Is the Lionfish invasion coming to an end? A case study from the southeast U.S.

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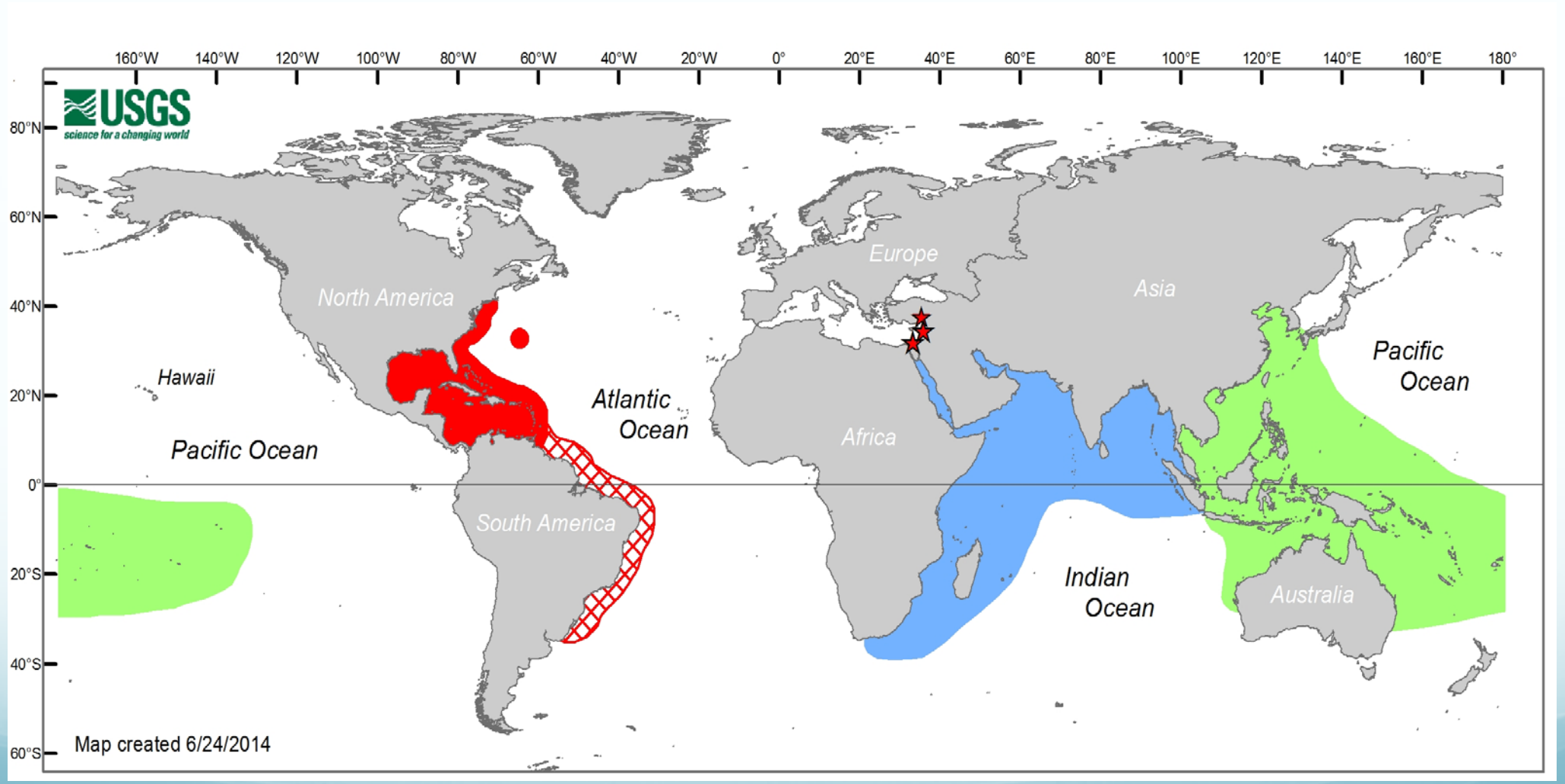
Introduction: Lionfish (*Pterois volitans/miles* complex)



P. volitans native range *P. miles* native range Lionfish invasive range

Why do we care about the invasion?

- Lionfish have many life history traits that make them successful invaders
- Lionfish can have negative impacts on the native ecosystem and fisheries resources

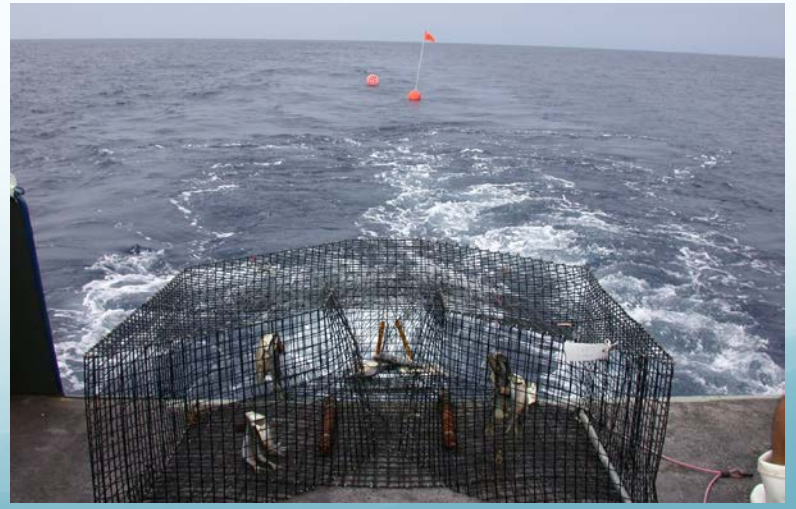


Objectives

- Describe the distribution and abundance of Lionfish off the southeast U.S. coast over a broad spatial and temporal scale
- Determine the environmental conditions that affect the distribution and abundance of Lionfish
- Provide insight on how the Lionfish invasion has changed through time

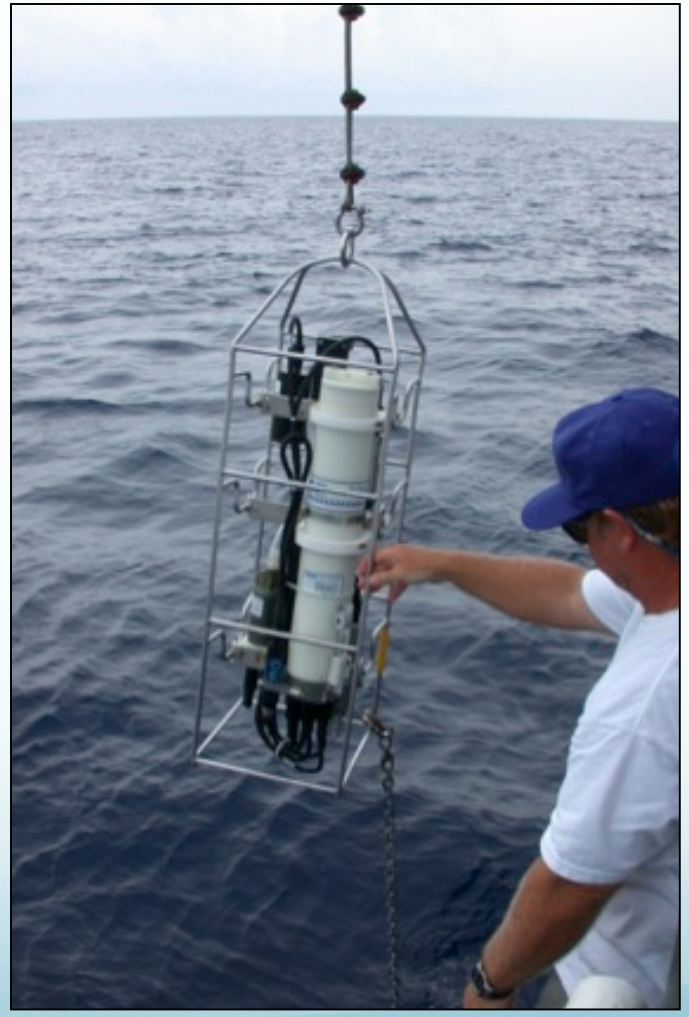
Southeast Reef Fish Survey

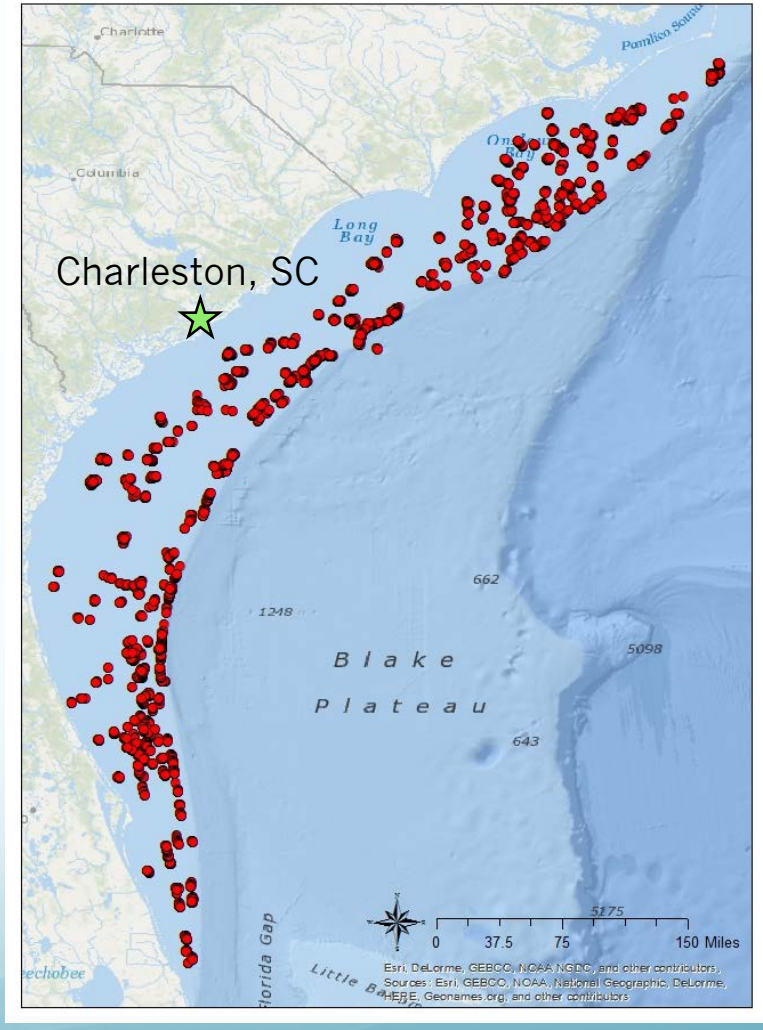
- SERFS- Long-term fisheries independent monitoring program
  - MARMAP- MArine Resources Monitoring, Assessment, and Prediction Program (1972-Present)
  - SEAMAP-SA- South East Area Monitoring, Assessment, and Prediction Program-South Atlantic (2009-Present)
  - SEFIS- South East Fishery Independent Survey (2010-Present)



Data

- Sampling location
- Depth
- DOY & Year
- Bottom Temperature





Video Data

- Since 2011 video cameras have been included on all traps
- 20 minutes of video
- SumCount Lionfish
- Habitat/water quality data

