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Corallite Skeletal Analysis on *Porites lobata* in Ngermid Bay

Abstract:

Ngermid Bay in Palau has water conditions unique from surrounding water qualities due to lowered pH levels and higher temperatures; these qualities are a cause of the geological features surrounding the bay. Limestone rock islands encompass Ngermid Bay stunting water movement from traveling in and out of the area. This somewhat stagnant movement increases the temperature and decreases the pH (Rivera et al. 2022). Warmer and more acidic seawater are not ideal circumstances for corals to proliferate as it may insight mass stress events (Jokiel et al. 2008). However, despite the unfavorable conditions, there exist significant and diverse coral communities within Ngermid Bay (Rivera et al. 2022). One such species of coral is essential for building reefs and has been associated with being resilient to the effects of climate change (Rivera 2018). Porites lobata (lobe coral) is a prevalent coral species in the Pacific. The morphology of the species may contribute to its resiliency. The skeleton itself is more dense and slow growing compared to other coral species (Tisthammer and Richmond 2018). This study aims to examine the corallite to determine if there are differences in corallite skeletal structures found on the top, middle, and bottom of colonies around the bay. Little research has been done in the area, thus, this will be the first to examine *P. lobata* morphology in Ngermid Bay, and as a result, more information on the morphology of *P. lobata* will contribute to existing knowledge.

Introduction:

This project will focus on a coral species from a place called Ngermid Bay in the Republic of Palau. Ngermid Bay has warmer and more acidic waters which are typically harmful for coral reefs (Jokiel et al. 2008; Rivera et al. 2022). This effect is due to the surrounding rock islands which stunt water flow, making the area relatively stagnant (Rivera et al. 2022).

However, the corals in this bay are continuing to thrive despite the stressful environment (Rivera et al. 2022). Studies of this bay are limited and conducting research on this area would expand knowledge on both Ngermid Bay and coral response to changing climates. Coral reefs contribute heavily to marine ecology, economical opportunities, and cultural identities. These ecosystems host a multitude of marine species such as reef fish. This results in a rich and biodiverse ecosystem which supports the tourism and fishing industry. Additionally, coral reefs provide spaces and resources for Pacific Island cultures to conduct practices, such as producing lime powder and fishing. These essential ecosystems face numerous anthropogenic threats, such as oceans increasing in temperature and acidity, thus, cases where reefs are thriving in less than suitable conditions are special and should be studied to better understand how we can address these issues (Rivera et al. 2022).

Hypothesis and Predictions:

Tristhammer and Richmond (2018) has suggested that 7 aspects and qualities of the Porites corallite are varied within their study. Thus, there should be significant variation in the certain qualities of the corallite such as the corallite spacing, columella diameter, ventral and lateral palus diameter, fossa width, ventral palus spacing, and lateral septal thickness amongst the colonies (Figure 1).

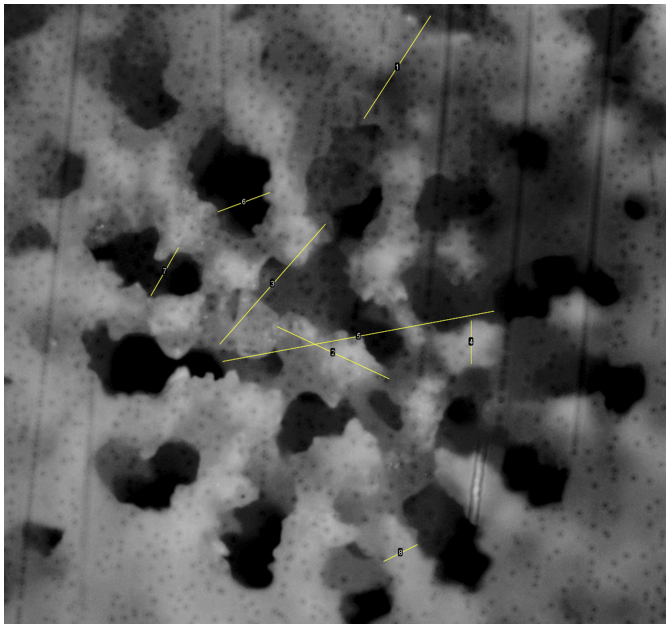


Figure 1. P. lobata corallite with measurements of corallite spacing (1), columella diameter (2), ventral palus diameter (3), lateral palus diameter (4), fossa width (5), ventral palus spacing (6,7), and lateral septal thickness (8).

