The renovation of the MSB aquarium for the display of captive bred fish

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Abstract: Exposure to the natural environment, which aquariums mimic, has shown to enhance awareness of conservation. Captive bred fish and coral are more sustainable than those collected from the wild. The aquarium in the marine science building of the University of Hawaiʻi at Hilo will display Hawaiian captive bred fish and coral because the current inhabitants are from the ocean. The aquarium was refurbished to better home the future inhabitants. A refugium was added for algae to grow and absorb excess nitrates from biowaste. Calcium and alkalinity level monitoring provided information for supplements to be added to correct levels to the proper concentration. The T5 light bulbs were replaced to supply an adequate spectrum of light to grow corals. Volunteers were recruited to gain experience and help maintain the aquarium. The aquarium currently has several species of algae, cucumbers, brittle stars, and hermit crabs in its refugium. The new lights and correction in water quality has led to the growth of corals that have resided in the aquarium. Next year aquacultured fish and corals will be available to introduce into the aquarium.

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INTRODUCTION

People have a greater awareness of conservation when they visit zoos and aquariums (Wagoner and Jensen 2010). Seven million people throughout the world visit aquariums (Guesset & Dick 2011) which represent the natural saltwater environment. Additionally, when people own a home aquarium, they not only care for the animals but also the environment from which they come from (Kosaki 2017). Although the aquarium trade in Hawaiʻi is sustainable, there are still unethical methods used in aquarium collecting elsewhere.

Approximately ninety percent of the animals that enter the aquarium trade are caught from the ocean. About 150 of species of stony coral, hundreds of invertebrates not including coral, and 1,472 reef fish species are targeted for the aquarium trade (Rhyne et al. 2012). Only about 2% of saltwater fish and 1% of corals are captive bred. (Wabnitz et al. 2003) However, that number is growing.

The purchase of captive bred fish is important because it reduces the number of wild caught fish. Aquaculture can help bring back wild populations by fulfilling the demand for ornamental fish (Tlusty 2002). Captive bred fish live longer, are healthier, and are more likely to accept commercial foods instead of live foods. The aquacultured fish are more accustomed to tank life (Stayman 1999) and do not exhibit nervous behaviors, such as pacing, constant hiding, or refusal to eat, when introduced to a tank. Additionally, captive bred fish are often sent directly from the aquaculture facility to their new tank or the local fish store. In contrast, after wild fish are captured, they are brought to a holding facility, sent to a wholesaler, and then received by the local fish store for sale to the new owner. This greatly increases their chance of picking up disease in confined areas at each new location. Aquaculture facilities located near international airports can help decrease transit time, cost of production, and mortality (Tlusty 2002). When fish are collected from the wild, aquaculturists make efforts to work with collectors to insure they arrive in great condition with no mortality (Macmillan 2000) unlike, most marine ornamentals that are sent to wholesalers. Moreover, captive bred fish in general are more sustainable. Instead of the fish making flights every day from exotic locations like Indonesia, the Philippines, and Papua New Guinea, the aquaculture facility may be located within the country the fish is being exported to. According to Coral Magazine, there are currently 94 species of marine fish that are captive bred, 236 species have not been captive bred, and 18 new captive bred species were added to the list this year. Additionally, Coral Magazine also shows that only 27 captive bred species are commonly available (Sweet 2016); this leaves sixty-seven other species that have already been successfully bred to supply to aquarists.

The display of captive bred fish and coral has many purposes such as showing how aquariums can be sustainable and the importance of purchasing captive bred animals over ones from the ocean. The display also shows the products and innovation of aquaculture facilities within Hawaiʻi such as the Oceanic Institute, Pacific Aquaculture Coastal Resources Center, and Pacific Planktonics. Students may also volunteer to help maintain the aquarium which may be a starting point for those interested in working at an aquaculture facility or at a public aquarium. Moreover, students who do not have a car or the means to fly to other islands to visit aquaculture facilities, may see the result of new captive breeding efforts. Additionally, the ability to purchase wild caught fish in Hawaiʻi is becoming more difficult. According to *Maui Now*, an online newspaper, on September 6, 2017 the Hawaiʻi's Supreme Court stopped the Department of Land and Natural Resources from issuing new collection permits pending further review. In the future, captive bred fish may be the only way to attain Hawaiian marine ornamentals.

Pacific Aquaculture and Coastal Resources Center (PACRC) is a UH Hilo facility that focuses on sustainable resources management and conservation through the use of aquaculture. PACRC is focused on breeding three popular Hawaiian reef fish, *Cirrihilabrus jordani* (flame wrasse), *Centropyge potteri* (Potter's angel), and *Pseudanthias hawaiiensis* (long fin anthias). The Potter's angel is occasionally seen at recreational SCUBA diving depths; however, the flame wrasse and long fin anthias are not. These fish may be the first to be introduced into the aquarium; therefore, giving students the opportunity to see deep-water fish.

Most students, especially ones without a vehicle, do not snorkel or dive in the ocean five days a week; however, students are at school those days. Students who enter the Marine Science Building (MSB) can observe the aquarium's inhabitants. We can watch them grow, feed, and interact with one another. Many aspects of ecology may be studied by watching the interactions of the organisms and their environment inside the aquarium.

The aquarium is located at the University of Hawaiʻi in the Marine Science building. The main display (Figure 1) is 300 gallons and contains one *Dascyllus albisella* and several *Chrysiptera parasema*. The aquarium also contains several Diogenidae, Holothuria, and Gastropods.

The MSB aquarium (Figure 1) was renovated in order to make it suitable to display captive bred fish and coral primarily provided by Pacific Aquaculture Resource Center. The components include a refugium, new light fixture, and new light bulbs. The alkalinity and calcium are maintained to stabilize the water quality.