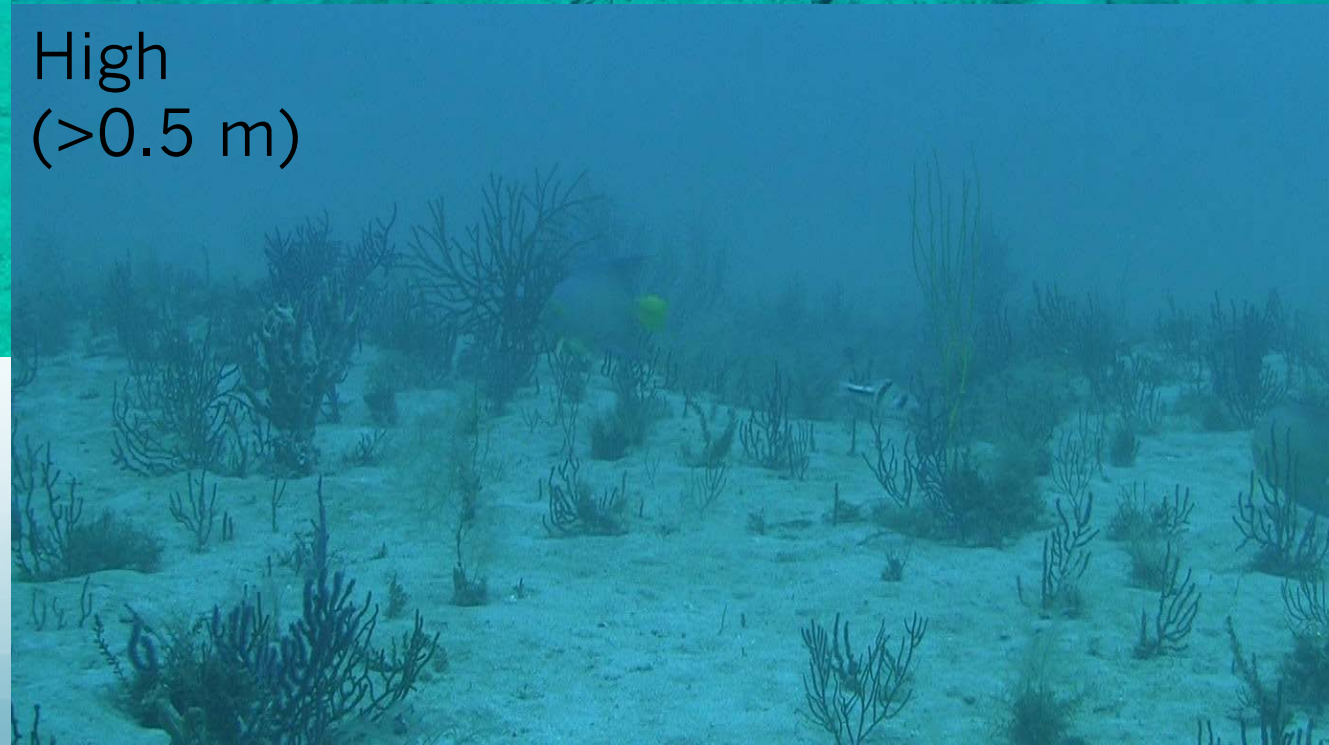
Biota Density

0 %

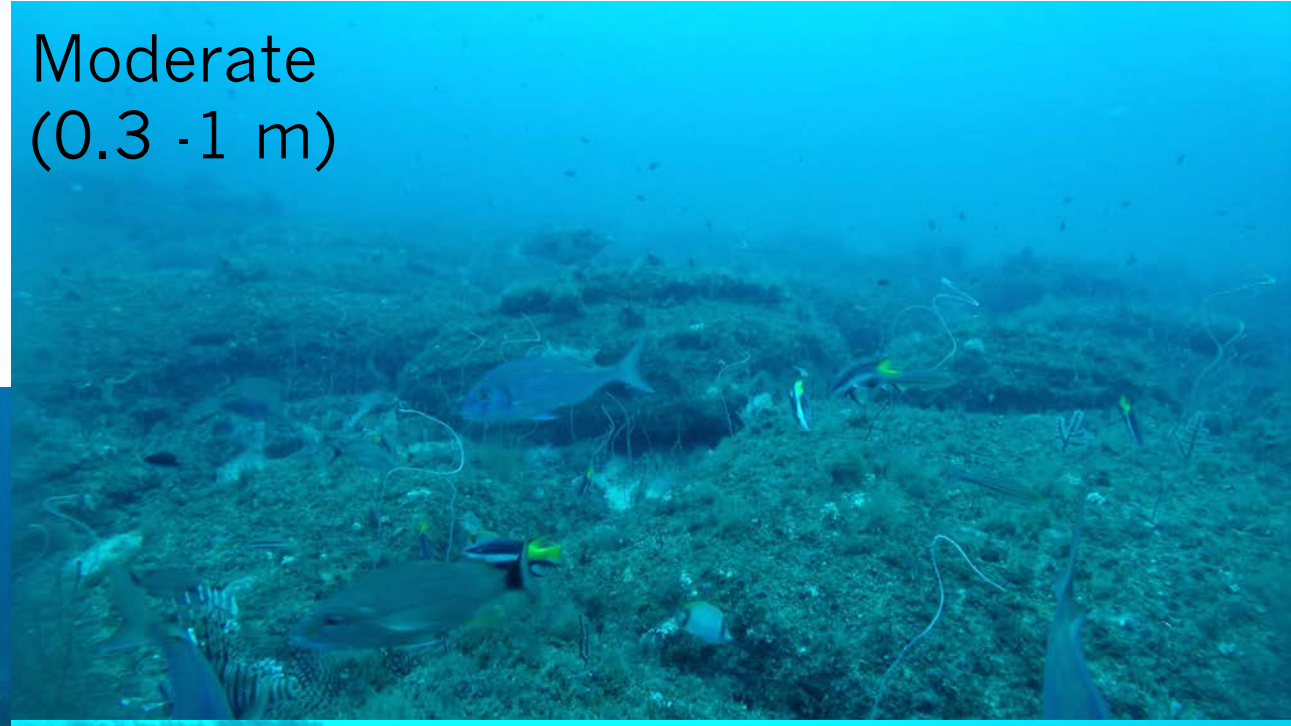
100 %

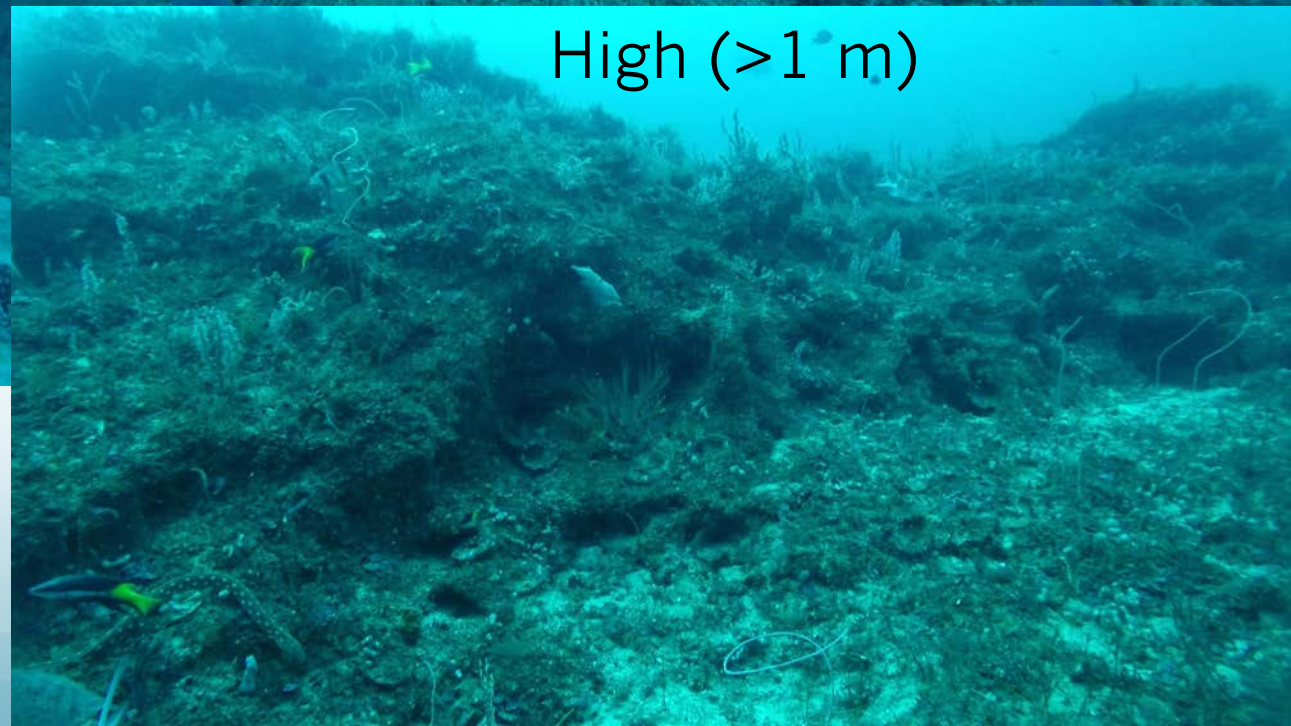
Biota Height

None



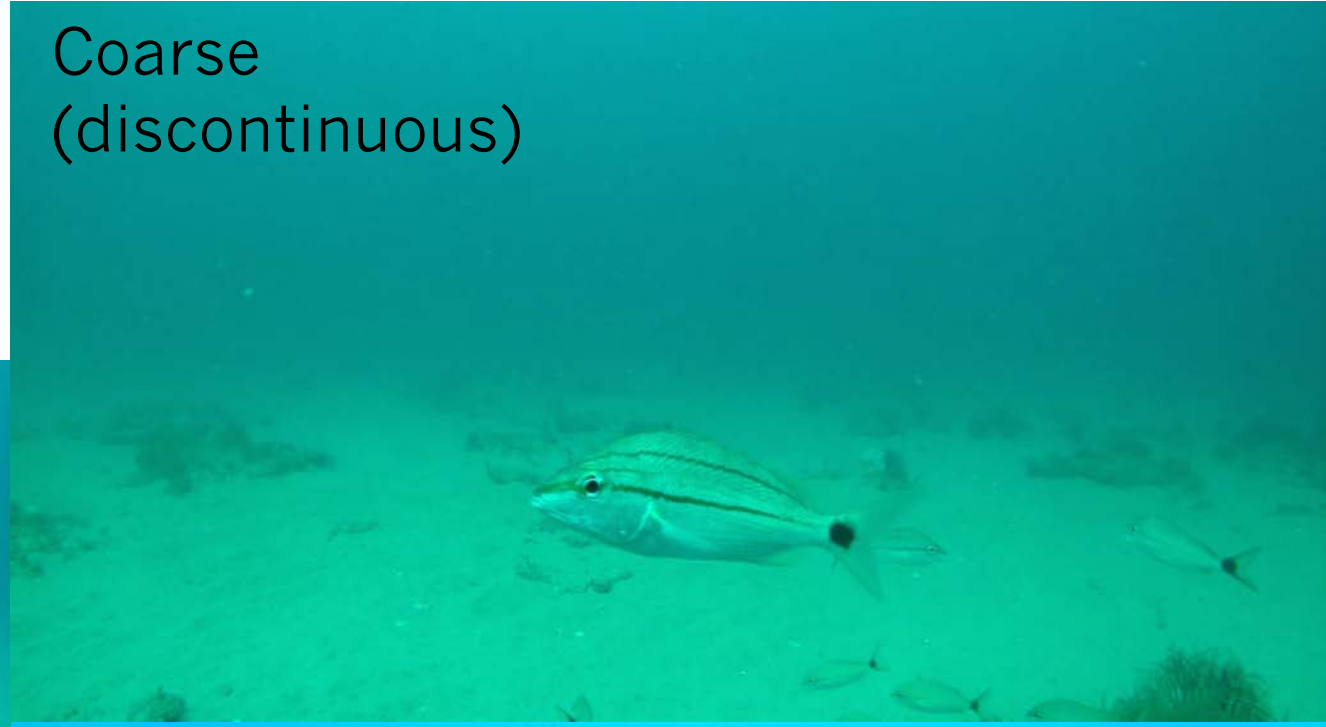
Substrate Relief



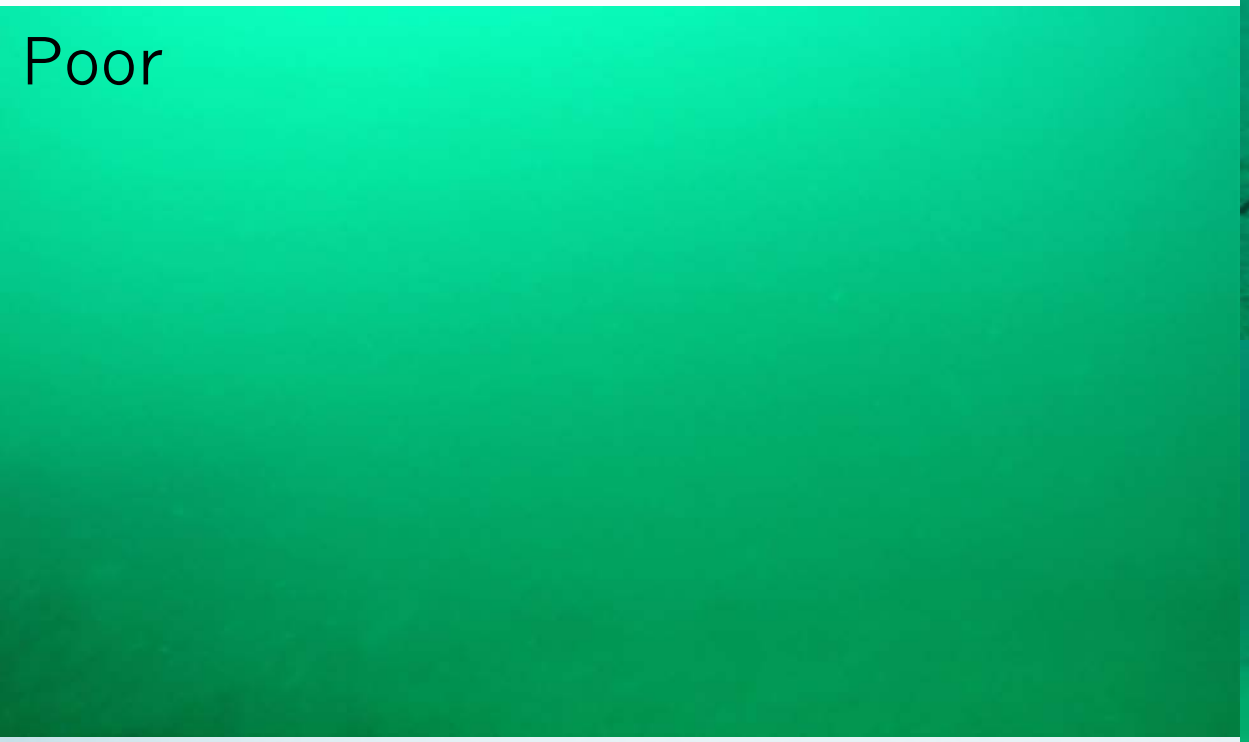


Substrate Size

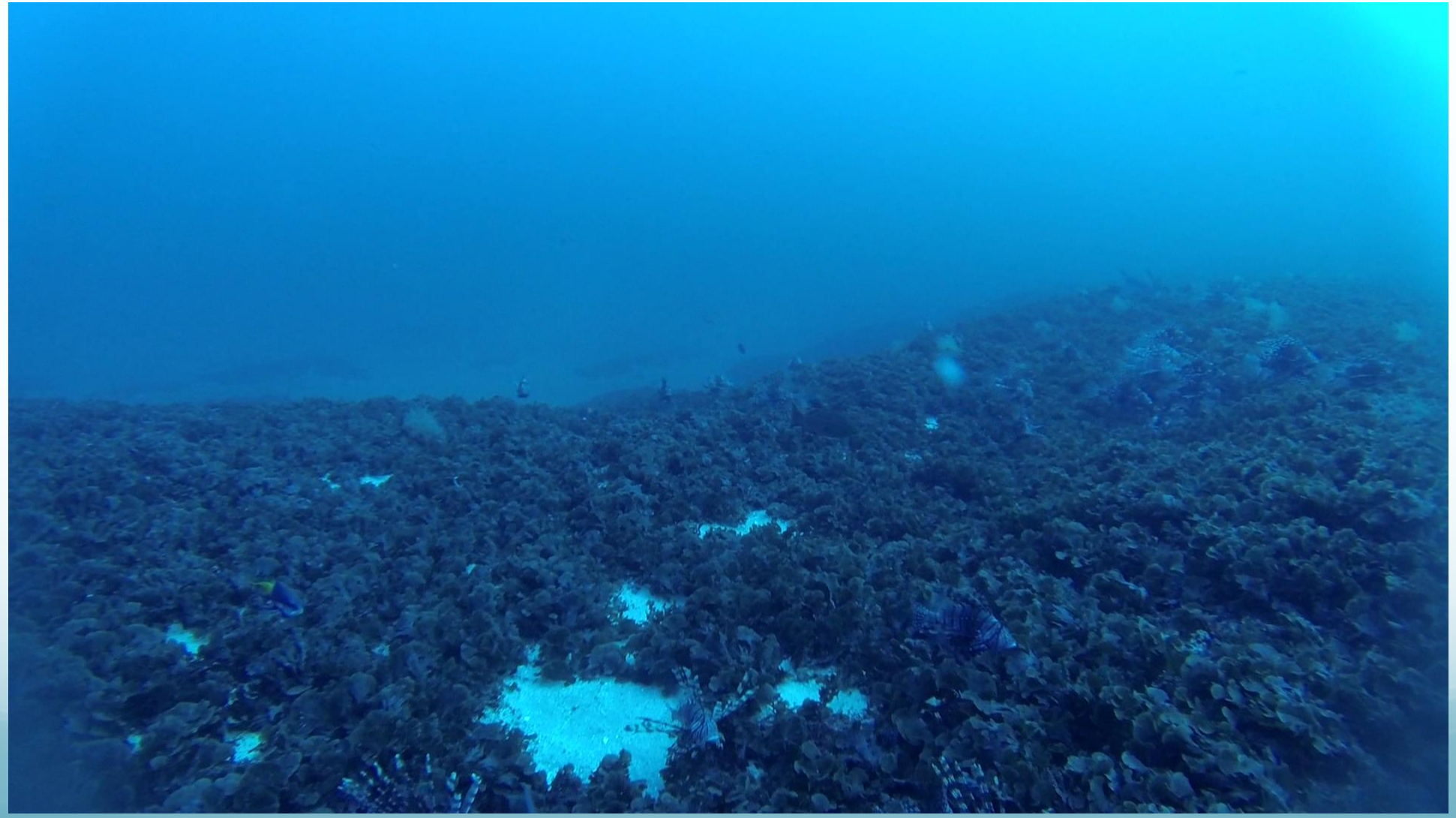
