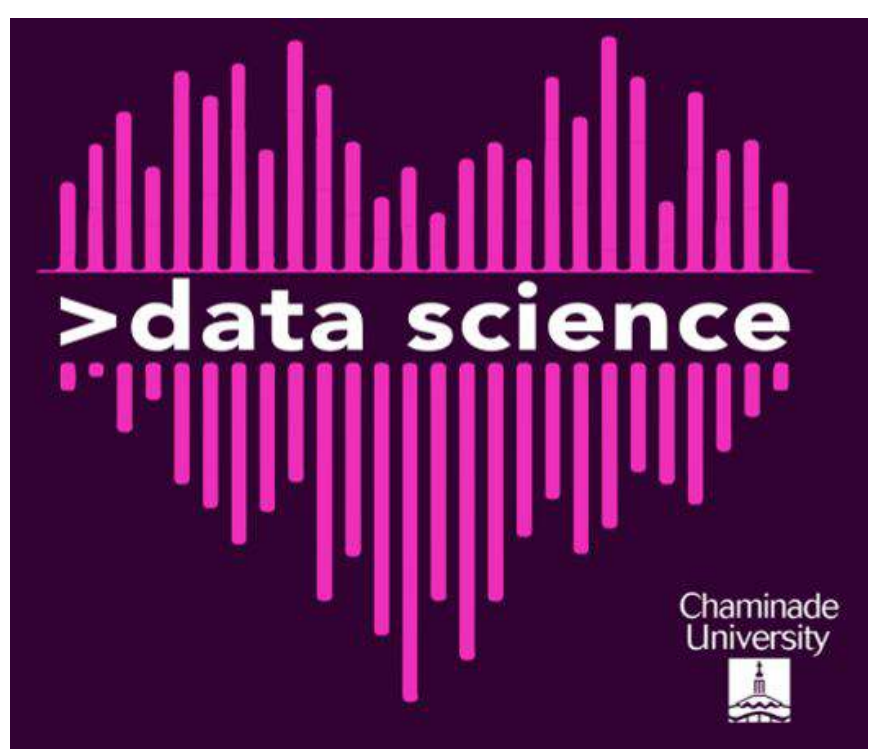




Reef Health in Maunalua Bay



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Introduction

Aloha, this semester our Advanced Marine Environmental Science Lab chose to study the ecosystem of Maunalua Bay. We partnered with the leading conservation non-profits in the area, Mālama Maunalua, Huli, and the Maunalua Fishpond Heritage Center (MFHC) and with their help, determined the scope of our lab. We chose to analyze temperature at six different locations across the bay, analyze water quality at two locations, gather survey data describing coral health, and photograph and geotag benthic coverage using R Studio and CoralNet.

This is the first lab of its kind at Chaminade University, so our main objective was to learn and develop a foundation that will allow students to have the most significant impact possible with their work in future marine labs. We grew tremendously as a team and individually as scientists.

We spent the majority of our lab sessions in the field completing surveys at Paikō located in Maunalua Bay, Hawaii.

