

Ecology Workshop: Project Proposal

Matt Woodstock

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Research Statement

Upper-trophic level fishes in the open ocean (e.g., tunas and billfishes) exert top-down pressure on lower trophic levels. These fishes traverse large distances throughout a year and utilize mesopelagic depths (200 - 1000m) as foraging regions. The spatial distribution of these fishes will impact the top-down pressure that the ecosystem experiences on a localized scale. Large distribution ranges, fast movement, and a proximity for oceanic regions that are not sampled as heavily as coastal zones, lead to a poor understanding of spatial distributions of tunas and billfishes. Satellite tagging studies and fisheries dependant data (catch per unit effort) suggest that certain species may have specific foraging and breeding grounds. The distribution of oceanic apex predators should be incorporated into ecosystem models to simulate the changes in predation pressure in different grid spaces over time.

Project Objectives

1. Create a 3-dimensional grid of environmental parameters in the oceanic Gulf of Mexico
2. Apply this 3-D grid towards environmental preferences (from literature)
3. Calculate the probability of a species to occupy each grid space

Hypothesis

The preferred distribution of tunas and billfishes in the Gulf of Mexico will change throughout the year according to environmental parameters.

Data Sources to Use

Environmental parameters, such as: temperature, salinity, current velocity, and sea surface height are available for download from the HYCOM consortium (www.hycom.org). These data span the entire Gulf of Mexico Large Marine Ecosystem (and a bit of the caribbean and east Florida shelf), and have numerous depth intervals that range from the surface to the seafloor.

Dissolved oxygen data are available at a 1 degree horizontal resolution and 5-m vertical resolution from the World Ocean Atlas data repository (<https://www.nodc.noaa.gov/OC5/woa18/>) (<https://www.nodc.noaa.gov/OC5/woa18/>).

Fisheries landing and effort data are available from the International Commission for the Conservation of Atlantic Tunas (ICCAT). These data are useful for calculating catch per unit effort (CPUE) for each species and fishing method.

Environmental preferences per species will be gathered from literature sources. Ideally, these values are the result of tagging studies or a quotient analysis. However, the observation of catch values at a particular time and space, corresponding to environmental conditions at the same time and space have been used (www.aquamaps.org). For each parameter and species, four parameters will be incorporated (minimum threshold, maximum threshold, minimum preference, maximum preference)

Statistical Analyses

To calculate the probability of a species occupying a grid space, the probability of occurrence for each environmental parameter will be calculated individually. Once all parameters have been run, the product of each parameter's probability will represent the probability of a species occupying a grid space. Beyond the scope of this project, the probabilities will be implemented into existing ecosystem models to improve model simulations.