Coral Relocation Compensatory Mitigation for the Hotel Wharf and Access Road Maintenance and Repair Project, Apra Harbor, Guam

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1.0 Introduction

Hotel Wharf is under the control of the Port Authority of Guam (PAG) and is located on the northern side of Outer Apra Harbor, between Pier Dog (Dog Leg Pier) to the west and Pier A to the east (**Figure 1**). Maintenance and repair work is proposed for the structure and will include removal of the cap, driving new sheet piles outside of the existing piles (wharf face), backfilling, and re-capping of the structure. As a result, all marine biota attached to the wharf face and on the seafloor within approximately 3 m of the wharf (Direct Impacts Zone) will be lost unless removed.

Biological surveys of the wharf face and adjacent seafloor were conducted in January-February of 2019 (Burdick, 2019) and documented significant hard coral populations, as well as macroalgae and various sponge species growing within the direct impacts area. Corals observed on the wharf face comprised 35 coral taxa and averaged approximately 5 cm diameter, while 29 coral taxa were noted on the immediately adjacent seafloor and were slightly larger at about 11 cm average diameter. The most abundant coral taxa in order of decreasing abundance included *Leptastrea purpurea*, *Pocillopora damicornis*, massive *Porites* sp., S*tylocoeniella armata*, and *Lobophyllia hemprichii*.

A Compensatory Mitigation Plan was prepared by Duenas, Camacho & Associates, Inc. (DCA) (2019) to present measures to minimize and offset adverse effects to resources within the project area. The plan primary objective was to mitigate for the loss of ecological functions and services due to direct impacts from the proposed construction activities on coral reef habitat.

Permits include:

- Guam Environmental Protection Agency (Guam EPA) 401 Water Quality Certification (WQC) Order #2020-03;
- U.S. Army Corps of Engineers Permit No. POH-2017-253;
- Department of Agriculture Special Permit for Scientific Coral Relocation, License No. SC-20-003; and
- Federal Consistency Certification, GCMP FC No. 2018-0011.

The proposed measures included the movement of corals feasible for relocation from the Hotel Wharf face and immediately adjacent seafloor to an acceptable nearby recipient site, and a post-relocation monitoring program. Based upon the results of the 2019 survey it was estimated there were potentially 636 corals on the wharf face and 194 colonies within the direct impact zone at the base of the wharf that were healthy enough and of a size suitable for relocation. Coral relocation criteria included:

1. Coral colonies located within the Direct Impacts Zone;
2. Coral size between 10 cm and 100 cm;
3. All coral species, excluding encrusting forms, small dendrophyliids, or any other corals that would not survive relocation; and
4. Healthy coral colonies with no bleaching or major paling.

Post-relocation monitoring was to include health assessments of selected relocated and reference corals during an immediate post-relocation baseline survey, and at 6-months, 18-months, and 36-months after relocation.