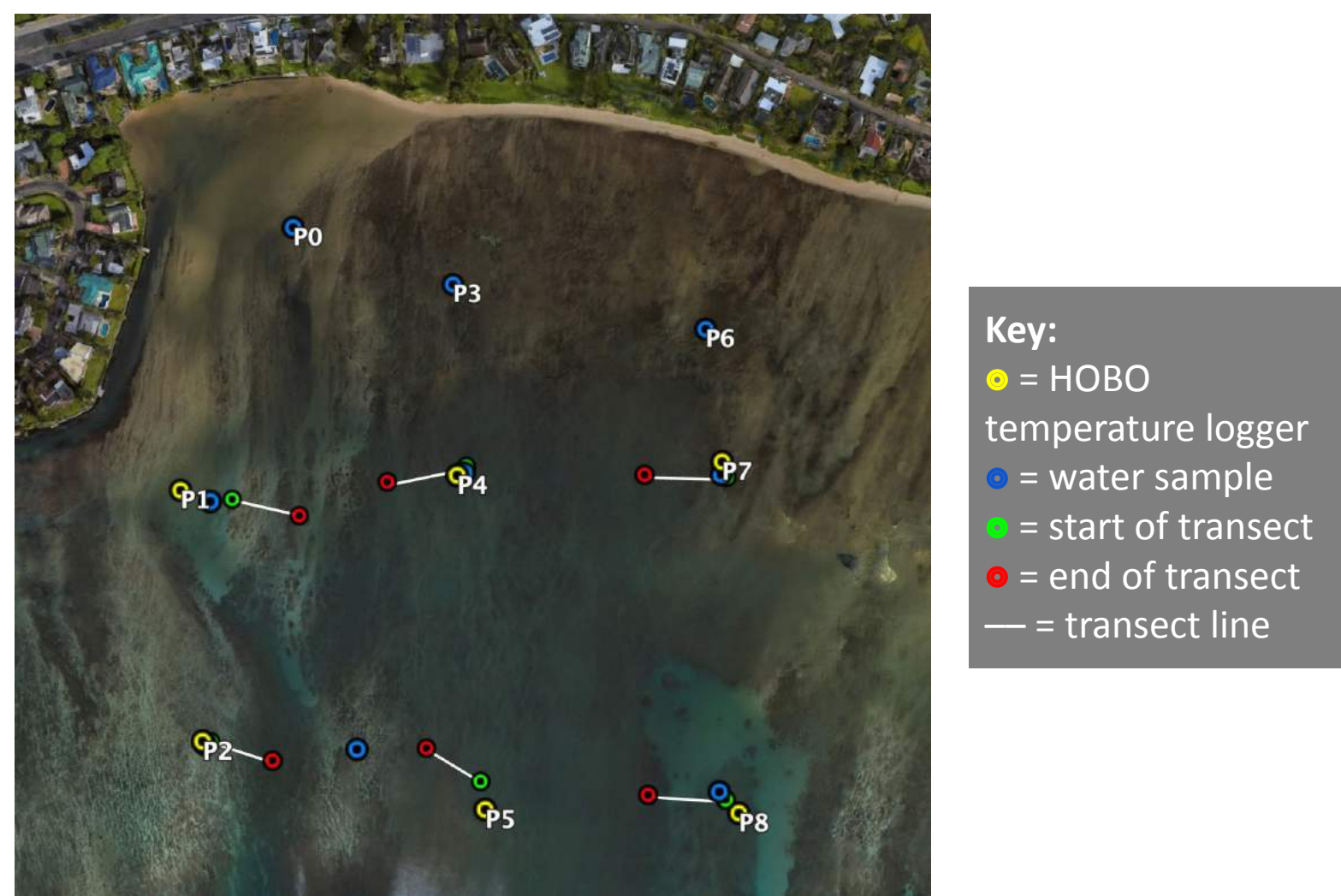


Figure 1. Paikō Coral Reef Coordinates Selected

Water Temperature Analysis

Methods: Onset HOBO Water Temperature Pro v2 Data Loggers were placed at six locations (see Figure 1) by being zip tied to a cinder block. Temperature loggers were programmed in HOBOWare to collect data every ten minutes. Data was collected from January 28 to February 26, 2021. After 30 days, the temperature loggers were retrieved from sites 1, 2, 4 and 7. Collected data was downloaded using HOBOWare and hourly mean temperature was analyzed using RStudio.

Results: The varying temperatures showed similar ranges of approximately 19°C to 28°C and patterns at each of the locations.

Discussion: There was little variation observed between the four sites in the Paikō region. Temperature fluctuations may be attributed to weather events (such as a heavy rainfall) and tidal influence. Further investigation in the temporal variation may be done by analyzing the correlation between rainfall and tide data with the observed temperature data.

