

# Integrating Bathymetric and Acoustic Fish Mapping Data to Identify and Designate Future Marine Protected Areas along the South Atlantic Bight

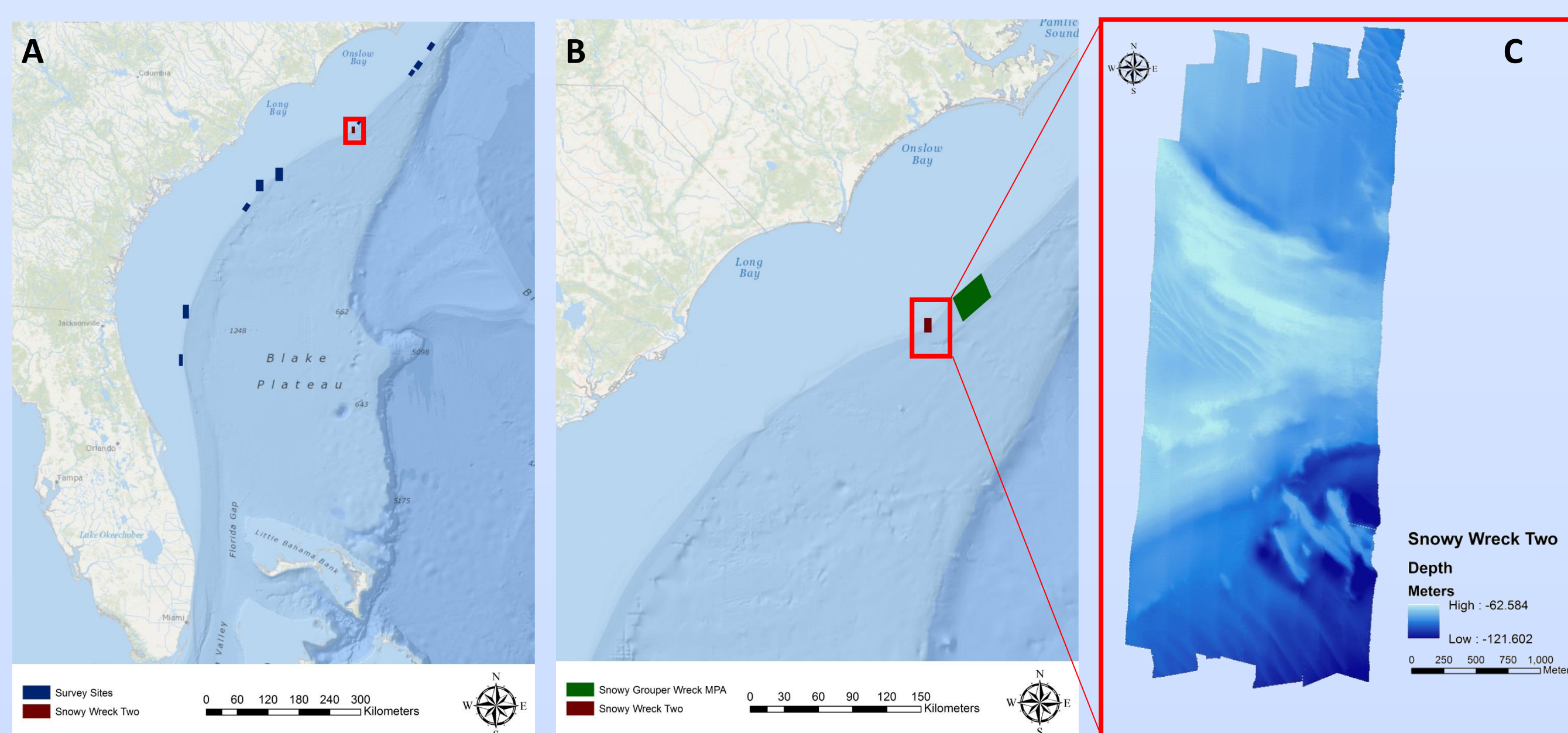
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## Executive Summary of Project Objectives

- Collect and process water column and bathymetry data aboard the NOAA Ship *Pisces* for ten potential habitat sites along U.S. Southeast Atlantic continental shelf. Completed.
- Identify features of the bathymetry that may accurately predict the presence of large fish in the water column. In Progress.
- Create an ArcGIS toolbox that will generate a predictive habitat map based on a limited number of statistically significant inputs. In Progress.
- Provide a geologic characterization and predictive biological hotspot analysis for each of the ten survey sites.

