2018 Summer Internship

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Environmental Studies Major w/ a Minor in Biology
Alysha Meno

- Bachelor Degree of Science in Environmental Studies from Chaminade University
- Conducted research on fungal endophytes for marine algae found in Oahu, Hawaii and wanted to expand my ocean knowledge by working with coral found on Guam.
Marilyn Connell

- Nuclear Engineering Technology, Excelsior College
- I spend time in the water and around coral so I thought it would be interesting to learn more about what I see when I am out snorkeling.
- I love to hike, spend time in the water and travel to any place I can.
Overview

- Introduction
- Methodology
- Results
- Discussion
- Personal Experiences
Effects of algae removal on near shore coral reef communities
Coral and algae interaction

- Algae growth rate vs. coral growth rate
- Coral and algae interaction varies
- Benthic algae plays an important role in healthy and degrading coral reefs
- Competition of resources leads to a “phase shift”
Coral and algae interaction cont.

- Algae creates a refuge on coral for pathogens
- Corals exert energy to protect themselves from algae growth
- Less energy available to grow in size
In a study done in the Indo-Pacific region a group of scientist grouped their study of herbivorous fishes into four groups based on their functional roles:

(Green & Bellwood, 2009)
Scrapers/Small Excavators

Large Excavators/Bioeroders

Grazers

Browsers
Fish Continued..

- Overfishing causes a threat to coral reefs.
  - Reduction in herbivores = increase in macroalgae
    - High abundances of macroalgae can overwhelm grazing abilities of herbivorous fish when coral cover is low
    - Bleached corals w/ algal cover means zooxanthellae can not return.

- Two important roles of herbivorous fish:
  - 1) generate space, e.g. for settling coral larvae
  - 2) prevent algal settlement, which otherwise may negatively impact coral recruitment.

(Jessen & Wild, 2013)
Invertebrates

- **What?** - An animal that lacks a backbone.
- **Where?** - They are located both in freshwater ecosystems and salt water.
- **Why?** - They help clean up the ocean, they break up decaying material and sometimes they make pretty things like pearls.
- **Freshwater and saltwater invertebrates differ just like fresh and saltwater fish do.**
- **They are usually smaller, but can be as big as 18 m (giant squid).**
Invertebrates Cont.

- Different invertebrates eat different foods: some are herbivores, carnivores and omnivores.
- Some large invertebrates even eat smaller animals like fish and crabs, while smaller invertebrates eat zooplankton and phytoplankton.
- Invertebrates and algae compete for food and other resources (space).
- Macroinvertebrates use algae to cover themselves from predators.
- Without invertebrates, algae overgrows making it hard for corals to regrow or to spawn and create more coral.
Purpose of the Project
Why this project?
Coral Bleaching
Have you ever wondered how a coral becomes bleached?

Healthy Coral:
1. Coral and algae depend on each other to survive.
   - Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral’s primary food source and give them their color.

Stressed Coral:
2. If stressed, algae leaves the coral.
   - When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral’s tissue.

Bleached Coral:
3. Coral is left bleached and vulnerable.
   - Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

What Causes Coral Bleaching?
- Change in ocean temperature increased: ocean temperature caused by climate change is the leading cause of coral bleaching.
- Runoff and pollution: Storm-generated precipitation can rapidly dilute ocean water and runoff can carry pollutants—these can bleach near-shore corals.
- Overexposure to sunlight: When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.
- Extreme low tides: Exposure to the air during extreme low tides can cause bleaching in shallow corals.

NOAA’s Coral Reef Conservation Program
http://coralreef.noaa.gov/
Super Sucker in Kaneohe Bay, Hawaii

1970s:
2 types of algae from Southeast Asia brought to Oahu as thickening agent in processed foods

2005:
Development of Super Sucker

2005:
Development of Super Sucker

Release of native sea urchin from hatchery

2012:
Creation of Super Sucker 2

2012:
Creation of Super Sucker 2

2015:
Some populations of the algae disappeared

2015:
Some populations of the algae disappeared

Today:
Sea urchins are able to manage algae population

Today:
Sea urchins are able to manage algae population
Before Super Sucker

Credit: State of Hawaii Division of Aquatic Research
After Super Sucker

Credit: State of Hawaii Division of Aquatic Research
Research Question

How has algal changed at control and experiment sites?
Hypothesis

Null hypothesis: Algal cover at sites will be the same at control and experiment sites a month after removal.

Alternative hypothesis: Algal cover will be lower at experiment sites a month after removal.

Variables: Benthic cover
Research Question

How does algal removal affect fish at control and experiment sites?
Hypothesis

Null hypothesis: Fish diversity and abundance will be the same at control and experiment sites.

