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Benthic Survey Analysis
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Comparison of Coral Populations found in Reef Flats and Reef Crests in Tranquilo Bay

Abstract:

Tranquilo Bay is a shallow water bay, located on the southeast coast of Bastimentos Island, which is home to some of the most vibrant and plentiful coral structures in the Bocas Del Toro archipelago. During our snorkeling outing our team layed down two 20 meter transects across the ocean floor; parallel to the coastline. Then we gathered photographic data of the 12 quadrats and analyzed the data by identifying the species of coral present within the quadrats. Then we utilized the data gathered by our peers to evaluate whether the richness, evenness, biodiversity, and composition differ between the reef crest and the reef flat. In this article, we will be discussing our findings and evaluating our findings using the Bray-Curtis method to determine the contrasts and similarities in the composition between the reef crest area and the reef flat area. Our null hypothesis states that whether the area observed was a reef crest or a reef flat, has no effect on the population of corals observed. Our alternate hypothesis states that whether the area observed was a crest or a flat, does have an effect on the population of corals observed.

Results:

Across reef crest zones, the species abundance of observed corals are as follows; 0 fire coral, 318 finger coral, 130.4 sea plumes, 33 lobed star coral, 9.1 mustard hill coral, 48 elkhorn coral, 80 knobby brain coral, 30 massive starlet coral, and 10 sea rods. The total count or species abundance is 688.5 individuals.

In the reef flat zones, the species abundance of observed corals are as follows; 52 fire coral, 332 finger coral, 8 mustard hill coral, 1 elkhorn coral, 14 knobby brain coral, 160 massive starlet

coral, 104 scroll coral, and 52 shy feather duster coral. Total count or species abundance is 724 individuals. A Jaccard similarity test resulted in 56.77876106.

Table 1. Species including calculated results of Bray-Curtis similarity

Species	**Bray-Curtis**
Fire Coral	30
Finger Coral	318
Sea Plume	0
Lobed Star Coral	0
Mustard Hill	8
Elkhorn Coral	1
Knobby Brain Coral	14
Massive Starlet Coral	30
Scroll Coral	0
Great Star Coral	0
Shy Feather Duster Coral	0
Sea Rod	0

Table created using data from the benthic survey. Left column includes the species names. Right column includes the number of each species' individuals.

Figure 1: T-Test indicating p-value of > 0.05 in the Inverted Simpson Statistical Analysis

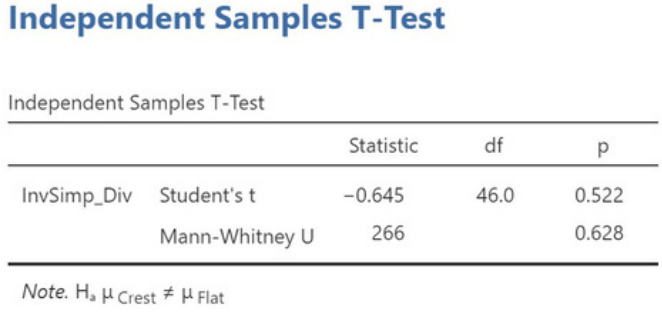

Figure sourced from Jamovi and created with data collected from the benthic survey analysis.

Figure 2: T-Test indicating p-value of > 0.05 in the Shannon-Weaner Statistical Analysis

Independent Samples T-Test

Independent Samples T-Test

		Statistic	df	p
SW_Div	Student's t	−0.305	46.0	0.762
	Mann-Whitney U	283		0.916

Note. H_a $\mu_{Crest} \neq \mu_{Flat}$

Figure sourced from Jamovi and created with data collected from the benthic survey analysis.

Discussion:

The results from our benthic survey data analysis at Tranquilo Bay provided comparisons between the reef crest and reef flat zones. There were overlapping species between the reef crest and reef flat, but there were notable differences in the species richness and species abundance. The reef crest and flat had species abundances, of 688.5 and 724 individuals respectively. The difference in these values could be due to the environmental conditions in the different reef zones. The crest zone is exposed to higher wave energy, inducing critical wave breaking and cross-reef reduction in energy that can withstand higher wave energy (Kench et al, 2022). The reef crest zone exhibits a higher number of species, most likely due to the zone's stability in shallow wind-swept environments. A study by Oakley-Cogan, Tebbett, and Bellwood done in the Great Barrier Reef in Orpheus Island concluded that the hard coral cover was highest on the reef crest, with the slope also containing a high amount of hard, wave-resistant coral species. In this study, the amount of hard corals declined across the reef flat, continuing towards the shoreline. This finding aligns with the data observed in this study, as finger coral had the highest number of individuals found on the observed reef crest. However, raw data extracted from the benthic survey observed that there is a large presence of finger coral in the Tranquilo Bay area, regardless of the reef flat or reef crest location, as it was also the highest number of individuals

(318 individuals) found on the observed reef flat. In contrast the reef flat zone had a greater abundance of massive starlet coral (160 individuals) and scroll coral (104 individuals). The shallow reef crest and outer reef flats are zones of a reef that control the dissipation and transmission of wave energy to their adjacent shorelines (Kench et al, 2022). This indicates that the middle and inner parts of the reef flat would have less exposure to waves, leading to a decline in the number of individuals of wave-resistant species, and an increase in species that can withstand high-energy environments.

The Jaccard similarity test comparing the two zones had a score of 56.78%, indicating moderate similarly in species composition. This score indicates that the crest and that flat were 56.78%, or moderately similar. This finding supports our reasoning that differing environmental conditions between the zones, such as wave energy, water flow, and sedimentation, could impact the differences between the populations of coral observed on the reef crest and flat.

The p-values from the data are greater than 0.5, and are therefore insignificant. This concludes that the data looks how it would be expected to look if the null hypothesis is true. Therefore, the difference between the reef crest and the reef flat does not have a significant effect upon the population of coral.

This benthic survey analysis performed at Tranquilo bay did not produce significant data to prove an alternate hypothesis. We can conclude that although the species abundance, diversity, and richness differed, the low p-value does not prove significance. Therefore, we must accept our null hypothesis, the reef crest and reef flat do not have an effect upon the population of observed coral. Future research could expand on the differences between the high and low wave-energy species found in the different reef zones.

Literature Reviewed:

Kench, Paul S., et al. “Sustained coral reef growth in the critical wave dissipation zone of a Maldivian Atoll.” *Communications Earth & Environment*, vol. 3, no. 1, 11 Jan. 2022, https://doi.org/10.1038/s43247-021-00338-w.

Oakley-Cogan, Arun, et al. “Habitat zonation on coral reefs: Structural complexity, nutritional resources and herbivorous fish distributions.” PLOS ONE, vol. 15, no. 6, 4 June 2020, https://doi.org/10.1371/journal.pone.0233498.