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BIOL 600: Annotated Bibliography

IHRTLUHC

Alvarez-Filip, L., Paddack, M. J., Collen, B., Robertson, B. R., & Côté, I. M. (2015, April 14th). Simplification of Caribbean Reef-Fish Assemblages Over Decades of Coral Reef Degradation. *Plos ONE, 10*(4): 1-14.

Researchers analyzed Caribbean reef fish based on their habitat preference from 1980 to 2008. Specialists were defined as species that depend on coral reefs for survival, while generalists were defined as species that had a wider habitat tolerance and did not solely provide on reefs. Results showed a statistical decrease in specialists from the 1980 baseline by up to 60% in the 1990s, with no significant difference for generalists. A minor increase in specialists then occurs in the 2000s, but numbers stay well below the baseline. This data will be helpful for my introduction and initial body paragraph. The data I have from Grand Cayman Island follows a similar time frame (1998 to 2018). I will be able to introduce the trends previous research has found and provide a reason, human impacts, for the decline in specialist species density. Finally, I can compare the results of my statistical analysis to these findings in the body to support or contrast their findings.

Andradi-Brown, D. A., Gress, E., Wright, G., Exton, D. A., & Rogers A. D. (2016). Reef Fish Community Biomass and Trophic Structure Changes Across Shallow to Upper Mesophotic Reefs in the Mesoamerican Barrier Reef, Caribbean. *Plos ONE, 11*(6): 1-19.

The authors of this study set out to identify the importance of reef depth in understanding the trophic levels of Caribbean reefs. To accomplish this, they surveyed reefs between the depths of 30 to 150 meters and used videography equipment to analyze the species at the site. Their research ultimately found that the relative species richness, abundance, and biomass declined as the depth got deeper. However, the reef health was not necessarily in decline simultaneously. This led them to investigate the three variables importance on reef health, and they found biomass was the best indicator of the three. The authors are hypothesizing deeper reefs will be a key to preserving reef and fish health because of the human impact on shallow reefs. I will be able to use this research in my body paragraph since I have the depths of each dive site provided to me along with a measure of biomass for my species. These authors found that the herbivore biomass decreased the most, and I should be able to make a direct comparison using fish, like the blue chromis, that our research has in common. Additionally, I can analyze the reef density changes across varying depths, which should give me more to discuss.

Beets, J. (1997). Effects of Predatory Fish on the Recruitment and Abundance of Caribbean Coral Reef Fishes. *Marine Ecology Progress Series,* 148: 11-21.

The research in this study focused on the removal of the predator squirrelfish *Holocentrus adscensionis* from model reefs. These fish primary feast on larva of non-predator species (known as grunts), which leads to population decline amongst these fish. The author found that removal of the squirrelfish during the initial grunt recruitment phase of reef development led to increases in community abundance over time. However, this was reliant on the re-introduction of the predator species during the post recruitment period. The hatched larva of the initial recruits would be subject to predation, which limited over population and promoted competition. This would be useful when looking at my results and discussion section. I would be able to see what sites had abundant predator species, and see if they experienced high density indexes of other species. Perhaps I may find site development is dependent more on both predators and herbivores which would link these two sources to my paper.

Benkwit, C. E. (2015). Non-Linear Effects of Invasive Lionfish Density on Native Coral-Reef Fish Communities. *Biological invasions,* 17: 1383-1395.

The author attempts to understand the relationship between invasive species and Caribbean coral reef health. The Pacific Red Lionfish, *Pterois volitans*, is used to study the modeling curve behind their impact on native reef prey. Overall, it was discovered using AIC and BIC comparisons that a non-linear negative exponential model best described the predator prey relationship between these species. The decline at reefs was approximately 42.9% for each additional lionfish predator that was introduced. Ultimately, this trend leveled off, but this indicated that keeping invasive species densities low at reefs is essential to their survival. My study has data on the density of these lionfish over the 20-year span, so I should be able to draw some comparisons with this data in my body paragraphs. It will also be helpful for determining what reefs may be the most vulnerable on Grand Cayman.

Lewis, S. M. and Wainright, P. C. (1985). Herbivore Abundance and Grazing Intensity on a Caribbean Coral Reef. *Journal of Experimental Marine Biology,* 87: 215-228.

This paper focused primarily on the assemblage of coral reefs under the presence of heavy and light herbivore fish species coverage. Overall, the results of this study indicated that reefs with high densities of herbivores typically have healthier corals and more expansive communities. Reefs which had little herbivore presence tended to be in decay with poor community structures and much harsher environmental conditions. However, statistical correlation comparisons found no evidence of heterogeneity of coral structures and depth of sites being linked to higher herbivore densities. Additionally, they observed that herbivores species varied significantly across reef habitats. Ultimately, this will serve as a paper to be used in my discussion. I will use my results to assemble a picture of herbivore density across the Grand Cayman reefs, and once I compare these results to a site description, I will be able to discuss if my results support these findings.

Pattengill-Semmens, C.V. and Semmens, B. X. (2003). Status of Corals reefs of Little Cayman and Grand Cayman, British West Indies, in 1999 (PART 2: FISHES). *Atoll Research Bulletin,* 496: 226-247.

