NOAA Coral Reef Conservation Program

**Project Final Report**

A. Award Number: NA11NOS4820006

B. Amount of Award: $64,208 (Federal), $30,0000 (Non-Federal Match)

C. Recipient: PCSU

D. Award Title: **Development of a biocontrol option for alien algae control**

E. Award Period: October 1, 2011 to September 30, 2012

F. Period Covered by this Report: April 01, 2012 to September 30, 2012

G. Summary of Progress and Expenditures to Date: *When describing the progress of projects, please evaluate projects against the scope of work described in the final application submitted to NOAA CRCP*

**3. Projects**:

* **Project Title**: Invasive Algae Control through Native Grazer Replenishment
* **Project Status** (please x): No activities to date \_\_\_\_ Planning \_\_\_\_

In progress Completed \_X\_\_\_

* **Summary of Project Accomplishments:**

Urchin Hatchery:

**April:** Spawns were conducted on April 2nd. Four larval rearing tanks were stocked. Three tanks were stocked at an approximate density of 5 larvae per milliliter; one tank was stocked at an approximate density of 2.5 larvae per milliliter. All tanks were treated similarly. One of the three higher density tanks crashed on day 16. The exact cause of the demise is unknown. However, the animals were exhibiting multiple types of deformity and pink coloration in the gut prior to the population crash. This has been observed on previous runs with similar results.

Group ‘A’ was divided into two populations on day 24. The rationale was that the population was still quite high (>400,000 larvae) for this time in the lifecycle and tank space was available. It is believed that if larvae are given more room they will be healthier, develop faster, and have a higher rate of survival. These groups were moved into settlement on Day 25. The two populations were at approximately 160,000 and 126,000 exhibiting >50% competency. Group ‘B’ was moved into settlement on Day 23. The population was approximately 120,000 with > 33% competent.

A total of 5,644 urchins were transplanted from the hatchery to Kaneohe Bay for outplanting during April.

**May:** Spawns were conducted on May 7th. Four larval rearing tanks were stocked. The cohorts were designated as groups E, F, G & H. Samples from Group “F” were preserved daily for future histology work with the State Animal Industries vet lab. Photographs of the same cohort were taken daily. The hatchery staff and the state vet lab are collaborating on a histological atlas of larval *T. gratilla*.

The effect of photoperiod on overall larval health was addressed. It had been posited that larval urchins might benefit from 24 light as a method of keeping phytoplankton both photosynthesizing and in suspension, thus making food both more available and more nutritious. Since September of 2011 the larval room has operated with 24 hour light. During the May 7th larval run, lights were left on 24 hours per day, but one tank, Group “H”, was shaded approximately 14 hours per 24 hour cycle. There was no significant difference in overall health of these larvae during this trial. It was decided to shut off lights at the end of the day, to save electricity. Midge flies and other nocturnal insects had been attracted by the light. Incidence of pest insects has diminished greatly as well.

A total of 6,604 urchins were transplanted from the hatchery to Kaneohe Bay for outplanting during May.

**June:** A spawn was conducted on June 18th. Four larval rearing tanks were stocked. A single urchin was used as the female gamete donor for three of the four cohorts. Multiple females were used in the fourth group. There larvae in the groups with single female parent stock seem to be more consistent, but more trials need to be performed to verify.

A total of 2700 urchins were transplanted from the hatchery to Kaneohe Bay for outplanting during June.

**July:** A spawn was performed on July 23rd. This spawn resulted in very low numbers of larvae. While the population density is low, the larvae appear healthy. It was decided to consolidate the run into one tank and perform another spawn to restock on August 6th. All cohort groups from the June 18th spawn were moved to settlement on July 12th. All groups achieved competency for metamorphosis by day 24. Competency refers to the time that the free swimming urchin larvae are ready or “competent” to go through metamorphosis, settle down, and begin their lives on the bottom as sea urchins. A single larva is considered competent when one or more well-developed tube feet are present and internal structures (the “rudiment”) have developed sufficiently to indicate larval maturity. Hatchery metrics dictate that a minimum of 30% of larvae be competent before larvae are transferred to settlement tanks. 50% is considered very good, anything above 60% is excellent. In the case of the June 18th spawn, the groups attained competency rates of 50%, 64%, 72% and 82%. Animals were moved into nine FUNSY units (floating urchin nursery system tanks) and one 30 foot long tank. Post-settlement assessments were performed on August 2nd. There appears to be a loose correlation between competency rates and post-larval populations. Groups with higher rates of competency appear to have higher post-settlement survival. Overall settlement is excellent in all groups.

