

Ocean/Climate Literacy, and Action at Hale Kula and Beyond

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In late 2017 the NOAA Climate Stewards Education Project changed its title to the NOAA Planet Stewards Education Project.

Abstract

This paper describes the NOAA Climate Stewards project selected by one elementary school on the island of O'ahu. The project focused on raising and releasing sea urchins to help restore the health of recently remediated reefs adjacent to the Waikiki Aquarium. In May of 2013, 117 urchins were released giving everyone involved a sense of accomplishment and the knowledge that in their small way they *could* do something to improve overall reef health. Also discussed are the challenges and successes encountered by the participating educators' and students', the logic for selecting the school to participate in this program, and recommendations for similar citizen science stewardship projects.

Introduction

Science in many elementary classrooms is given minimum time and generally is taught out of a textbook (Jones and Swanson, 2009) and according Chamberlain and Crane, (2009) moving beyond the textbook can be a valuable tool when introducing new science concepts to students. The Sea Urchins for Reefs Future (SURF) Project was designed to engage teachers and students in science content and process by linking the content to students' lives through a Citizen Science research experience focused on restoring the health and sustainability of Oahu's reefs.

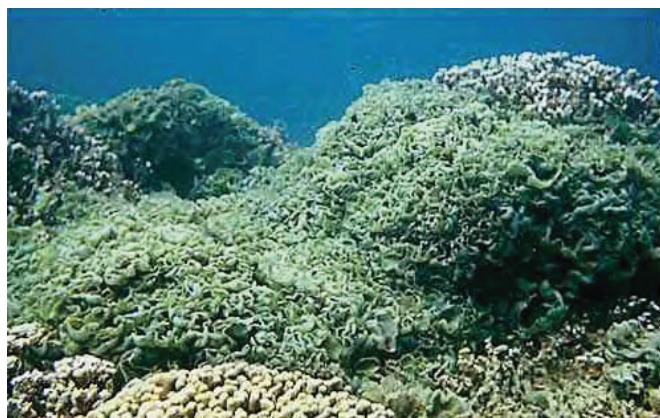


Figure 1. The invasive species *Dictyosphaeria cavernosa* or "bubble algae". Photo Credit: University of Hawai'i Botany Department.

Why the reef's? In Hawai'i, scientists from the Hawai'i Institute of Marine Biology, Waikiki Aquarium, the Hawai'i Department of Land and Natural Resources (DLNR) and Hawai'i Pacific University's Ocean Institute, have noticed high-diversity coral communities around O'ahu shifting over the past several decades to algae dominated reefs with greatly reduced species diversity. In most cases these algae are invasive species like *Dictyosphaeria cavernosa* or "bubble algae" (Stimson, Larned, and Conklin, 2001) (Figure 1) and *Gracilaria salicornia* or "gorilla ogo" (Meditz and Jang, 2010). According to Vitousek, D'Antonio, Loope, Rejmanek, and Westbrooks (1997), understanding the impacts of invasive species is crucial to preserving marine biodiversity and biocomplexity because these invaders, not only consume, outcompete, or hybridize with

native species, causing a loss of native biodiversity, they can also alter the ecosystem through uncontrolled growth that potentially smothers corals, altering reefs permanently.

With this research in mind, especially the unchecked growth of algae potentially smothering and killing corals, the initial focus of the SURF project at Hale Kula Elementary was designed to make teachers and their students aware of the impacts of invasive alga-like *bubble algae* and *gorilla ogo* on the reefs of O‘ahu. This project, designed by the author, the teachers, and the students focused on teacher participation in professional development as well as Citizen Science research projects designed and developed to be not only place-based but to provide the teachers with a new set of tools and different perspectives on science that in turn helped students connect science content more easily to their everyday lives (Vardell, Hadaway, and Young, 2006; Hadaway, Vardell, and Young, 2002).

As the project developed and matured, the teacher and student teams learned how to reduce the impacts of invasive algae by growing and releasing the common collector urchin, *Tripneustes gratilla*, (Figure 2) which have been found through previous research studies to be promising as a biocontrol agent (Stimson, Larned, and Conklin, 2001; Hunter, 2003; Conklin and Smith, 2005; Meditz and Jang, 2010), acting as common reef grazers, eating alien algae off of reefs where the algae has been mechanically or hand removed previously. Once introduced on these “cleaned” areas of the reef, Hale Kula urchin’s are able to control the regrowth of the algae which improves reef health and ultimately community sustainability.