These researchers focused on outlining the reef fish species assemblage on both Grand and Little Cayman Island. To accomplish this, they used REEF scuba diving techniques to document sighting frequency and density index scores for fish at 33 unique sites. Additionally, they multiplied these scores to find an overall percent abundance score for each site. These scores were then analyzed to identify the relative health of each reef. This study is a direct comparison to my study, as I am also using REEF data to analyze fish sites on Grand Cayman. However, my study focuses only on the density index variable to identify the reef health. Truthfully, I could use the results of this study in any part of my paper. I could introduce the reader to another group that performed the same tests at this site. Next, I could contrast our results to see how the data has evolved from 1999 when they collected data until 2018. This will likely be the strongest comparison article I will have for my results section. Additionally, I could use their article to group my fish species into families, as they have done this with the 173 species they recorded.

Roberts, C.M. (1995). Rapid build-up of fish biomass in a Caribbean Marine Reserve. *Conservation Biology, 9*(4): 815-826.

The researcher examined the effectiveness of Marine Reserves, sites were recreational and commercial fishing are band, on reef fish species biomass. This study was also conducted in the Caribbean, which makes it applicable to my Grand Cayman data. The research also focused on species, like the Princess Parrotfish *Scarus taeniopterus,* that are also found in my data. Ultimately, the results showed that the reef species living in Marine Reserves had increased biomass due to lack of external pressure. However, this was only true when these reserves incorporated species ranges to link larval supplies to the habitat. This information will be very useful in my initial body paragraph. I have a map of Marine Reserves on Grand Cayman, and I can overlap this map with the dive site locations from LU Marine Term. I will then be able to analyze these sites to see if biomass is indeed higher in protected areas. If not, then I will be able to argue that the Marine Reserves likely fail to encase fish species ranges on the island.

Shullman, M. J. and Ogden, J. C. (1987). What Control Tropical Reef Fish Populations: Recruitment or Benthic Mortality? An Example in the Caribbean Reef Fish *Haemulon flavolineatum. Marine Ecology progress series,* 39: 233-242.

To try and understand the reason behind collapsing reef species abundance in the Caribbean, researchers performed REEF data collection techniques on a common reef grunt *H. flavolineatum.* They used the life cycle of this grunt as a measurement of reef vulnerability. This was accomplished by measuring mortality rates among juveniles in the benthic stage of development (0-3 months). Additionally, they measured recruitment levels of *H. flavolineatum* adults to reefs to compare against benthic deaths. They found that reefs with high benthic stage *H. flavolineatum* mortality rates had less stable community reef structures than those with low grunt recruitment. This allowed them to conclude that benthic mortality rates had more impact on reef health than recruitment, which had previously been considered the

primary measure of healthy reefs. Though I thought this study would provide great information, I do not believe it will be helpful to my report. I do not have data on benthic death rates or grunt recruitment levels, so I am likely not going to be using this study.

Wedding, L. M., Jorgensen, S., Lepczyk, C. A., & Friedlander, A. M. (2019). Remote Sensing of Three-Dimensional Coral Reef Structure Enhances Predictive Modeling of Fish Assemblages. *Remote Sensing in Ecology and Conservation, 5*(2): 150-159

The authors of this study used reef data collected from Light Detection and Ranging (LiDAR) remote sensing technology from the Hawaiian Islands. The system created either a 2D or 3D map of each reef it analyzed, and key variables like fish density, biomass, and abundance were analyzed from these scans. Next, the authors performed Linear Mixed Effect Models to investigate the significant of 2D versus 3D LiDAR modeling on predicting these variables. Ultimately, the 3D LiDAR models were shown to produce the highest quality predictions of actual reef assemblage. This study will be of huge importance to my introduction and discussion sections. I will be performing Linear Mixed Effects Modeling for my data, which this paper provides a perfect introduction to this methodology. In the discussion, I can use these findings to suggest future research options for the Caribbean reefs. Perhaps the LiDAR methods could accurately model the structural assemblage of Grand Cayman reefs, and this data could be useful for predicting species density. After all, prediction will be a key to understanding where to target conservation efforts on my reefs.

Williams, I. D. and Polunin, N. V. C. (2001). Large Scale Associations Between Macroalgal Cover and Grazer Biomass on Mid-Depth Reefs in the Caribbean. *Coral Reefs,* 19: 358-356

The researchers in this article studied reefs all throughout the Caribbean to gain insight into the harmful effects of macroalgae on herbivorous fish. They noted that since the mass death of species in 1984, macroalgae have been increasing significantly throughout the area. The addition of macroalgae has been hypothesized to be associated with increased fishing activity from humans. The researchers found this to be true at many reefs, as herbivore biomass ranged from 20 to 30% of reef coverage on heavily fished sites, and between 50 and 60% on less fished sites. However, they did note that these herbivorous fish never exceeded 60% coverage at any site, which led to a significant amount of coverage exploited by macroalgae. They hypothesized that the mass decline of herbivorous sea urchins and population density declines of these fish are likely behind this new macroalgae boom. This study could be very useful in my discussion section because I can mention the likely cause of any declines I see over time. Additionally, I could examine the difference in fish species from this data and my own. They claimed that Grand Cayman Island had low percent coverage of herbivores, around 20% only, which will be a great comparison statistic.