A Hydroacoustic Spatial Evaluation of the Effective Area Sampled by Baited Underwater Camera Surveys in the Eastern Gulf of Mexico

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Introduction

- Stereo-Baited Remote Underwater Video arrays (S-BRUV) provide fisheries-independent, multi-species relative-abundance and length-frequency data for stock assessments and ecological studies in a minimally invasive manner
  - Bait attracts fishes, helping to overcome visibility limitations
- To transition from relative to absolute abundance estimates, we need to quantify how gear presence affects reef fish distribution
- Hydroacoustic technology rapidly surveys the water column over a large area and is less disruptive to the reef fish and the habitat than S-BRUVs
- Hydroacoustics is complementary method to S-BRUV surveys to provide spatially-explicit information about reef fish distributions during S-BRUV deployments

Objectives:

1. To quantify trends in fish biomass before and during S-BRUV deployment on natural and artificial reef habitats
2. To evaluate spatial fish re-distribution from the S-BRUV site at various distances before and during a deployment

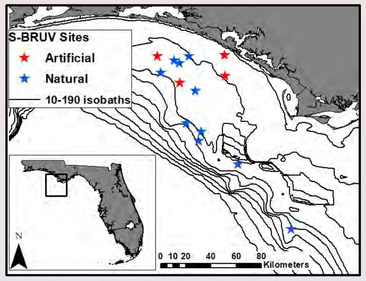

Figure 1: A map of the selected sampling sites for this project.

Methods

Field Collection:

- Surveys were conducted before and during S-BRUV deployments at multiple natural and artificial habitat types from 10–91 m (Fig. 1)
- Vessel-mounted hydroacoustic array equipped (Fig. 2) with split-beam 38 and 120 kHz Simrad Ek80 transducers was used to survey 14 transects within a 375 x 375 m area centered around sampling sites (Fig. 1)
- Data were collected in continuous wave (CW) pulses at intervals of 250 ms at a vessel speed of 4.5 knots

Figure 2: The *R/V Gulf Mariner* (left) used for sampling, the hydroacoustic array out of water (center), and the S-BRUV array (right)

Data Processing:

- In Echoview 10, we used school detection tool to create polygons around aggregations of backscatter (Sv) in the water column
- Applied background noise filters to 38 and 120 kHz Sv and target strength (TS) data
- Differences in Sv and TS values between 38 and 120 kHz were used to remove non-fish signatures in the water column
- Mean Sv and TS values falling within fish-school polygons were used to calculate fish densities within 5 x 5 m bins along the survey track from 0.3 m above the seafloor to 6.0 m below the sea surface (Fig. 3)

ArcGIS and Summary Graphs:

- Spatially-referenced center points for the 5 x 5 m fish density data for before and during surveys were imported into ArcGIS 10.7 (Fig. 4)
  - Artificial and natural geoforms were added to the base map
  - Buffer areas of 10, 70, 140, and 210 m were overlain around the deployment location
- Lower water column density data were exported from each site, then averages densities and standard error were plotted (Fig. 5 and 6)

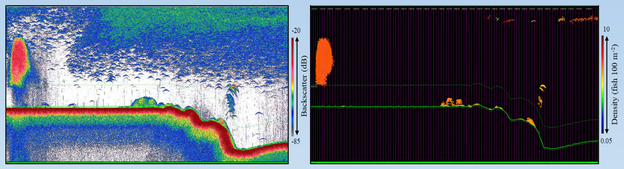

Figure 3: An example image of the completed processing in Echoview representing Sv (left) and fish density (right)