The Project

Why Hale Kula Elementary? The teachers in this school, while not unique in their limited understanding of environmental education, climate science, and earth system science as a whole, do work with a unique student population for O‘ahu. The majority of their students, on average 22 per classroom, have one or both parents serving in an active duty capacity in the US Army. Due to the transient nature of military family life, these students also have limited experience with the reefs on O‘ahu, threats to the reefs, and the importance of protecting these reefs to ensure a sustainable future (ecological and economic) for O‘ahu. Another reason for choosing Hale Kula is that the building Principal and the teachers in this school had recently engaged with the author and several other education faculty from the University of Hawai‘i - West O‘ahu in a Title II STEM Professional Development project and they were eager to apply many of their newly-learned skills into another project, one that would engage their students directly in “doing science”, or what the Next Generation Science Standards call, “developing an understanding of the enterprise of science as a whole (NGSS Lead States, 2013). This initial cohort of six teachers was also selected because they represented grades K through 5 at the school and had the potential to initially reach 110 students through their participation in the NOAA Climate Stewards Education project and the “Citizen Science” Research conducted in conjunctions with these students.

One key component of the Citizen Science Research project is that it provided teachers and their students field-oriented and place-based experiences and curriculum that not only enhanced their understanding of the natural and cultural environment (Cusick, 2012) but also got them actively involved in an ecological restoration project that is locally and globally relevant, improving the sustainability of the reef ecosystem of O‘ahu. Engaging in Citizen Science with the goal of



Figure 2. Baby Hawaiian collector sea urchins (*Tripneustes gratilla*).

Photo Credit: NOAA.



Figure 3. Collector sea urchins after transport from the Sand Island Hatchery and prior to introduction to classroom saltwater tanks.



Figure 4. Sea urchins in salt water fish tank.

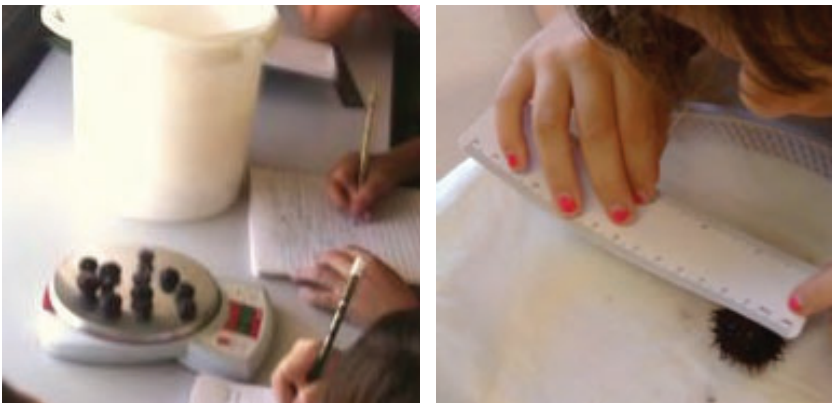


Figure 5. Students mass and measure the sea urchins to reveal growth patterns.

improving local reefs has been supported during and after the initial project by David Cohen at the Hawai'i Department of Land and Natural Resources (DLNR) Fish Hatchery at Sand Island who provided both essential instruction and focused science content concerning the common collector urchin, *Tripneustes gratilla* as well as larval and juvenile animals for the classroom growth tanks (Figure 3).

The project was initially carried out in the fall of 2012 by students and teachers at the individual classroom level, each with a 29-gallon "BioCube" saltwater fish tank that housed between 15 and 20

two- to five-millimeter urchins (Figure 4). The teachers, in partnership with their students, designed a variety of experiments to maintain and grow the urchins for release on the reefs either in Kāne'ohe Bay or the waters adjacent to the Waikīkī Aquarium adding to current efforts by the Aquarium and the DLNR to mitigate invasive algae (Figure 5).