A total of 5300 urchins were transplanted from the hatchery to Kaneohe Bay for outplanting during July.

**Aug/Sept:** A spawn was conducted on August 6th to compensate for a poor fertilization event from the July 23rd spawn, and a follow up spawn was completed on September 10th.  Between the July, 23 and the August, 6 spawns, 284,000 competent larvae were moved into settlement tanks.  Resident adult urchins have been placed in settlement tanks (outside of FUNSYS) prior to settlement to act as grazers and for the possible settling cues they may provide.

Harvesting habits have changed in the last several months in response to several good settling events.  Urchins have been moved out of the FUNSYS and into barrels more quickly to prevent overcrowding and to keep urchins in a cleaner environment. Preparation for expansion of the microalgae room during the winter months has also begun.

A total of 6,450 urchins were transplanted from the hatchery to Kaneohe Bay for outplanting during August/September.

Phytoplankton Production:

A new *Chaetoceros muelleri* culture was acquired from Oceanic Institute in March. This is a Hawaii strain isolated by CCMP in Maine. The new cultures are working well but contain ciliates. Isolation and dilution techniques are being used to eliminate the contaminants.

The standard feeding regime in the hatchery is 75% *Rhodomonas sp*., 24% *Chaetoceros muelleri* by cell count. Culturing a single specie or strain of phytoplankton would streamline production and reduce labor. One of the four larval tanks was fed a diet of 100% Rhodomonas. While the treated animals made it through the larval cycle to settlement, their numbers were comparatively reduced and they seemed less healthy than the other three groups. This trial has been performed in previous runs, usually resulting in complete mortality prior to settlement. Further investigation and discussion with staff will determine the fate of future dietary trials.

Macroalgae Production:

All five 4-ton “H” series tanks in the greenhouse were refitted to accommodate macroalgae production. A starter culture of *Halymenia formosa*, a red sea lettuce, was acquired and put into production in one of the newly refitted “H” tanks. Consumption of all macroalgae continues to outstrip production. Present combined macroalgae production is about 24 Kg per week.

Coral Reef Strategy:

The goal of this project is to continue to research and improve methods to raise native sea urchins to be used as a bio-control tool in the fight against alien invasive algae. Data collected through this project will help DAR managers in their goal of reef restoration to conserve healthy coral that is threatened by alien invasive algae throughout the State. The reduction of invasive algae will open more space for new coral recruits, native algae, and a more suitable habitat for reef fish species.

* **Obstacles or Delays***:*

Lack of manpower to move urchins as quickly as they should be continues to be an issue. New trials using a very dilute concentration of KCl are being tested in attempt to make the urchins release themselves from the sides of their tanks and allow for easier and faster harvesting.  There was no mortality associated with this experiment, and it seems to work as intended, so this may be a new technique to use in the future.

In addition, determining urchin mortality in the field has been difficult due to their small size at the time of outplanting. They are very cryptic and can easily hide in small holes, so conducting thorough counts is a challenge. In addition, the patch reefs where urchins are transplanted are very large and it is not feasible to conduct an urchin count of the entire reef. Partnering with The Nature Conservancy, we have tested a variety of survey methods to better understand detectability and actual urchin density. Data is being analyzed to determine efficacy.

* **Status of Special Award Condition** (if applicable): N/A

Progress Report Prepared by: Jonathan Blodgett, AIS Program Leader

Signature of Point of Contact: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Table of sampling efforts for coral reef monitoring activities:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Site Name | Site Location (lat/long) | | Sampling Dates | | |
| Year 1 | Year 2 | Year 3 |
|  |  |  |
| Reef 16 | 21.45469564 | -15780378303 | 02/12 |  |  |
|  |  |  | 06/12 |  |  |
|  |  |  | 09/12 |  |  |
| Reef 26 | 21.46589706 | -157.81894740 | 11/11 |  |  |
|  |  |  | 02/12 |  |  |
|  |  |  | 05/12 |  |  |
|  |  |  | 08/12 |  |  |
| Reef 27 | 21.46717241 | -157.82198344 | 01/12 |  |  |
|  |  |  | 05/12 |  |  |
|  |  |  | 08/12 |  |  |
| Reef 28 | 21.46854699 | -157.81998821 | 12/11 |  |  |
|  |  |  | 04/12 |  |  |
|  |  |  | 06/12 |  |  |
|  |  |  | 09/12 |  |  |
| Reef 29 | 21.47000487 | -157.82053784 | 04/12 |  |  |
|  |  |  | 07/12 |  |  |
|  |  |  | 10/12 |  |  |
|  |  |  |  |  |  |