None



Water Clarity



How many Lionfish are there?



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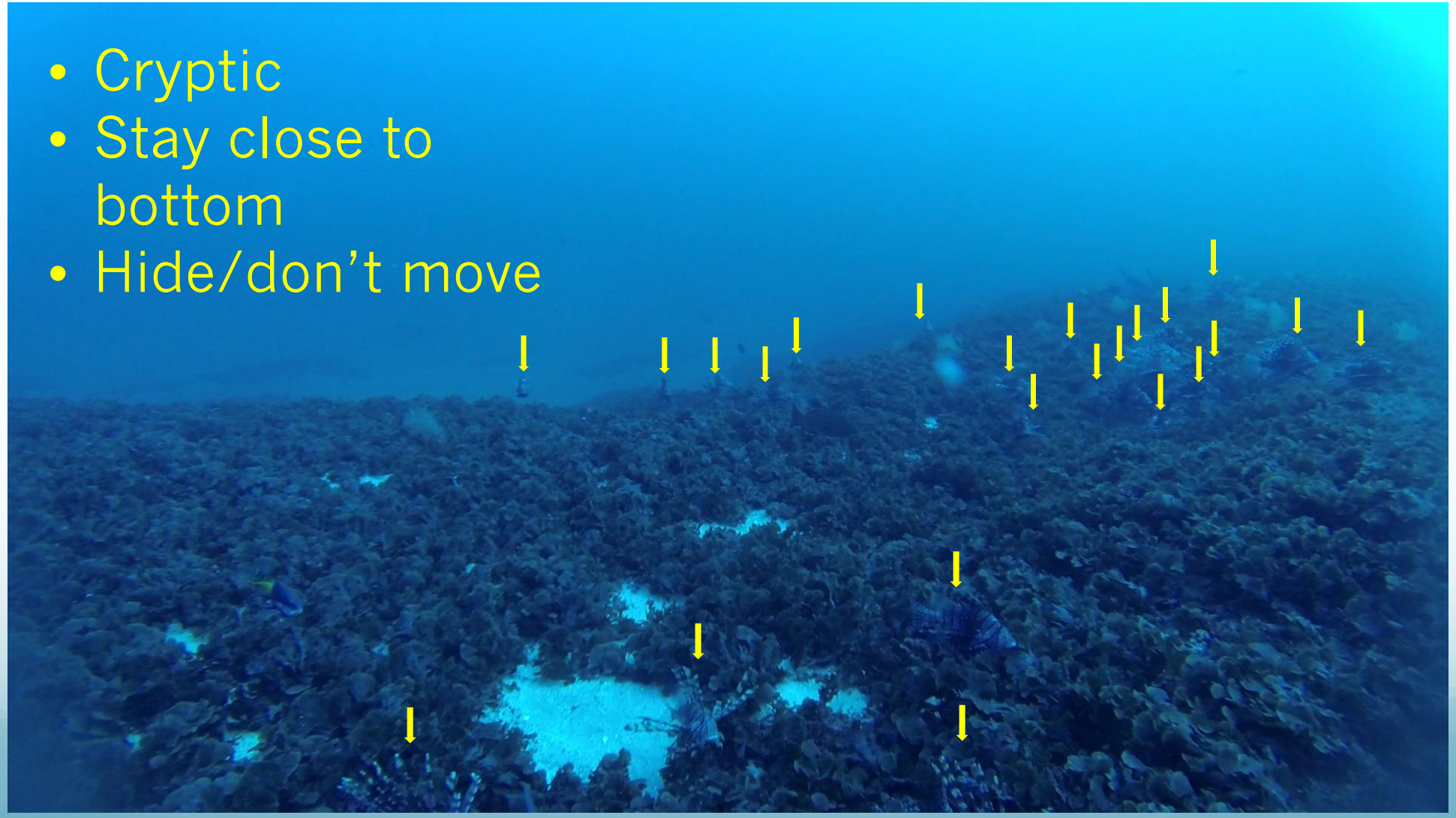


Methods-Modeling

Input Parameters:
Year, DOY, Clarity, Current, Bottom Type, Depth, Latitude, Temperature, Biota Density

Two Part Model

Distribution – Where are the lionfish?