Methodology:

Four different sites have already been established within and outside Ngermid Bay. The first site will be near human settlement, the second and third will be within the bay itself, and the fourth site will serve as a control group as it is located outside the bay with relatively standard conditions.



Figure 2. Map of Ngermid Bay with sites 1-4 tagged.

Site #	Coordinates
1	N 07.33526, E 134.49071
2	N 07.322667, E 134.496385 - colonies to front and right of waypoint
3	N 07.31158, E 134.49916 - colonies to right of waypoint
4	N 7.29102, E 134.50363

Figure 3. Site coordinates of 1-4 in Ngermid Bay with directions to coral colonies

Samples will be collected from six coral colonies at each site, where three skeletal samples are retrieved from the top, middle, and bottom of the colony. Collaboration with the Palau International Coral Reef Center (PICRC) will allow for boat travel to each site, where initial surveys will locate healthy colonies. Sampling will include the collection of coral fragments from the top, middle, and bottom of each colony with a hammer and chisel. After collection, a small tissue sample will be stored in 99% ethanol for DNA analysis. The remaining tissue will then be removed by soaking fragments in a 10% bleach solution, after which it will be

sun dried. Moreover, data collection and field work will be utilized for this portion of the research, and travel to Palau is necessary to do so.

Once all samples have been collected, they will be transferred to Kewalo Marine Laboratory (KML) for analysis. Coral skeletons will be examined using a dissecting microscope, and then processed by Image J, which will gather precise measurements of the corallite structures to distinguish differences between samples. The corallite spacing, columella diameter, ventral and lateral palus diameter, fossa width, ventral palus spacing, and lateral septal thickness of the corallite are specifically measured. Morphometric analysis will be produced via PERMANOVA. The molecular analysis will then be done in Hawai‘i at Kewalo Marine Laboratory. DNA will be extracted from preserved tissue samples using Qiagen DNeasy Blood & Tissue Kits, and amplified using PCR before being sent to the Advanced Studies in Genomics, Proteomics, and Bioinformatics (ASGPB) for Sanger Sequencing. This will genetically confirm the species of coral that we collect and analyze.

Intellectual Merit:

This project aims to build off of and add more to the existing knowledge on corals and coral communities in Ngermid Bay and Palau as a whole. Ngermid Bay has particularly unique conditions that may emulate future ocean conditions that are worsened by climate change (Rivera et al. 2022; Jokiel et al. 2008). As there are limited studies on this site, research in this area will contribute to the available knowledge on how corals react to harsh conditions. This project will also provide insight into morphological adaptations/skeletal analysis of corallite structures of *P. lobata* found in Palau, which has not been done before on any coral species in the area.

Broader Impacts:

Changing climate patterns and its effect on marine life are disproportionally affecting coastal and island communities. As a Pacific Islander, I experience these effects on my community first hand. Being in Marine Biology, I want to use my knowledge to help my community. By studying and working throughout the Pacific, I can better help not only my island but assist my fellow brothers and sisters connected by sea. Conducting this research on corals in Palau allows me to perform a study in my own island. I hope the research that I conduct in my home island reflects the love and care I have for our oceans. As an indigenous Pacific Islander in academia, I strive to have my research be beneficial to the cause of my people. The ocean is an integral key aspect of Palauan culture; the reefs within support the biodiversity that feeds our island, thus, we have cultural protocols to conserve these resources. Figuring out how to study corals and figure out how to help them combat changing climate conditions seems to be my way of practicing my culture. I want to emulate the principle "*A klengar er a kid el chad er a Belau a ultuil er a daob*"; meaning, the existence and the livelihood of us Palauans is reliant on the ocean. Additionally, I want to use my position to take on mentees and to help other students who are interested in choosing STEM pathways. There is not an abundance of Pacific Islanders in STEM fields, thus, I would want to use my position to address the disparities.

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