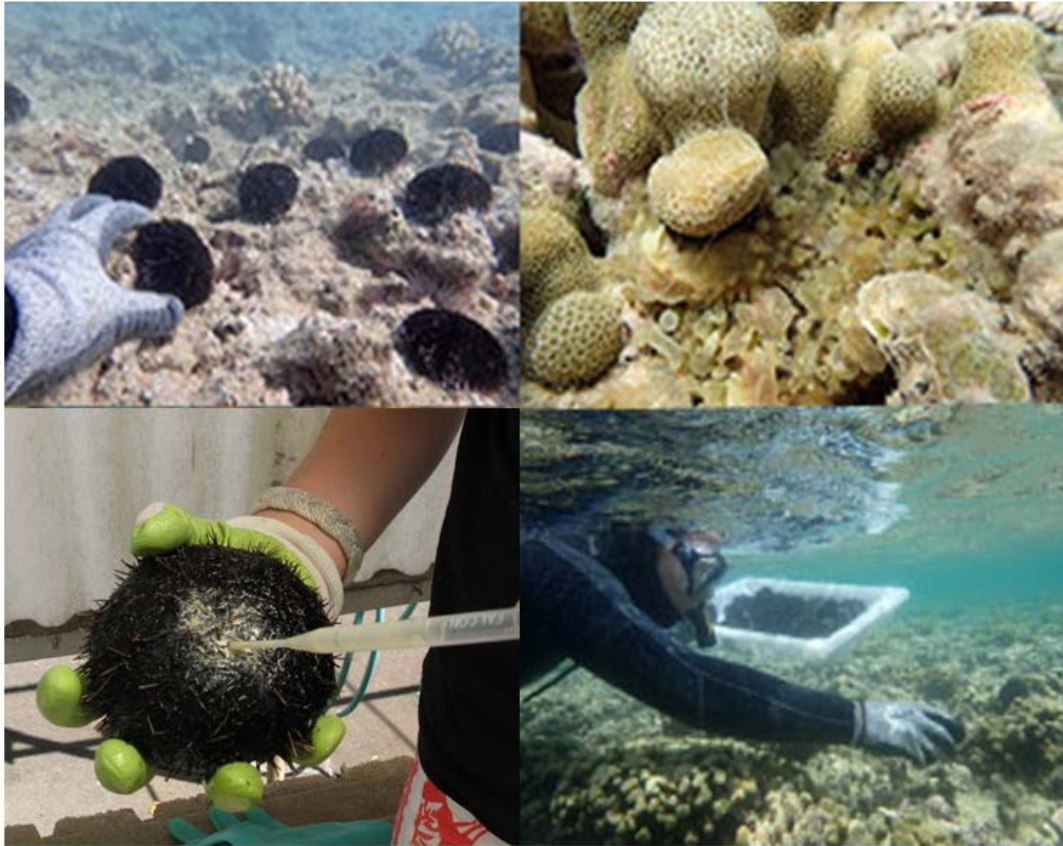


Cape Flattery Settlement Restoration Project: Restoring Reefs in Kāneʻohe Bay



PROGRESS REPORT

Division of Aquatic Resources
Aquatic Invasive Species Team

June-December 2016

TABLE OF CONTENTS

MANAGEMENT PLAN ACTIONS IMPLEMENTED.....	3
Table 1: Work plan progress for June - December 2016.....	4
Figure 1: Invasive algae control progress on priority reefs in Kāneʻohe Bay.....	5
Table 2: Reef characteristics and progress on priority reefs in Kāneʻohe Bay.....	6
URCHIN HATCHERY.....	7
Table 3: DAR Urchin Hatchery monitoring metrics for June-December 2016.....	7
URCHIN OUTPLANTING.....	8
Table 4: Urchin transplants for June- December 2016.....	9
Figure 2: Number of urchins outplanted to priority reefs by month.....	10
OTHER PROGRESS.....	10

RESTORATION PLAN ACTIONS IMPLEMENTED

During the period from June-December 2016, work has focused on the deployment of collector urchins (*Tripneustes gratilla*) as biocontrol to reefs in Kāneʻohe Bay affected by four species of invasive algae: *Eucheuma denticulatum*, *Kappaphycus alvarezii*, *Gracillaria salicornia*, and *Acanthophora spicifera* (hereafter referred to as invasive algae). In the previous reporting period, Marker 12 was identified as the priority restoration site; therefore, management activities were focused on this reef for much of the current period. Once all targets had been met on Marker 12, work continued on the previously identified patch reefs.