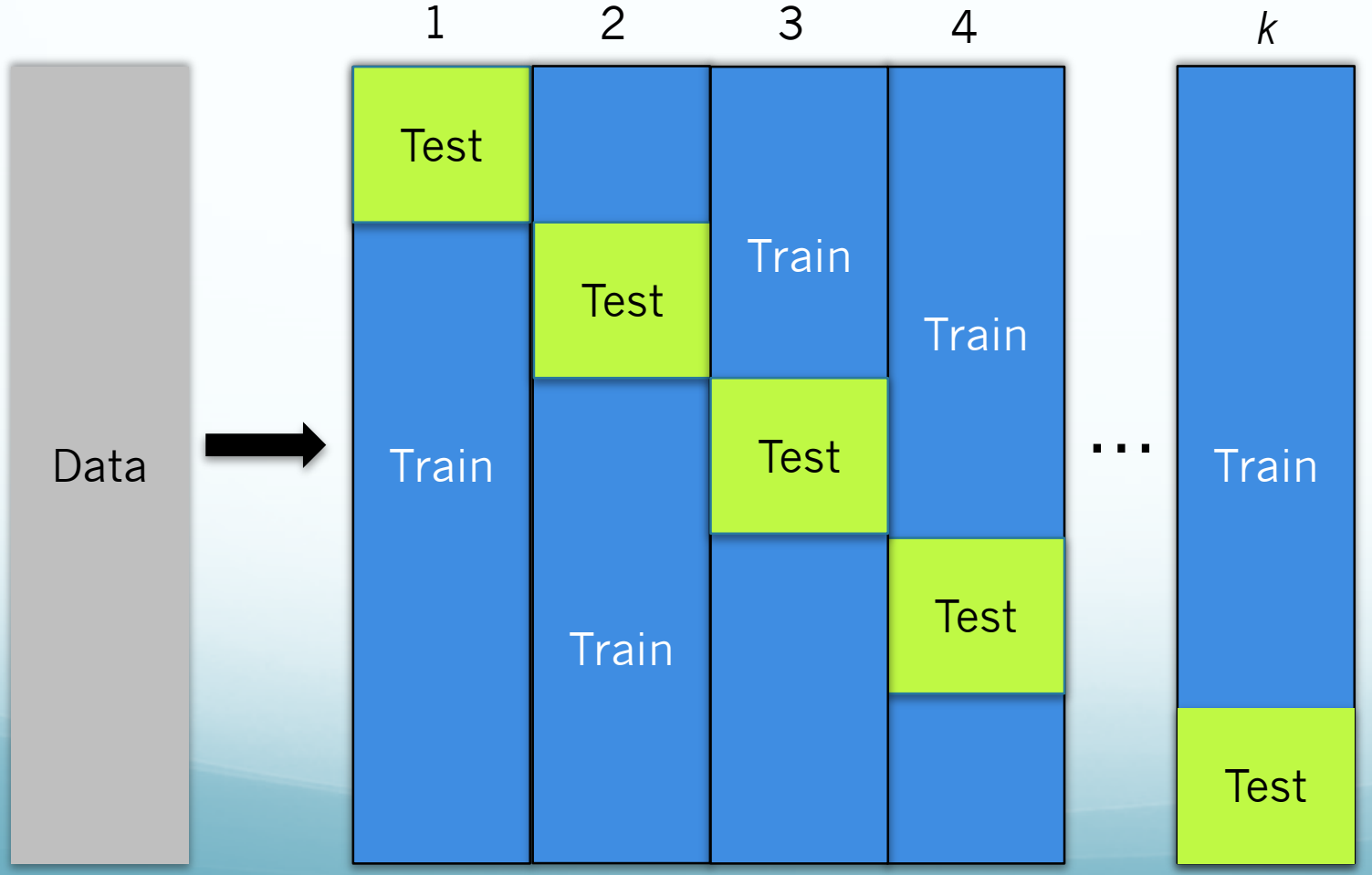
Species Distribution Model
- Binomial logistic regression

Abundance – How many lionfish are there?