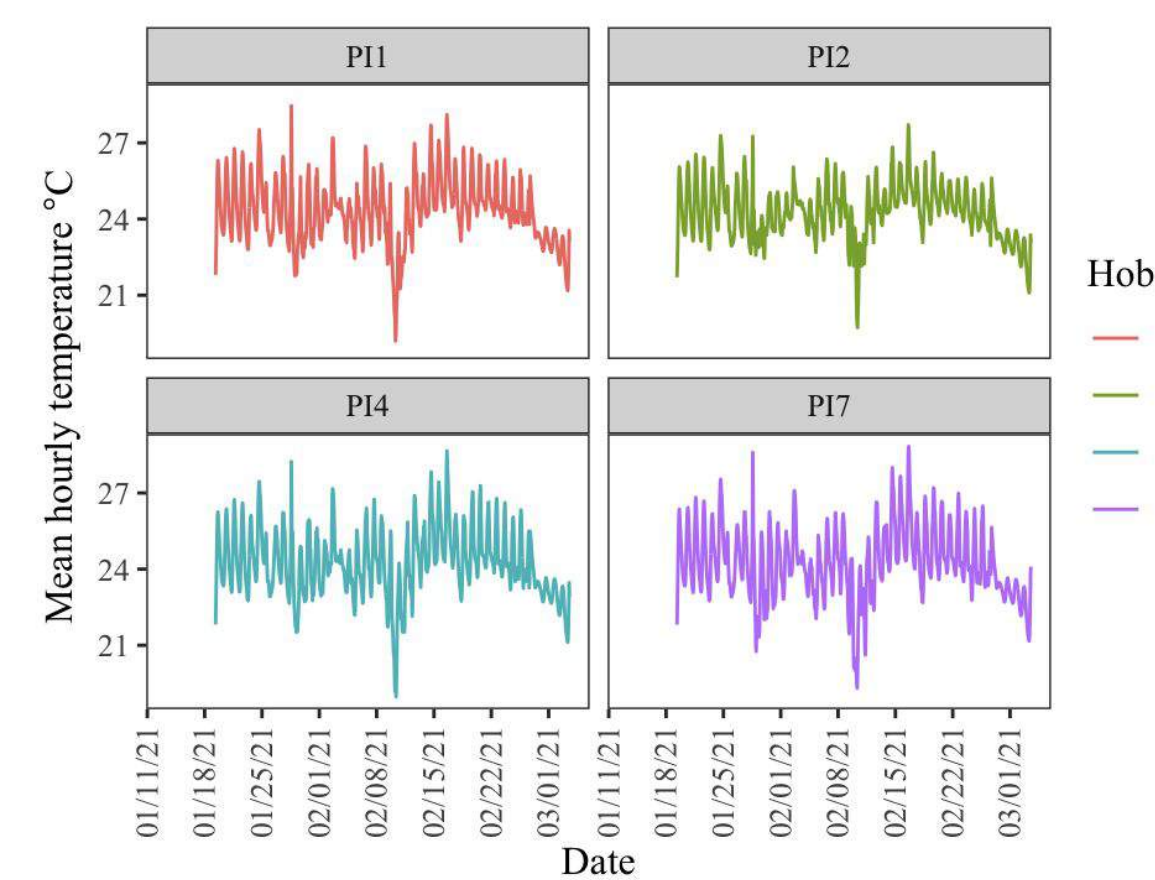


Figure 2. Temperature Data Collected by Hobo Temperature Loggers

Water Quality Analysis

Methods: 50mL water samples were collected (in triplicate) in falcon tubes approximately one foot beneath the water's surface at ten different sites (see Figure 1). Collected samples were stored in -20°C until analysis. Analysis of Sulfate, Nitrate+Nitrite, O-Phosphate, and Nitrite was performed using Seal Analytical AQ400 Instrument.

Results: O-Phosphate, nitrite, and calculated nitrate concentrations are displayed in Table 1. The other analytes measured were found at concentrations beyond standard levels, thus those standards need to be revisited for future readings. Calculated nitrate concentrations were similar across all sampling sites. O-Phosphate was highest at site 5 and lowest at site 6. Nitrite was highest at site 5 and lowest at site 1.