Significant progress on the work plan has been made during this reporting period. Most notably, production of urchins in the hatchery and outplanting by the field team has increased dramatically. This led to target numbers of urchins being deployed on Marker 12 ahead of our predicted schedule. Once the main goal of stocking Marker 12 was reached, outplanting efforts expanded to other priority reefs. Reefs 44, 43, and 40 were fully stocked, and over half of the target number of urchins were released on Reef 41. In total, 80,368 urchins were deployed on priority reefs during this period, exceeding the original target total of 71,036 for all priority reefs. Two full-time staff- a Monitoring Coordinator and a Technician- were hired for the project, leading to increased productivity; however, the Technician left the project in November 2016, and that position is currently in the process of being filled. Table 1 shows the project progress to date, and planned timeframes for future activities. Figure 1 shows the location and progress of priority reefs.

Table 2: Work plan progress for June - December 2016

Action	Who is responsible	Timeframe	Progress	Accomplishments	Notes
Conduct baseline monitoring surveys.	Monitoring Coordinator, Project Technicians	March – May 2016	Complete	2016 SNAP patch reef assessment completed 4/2016; Marker 12 assessment completed 5/2016	
Prioritize reef restoration efforts	DAR Aquatic Biologist, Trustees	March 2016, November 2016	Complete	Prioritization complete	Marker 12 is priority restoration site, patch reefs are prioritized from North to South
Outplant native sea urchins to restoration area.	Project Technicians, DAR Urchin Hatchery	April 2016 - end of project	In progress	Since the last reporting period, 80,368 urchins have been released on priority reefs	Target reached for Marker 12 & R44 in November 2016; R43, R40 reached in December 2016
Bi-annual reporting to the Cape Flattery trustee council.	Monitoring Coordinator, DAR Aquatic Biologist	May 2016, December 2016	In progress	Second progress report submitted to trustee council December 2016	
Follow-up monitoring of coral and algae conducted annually.	Monitoring Coordinator, Project Technicians	March – April 2017	Upcoming		
Maintenance of outplanted urchins	Monitoring Coordinator, Project Technicians	April 2017- end of project	Upcoming		
Identification of and continuation on future priority reefs	DAR Aquatic Biologist, Trustees	January 2017- end of project	Upcoming		



Figure 1: Invasive algae control progress on priority reefs in Kaneohe Bay.

Reef priority for patch reefs following the completion of work on Marker 12 was determined by the proximity of each reef to the Northern end of the bay. Currently, *Eucheuma/Kappaphycus* occur primarily in Kaneohe Bay, so Northern reefs were given a higher priority in an effort to contain invasive algae and prevent their spread out of the bay. This prioritization strategy was determined in conjunction

with project partners at The Nature Conservancy and the Trustees in November 2016. Table 2 indicates the priority order and progress up until December 2016.

Table 3: Reef characteristics and progress on priority reefs in Kāneʻohe Bay.

		2016 SNAP Survey					
Priority	Reef	Reef Area (m ²)	Area of Coral (m ²)	Area of <i>Eucheuma/Kappaphycus</i> (m ²)	Area of <i>Gracillaria/Acanthophora</i> (m ²)	Target number of urchins needed (2 urchins/m ² of algae)	Number of urchins needed to reach target (as of Dec. 2016)
1	Marker 12	275,764	149,101	2,684	17,538	40,444* (*Increased to 60,000)	0
2	44	50,115	46,039	1,257	33	2,580	0
3	43	24,833	24,727	1,229	0	2,458	0
4	41	25,893	24,752	5,877	173	12,100	3,200
5	40	4,645	4,618	784	0	1,568	0
6	38	9,707	8,646	692	7	1,398	1,398
7	31	22,233	21,686	182	0	364	364
8	30	21,528	20,386	422	0	844	844
9	28	16,541	14,530	425	1,942	4,734	4,734
10	24	12,155	10,780	21	0	42	42
11	20	3,316	3,284	1	0	2	2
Control	15	8,570	8,458	1,753	0	N/A	N/A
Control	9	32,404	27,162	290	0	N/A	N/A
Control	23	5,017	4,996	208	0	N/A	N/A
TOTALS		517,738	369,165	15,825	19,693	91,036	10,584

In October 2016, the initial urchin treatment goal of 40,444 urchins on Marker 12 was reached. However, it was determined that the initial estimate of urchins needed to treat Marker 12 should be increased by approximately 50% to 60,000 urchins (3 urchins/m²), in order to ensure that all known patches of *Eucheuma/Kappaphycus* were fully treated. This elevated goal was reached on November 9, 2016. The number of urchins needed to treat the remaining priority reefs is unchanged from the previous reporting period.

