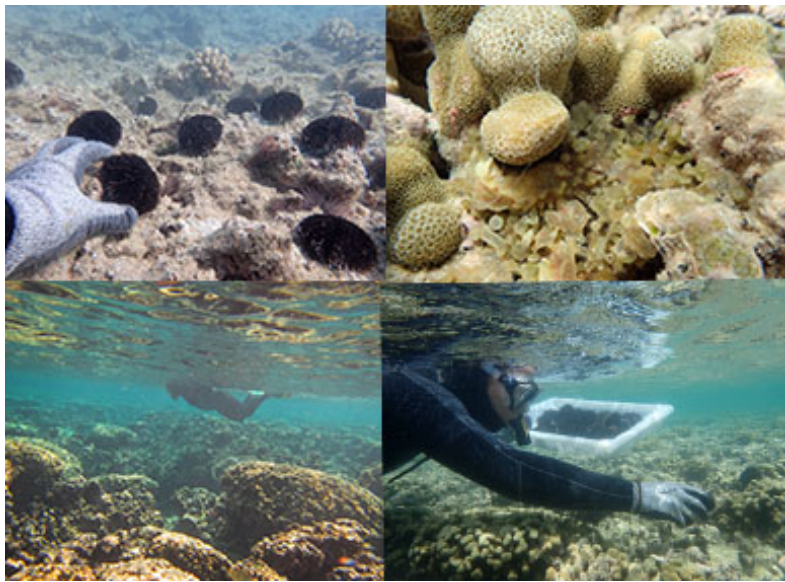


Cape Flattery Settlement Restoration Project: Restoring Reefs in Kāneʻohe Bay



PROGRESS REPORT

Division of Aquatic Resources
Alien Invasive Species Team

January - May 2016

Contents

MANAGEMENT PLAN ACTIONS IMPLEMENTED.....	3
Table 1 Work plan progress for January - May 2016.....	3
CORAL AND ALGAE PERCENT COVER	4
Table 2 Results of the SNAP Survey Baseline Assessment.....	4
Figure 1 Restoration reef areas ranked by coral cover (m ²)	5
Figure 2 Baseline coral coverage in the Kāneʻohe Bay restoration area	6
INVASIVE ALGAE.....	7
Figure 3 Restoration reef areas ranked by percent cover of <i>Eucheuma spp.</i> and <i>Kappaphycus spp.</i> ...	7
Figure 4 Restoration reef areas ranked by cover area of <i>Gracilaria</i> and <i>Acanthophora</i>	8
Figure 5 Baseline <i>Kappaphycus/Eucheuma</i> coverage in the Kāneʻohe Bay restoration area.....	9
Figure 6 Baseline <i>Gracilaria/Acanthophora</i> coverage in the Kāneʻohe Bay restoration area	10
URCHIN HATCHERY.....	11
Table 3 DAR Urchin Hatchery monitoring metrics for January - May 2016.....	11
Table 4 Urchin Transplants for January - May 2016	12
OTHER PROGRESS.....	12
Appendix I. Reef-specific coverage maps of coral, <i>Eucheuma/Kappaphycus</i> , and <i>Gracilaria/Acanthophora</i>	13

MANAGEMENT PLAN ACTIONS IMPLEMENTED

For the period of January – May 2016, the project has made significant progress on the work plan milestones outlined in the *Reef Restoration Work Plan for Kāneʻohe Bay, Oʻahu* (Table 1). All baseline monitoring surveys have been completed to map the initial percent cover of coral and algae throughout the restoration area. Multiple meetings resulted in a prioritization of the restoration patch reefs; Marker 12 remains the primary priority area. Priority of additional patch reefs was based on cover of coral and algae, size of reef, and location within Kāneʻohe Bay. A more detailed description of this process can be found in the monitoring plan. Urchin outplanting began on April 14, 2016 with the translocation of 697 wild collector sea urchins (*Tripneustes gratilla*) to Reef 40. More information on this update can be found in the Urchin Hatchery section of this report. The urchin rearing process has also begun in the DAR Urchin Hatchery for release into the restoration area. This report marks the first progress report submitted from the project; reports will be delivered bi-annually in December and May. The next progress report will be delivered in December 2016.

Table 1: Work plan progress for January - May 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 complete 4/2016; Marker 12 assessment completed 5/2016	
Prioritize reef restoration efforts	DAR Aquatic Biologist, Trustees	March 2016	Complete	Prioritization complete 4/2016	Marker 12 is priority restoration site, patch reefs are prioritized based on size, location, and coral and algae cover
Outplant native sea urchins to restoration area.	Project Technicians, DAR Urchin Hatchery	April 2016 - end of project	In progress	Urchin hatchery grow-out began 4/2016, first urchins transplanted to restoration area 4/14/2016	
Bi-annual reporting to the Cape Flattery trustee council.	Monitoring Coordinator, DAR Aquatic Biologist	May 2016, December 2016	In progress	First progress report submitted to trustee council May 2016	
Follow-up monitoring of coral and algae conducted annually.		March – April 2017	Not in progress		
Site maintenance of additional outplanting of urchins.			Not in progress		
Continuation of the project on priority reefs			Not in progress		

CORAL AND ALGAE PERCENT COVER

A baseline snapshot, or SNAP survey, was conducted on 14 reefs (12 restoration reefs and two control reefs) between March – May 2016 to determine initial levels of live coral and invasive algae (Table 2). Based on the area of algae, the team also determined the number of sea urchins needed to stock the target density two urchins per square meter of invasive algae cover (*Eucheuma/Kappaphycus* + *Gracilaria/Acanthophora* covered area). Details on the survey methodology are available in the monitoring plan.