Site	oPhos 5 (mg P/L)	Nitrite (mg/L)	NO3 (Calculated)
PW0	0.003	0.0013	0.0399
PW1	0.003	0.0005	0.0277
PW2	0.0037	0.0007	0.0259
PW3	0.0027	0.0019	0.0295
PW4	0.0017	0.003	0.0240
PW5	0.004	0.0021	0.0331
PW6	0.0003	0.0013	0.0399
PW7	0.0017	0.0012	0.0341
PW8	0.0013	0.0013	0.0370

Paikō Ko'a Card Coral Reef Survey Results



Figure 4. Hawaiian Ko'a Card: Coral Health Assessment Tool

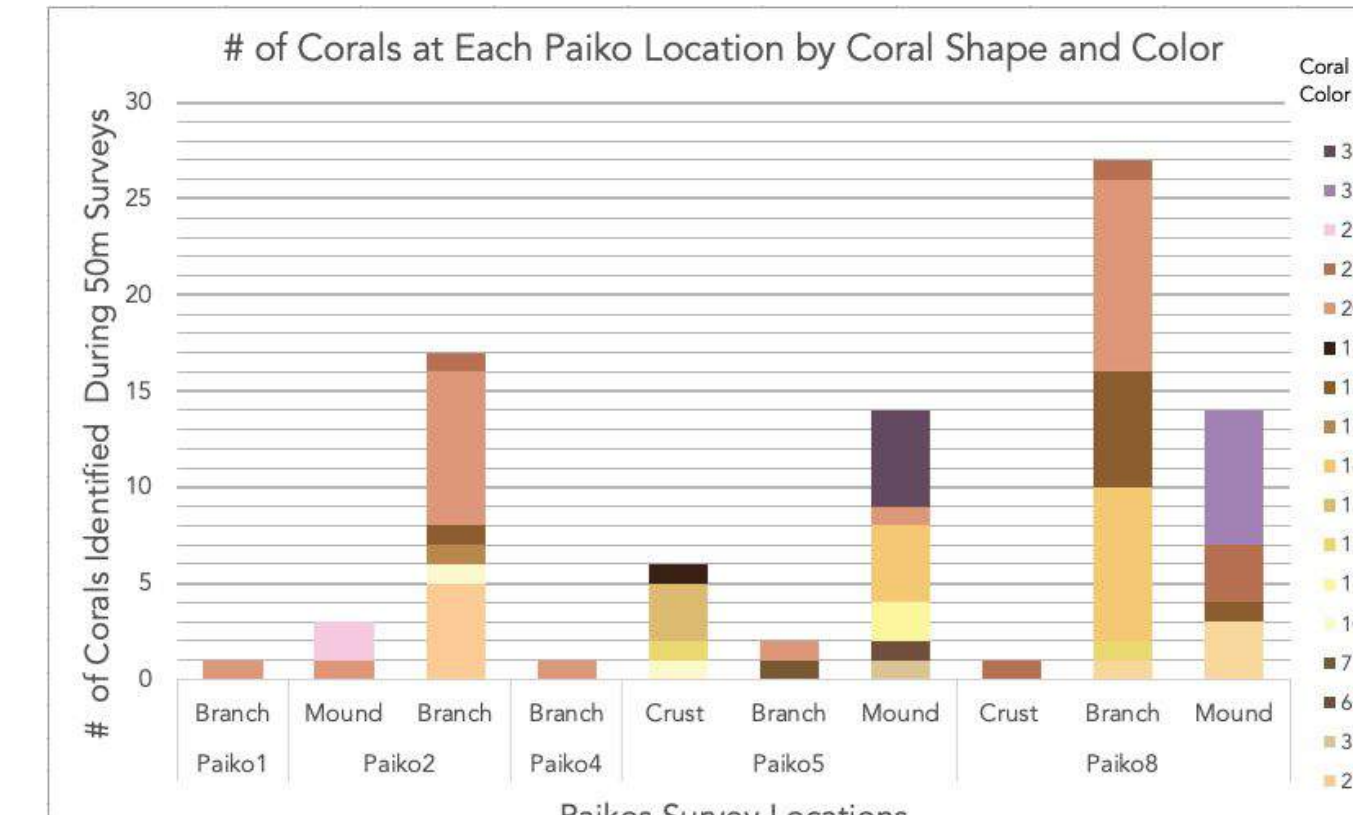


Figure 3. # of Corals at Each Paikō Location by Coral Shape & Color

Methods: Mālama Maunalua provided our team with Hawaiian Ko'a Cards to use as a tool to accurately record the color of each coral for coral health assessment. Two surveyors swam for 50 meters guided along a tape measure and recorded the shape and color of each coral within a five meter range.