URCHIN HATCHERY

In order to rear *T. gratilla* in the hatchery, wild broodstock urchins are needed to collect gametes. During the period from June- December 2016, Flattery staff assisted with five urchin spawning events in order to help increase urchin broodstock in the hatchery, resulting in 208 wild urchins being spawned. For each spawning event, staff collect adult urchins from the wild and transport them to the hatchery at the Anuenue Fisheries Research Center. There, Flattery staff assist with spawning the urchins and collecting gametes so that the spawning event can be completed quickly and efficiently.

From June-December 2016, 22,931 liters of phytoplankton were produced to feed urchin larvae, and 855.97 kg of macroalgae were produced to feed juvenile urchins. In total, 17,033,000 larvae were produced and moved into tanks for the settlement and grow-out phases during this reporting period. Of those, 79,635 (0.47%) grew to transplantation size (~10mm) and were released onto priority reefs.

Table 3: DAR Urchin Hatchery monitoring metrics for June - December 2016

Date	Food production		Urchin production		
	Phytoplankton produced (l) (for urchin larvae)	Macroalgae produced (kg) (for urchin juveniles)	Broodstock urchins	Number of larvae moved into settlement/grow out phase (x1000)	Number of hatchery urchins outplanted
Jun 2016	3,704	120.05	30	6,406	5,500
Jul 2016	3,696	139.2	30	700	1,714
Aug 2016	80	122.18	0	0	1,270
Sept 2016	4,640	122.76	40	0	15,370
Oct 2016	3,408	104.28	77	2,967	21,386
Nov 2016	3,698	131.24	31	2,416	22,395
Dec 2016	3,705	116.26	0	4,544	12,000
Totals	22,931	855.97	208	17,033	79,635

URCHIN OUTPLANTING

Between June and December 2016, 80,368 urchins were released onto the following priority reefs: Marker 12, Reef 40, Reef 41, Reef 43, and Reef 44 (Table 4, Figure 2). In total, 60,202 urchins were deployed on Marker 12, meeting the increased target number of 60,000 urchins. 1,333 urchins were deployed on Reef 40, which when combined with the 697 urchins translocated there in April, totals 2,030 urchins, meeting the target goal of 1,568. Beginning in November, work began on the remaining priority reefs, with 7,433 urchins released on Reef 44, 2,500 urchins on Reef 43, and 8,900 released on Reef 41. Field teams applied a “spot treatment” method to the urchin deployments, in which urchins were only released in areas determined to have invasive algae by the baseline monitoring surveys (SNAP surveys). This was especially necessary on Marker 12, which covers a large area punctuated with small, isolated patches of invasive algae.

The following table (Table 4) shows specifics regarding each urchin release performed during this reporting period. The hours reported in this table are for urchin releases only; however, Flattery staff (Monitoring Coordinator and Technician) allocated the remaining portion of their work hours to monitoring, maintenance, analysis, and reporting on Flattery projects. In addition, hatchery staff worked full time on urchin production and hatchery maintenance to support the needs of Flattery projects.