## Study Area



## Data Acquisition

- Data acquired aboard the NOAA Ship *Pisces* (07/01/2013 – 07/14/2013)
- Bathymetry and backscatter collected with the Simrad ME70 Multibeam Echo-sounder System
  - 45 beams in fan with frequency range of 70 to 120 kHz
  - Bathymetry processed in CARIS HIPS at 2m resolution using IHO Special Order 2
  - Backscatter processed in QPS FMGT at 1m resolution
- Water column (fish) data collected with Simrad EK60 Echosounder System
  - Single beam system with frequency range of 18 to 710 kHz
  - Data processed in Echoview. Any fish smaller than 5 cm and higher than 20 m in the water column above the seafloor were excluded.

Survey Site Name (unofficial)	Approximate Location	Area (km <sup>2</sup> )	Min Depth (m)	Max Depth (m)
South of North Florida MPA	FL, 90 km E off Jacksonville	15	52	72
North of North Florida MPA	FL, 115 km E off Jacksonville	30	43	74
Edisto New MPA	SC, 95 km SE off Charleston	21	100	120
Edisto North of MPA	SC, 90 km SE off Charleston	25	50	142
Snowy Wreck One	Wilmington NC, 105 km SE off	3.8	71	100
Snowy Wreck Two	Wilmington NC, 110 km SE off	9	62	121
North Carolina 780	Harker's Island NC, 65 km SE off	14	66	96
Cape Lookout One	Harkers Island NC, 70 km SE off	26	53	147
Cape Lookout Two	Harkers Island SC, 125 km E off	10	72	120
East Devils Hole	Charleston	52	45	250

Table 1. 10 survey sites mapped during the July 2013 NOAA Ship *Pisces* cruise. A total of 205 km<sup>2</sup> of potentially critical fish habitat were mapped between Mayport, FL and Wilmington, NC.