Abundance Index
- Zero-inflated negative binomial model

Model Accuracy

- K- Fold Cross Validation



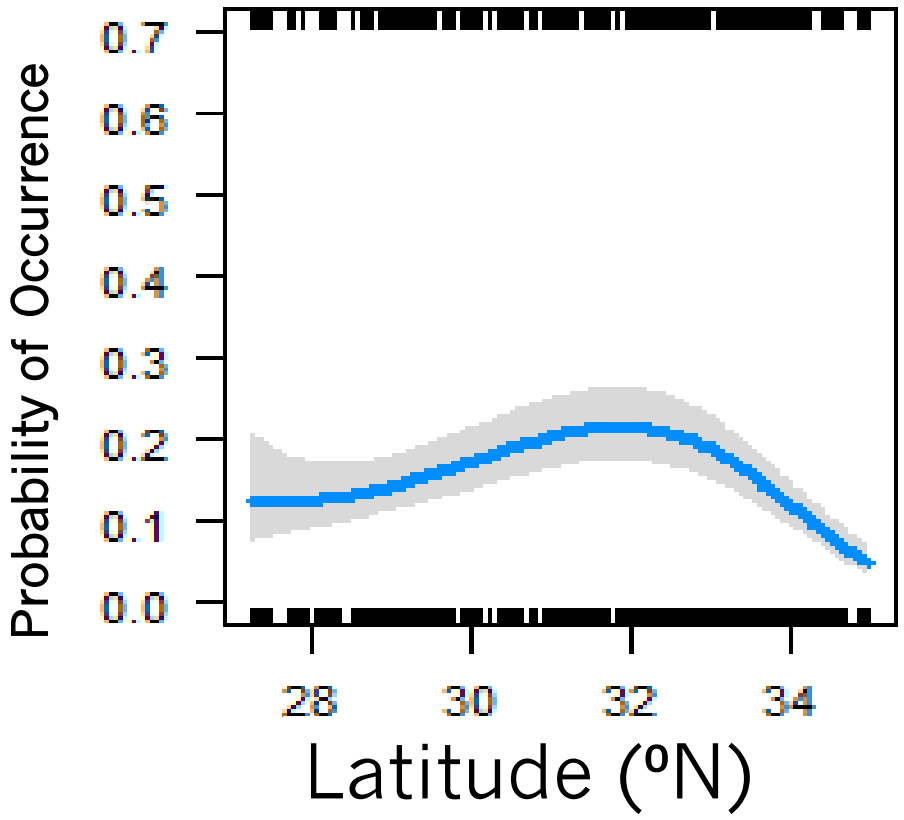
Average-

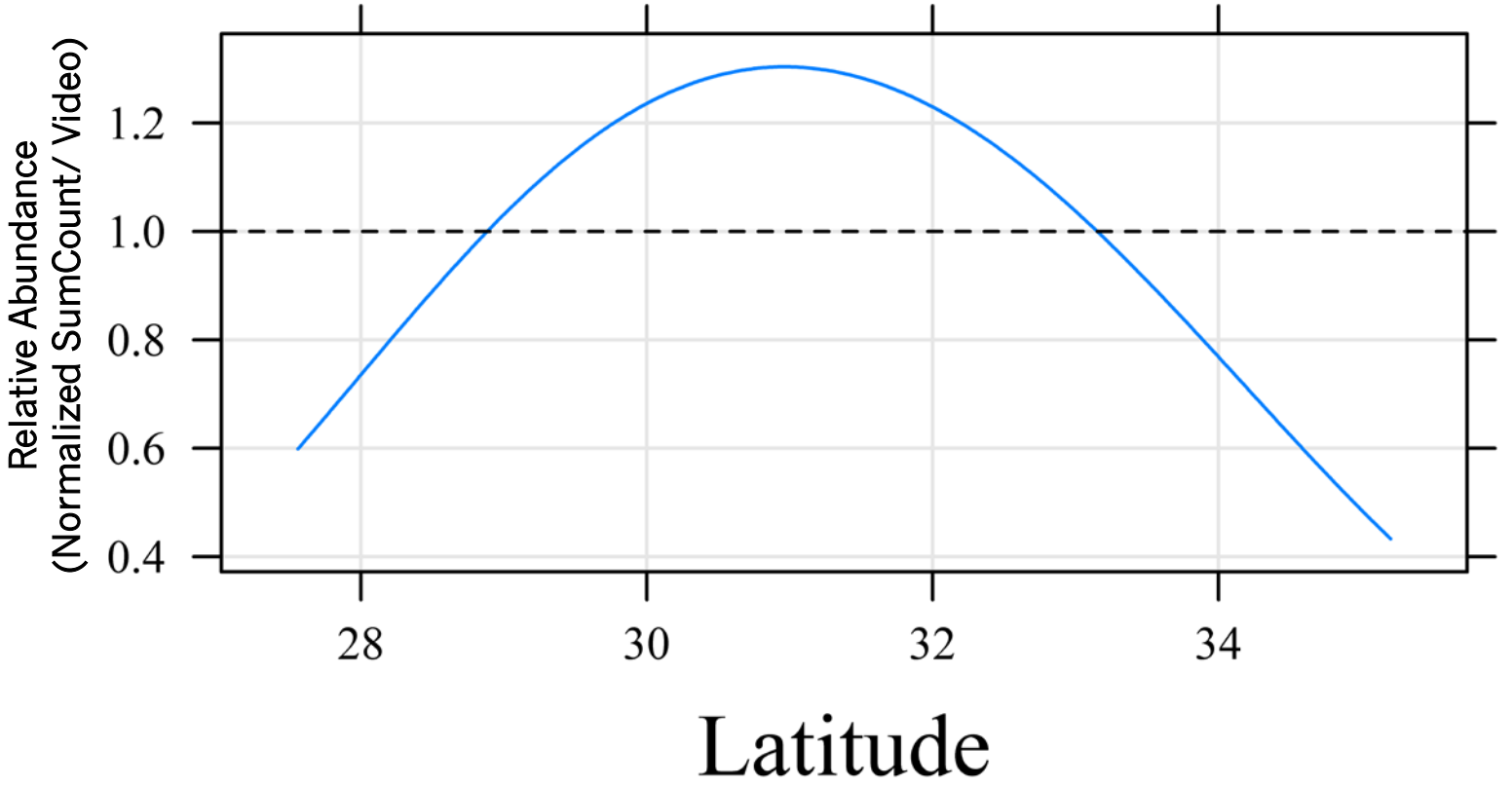
1. Model Accuracy- 85%

2. False Positive Rate -2 %

3. False Negative Rate – 13 %

Covariate Effects





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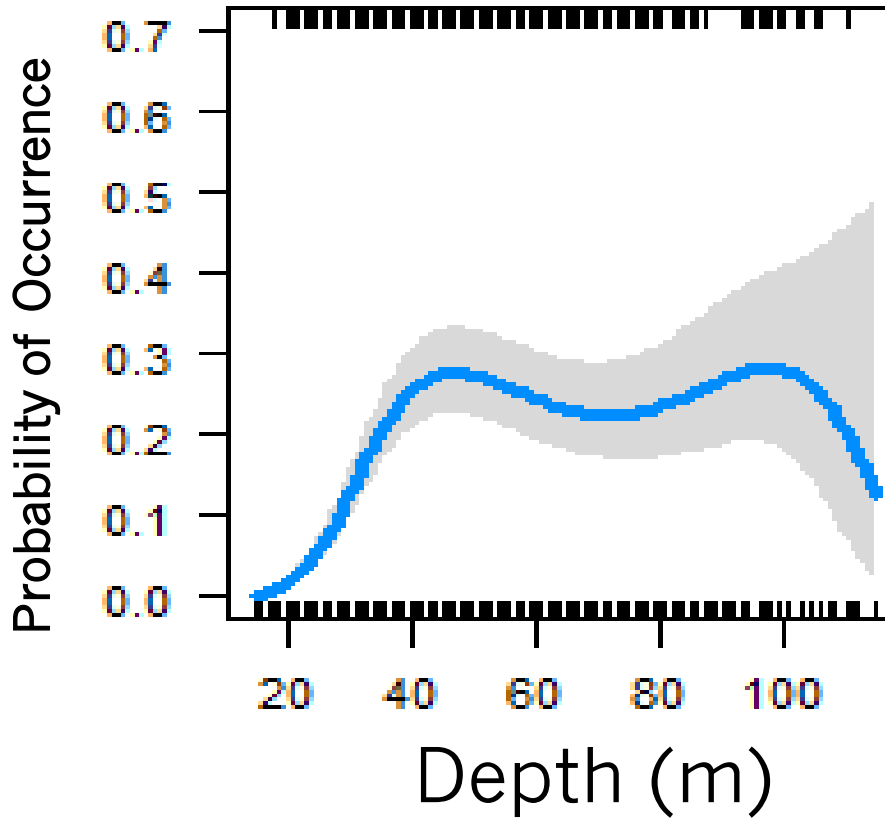

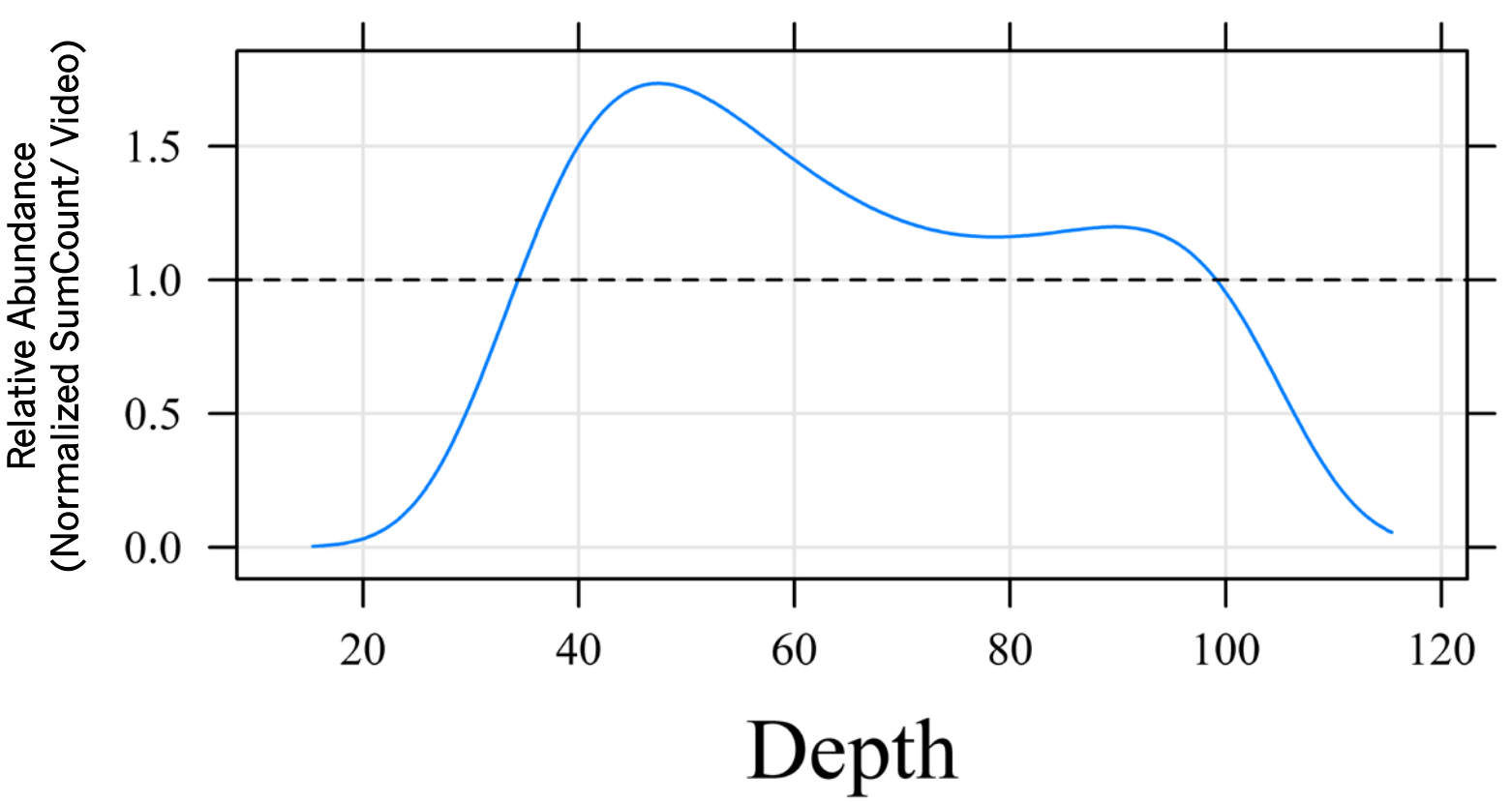

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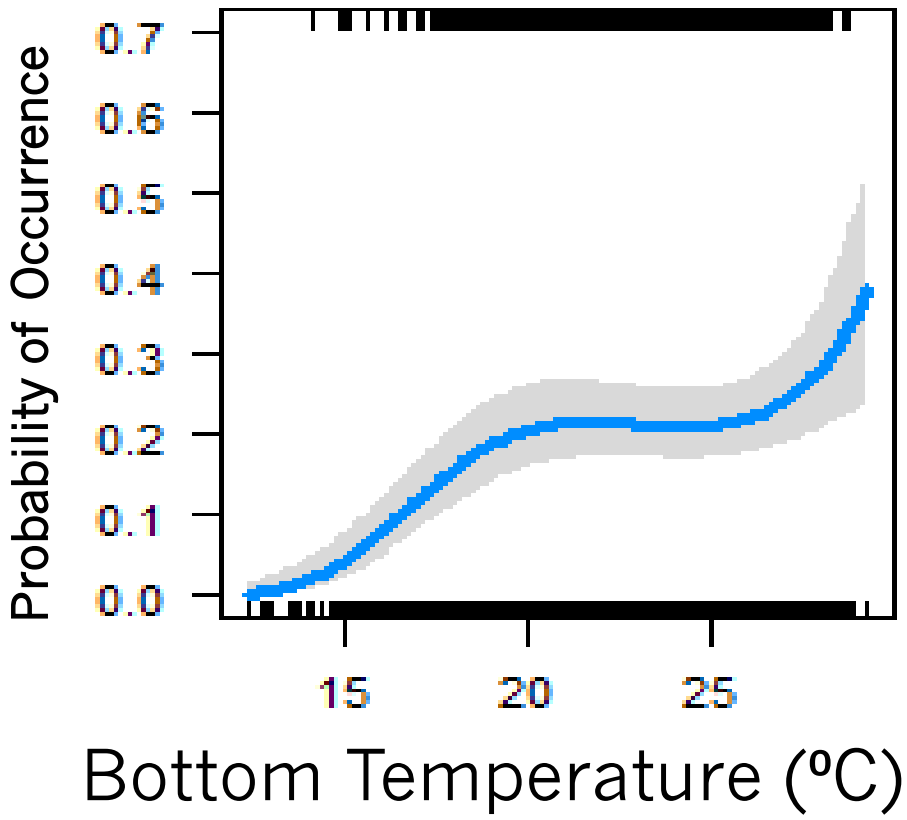