Table 4: Urchin transplants for June-December 2016

Date	Urchin source	Reef Number	Number of Urchins Released	Area treated (m ²)	Work Hours	Flattery team members	DAR team members	Total Hours
6/27/16	Hatchery	Marker 12	5500	1833	4	0	3	12
7/13/16	Sand Island	Reef 40	733	367	5.5	1	4	27.5
7/14/16	Hatchery	Marker 12	1714	571	4	1	3	16
8/16/16	Hatchery	Marker 12	1270	423	5	2	5	35
9/7/16	Hatchery	Marker 12	2370	790	3.5	1	5	21
9/19/16	Hatchery	Marker 12	6000	2000	4	2	5	28
9/27/16	Hatchery	Marker 12	7000	2333	5	2	4	30
10/5/16	Hatchery	Marker 12	4000	1333	4	1	4 + 1 Kupu	24
10/6/16	Hatchery	Marker 12	2786	929	3.5	1	4	17.5
10/12/16	Hatchery	Marker 12	3000	1000	3.5	1	3	14
10/13/16	Hatchery	Marker 12	4400	1467	3.5	1	3	14
10/27/16	Hatchery	Marker 12	7200	2400	3.5	2	5	24.5
11/3/16	Hatchery	Marker 12	3415	1138	3.5	1	4	17.5
11/7/16	Hatchery	Marker 12	4377	1459	3.5	2	4 + 1 NOAA	24.5
11/9/16	Hatchery	Marker 12	7170	2390	4	2	4	24
11/29/16	Hatchery	Reef 44	7433	1290	4	1	4 + 1 Kupu	24
12/8/16	Hatchery	Reefs 43, 41, 40	7500	3750	4	1	5 + 1 Kupu	28
12/22/16	Hatchery	Reef 41	4500	2250	3.5	1	3	14
Totals			80,368	27,723	71.5			395.5

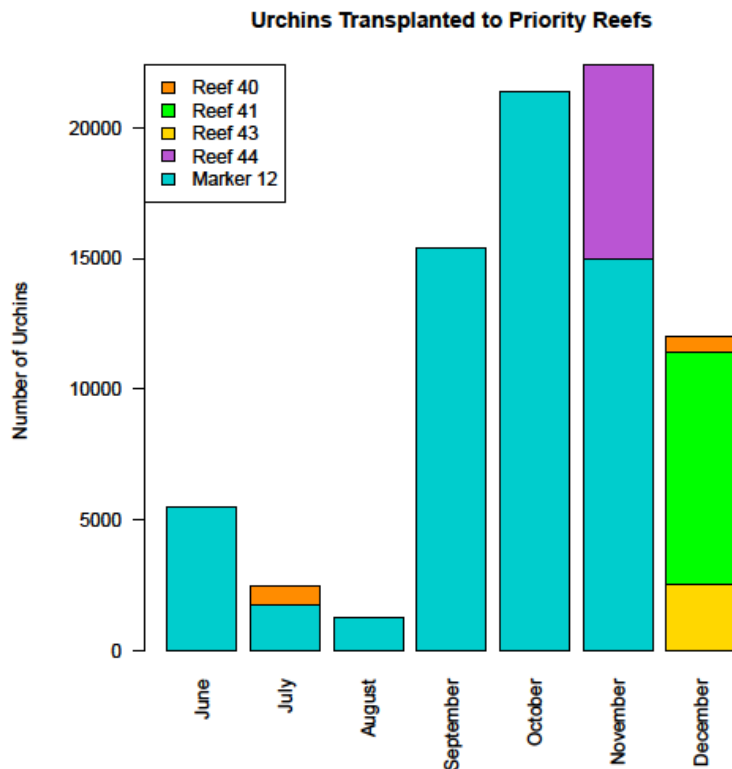


Figure 2: Number of urchins outplanted to priority reefs by month.

An increase in urchin production by the urchin hatchery led to a sharp increase in the frequency and size of urchin releases beginning in September 2016. This allowed for the initial treatment goal of 40,000 urchins on Marker 12 to be met in October 2016, and the elevated goal of 60,000 (an increase of 50%) to be met just weeks later on November 9, 2016. Given current urchin production predictions provided by the urchin hatchery, sufficient urchins to meet the current target goals on the remaining patch reefs will likely be produced before the annual monitoring survey begins in April.

OTHER PROGRESS

The project successfully hired a full-time Monitoring Coordinator and technician through the Hawai'i Coral Reef Initiative (HCRI) in July 2016. The technician left the project in November 2016; however, the position is in the process of being filled. To date, applications have been received and reviewed, interviews have been conducted, and an offer is currently in progress. Additional purchases include basic dive and field gear, materials and supplies.

Work has also begun on planning a small pilot coral reattachment project in order to opportunistically salvage at-risk corals and coral fragments that are observed during urchin outplanting efforts. Efforts are being made to determine how normal ongoing urchin outplanting efforts can assist with nascent coral nursery efforts within the Bay.