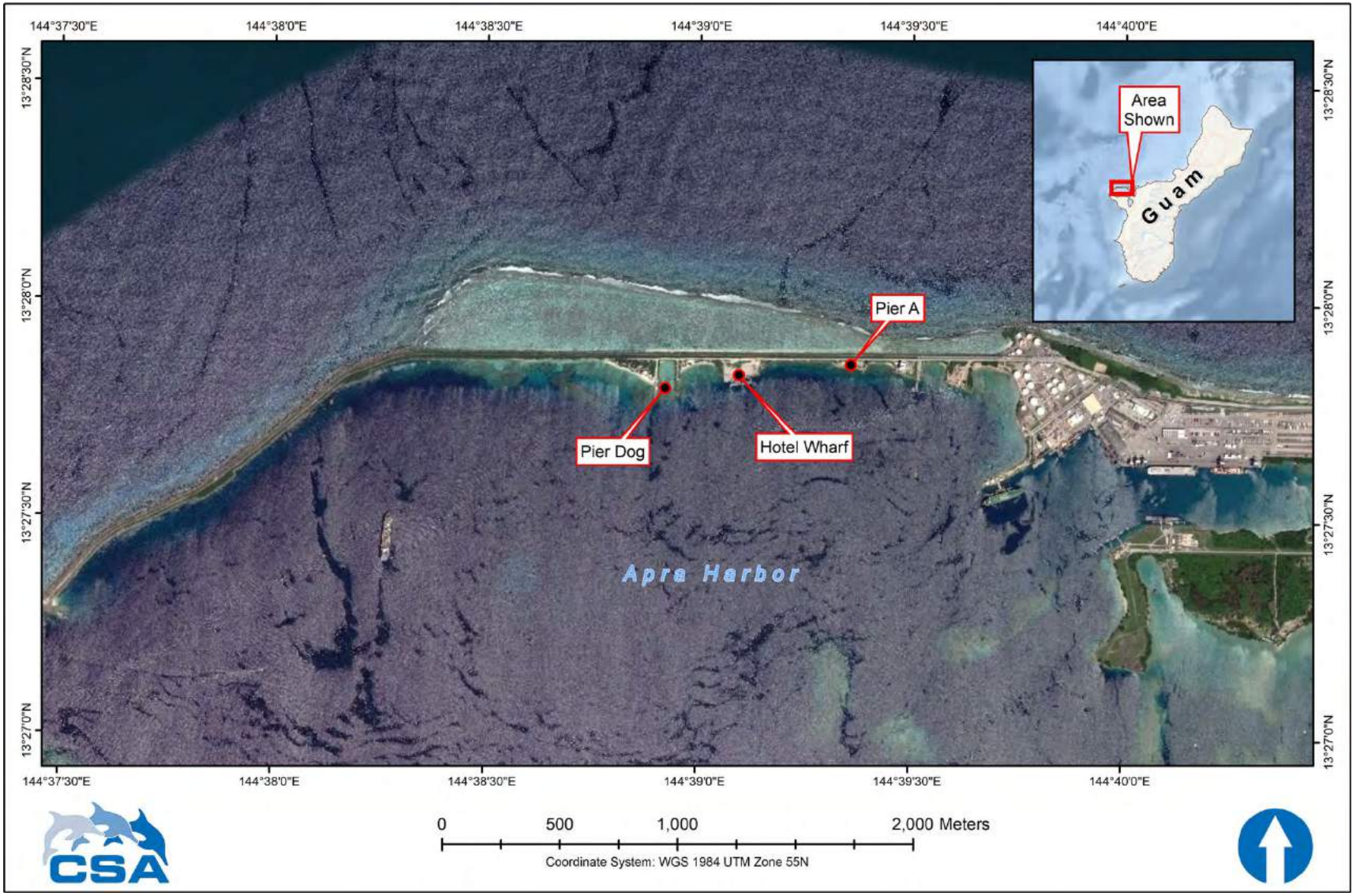

Figure 1. Location of Hotel Wharf along the northern edge of Apra Harbor, Guam.

CSA Ocean Sciences Inc. (CSA) was contracted by WSP USA Inc. to prepare a coral relocation and monitoring plan, complete the coral relocation effort, and conduct subsequent monitoring activities. An additional task was to conduct an assessment for the invasive octocoral species *Carijoa riisei*, reported to be growing along the southern wharf face. In mid-March 2020 CSA staff mobilized to Guam, participated in a kick-off meeting with Port officials, conducted an initial survey of the wharf face, identified suitable coral reattachment sites, relocated all healthy corals within the required size range to the reattachment sites, tagged representative numbers of relocated and reference corals, and completed baseline health assessment monitoring. This report describes the methods of the coral relocation effort and the results of the coral relocation and baseline monitoring survey.

The coral relocation effort was undertaken just prior to the implementation of COVID-19 quarantine measures in Guam. When initial quarantine measures were announced, CSA field staff implemented social distancing measures, minimizing contact with other persons, and initiated frequent hand washing and use of hand sanitizers. Staff avoided all restaurants and, as possible, minimized visits to grocery stores and other retail outlets. Following the completion of the coral relocation and monitoring field effort all staff were able to return safely home and no one has developed any symptoms of COVID-19 infection.

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2.0 Methods

2.1 VESSEL AND DIVING

CSA field operations were conducted from the *Sea Spinner*, a 40-ft long local dive vessel provided by Poseidon's Maidens Charters. In addition, Poseidon's Maidens Charters provided additional dive support including Nitrox scuba bottle fills and required dive safety equipment.

Coral relocation activities and monitoring surveys were performed by a five-person field team, including a Dive Safety Officer and four scientific divers. All divers were certified by an internationally recognized dive association, in good standing with the CSA member organization (American Academy of Underwater Sciences [AAUS]), and current with all required safety certifications. Divers were covered by Maritime Employers Liability Insurance (coverage for divers and crew personnel while in navigable waters, including Jones Act).

2.2 INITIAL SITE SURVEYS

Prior to the start of diving activities, discussions were conducted with Port officials, Port Police, and on-site vessel repair supervisors regarding coordination of efforts and scheduling to prevent and minimize operational conflicts. Notes were made of positions of barges and vessels at the wharf, and potential locations for the mooring of the dive support vessel were identified. Daily communication plans were established with the Port Control, repair supervisors, and Port Police.

Initial dive surveys of the wharf face were then conducted to familiarize dive team members with the wharf structure, identify any potential safety hazards, and delineate general coral distribution within the Direct Impacts Zone. Divers collected video with GoPro Hero 7 cameras and still photographs with multiple DSLR cameras in underwater housings of the wharf face and adjacent seafloor prior to the relocation of coral colonies. Observations were made of coral sizes and abundance to allow planning of subsequent removal efforts. A dive was also conducted to assess the presence and abundance of the invasive octocoral *Carijoa riisei* along the upper wharf face.

Dive teams then made dives at the potential coral reattachment area described in the Compensatory Mitigation Plan to assess suitability of the location for the receipt of corals observed on the wharf. Dives included areas to the east, south, and west of the Dog Leg Pier (**Figure 2**).