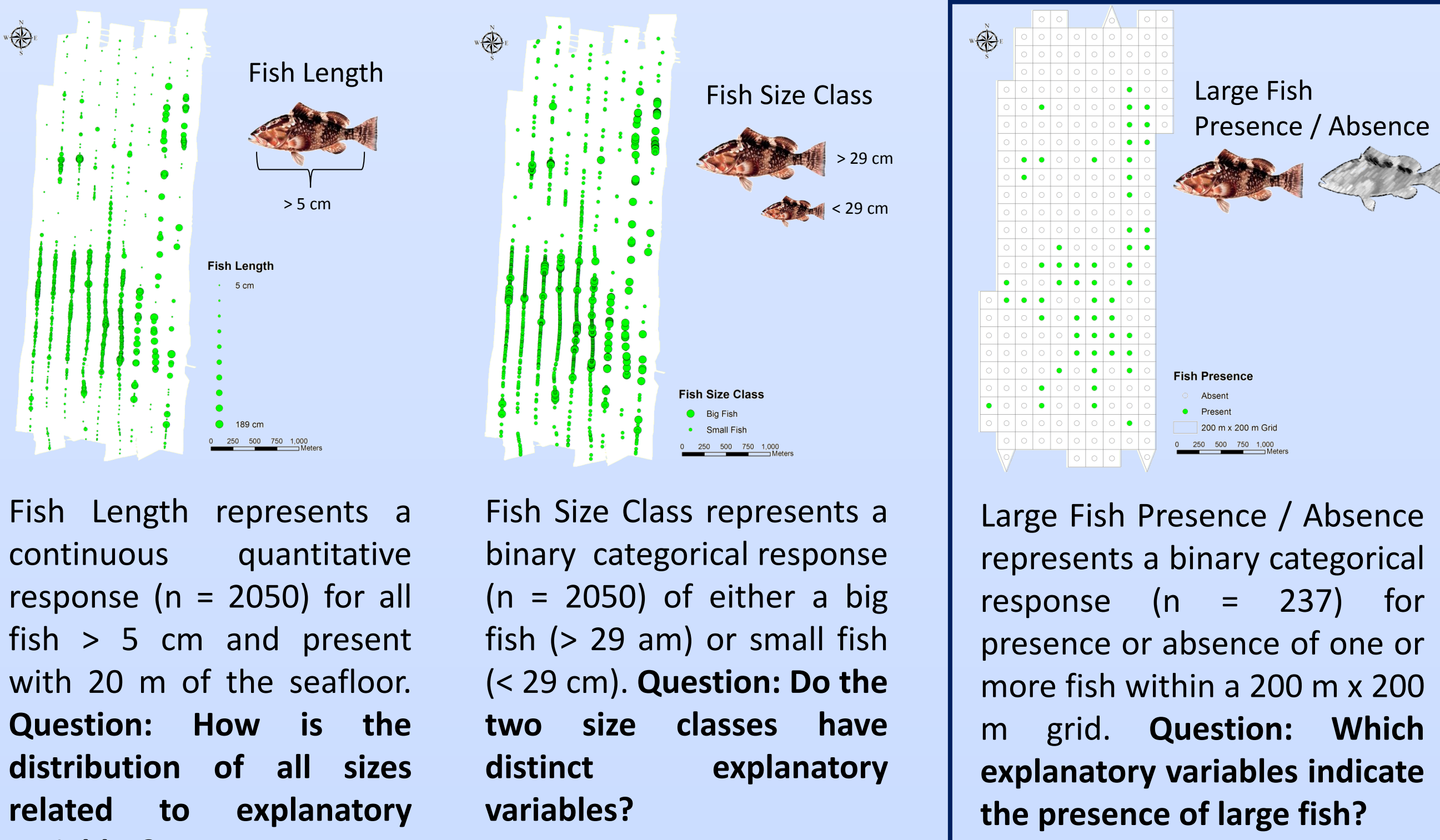


A. NOAA Ship *Pisces* B. *Pisces* Crew C. How the ME70 and EK60 transducer work conceptually D. Friedrich in front of ME70 and EK60 control screens E. Office Panorama