Results: The coordinates located close to the shoreline, Paikōs 1 & 4, both had one coral while Paikō 7 had no coral. Paikō 2, 5, & 8 had between 20-42 corals present with a large variety of coral shapes and colors. The distance between all the sites ranged between 150 - 200 meters. The sites closest to shore also had low wave action and higher temperatures than the sites furthest from shore. The sites furthest from shore had a lot more coral coverage than the sites closest to shore. The sites closest to shore are more shallow than the sites furthest from shore. Overall, majority of the corals observed were branch type corals (i.e. *Pocillopora meandrina*) followed by mound corals (i.e. *Porites lobata*).



Benthic Coverage Photos - Geotagging/Coral Net

Methods: At each of the six locations, a photo quadrant with a gopro attachment was used to take a picture every 4 meters along a 50 meter transect line. These photos were downloaded into google drive, cropped, labeled, and put into CoralNet Software to analyze the benthic surface (coral,algae,rock,sand, etc.) The photos were also geotagged in RStudio by using latitude and longitude points.

Results: Transect 1, 4, & 7 was compared to transect 2, 5, & 8. There's a higher percentage of macro algae closer to shore. There's a higher percentage of coral rubble further away from shore. CoralNet Analysis: 10 computer generated plots were chosen and analyzed manually by CoralNet users. No live coral was found throughout this analysis, with the majority of data representing coral rubble or dead coral which indicates there was a large amount of live coral previously.



Discussion

The most significant outcomes of our work were the relationships established between Chaminade University and Mālama Maunalua/Huli/The Maunalua Fishpond Heritage Center, and the evolution of our survey/methods protocols. These relationships allowed us to expand our network within the science community and connect through service learning.

The HOBO Temperature Loggers can be placed in more locations for a more significant time period and the process of downloading the data and analyzing it in RStudio is thoroughly documented. Water Quality sampling methods can be further improved by creating a consistent collection protocol, analyzing rainfall data, and collecting other water quality measurements concurrently (i.e. temperature, salinity, and pH). The reef and fish survey methods were taught to us by the team at Mālama Maunalua. The two survey methods that we used for benthic surveys were the Ko'a Card Along Transect Line and the PhotoQuadrat Along Transect Line. (Methods explained in detail in methods section)

Conclusion and Next steps

The data that we were able to gather was on water quality, benthic surveys (bio-analysis of invertebrates, coral, algae and fish), and water temperature data at Paikō. The data collected suggests a significant difference in biomass/diversity between the three transects closer to shore and the transects further out; higher biomass and diversity was found in the transects furthest from the shore. There may be a correlation between biomass/diversity and the historical fresh stagnant water flowing from the mountains into the ocean. This could be tested in future research. For future studies, there could also be an analysis of other organisms, such as: invertebrates, limu and fish. Another addition to this coral reef collaboration would be to take pictures of every coral spotted and where it was found on the transect line whilst looking over the koa card transect line survey. This would be a good idea for Paikō, due to the low amount of biodiversity. Another addition to the program would be to look over different site locations in order to compare and contrast the two sites (would be great when feasible). Water Quality measurements should be collected more frequently and over a longer period of time. Other water parameters (such as salinity, pH, and temperature) should be measured when water samples are collected. Comparison of water quality between seasons and during rainfall events would create a better understanding of how the water quality naturally fluctuates throughout the year. This would then allow us to observe and identify unusual changes in the water quality and investigate its cause. For water temperature, the HOBOS should be out all year long in order to see if there is a significant difference throughout the seasons and/or if the temperature affects marine life. Future studies may also be done on tracking specific species and how they are positively or negatively affected by other life in a given area; for example, if a certain fish species are higher in abundance where there is more coral. A lot of information can be drawn from the data we collected and it would be great to see this program thrive.

(<https://www.pacioos.hawaii.edu/coral-card/submit.html> - website to use for Ko'a Card.)

Acknowledgements

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