Alternative hypothesis: Fish diversity and abundance will be different at control and experiment sites.

Variables: Fish
Research Question

How does algal removal affect macroinvertebrates at control and experiment sites?
Hypothesis

Null hypothesis: Macroinvertebrate diversity and abundance will be the same at control and experiment sites a month after removal.

Alternative hypothesis: Macroinvertebrate diversity and abundance will be different at experiment sites a month after removal.

Variables: Macroinvertebrates
Methodology
2018 Internship - Merizo Sites
Marked transects of control (MEC7, MEC7, MEC1) and experimental sites (ME1, ME2) for summer internship algal removal project.
Benthic Monitoring with ½ m Quadrats

NOTE: Animation is not to scale
Benthic Cover survey method

- A 25 meter transect tape is laid down.
- A square containing 6 points called a quadrat is used.
- Under each of the six points the terrain is recorded (types of coral, type of algae, etc).
- Only the right side of the transect tape was monitored.
Macroinvertebrate Belt Transects

NOTE: Animation is not to scale
Macroinvertebrate survey method

- A 25 meter transect tape was laid
- A meter stick was used to aid in the counting of macroinvertebrates within one meter of each side of the tape.
- Using a field guide to help in identification, the macroinvertebrates were counted including those hiding under coral and/or algae.
- After surveying both sides of the transect tape, each of the macroinvertebrate species were totalled
Algal Removal method

- Along set transects, we removed algae within 1m on either side (2x25m)
- We drained the algae by letting it sit outside of the water for 13 minutes.
- After the 13 minutes, using a luggage scale, the bags of algae were weighed.
- After we weighed the algae and bag we removed the algae and weighed the bag by itself.
- Taking the weight of the algae + bag and subtracting the bag weight gave us the weight of the collected algae.
Some brown algae that were removed
Fish Survey Method

- Trained fish counters identified fish to species and recorded size of each individual within a 25m x 2m belt transect at all project transects.
- One pass was made down each transect including all fish within 1m of the transect line.
Results
Benthic Cover
Benthic Cover Control Transects

- Coral: 23.9%
- Branching CA: 3.2%
- Crustose coralline (CCA): 0.2%
- Red Algae: 2.0%
- Brown Algae: 15.3%
- Cyanobacteria: 0.2%
- Pavement: 2.5%
- Rubble: 0.2%
- Sand: 23.9%
- Turf Algae: 28.4%
Benthic Cover Experiment Transects

- Cyanobacteria: 0.7%
- Pavement: 4.0%
- Rubble: 2.2%
- Sand: 24.9%
- Turf Algae: 20.0%
- Brown Algae: 19.1%
- Green Algae: 2.7%
- Red Algae: 3.6%
- Crustose coralline (CCA): 5.1%
Fish Surveys
Macroinvertebrates
Control Groups Before and After Algal Removal At Each Site

- Sea cucumbers
- Sea urchins
- Sea stars
- Other Mollusks
Experimental Groups Before and After Algal Removal At Each Site

- **Sea cucumbers**
- **Sea urchins**
- **Sea stars**
- **Other Mollusks**
2018 Internship - Merizo Sites
Marked transects of control (MEC7, MEC7, MEC1) and experimental sites (ME 1, 5, 8) for summer internship algal removal project.
Algal Removal

![Bar chart showing total algae removed at different stations: ME1, ME9, and ME5. The chart indicates significantly higher algae removal at ME9 compared to ME1 and ME5.]
Discussion
Discussion

- Whether algal removal was effective or not?
- Qualitative observations
- Recommendations / for future research
- Weather during field work
For future research...

Bringing the super sucker to Guam...etc.
Personal Experiences
This was definitely an interesting experience and some aspects were much harder than originally anticipated. The process of removing algae seemed like it would be quick and easy, which in reality it was time consuming and tiring. Being out in Guam waters in the Guam sun were also very different and I got several sunburns even with applying sunscreen and reapplying. I do feel a sense of satisfaction in learning more about coral reefs and helping even on a small scale. Eventually my family and friends will tire of me pointing out every different type of algae we come across at the beaches.
Brittany

- Grateful to do another research project in the same area
- I feel that I am making a difference
- Helped me to narrow down a career path
- Great experience
- Gained more knowledge
Alysha

- Interesting & informational
- Cool to see fishes interaction during algal removal
- A higher appreciation for ocean life & coconut oil when admiring marine life
References

- [http://www.guamreeflife.com](http://www.guamreeflife.com)
- FOR Guam Training Presentation
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