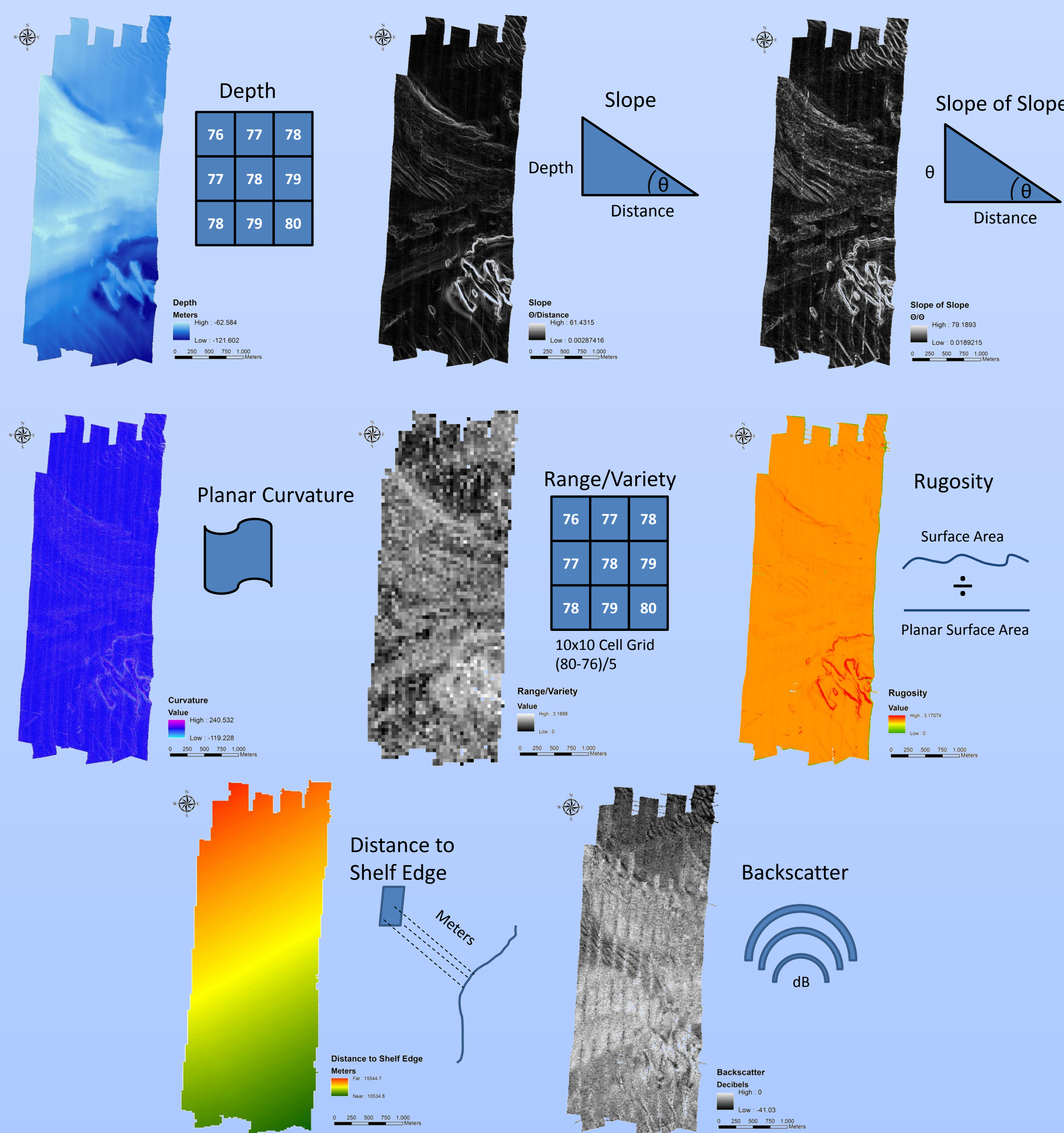
## Data Analysis

For the purpose of this poster we focused our analysis on a single site, nicknamed Snowy Wreck Two. Our goal is to understand where large seafloor dwelling fish (>29 cm in length) are congregating. Our candidate dependent variables are Fish Length, Fish Size Class or Fish Presence. Our explanatory variables include Depth, Slope, Slope of Slope, Planar Curvature, Distance to Shelf Edge, Rugosity, Range/Variety and Backscatter. Distance to Shelf Edge is defined as the distance to the 100th fathom. Rugosity represents surface area/planar surface area, calculated using the DEM Surface Toolbox. Range/Variety is the zonal statistic within a 10x10 cell size grid dividing the total range by the variety of values within each grid.