Table 2: Results of the SNAP Survey Baseline Assessment

Reef Name	Reef Area (m ²)	2016 SNAP Survey			Number of urchins needed (2 urchins/m ² of algae)
		Area of Coral (m ²)	Area of <i>Eucheuma/Kappaphycus</i> (m ²)	Area of <i>Gracilaria/Acanthophora</i> (m ²)	
Marker 12	275,764	149,101	2,684	17,538	40,444
20	3,316	3,284	1	0	2
23	5,017	4,996	208	0	416
24	12,155	10,780	21	0	42
28	16,541	14,530	425	1,942	4,734
30	21,528	20,386	422	0	844
31	22,233	21,686	182	0	364
38	9,707	8,646	692	7	1,398
40	4,645	4,618	784	0	1,568
41	25,893	24,752	58,877	173	12,100
43	24,833	24,727	1,229	0	2,458
44	50,115	46,039	1,257	33	2,580
15 - control	8,570	8,458	1,753	0	3,506
9 - control	32,404	27,162	290	0	580
TOTALS/ AVERAGES	513,721	369,165	15,825	19,693	71,036

CORAL

Coral distributions were variable throughout the restoration area (Figure 2). Coral cover ranged from 3,284 m² to 149,000 m² with an average of 26,370 m² for the entire restoration area (Table 2). Marker 12 had the highest coral area of 149,000 m² at ranges of 1% to 100% (Figure 1). The total area of the restoration area covered by coral is estimated at 369,165 m². Additional reef-specific maps can be found in Appendix I.

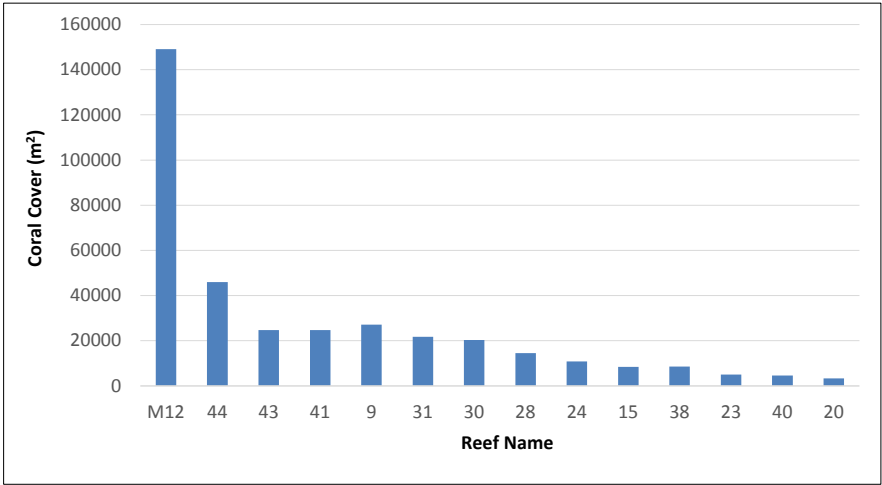


Figure 1: Restoration reef areas ranked by coral cover (m²)

