EXPLORING THE GEOSPATIAL RELATIONSHIPS BETWEEN FISH AND THE SEASCAPE ALONG THE SOUTH ATLANTIC CONTINENTAL SHELF

Friedrich Knuth M.S., Environmental Studies, College of Charleston, Charleston, S.C.
Laura Kracker Ph.D. National Center for Coastal Ocean Science, NOAA, Silver Spring, M.D.
Norman S. Levine Ph.D. Geology and Environmental Sciences, College of Charleston, Charleston, S.C.
Leslie R. Sautter, Ph.D. Geology and Environmental Sciences, College of Charleston, Charleston, S.C.

Project Objectives
1. Collect and process water column and bathymetry data aboard the NOAA Ship Pisces for potential Essential Fish Habitat (EFH) sites along U.S. Southeast Atlantic continental shelf.
2. Provide a morphometric characterization and quantitative assessment of fish size classes present within each survey site.
3. Identify morphometric features of the bathymetry that may explain the presence of demersal fish.

Study Area
Survey Sites MPAs

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
- Backscatter processed in QPS FMGT at 2m resolution
- Water column (fish) data collected with Simrad EK60 Echosounder System
- Split-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 sea floor were excluded.

Results by Project Objective
1. Collect and process water column, bathymetric and backscatter data for potential habitat sites along the U.S. South Atlantic continental shelf.
   - 10 sites mapped for a total of 205 km² of Bathymetry and Backscatter.
   - 7401 fish counts recorded at six of ten survey sites. See Figure 7 and Table 2.
2. Provide a morphometric characterization and quantitative assessment of fish populations present within each survey site.
   - 7 Base layers created for 10 sites (70 total) that describe the morphometric nature of the seafloor in the form of maps. See Figure 6.
   - Subset and map fish distributions for seafloor dwelling fish < 20 m above the seafloor.
3. Identify morphometric features of the bathymetry that may explain the presence of demersal fish.
   - Created 14 explanatory morphometric variables, averaged to a site-wide scale.
   - Generated fish responses in small, medium and large classes.
   - From the 14 explanatory variables, we identified Mean Slope, Slope of Slope, Range/variety and the Depth to have a strong relationship with Medium and Large fish at the site-wide scale. See Figure 8.

Future Work
As seen in Figure 9 below, there appears to be a visible pattern in which Large vs. Small and Medium fish are congregating at survey site Snowy Wreck. Large fish are present amongst the slopes of the topographically complex plateau in the south east section of survey site, while Small and Medium fish are more predominant on the western shallow plateau. All fish size classes seem to be avoiding the what seem to be sand ridges in the mid-western and north eastern sections of the survey site.

Using spatial statistics, we aim to model and quantify these observable spatial patterns at multiple scales. The success of this approach will hopefully aid in identifying the spatial extent of ecologically relevant seafloor and can aid managers in effectively delineating Marine Protected Areas and efficiently managing Essential Fish Habitat.

Data Analysis and Visualization
- Figure 4. Three dimensional view of large fish plotted over survey site Snowy Wreck Two, generated in ArcScene. Fish seem to congregate near steep slopes and topographically complex bathymetry.
- Figure 5. Schematic of explanatory and response variables generated from raw multibeam and split-beam data. In ArcGIS, using Spatial Analyst and Raster Calculator, a total 14 explanatory variables and 4 responses were generated.

References

Figure 1. Ten survey sites along South Atlantic Bight. 205 km² of potentially critical fish habitat mapped between Mayport, FL and Wilmington, NC. 7401 fish observations recorded at six of ten sites.

Figure 2. Seven of the eight South Atlantic Fisheries Management Council (SAFMC) designated Marine Protected Areas (MPAs).

Figure 3. A. NOAA Ship Pisces B. Pisces Crew C. How the ME70 and EK6000 transducer work conceptually (Hashimoto 2013) D. Friedrich in front of ME70 and EK6000 control screens E. Office Panorama

Figure 4. Schematic of explanatory and response variables generated from raw multibeam and split-beam data. In ArcGIS, using Spatial Analyst and Raster Calculator, a total 14 explanatory variables and 4 responses were generated.

Figure 5. Schematic of explanatory and response variables generated from raw multibeam and split-beam data. In ArcGIS, using Spatial Analyst and Raster Calculator, a total 14 explanatory variables and 4 responses were generated.

Figure 6. Conceptual view of spatial relationships between explanatory variables and response. Each explanatory variable was averaged for the entire site and plotted against the total fish count for a given response category, either All, Small, Medium or Large fish.

Figure 7 and Table 2. Six of ten survey sites with recorded fish observations. Large Fish > 29cm depicted above bathymetry in Figure.

Figure 8. Linear exponential univariate model showing Mean Slope , Slope of Slope, Range/variety and the Depth to have strong relationship (R² = 0.8) with Large Fish > 29cm at the site-wide scale.

Figure 9. Depiction of Small, Medium and Large Fish recorded across survey site Snowy Wreck Two.