Fig. 1. The aquarium is located in the Marine Science building.

The 55 gallon refugium tank (figure 2) was previously converted by a MOP student to a Jaubert Plenum filter, a layer of sand held up by screen attached to eggcrate. The display tank drains water into filter socks and then it is pumped into the refugium. The refugium drains into a second sump that houses a skimmer. Finally, the second sump drains into the primary sump to be pumped back into the display.

Fig. 2. Above is the tank which contains the refugium.

METHODS

Creating a Refugium

A refugium was created in the 40-gallon aquarium. An Aquasun LED high output light was added to the tank. Then, macroalgae was added to help absorb excess nutrients within the system. The algae grow without pressures from herbivores and creates a refuge for cryptic invertebrates. Extra rocks from the main display were moved to the refugium to create surfaces for the algae to grow on and to create more open space in the display. A clean-up crew consisting of hermit crabs, sea cucumbers, brittle stars, and snails were also added to the aquarium.

Replacing Light Bulbs

The original light fixture was changed to an ATI T5 fixture. The light fixture that is currently on the aquarium had its T5 bulbs replaced, slowly overtime. Eight bulbs were replaced with ATI bulbs. The colors consisted of 4 coral plus, 2 aquablue special, and 2 blue plus. This spectrum discourages the growth of nuisance algae and cyanobacteria, but also improves the coloration of the corals.

Dosing

The aquarium's alkalinity and calcium levels are now maintained by testing and dosing. The alkalinity and calcium are tested three times per week with Salifert test kits. Seachem reef calcium and buffer are poured into the aquarium after the water quality has been tested. The buffer is made by adding equal parts of baking soda and washing soda to reverse osmosis de-ionized water. The volume that is dosed depends on the results of the water quality tests.

Removing Scratches

The scratches were to be removed from the viewing panels by buffing the acrylic with the Lifeguard scratch removal kit. By gradually moving from coarse to very fine grit, the panels become more transparent. The large *Diadema paucispinum* was rehomed to prevent any new scratches.

RESULTS

After completing these objectives, the MSB aquarium now has a refugium, a new light fixture, and new lights. The refugium has several species of unknown algae as well as the genera *Gracilaria* and *Halimeda.* The algae have attached to the rocks and have begun to spread throughout the refugium. The algae that were placed into the refugium have now been overgrown by unknown algae that began to grow in the refugium.

Replacing the light bulbs in the T5 fixture has allowed the corals to grow faster and intensify their colors. The *Porites* has changed colors from brown to light tan and the blue *Fungia* has become more vibrant. The *Porites* has expanded its edges and has started to grow upwards into columns. The change in light bulbs combined with the refugium and removal of the nuisance algae, has disable the cyanobacteria from growing in the display aquarium.

The calcium and alkalinity were slowly brought to appropriate levels once the water quality was tested. The calcium promotes the growth of coral, *Halimeda*, and coralline crustose algae. The alkalinity maintains a high stable pH that is required for the health of the fish and coral.

The acrylic panels were not buffed. The scratch removal kit did not have a grit coarse enough to remove the deep scratches caused by the urchin. Because the *Diadema paucispinum* was removed, any new scratches formed would be due to human error.

DISCUSSION

The Marine Science Building aquarium currently has the equipment needed to grow corals and maintain fish. The light fixture that was originally on the tank was falling apart and was deemed to be a fire hazard. Therefore, a new light fixture of better quality was purchased. In the future, a larger light will be needed for the light to cover the entire tank. The Aquasun light fixture on the refugium tank was not purchased with the intent of growing algae. If the light were changed to a warmer spectrum instead of the cool blue spectrum, the algae would probably grow better and one type would not be taking over the entire refugium. The corals are growing faster with the new light but the algae surrounding them is preventing them from growing at their maximum capacity.

The addition of higher quality and larger wavemakers would disallow the algae to attach to substrate. Additionally, corals equally rely on light and heavy water flow; so, the addition of more wavemakers would also directly benefit the corals. Although the refugium is growing algae, the algae have not diminished in the display tank.

The water quality has provided a stable environment for the corals to grow in. The calcium has always maintained high levels; however, buffer needs to be added to maintain the alkalinity. The original buffer, Kent Marine Pro Buffer, was used very quickly; so, a less expensive alternative homemade buffer was used instead.

Volunteers were recruited and trained which was not originally intended. Now, other volunteers will be maintaining the tank. The volunteers are responsible for feeding the fish, using the magnet to clean the acrylic panels, cleaning the skimmer, swapping the filter socks, and topping off the tank with freshwater. The volunteers have been helpful in keeping the aquarium stable.

The transformation was successful, and it is ready to home captive bred corals and fish. I would like to add aquacultured corals of the genera *Leptoseris, Psammacora, Tubastrea, Pavona, Montipora,* and *Pocillopora. Chaetodon tinkerii* and *Acanthurus achilles* will be added to the aquarium once PACRC completes their life cycle.

In the future, I will continue to maintain the tank and add equipment to the system. Written guidelines will be provided for the future volunteers and I will help guide them through troubleshooting problems with the aquarium. Other equipment may include an automatic top off system, a Granular Ferric Oxide (GFO) reactor, additional wavemakers, and larger lights. The automatic top off system provides stable salinity. Instead of adding five gallons of freshwater twice a week, the aquarium would constantly receive drips of freshwater as the water evaporates from the tank. Ultimately, this would aid to the health and growth of the corals. The GFO reactor removes phosphates from the system with iron. The removal of nutrients would starve the existing algae in the aquarium and prevent it from re-growing. Overall, the aquarium has impacted many students directly and indirectly. There is more work to be done but the aquarium has improved vastly compared to before the project was started.

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