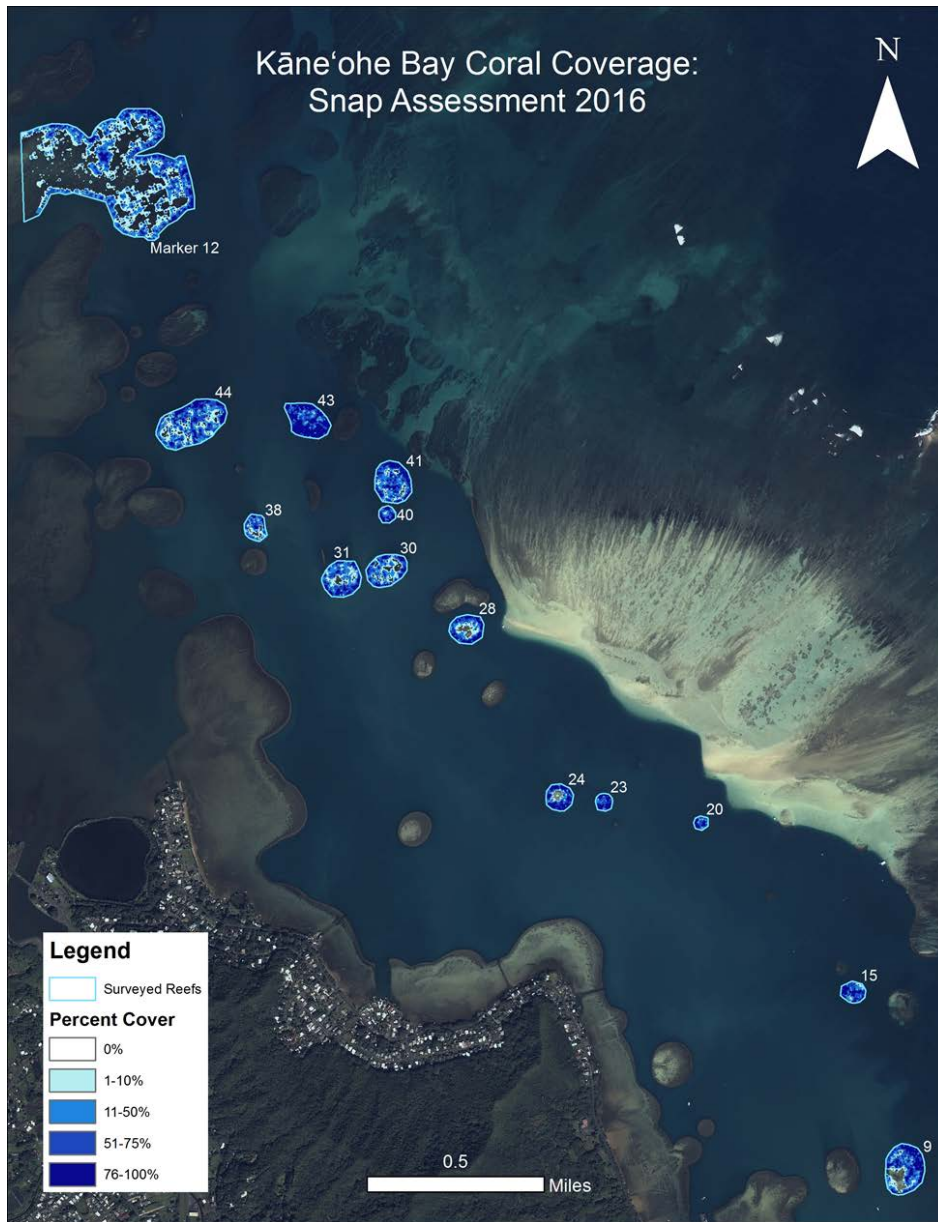


Figure 2: Baseline percent coral cover in the Kāneʻohe Bay restoration area

INVASIVE ALGAE

Invasive algae was found throughout the restoration area (Figures 5, 6). *Eucheuma/Kappaphycus* was distributed throughout the restoration area and cover per reef varies from 1 m² to 5,877 m² with an average of 1,130 m² (Table 2). The baseline assessment revealed that the highest area of invasive algae occurred on Reefs 41 (5,877 m²) and Marker 12 (2,684 m²) (Figure 3).

Gracilaria/Acanthophora was also distributed throughout portions of the restoration area. Algae cover varies from 0 to 17,538 m² (Table 2). The highest area covered with *Gracilaria/Acanthophora* was on Marker 12 (17,538 m²) and Reef 28 (1,942 m²) (Figure 4).

While these values appear low, it must be recognized that these numbers are interpolations across the whole patch reef area. High densities of algae cover can be found in smaller areas across individual patch reefs (see Figures 5 & 6, Appendix I).

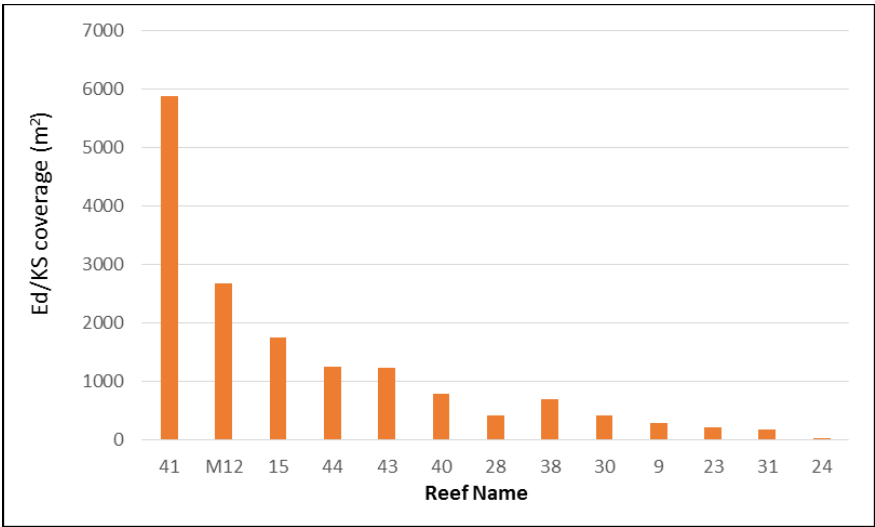


Figure 3: Restoration reef areas ranked by coverage (m²) of *Eucheuma* and *Kappaphycus*

Commented [a1]: Why is

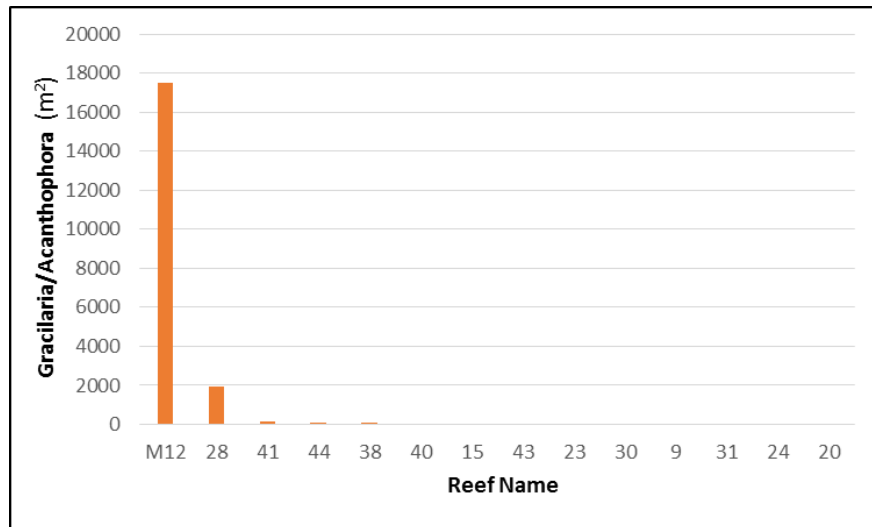


Figure 4: Restoration reef areas ranked by coverage (m²) of *Gracilaria* and *Acanthophora*