The first attempt at raising urchins in the classrooms was mixed, and several tanks had catastrophic mortality (100%). Other classrooms were more successful, with mortality ranging from 20% to 75%. Much learning came from this initial semester; participants discovered that several classrooms would get hot over weekends when fans were off and windows were closed, raising the temperature in the tanks to levels fatal to urchins. Other teams realized that they overfed the urchins and the pH and water chemistry drifted beyond optimal levels, and one team found that it was better to measure and mass the urchins weekly rather than handling them on a daily basis. The classroom with the lowest mortality, 16 or 20 survived four months and grew to a size suitable for introduction onto reefs on O'ahu, used fresh seawater, refreshed weekly, and fed them only fresh *limu mane`one`o*, a Native Rhodophyta (UHM, 2015).

The project focused on raising and releasing sea urchins to help restore the health of recently remediated reefs adjacent to the Waikīkī Aquarium and acted as the motivator for one teacher and her students' to create a Public Service Announcement, "The Time We Became Citizen Scientists" (vimeo.com/65187852) that they entered in the 2013 Olelo Youth XChange.

In December the teachers, several parents, and students made the trip to the reef adjacent to the Waikīkī Aquarium, where they released 41 urchins (Figure 6). During the spring of 2013 the teachers and students were ready to “try again” and this time, the experiences they gained during the fall paid off with roughly 25% of the initial starting population of 156 urchins suffering mortality. In May of 2013, 117 urchins were released giving everyone involved a sense of accomplishment and the knowledge that in their small way they *could* do something to improve overall reef health. Over the summer the teachers expressed interest in adding tanks in other classrooms at their school and asked to include other schools in their area as well. This development is exactly what NOAA had in mind when it began the Climate Stewards Education Project (United States Global Change Research Program, 2009).

This project turns out to be scalable and had the ability to move beyond the initial 6 classrooms at Hale Kula. The potential for other classrooms and even private citizens to become involved with growing sea urchins for future release on the reefs of Oahu is exceptional and growth of the project beyond the initial cohort will not only provide an opportunity for students and other nonprofessional scientists to participate in scientific research, it will provide needed place-based experiences for students and the community that will enrich learning and help teachers meet the Next Generation Science Standards (NGSS Lead States, 2013) (Table 1). While Hale Kula was the initial target audience for the NOAA Climate Stewards project, and the campus continues to grow urchins, it is hoped that further sources of support will allow second and third iterations that could eventually be included in all public and private regular and special education teachers, island wide.

Going Further

By actively participating in the Hale Kula’s SURF NOAA Climate Stewards project, teachers and students have studied, cared for, grown, and eventually released urchins to the reefs in the waters adjacent to the Waikīkī Aquarium. This not only has the potential to improve overall reef health, but it has also given the teachers and students an opportunity to provide a service to the community that is directly tied to community resilience through improved reef health. Improving reef health not only provides a more diverse ecosystem, these healthier reefs have the potential to positively impact the local economy in several ways. As corals regain their role in an ecosystem that has been hampered by invasive algae and other stressors, they become a prime destination of Hawaii’s tourist industry as well as a renewed source of juvenile fish, growing the availability and diversity of species for both subsistence and sport fishing. Healthy reefs also help buffer O’ahu’s fragile beaches from erosion and inundation during storms and from rising sea levels.

Finally, participation in SURF’s “Citizen Science” has provided teachers and students with meaningful, first hand experiences engaging in place-based science, thus enabling them to understand that they do have the ability to make a difference for the future of O’ahu Hawai’i and globally. Participation in NOAA’s Climate Stewards project has been a very successful program that shows that even a small project, like the project at Hale Kula Elementary has the potential not only to change the teachers and the students directly involved, but countless others beyond the walls of their classroom.



Figure 6. Hale Kula Elementary teachers release sea urchins into the ocean.

Table 1. Next Generation Science Standards Performance Expectations Addressed by Project

Performance Expectations

- K-ESS3-3.** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
- K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive.
- 3-LS4-4.** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
- 5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

Resources

The Time We Became Citizen Scientists: vimeo.com/65187852

How Tiny Sea Urchins Are Saving Kāneʻohe Bay: fisheries.noaa.gov/feature-story/how-tiny-sea-urchins-are-saving-kaneohe-bay

Sea Urchins Help Combat Invasive Algae on Corals: oceanservice.noaa.gov/news/mar17/sea-urchins-hawaii.html

Sea Urchin Hatchery: dlnr.hawaii.gov/ais/invasivealgae/urchn-hatchery/

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