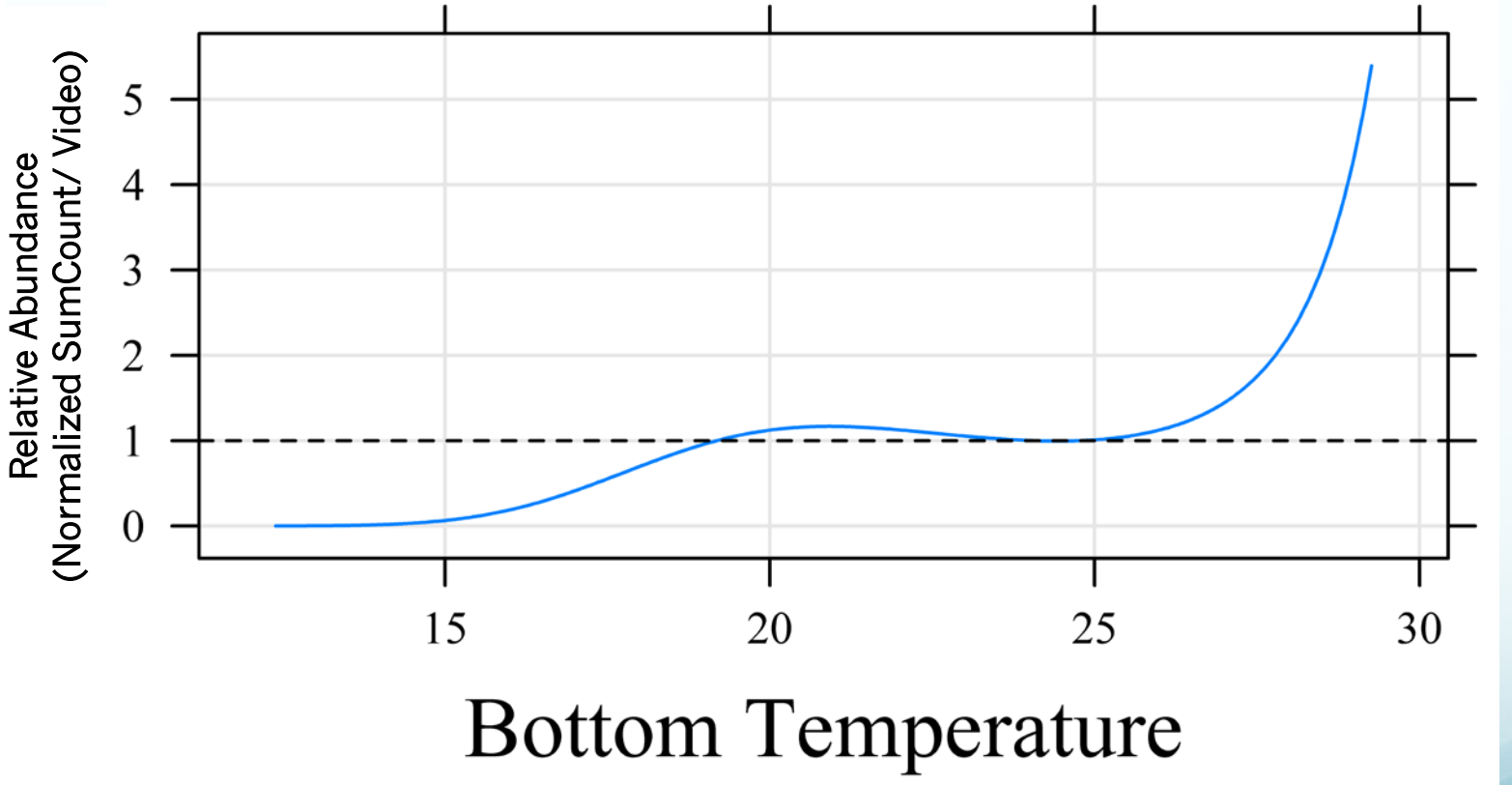

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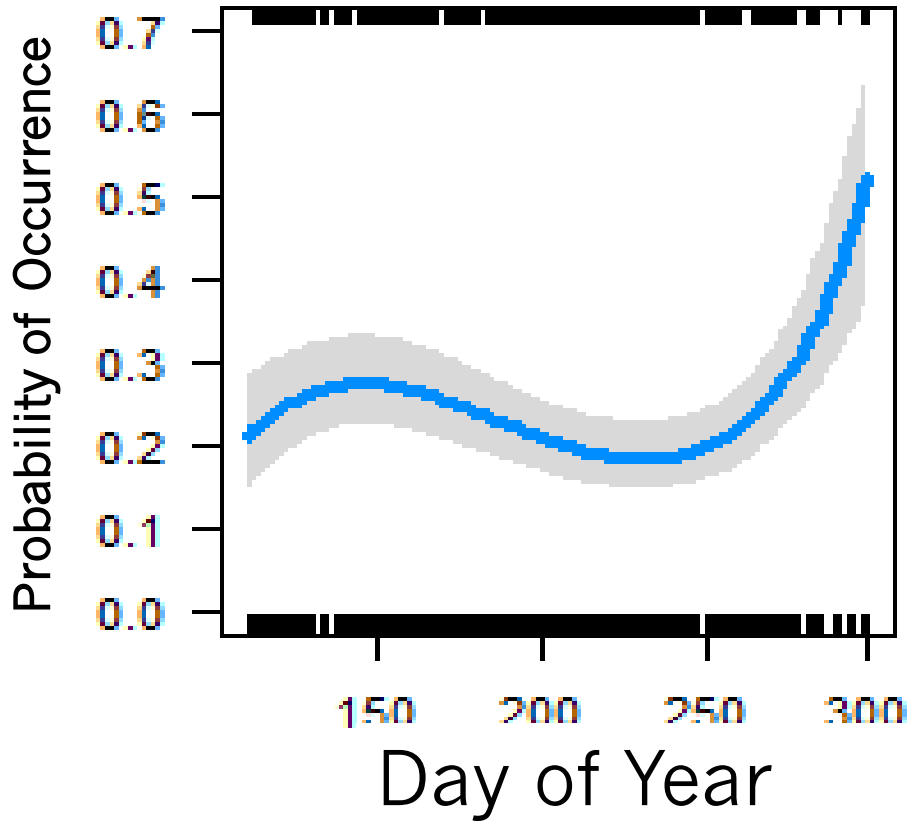