Commented [a2]: Y axes are not consistent between these two plots

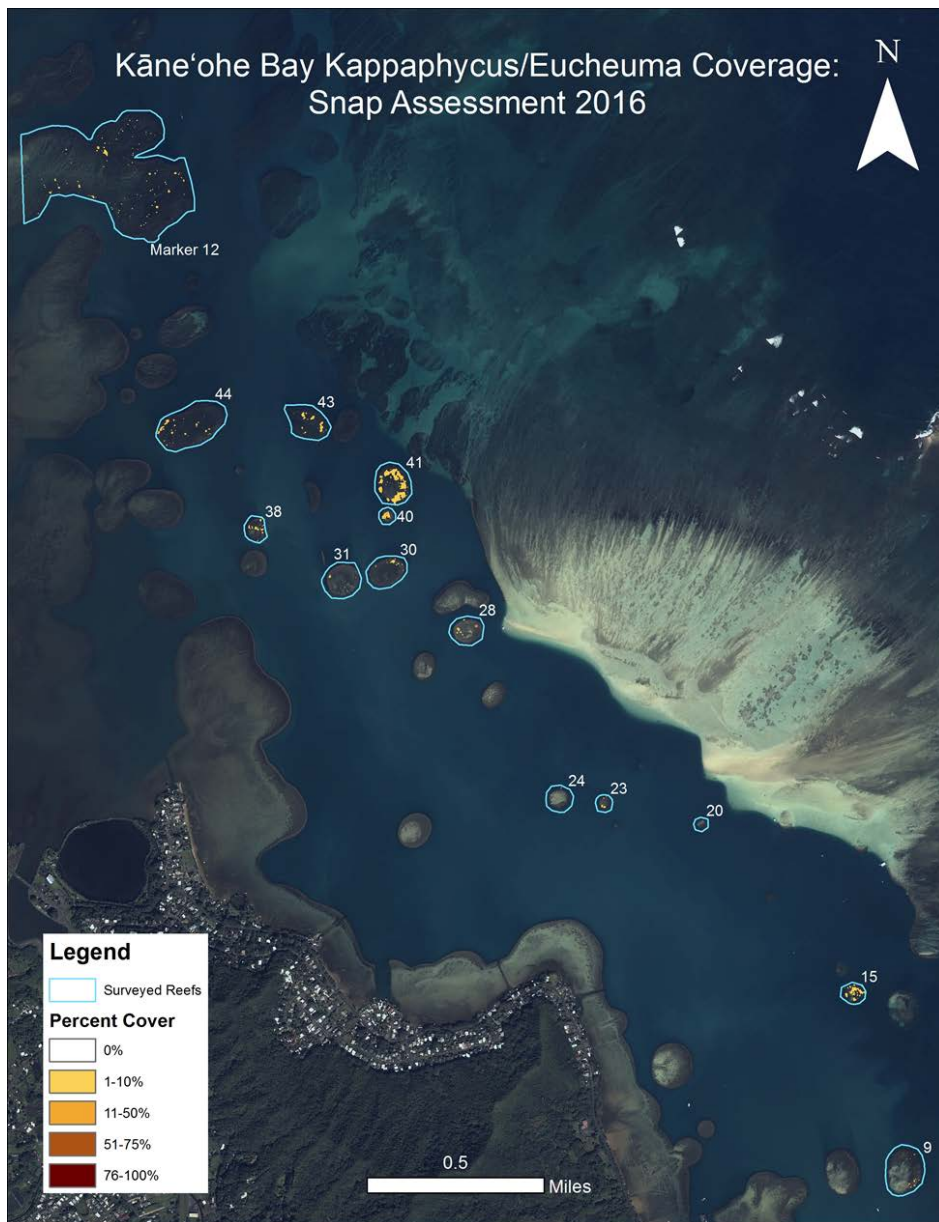


Figure 5: Baseline percent *Kappaphycus*/*Eucheuma* cover in the Kāneʻohe Bay restoration area

