Reef Health in Maunalua Bay

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Introduction

Maunalua, this semester our Advanced Marine Environ mental Science Lab chose to study the ecosystem of Maunalua Bay. We partnered with the leading conservation non-profits in the area, Mālama Maunalua, HuL, 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 an R Studio and CoralNet.

Methods: Mālama Maunalua provided our team with Hawaiian Koa’ 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 the five meter range.

Results:

Water Temperature Analysis

Methods: HOBO Water Temperature Pro V2 Data Loggers were placed at six locations (see Figure 1) by being attached to a cinder block. Temperature loggers were programmed in HOBOware to collect data every ten minutes. Data was collected from January 28 to February 24, 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 R Studio.

Results: The varying temperatures showed similar ranges of approximately 19°C to 29°C and patterns at each of the locations.

Water Quality Analysis

Methods: 50ml water samples were collected (in triplicate) in falcon tubes approximately one foot beneath the water’s surface of ten different sites (see Figure 1). Collected samples were stored in 20°C unit analysis. Analysis of Nitrate, Nitrates+Nitrite, O-Phosphate, and Nitrite was performed using a Seal Analytical AQ400 Instrument. Results: O-Phosphate, nitrates, and calculated nitrate concentrations are displayed in Table 1. The other analyses were found at concentrations beyond standard levels. Thus those standards need to be revised 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 3 and lowest at site 1.

Benthic Coverage Photos - Geotagging/Coral Net

Methods: At each of the six locations, a photo quadrat with a GPS 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.

Discussion

The most significant outcomes of our work were the relationships established between Chaminade University and Mālama Maunalua/HuL/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.

Acknowledgements

Mahalo to Professor Lupita Rub-Jones, Austin Kin, and Jesse Yonover of the HuL Movement, Kaliheli K. Akahi Wood and Marky Cancan from Chaminade University of Honolulu, Pam Wairan of Mālama Maunalua and her team, Chris Cramer of Maunalua Fishpond Heritage Center, and Callum Hobbs.

Table 1. Average Water Analyte Concentrations

<table>
<thead>
<tr>
<th>Site</th>
<th>O-Phosphate (mg/L)</th>
<th>Nitrate (mg/L)</th>
<th>Nitrite (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PW1</td>
<td>0.0013</td>
<td>0.003</td>
<td>0.0005</td>
</tr>
<tr>
<td>PW2</td>
<td>0.003</td>
<td>0.002</td>
<td>0.0019</td>
</tr>
<tr>
<td>PW3</td>
<td>0.0017</td>
<td>0.0017</td>
<td>0.003</td>
</tr>
<tr>
<td>PW4</td>
<td>0.003</td>
<td>0.0019</td>
<td>0.0019</td>
</tr>
<tr>
<td>PW5</td>
<td>0.003</td>
<td>0.0017</td>
<td>0.0013</td>
</tr>
<tr>
<td>PW6</td>
<td>0.0017</td>
<td>0.0017</td>
<td>0.0013</td>
</tr>
</tbody>
</table>

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 Paiko. The data collected suggests a significant difference in biomass/diversity between the three transects closer to shore and the transects further out. Higher biodiversity and biomass was found in the trancts furthest from the shore.

Conclusion and Next steps

To improve the current program of coral reef health assessment, we would like to do the following:

- Collect water quality measurements concurrently (i.e. temperature, salinity, and pH).
- Improve the analysis of Koa card transect line survey. This would be a good idea for Paiko, due to the low amount of biodiversity. Another addition to the program would be to take over different site locations in order to compare and contrast the two sites (would be great when feasible).
- Add water quality measurements should be measured more frequently and over a longer period of time. Other water parameters (such as salinity, pH, and temperature) should be measured during future surveys.
- Add an analysis of other organisms, such as invertebrates, fish, and algae. Another addition to the coral reef collaboration would be to take pictures of every coral spotted and where it was found on the transect line whilst testing how the koa card transect line survey. This would be a good idea for Paiko, due to the low amount of biodiversity. Another addition to the program would be to take over different site locations in order to compare and contrast the two sites (would be great when feasible).
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PhotoQuadrat Along Transect Line. (Methods explained in detail in methods section)

For future studies, there could also be an analysis of other organisms, such as invertebrates, fish, and algae. Another addition to the coral reef collaboration would be to take pictures of every coral spotted and where it was found on the transect line whilst testing how the koa card transect line survey. This would be a good idea for Paiko, due to the low amount of biodiversity. Another addition to the program would be to take over different site locations in order to compare and contrast the two sites (would be great when feasible).

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