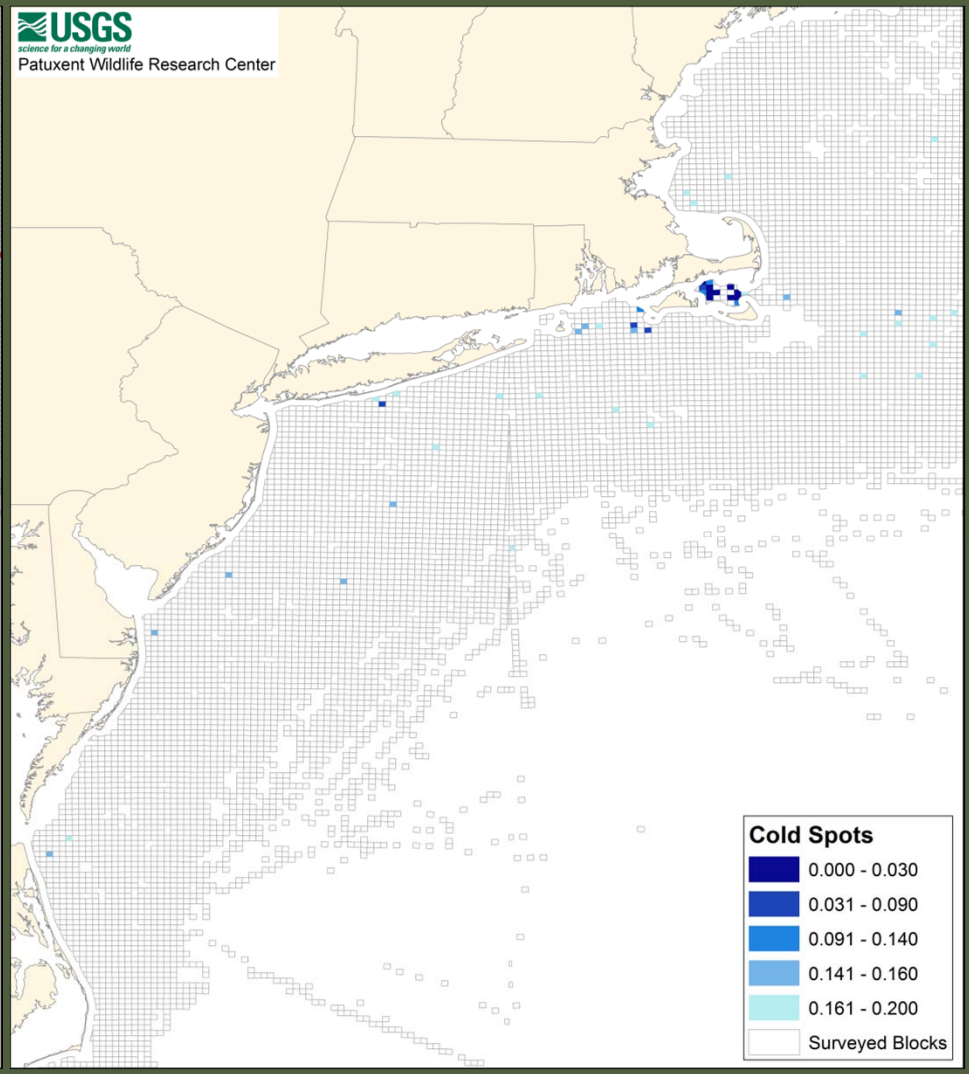

Summary of results

- Seabirds tend to be highly aggregated and require skewed statistical distributions to accurately describe populations
- For many species, we need a large number of surveys to detect areas with atypical abundances

Implications for wind power

- Intensive sampling in multiple seasons will be required to determine potential impacts on seabirds
- A possible approach could be to combine data on functionally similar species or species of high conservation value

Acknowledgments

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