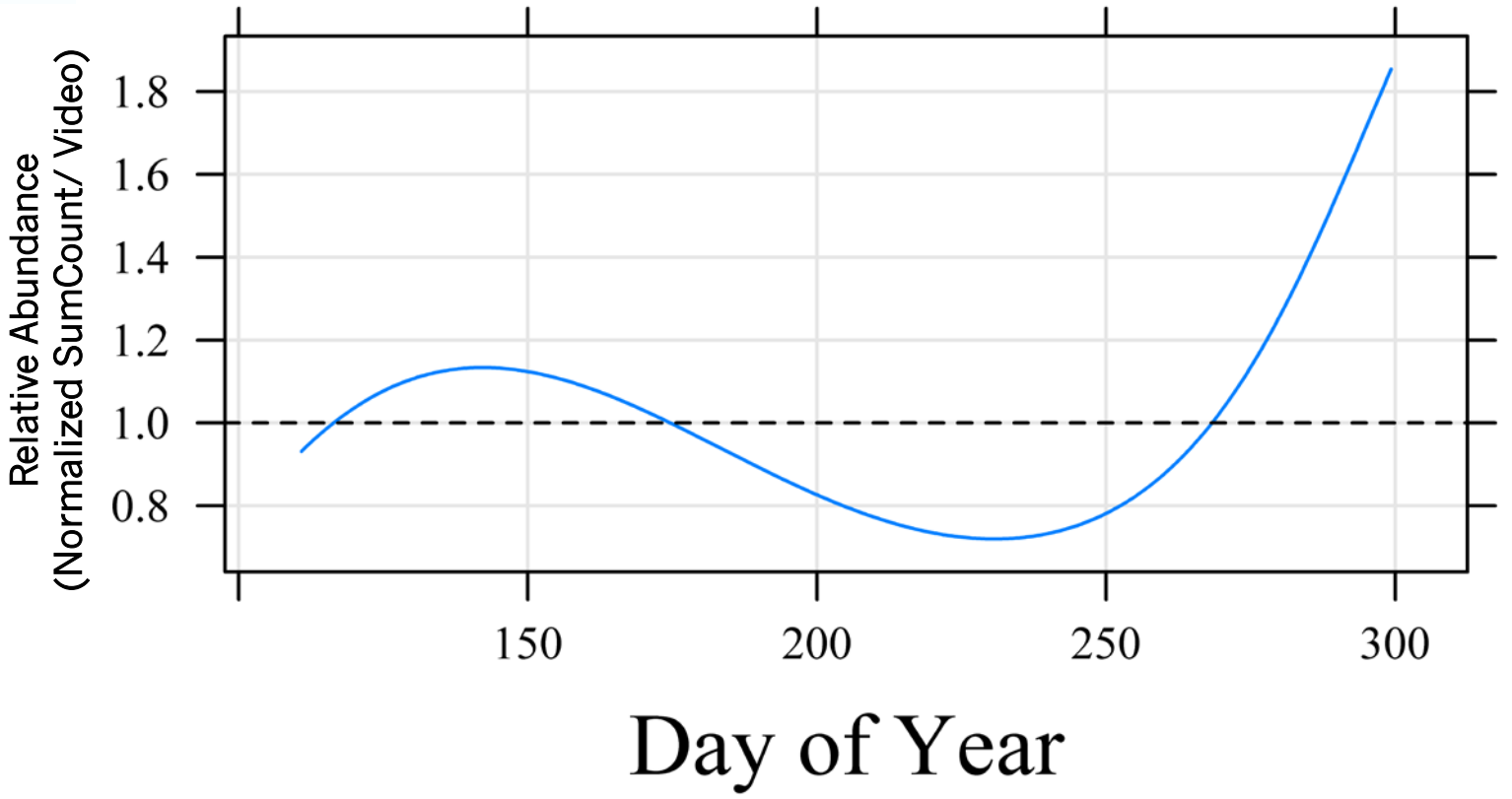

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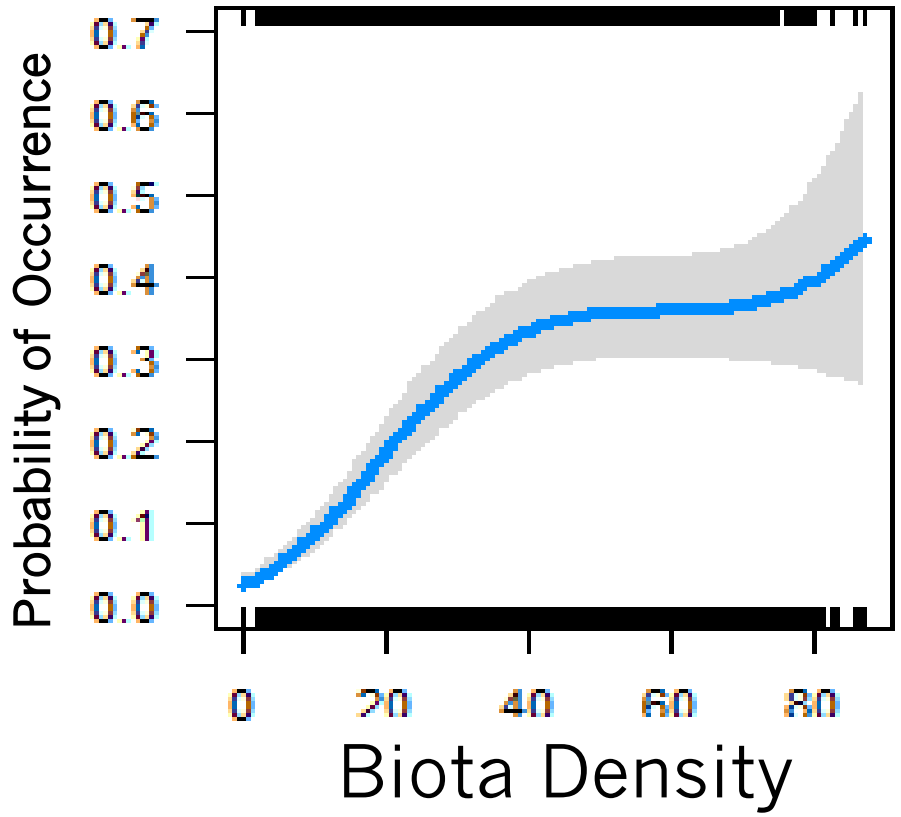
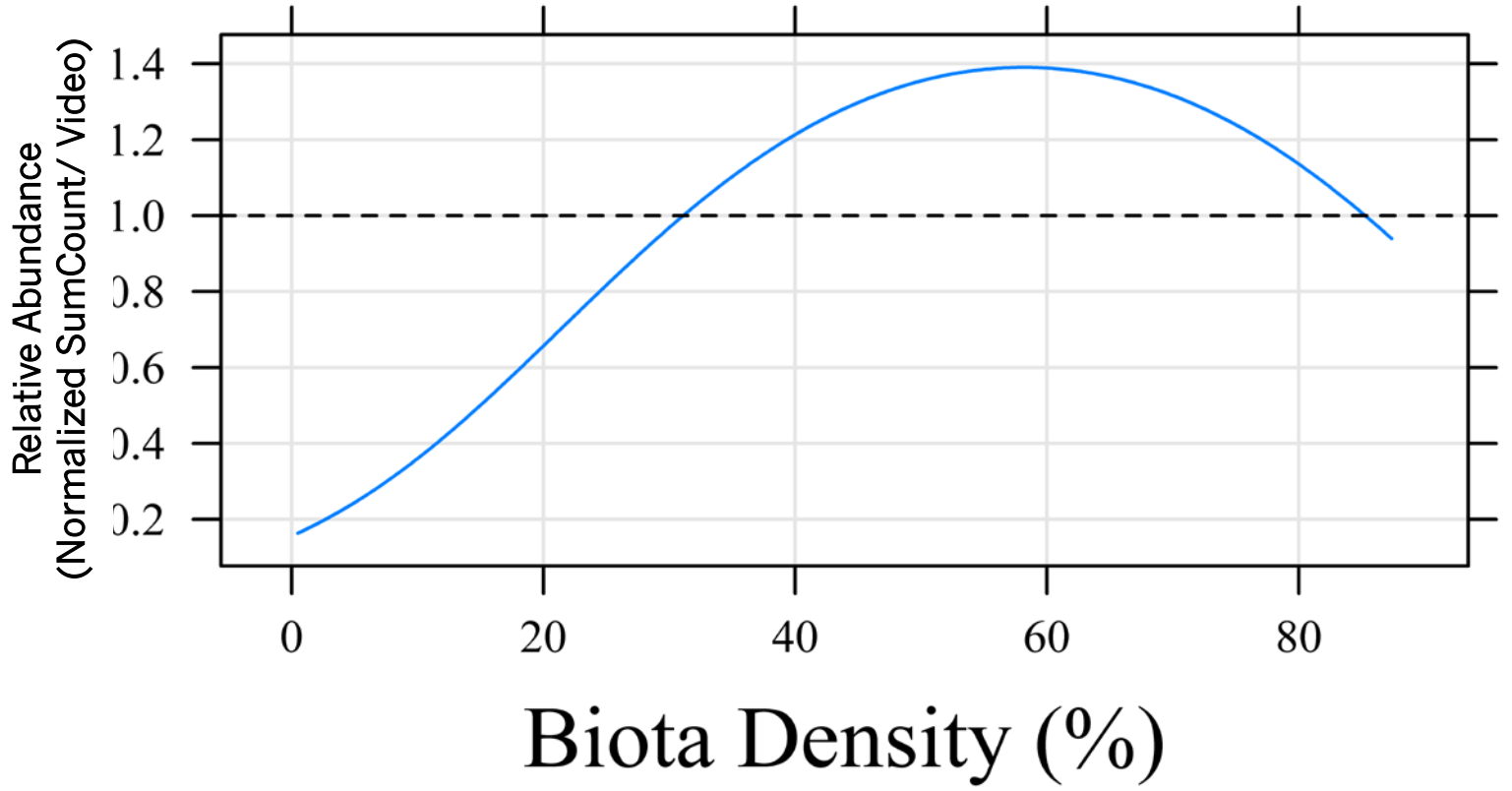
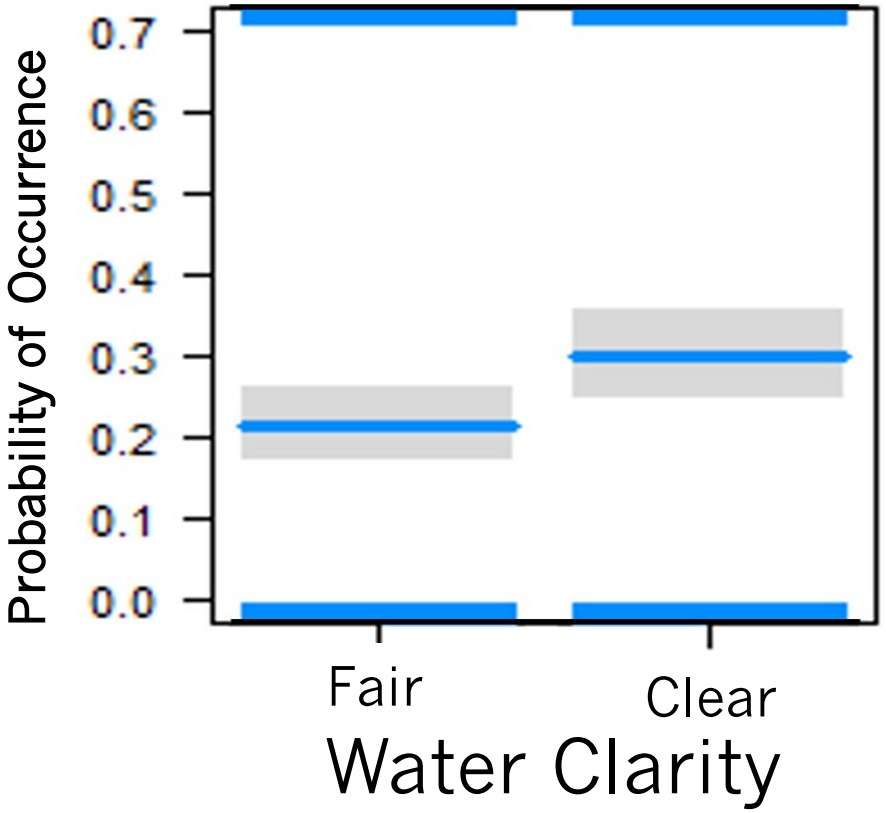
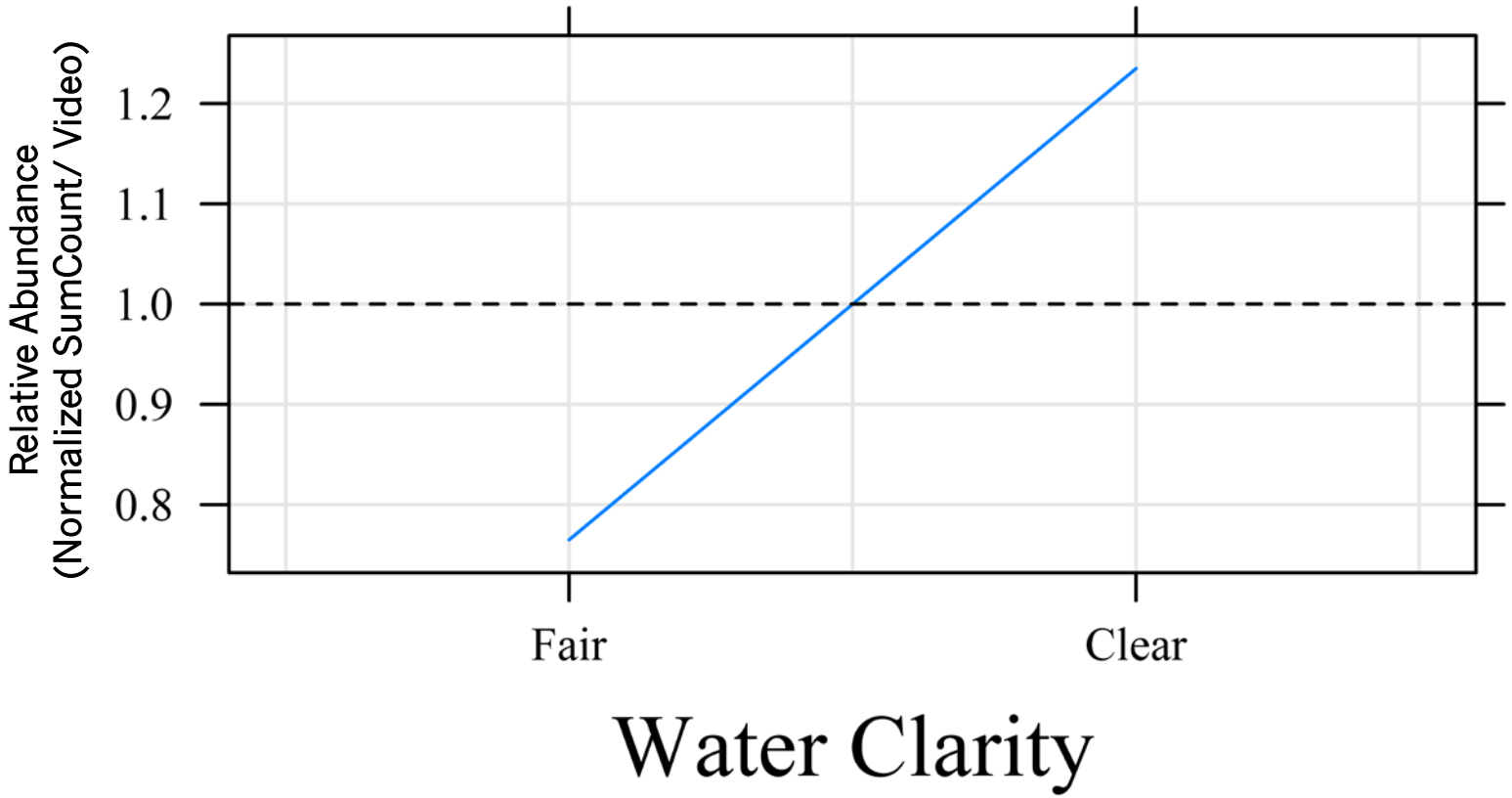