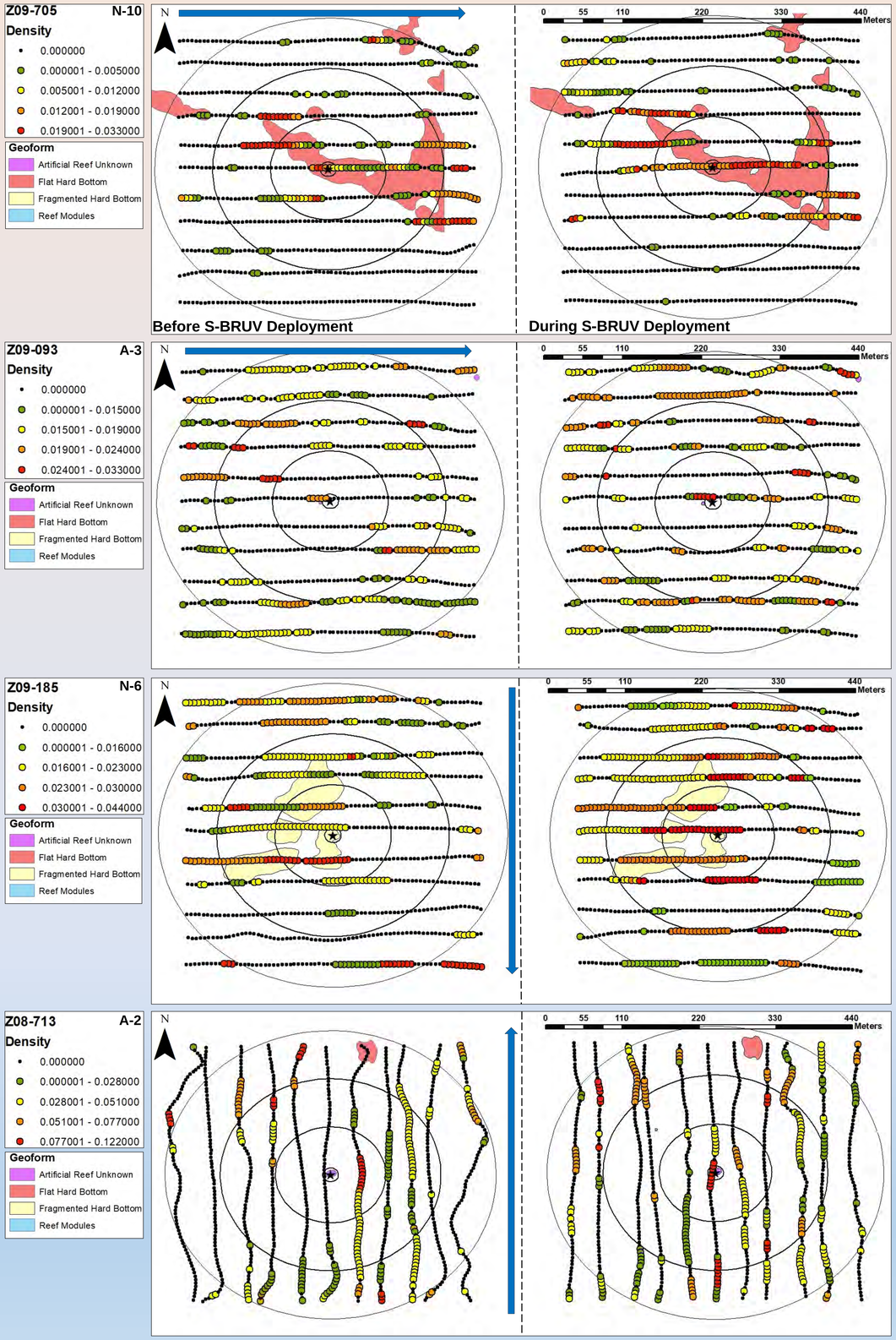

Figure 4: Fish density data before (left) and during (right) S-BRUV deployment at four representative sampling sites over natural (N) and artificial (A) habitats. These values are represented by a color scale, black being zero values and red being the greatest fish density value per site. Buffer layers (10, 70, 140, and 210 m) were overlain from the S-BRUV deployment locations and density data were summarized by distance. Geoforms coded for each site are the base layer for these maps. The blue arrows represent the current directions recorded from the S-BRUV computer deployed at the site.