## Candidate Dependent Variables



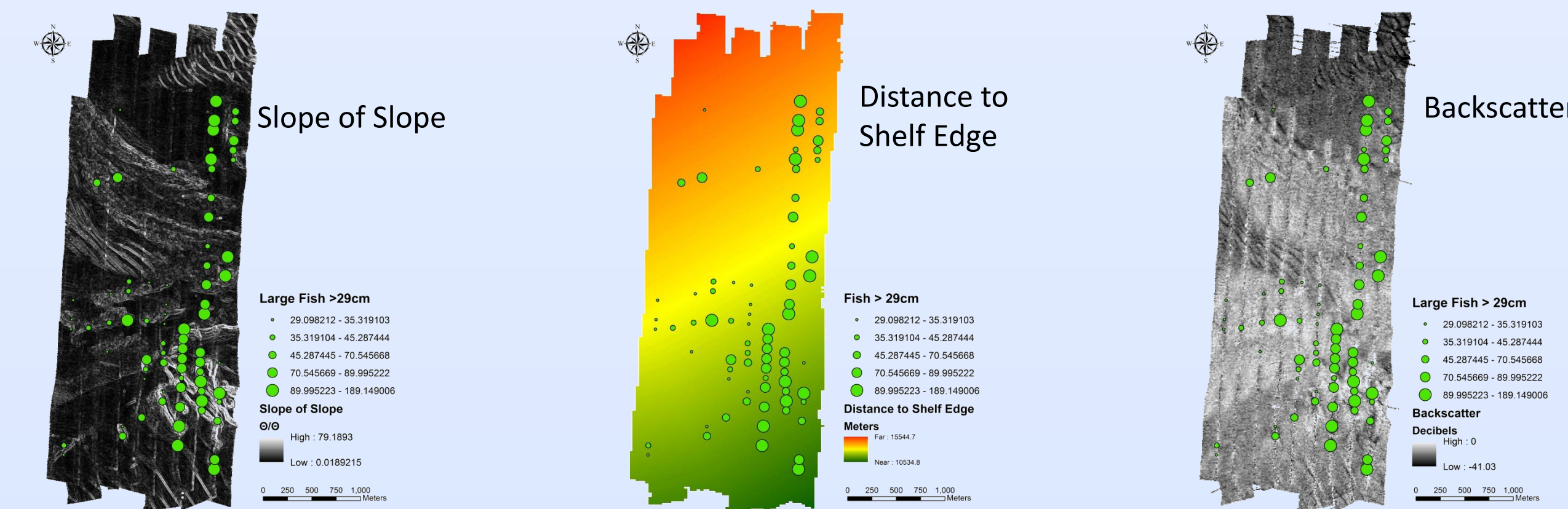
## Candidate Explanatory Variables



## References

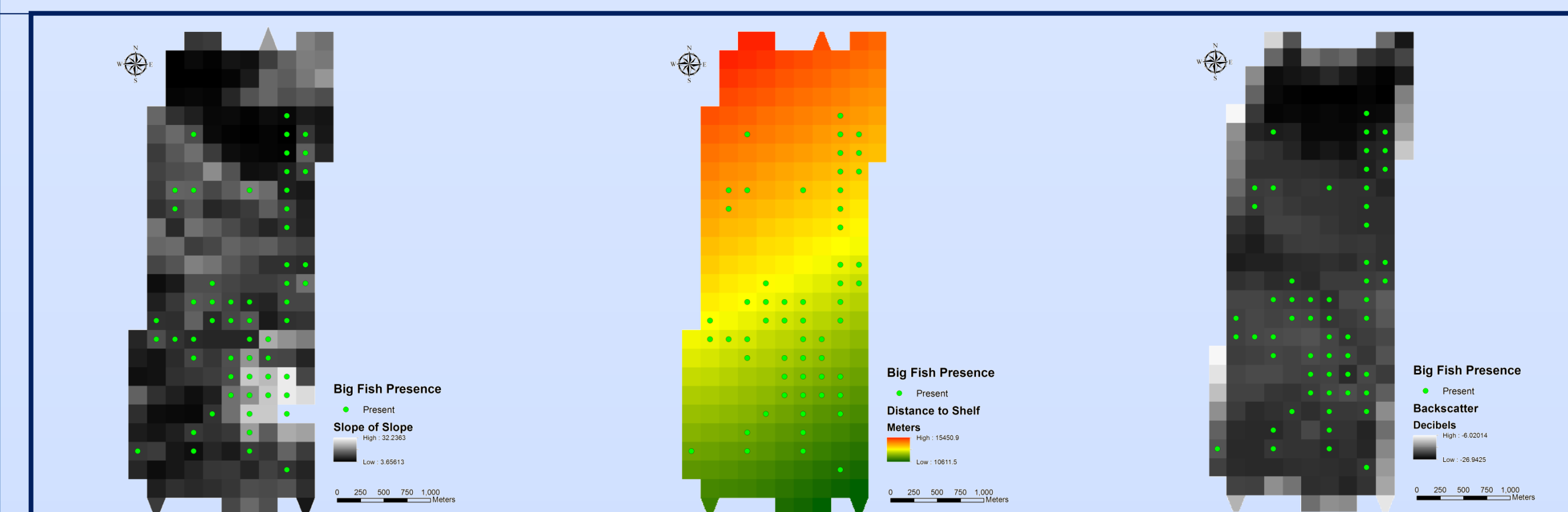
- Costa, Bryan M., Christopher Taylor, Laura Kracker, Tim Battista, Simon Pittman. "Mapping Reef Fish and the Seascape: Using Acoustics and Spatial Modeling to Guide Coastal Management." *PLOS ONE* (2014): e85555
- Pittman, Simon J., Bryan M. Costa, and Tim A. Battista. "Using lidar bathymetry and boosted regression trees to predict the diversity and abundance of fish and corals." *Journal of Coastal Research* (2009): 27-38.