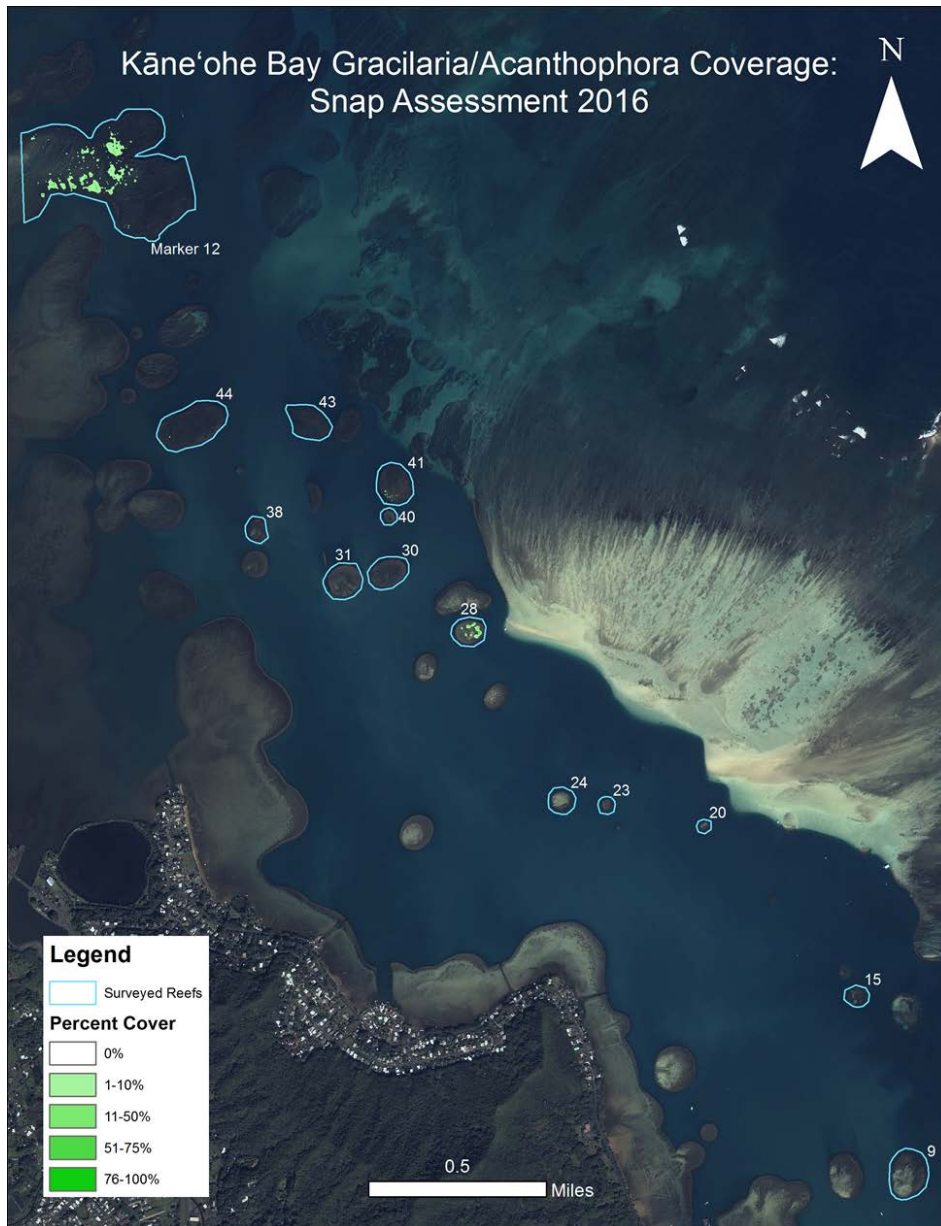


Figure 6: Baseline percent *Gracilaria/Acanthophora* cover in the Kāne'ohe Bay restoration area

URCHIN HATCHERY

Since the project initiation, the DAR Urchin Hatchery has begun operations to produce hatchery-raised collector sea urchins (*Tripneustes gratilla*) for the restoration area (Table 3). As of May 2016, 13,834 liters of phytoplankton have been produced to feed urchin larvae and 504 kg of macroalgae have been produced to feed juvenile urchins. A total of 198 wild, adult urchins have been spawned in the hatchery to collect gametes for cultured urchins destined for the restoration area. The number of urchin larvae moved into tanks for the settlement and grow-out phases for this reporting period was 5.66 million.

Typically, the hatchery expects approximately 2% survival of competent larvae to outplant based on historical results from 2012 – 2014. The hatchery-raised urchins are currently in the grow-out phase and will be moved to restoration reefs when they reach adequate transplantation size (~10mm). The urchins take approximately 5 months from spawning in the hatchery to outplanting on the reef. The hatchery anticipates to produce approximately 87,000 urchins by the next progress report in December for this restoration area.

Table 3: DAR Urchin Hatchery monitoring metrics for January - May 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	Number of hatchery urchins outplanted
Jan 2016	8	66	0	0	0
Feb 2016	2,593	99	41	0	0
Mar 2016	4,120	97	57	1,964,000	0
Apr 2016	3,909	92	60	770,000	0
May 2016	3,204	150	40	2,931,000	0
Totals	13,834	504	198	5,665,000	0

On April 14, 2016 the project team translocated 697 wild urchins from Sand Island, O‘ahu to Kāne‘ohe Bay, O‘ahu (Table 4). The urchins were brought to an area within Reef 40 that was determined to be covered in invasive algae in the baseline assessment.

Table 4: Urchin Transplants for January - May 2016

Date	Urchin source	Reef Number	Number of Urchins Released	Area treated (m ²)	Work Hours	Number of team members	Total Hours
4/14/2016	wild - sand island	40	697	1,183	4.3	5	4.3
Totals		40	697	1,183			4.3

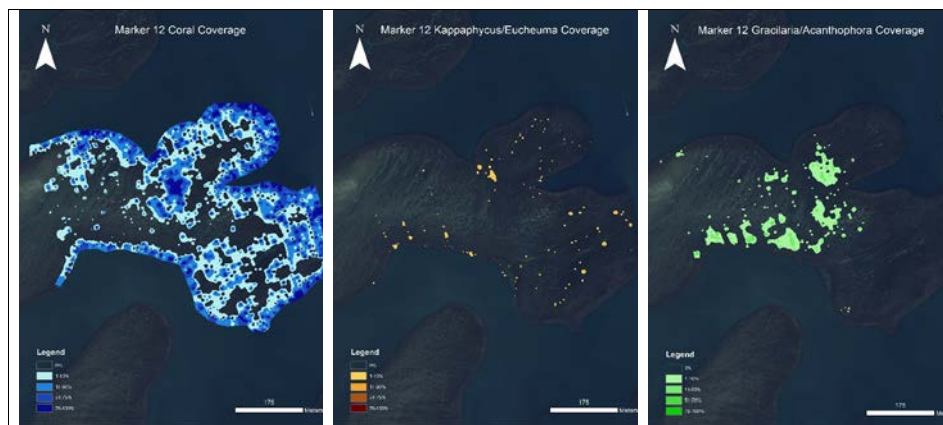
OTHER PROGRESS

The project successfully hired a Monitoring Coordinator and a temporary technician through the Hawai'i Coral Reef Initiative (HCRI) in January 2016. The hiring process for two additional technicians began in April 2016, and candidates are planned to start in July.