Covariate Effects





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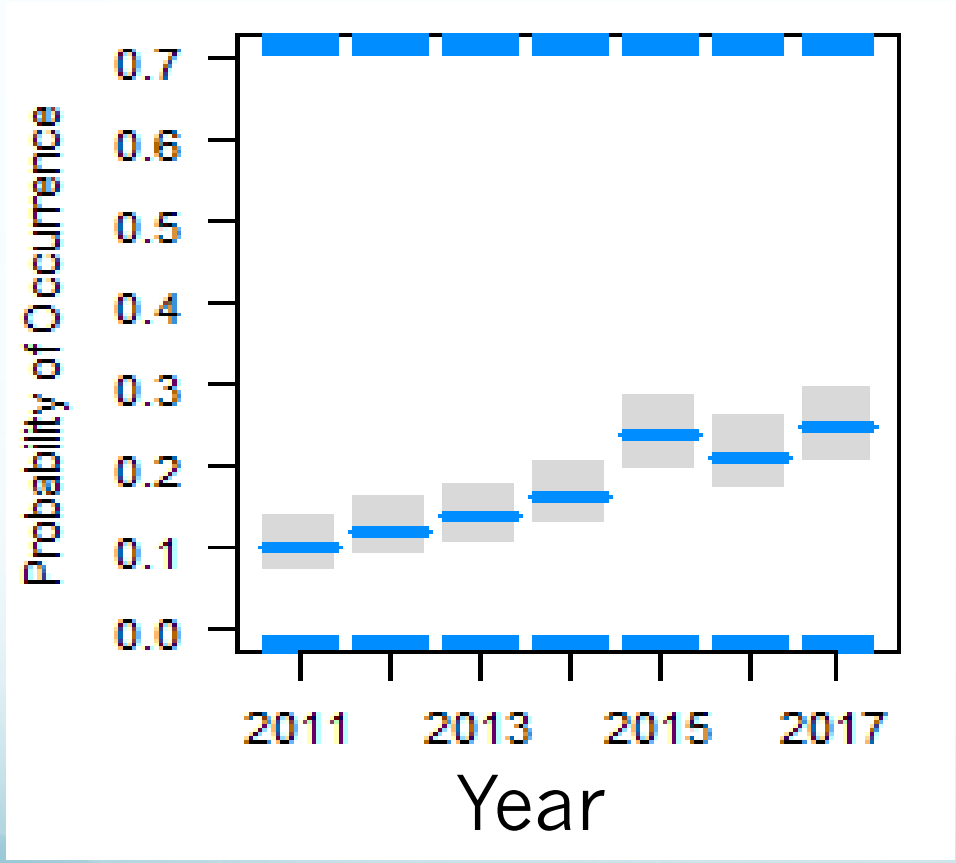
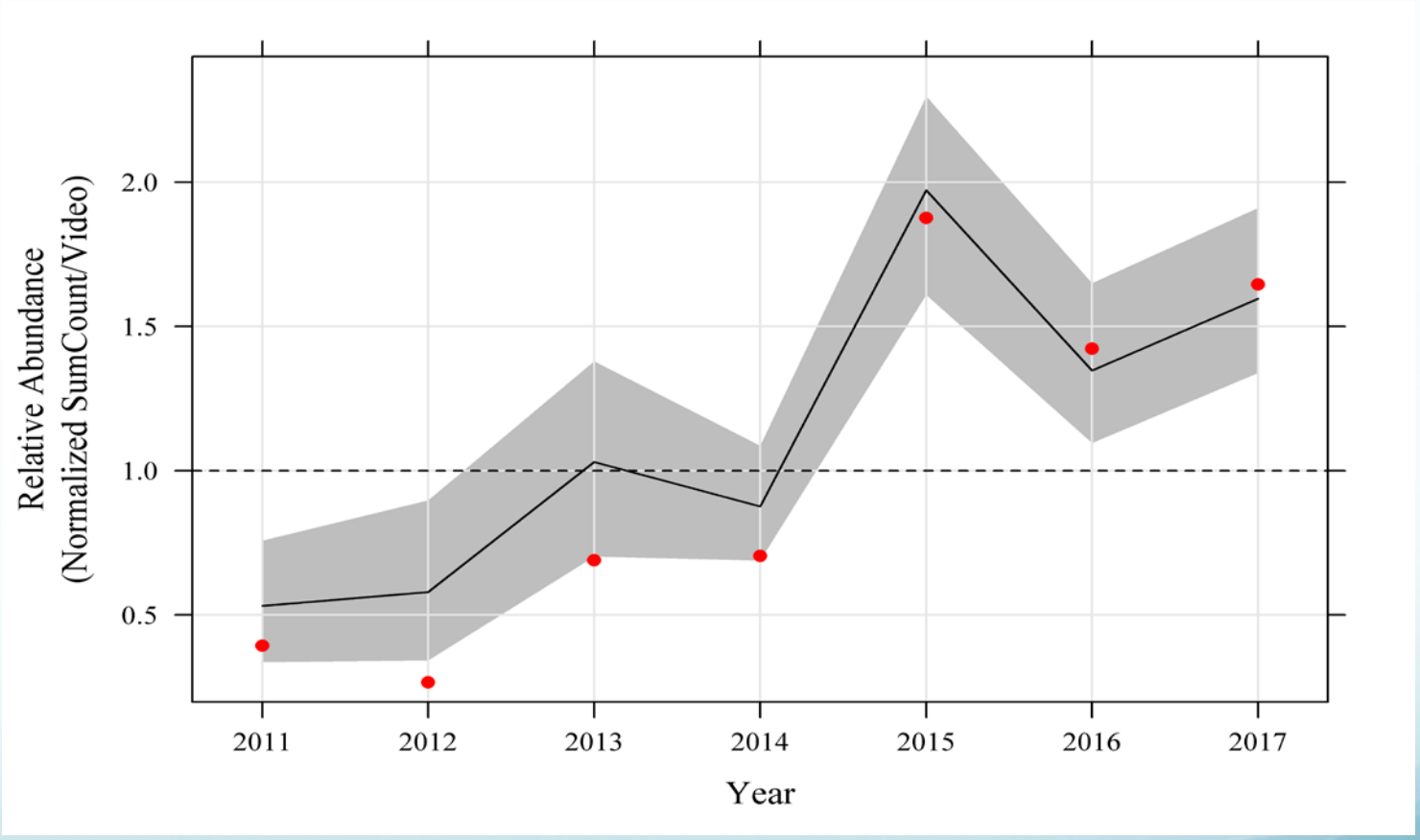
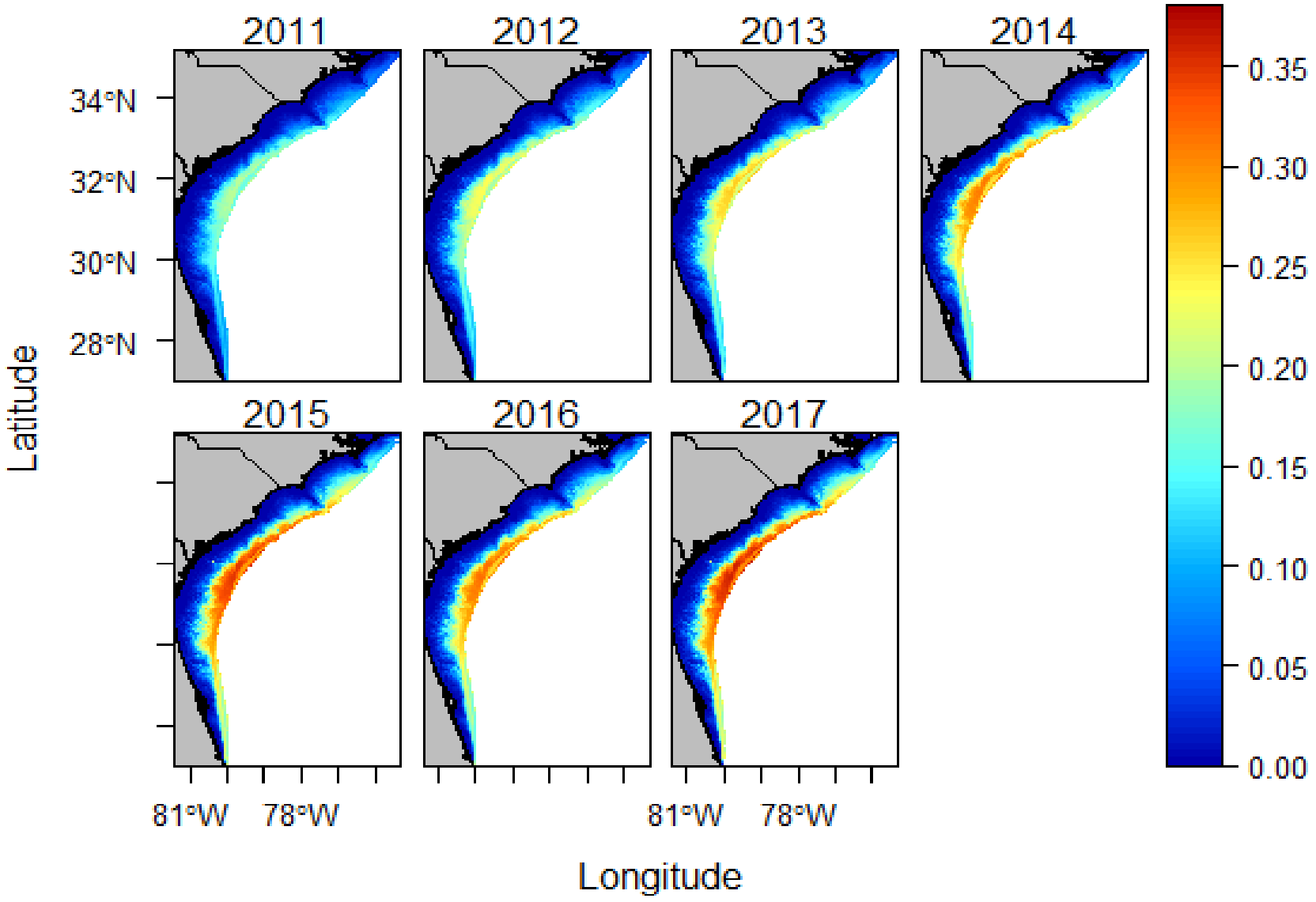


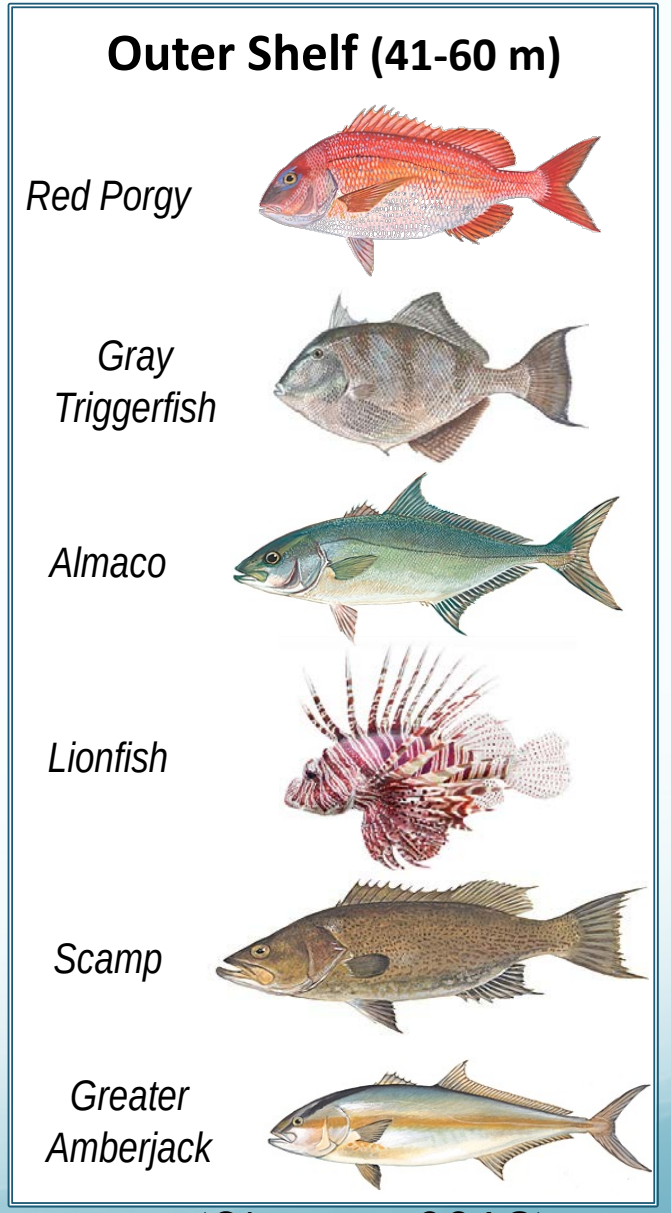


Heat Maps


2011
2012
2013
2014
2015
2016
2017
34°N
32°N
30°N
28°N
Latitude
81°W
78°W
81°W
78°W
Longitude
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00

Discussion

- Lionfish prefer hard bottom habitats in deeper waters
- Outer shelf species more susceptible to impacts from lionfish



(Glasgow 2018)

Conclusions

- First large scale study of Lionfish abundance and distribution in this region
- Lionfish occurrence and abundance increased until 2015 but has since stabilized
- Future range expansion is possible with increasing water temperatures and Lionfish preference for deeper water
- Therefore, fisheries managers and scientists need to continue monitoring the Lionfish invasion

Acknowledgements

- MARMAP Lab
- SEFIS

Questions?

Reef Level Habitat Covariates

- Scale mismatch between habitat features measured at the trap level and the scale of habitat important to fish
- Weighted k-nearest neighbor used to upscale trap level habitat data to a better metric to describe the habitat surrounding trap