Results

- The subset of sites sampled showed fish densities were influenced by the habitat and the S-BRUV array (Fig. 4)
  - The bait plume of the S-BRUV seem to attract fish, as shown by hotter densities down-current during the soak in comparison to before the S-BRUV deployment
- From the subset of sites, densities were averaged by buffer distances (Fig. 5), which showed no consistent trend when comparing between distances and habitat types from before and during the S-BRUV soak
- When comparing the average densities before and during the S-BRUV soak, there were no consistent differences (Fig. 6)
  - For half the sites, the mean density appeared to increase during the S-BRUV deployment
- Higher average density of fishes were observed on natural (n=10) compared to artificial habitats (n=4)

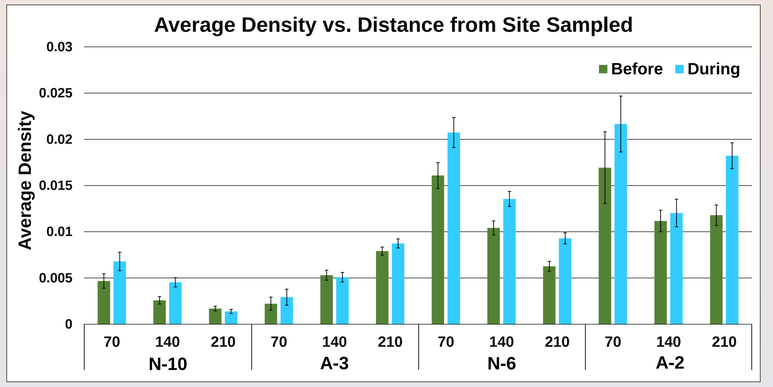

Figure 5: The average densities from the subset in Figure 4 were compared by distance over natural (N) and artificial (A) habitats, before and during the S-BRUV soak with standard error represented by error bars.

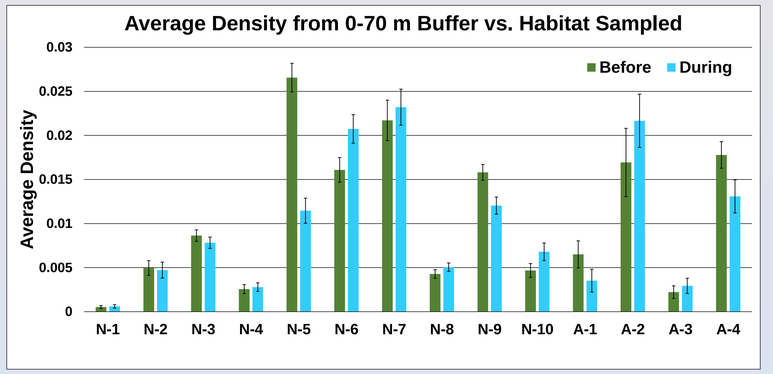

Figure 6: The average densities with standard error bars of all sites sampled were plotted to compare before and during the S-BRUV deployments over natural (N) and artificial (A) habitats from 0-70m distance away from the site. This distance was selected to show densities most comparable to what the S-BRUV observed.

Discussion and Future Projects

- The subset of sites (Fig. 4) showed a trend of the bait plume influencing the fish distribution during the S-BRUV soak, but was inconsistent overall
  - Variation in current strength and direction has potential to influence the distance in which the fish would be attracted to the S-BRUV
- When comparing natural and artificial reefs, habitat size need to be analyzed further in order to see a true effect of the S-BRUV on those fishes occupying those areas
  - One limitation was that there was not an even effort of sampling between habitat types. Four artificial sites sampled for this project versus ten natural sites
- Mean density values were generally highest in close proximity (0 - 70 m) to the S-BRUV array
  - Depicting the mean density in this way could be an issue because of averaging zeros with nominal values are reflected at the greater distances away from the S-BRUV site
  - Further analysis of density values at these distance buffers will need to occur to expand on these comparisons
  - The concentration of the habitat type sampled could also be a result of higher densities at greater and or lesser distances to the S-BRUV site
- High resolution of fish densities associated with various habitat types could be gained from geospatial analyses
- Further effort needs to be accomplished in other areas of the Eastern Gulf of Mexico in order to see if these trends are consistent throughout

Acknowledgements

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