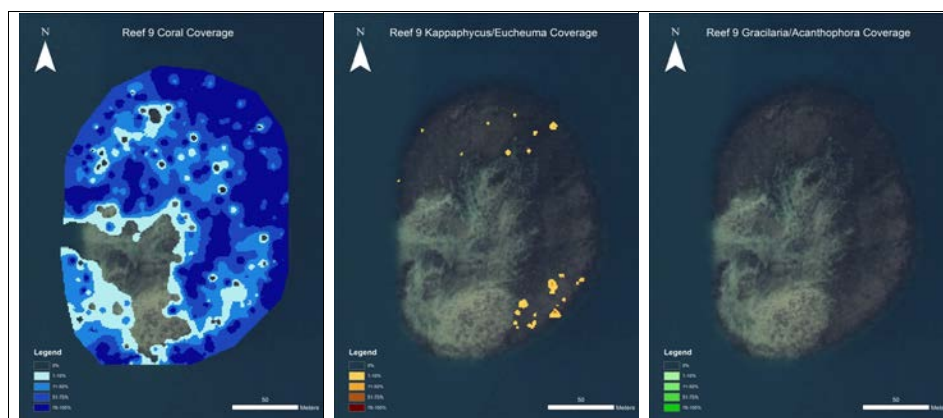
Two boat motors were purchased for the project's vessel, costing approximately \$30,000. Additional purchases include basic dive and field gear for project staff.

Appendix I: Reef-specific coverage maps of coral, Eucheuma/Kappaphycus, and *Gracilaria/Acanthophora*

Marker 12

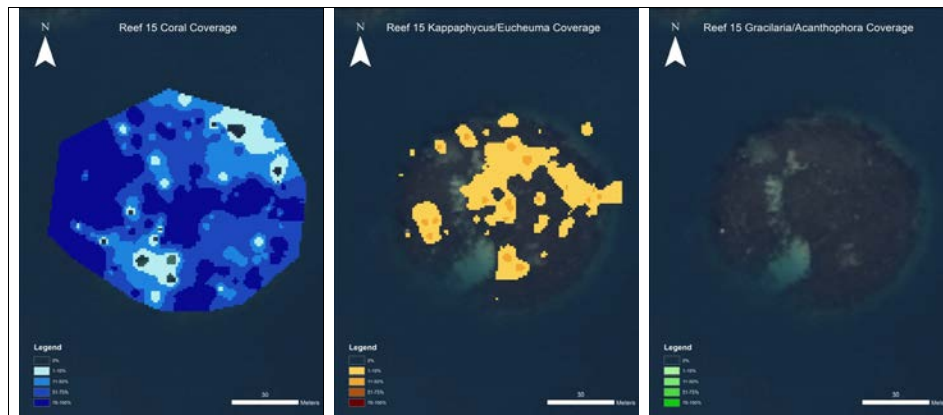


Reef 9

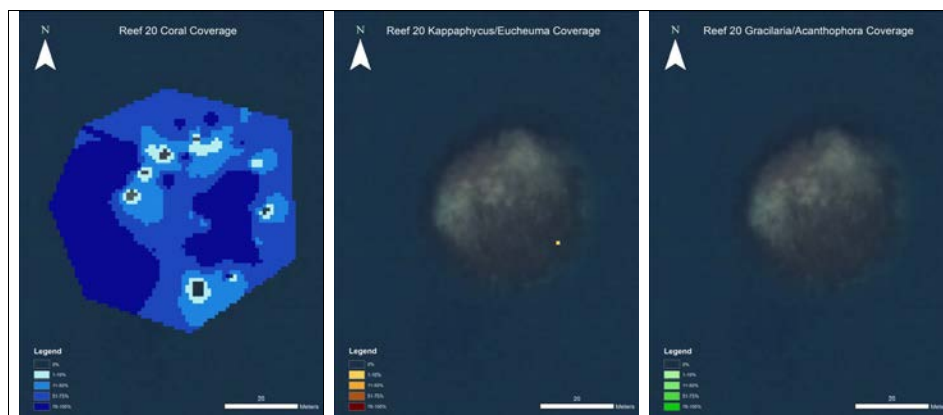


Appendix I: cont'd.