## Visual Assessment of Data



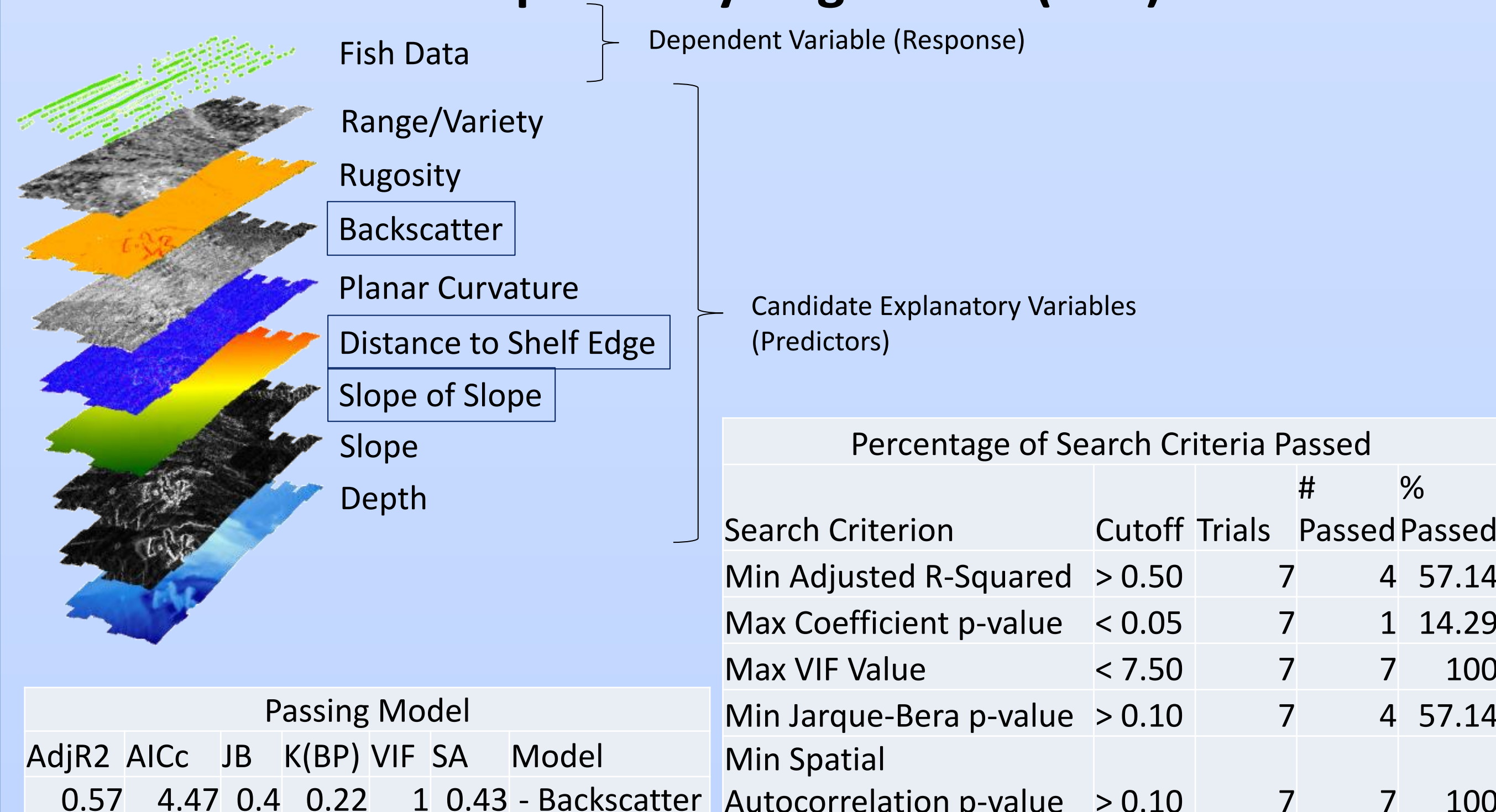
Upon visual assessment of the distribution of just large fish plotted above each explanatory variable, we preliminarily determined that Slope of Slope, Distance to Shelf Edge and Backscatter represent three distinctly different signals that show an apparent correlation between the distribution of large fish and variables specific features.

## Large Fish Presence/Absence Approach



We ran an exploratory regression model on just Slope of Slope, Distance to Shelf Edge and Backscatter using Presence/Absence as our dependent variable. Each associated raster value represents the mean predictor variable value within a 200 m x 200 m grid cell.

## Exploratory Regression (OLS)



## Limitations

- We believe we are losing some of the signal for each predictor by using a coarse 200 m x 200 m grid. We are in the process of testing cell sizes ranging from 5 m to 100 m.
- Backscatter is being distorted by false values at nadir. We aim to extract noise at nadir and interpolate a new surface to create a smoother version of the Backscatter, showing distinct areas of hard and soft bottom.
- The clustering of fish data in the southwestern portion of the study area may be directly related to the distance to the shelf break or could simply be due to the presence of the topographically complex rocky plateaus. The integration of data from the other nine study sites across the region will help to validate Distance to Shelf Edge as a predictive variable in future model iterations

## Big Picture Significance

Marine Protected Areas (MPA) are critical in sustaining the resilience of fish populations to commercial fishing operations. The geomorphic and bathymetric environment of the MPA has been found to be predictive of biomass and fish populations (Pittman *et al.* 2009). Using acoustic data to survey potential hotspots of biological activity promises efficiency, accuracy, and minimal environmental impact and will hopefully allow for the development of better fisheries management information. Using spatial statistics we aim to identify features of the bathymetry, that can accurately predict the presence of large fish in the water column. The success of this approach will greatly expedite fishery surveys, minimize operational cost and aid in making timely management decisions.