Reef 15

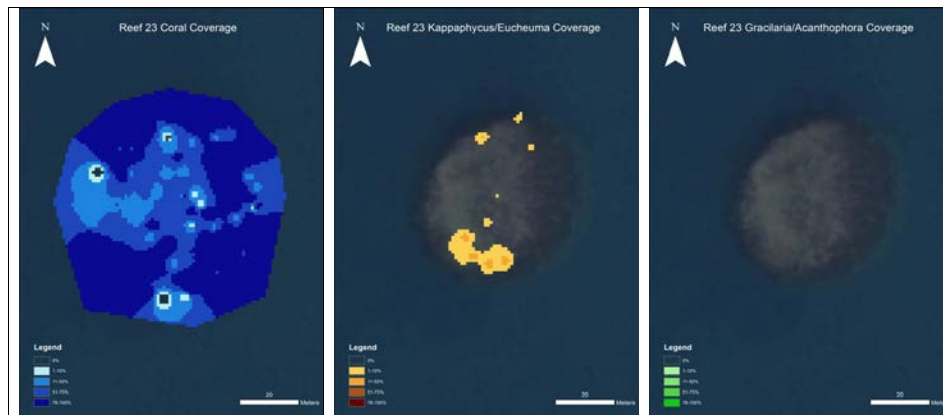


Reef 20

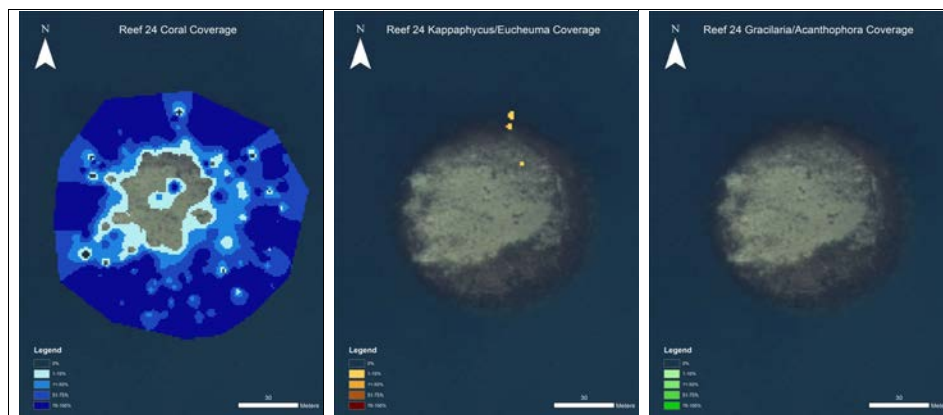


Appendix I: cont'd.

Reef 23

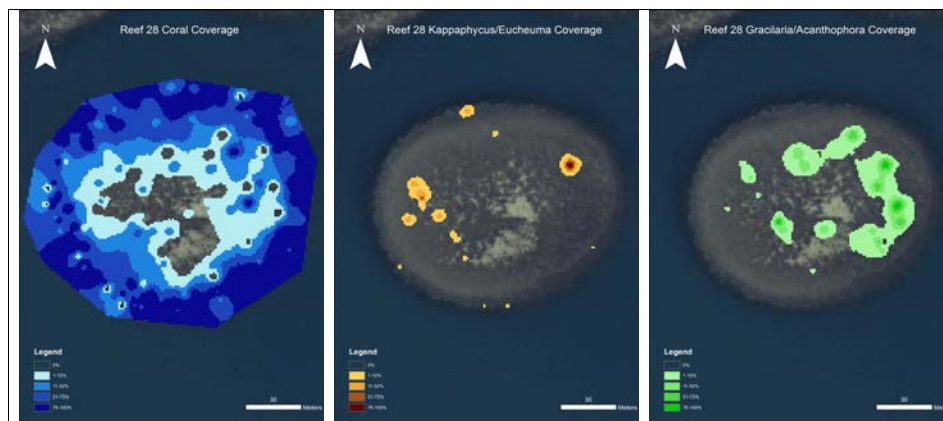


Reef 24

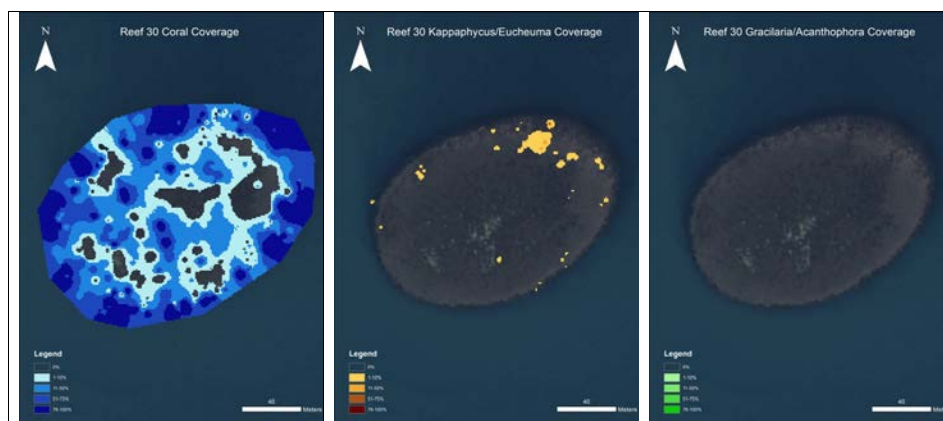


Appendix I: cont'd.

Reef 28

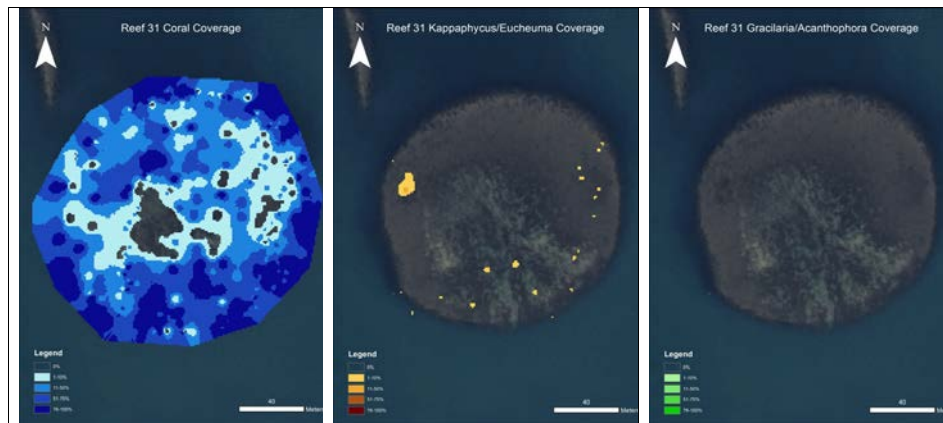


Reef 30

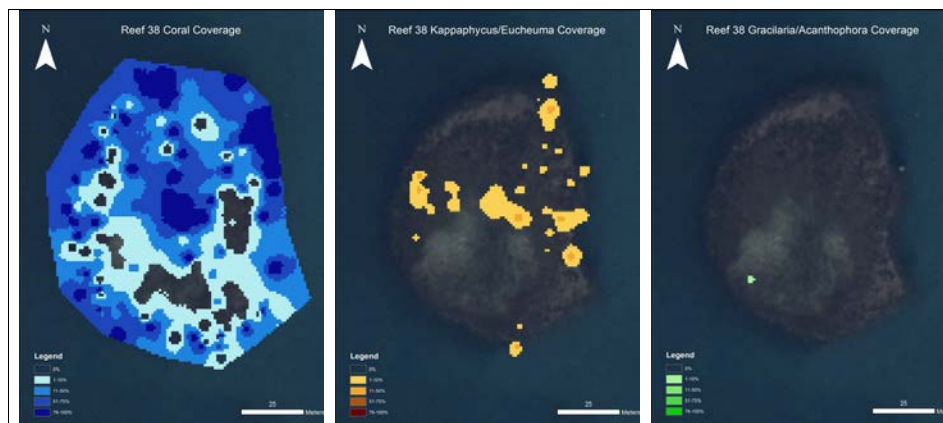


Appendix I: cont'd.

Reef 31

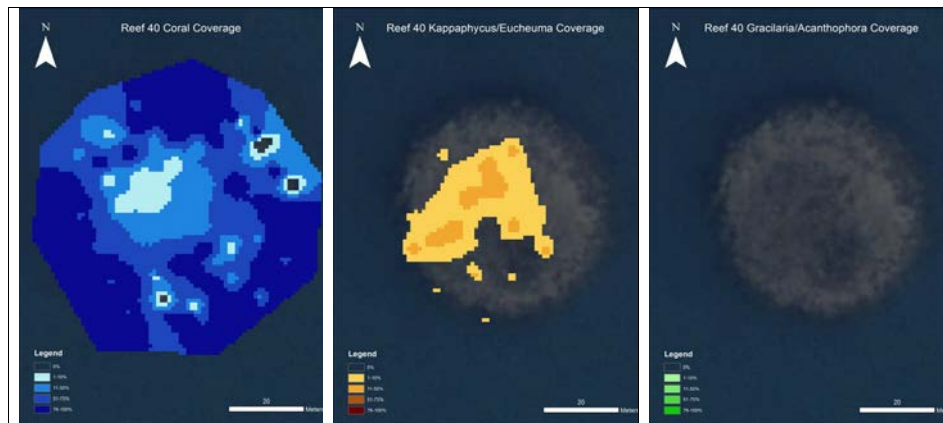


Reef 38

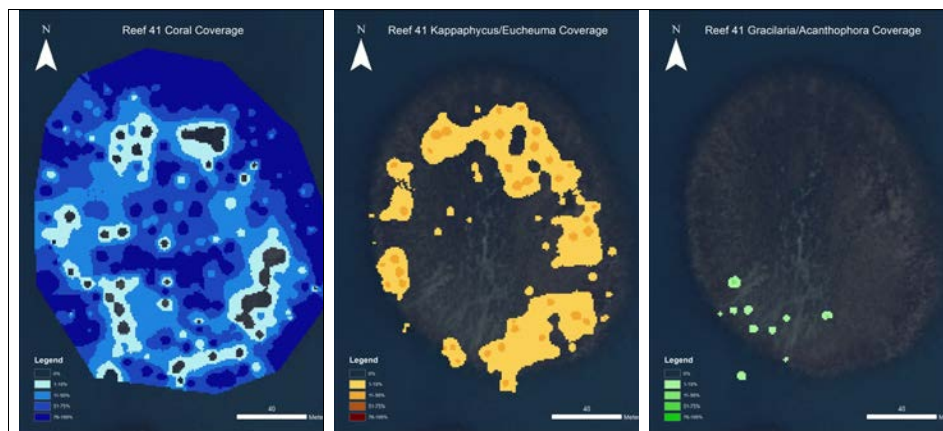


Appendix I: cont'd.

Reef 40

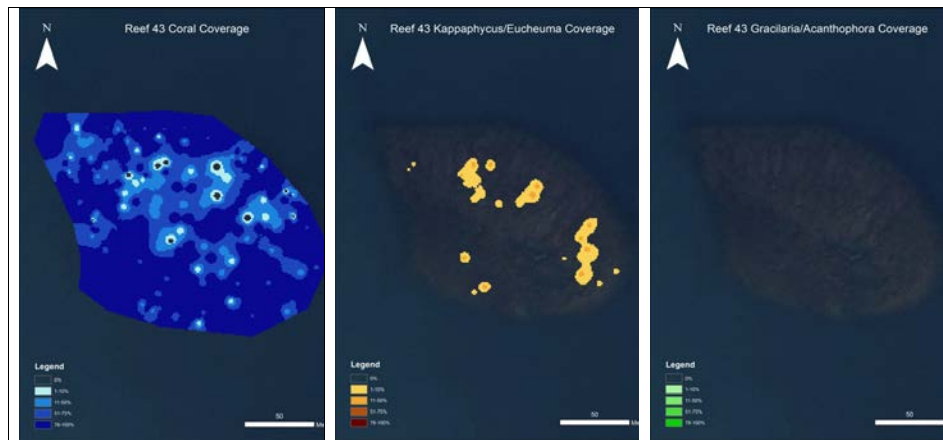


Reef 41



Appendix I: cont'd.

Reef 43



Reef 44