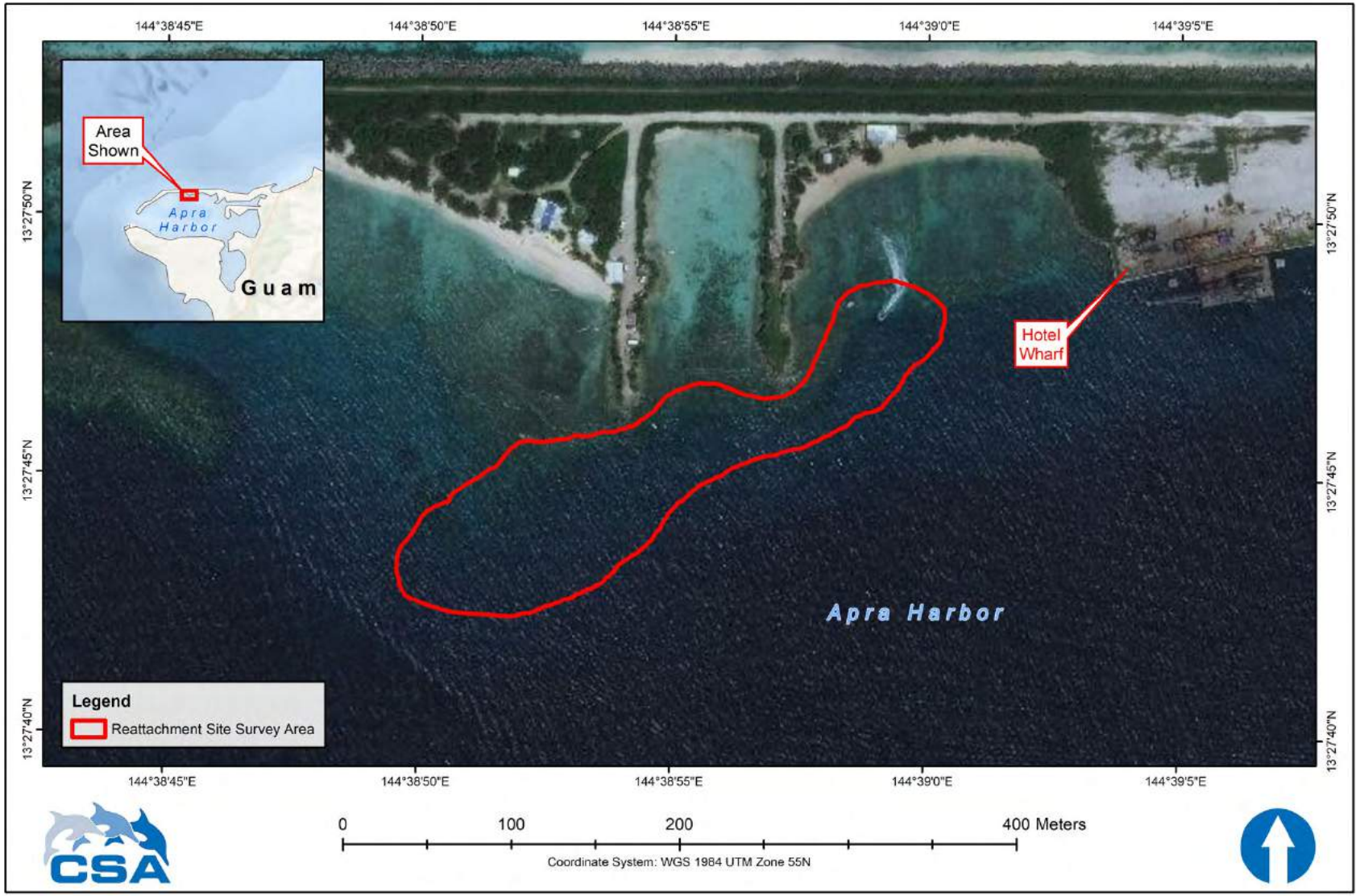

Figure 2. Area surveyed to identify coral reattachment sites for corals removed from Hotel Wharf and adjacent seafloor.

2.3 CORAL RELOCATION

2.3.1 Reattachment Site Selection

Suitable reattachment sites were selected based on site-specific conditions, including relative proximity to the wharf, similar water depth, available exposed substrate for coral attachment, and the presence of other healthy corals of the same species. The available substrate at the potential reattachment area off the Dog Leg Pier identified in the Compensatory Mitigation Plan was deemed to be insufficient for the number of corals to be relocated, as well as being covered with layers of surficial sediments with fairly heavy *Padina* (macroalgae) growth. Additionally, the bottom between the Dog Leg Pier jetties at water depths up to nearly 6 m was heavily disturbed, with exposed rock and rubble, as well as significant amounts of loose sediments settling out on corals and cascading down the slope. This may be partly due to jet skiing and flyboarding in this area, as mentioned in the mitigation plan. Because of these conditions, reattachment sites were identified slightly to the west in an area to the southwest of the western Dog Leg Pier at depths ranging from about 2 to 13 m. A total of 11 distinct reattachment and reference sites or areas were ultimately selected and were marked with centrally positioned fiberglass rods cemented into the bottom. The three shallowest sites were along the reef flat and slope at water depths of from 2 to 4.5 m. The other 8 sites were on individual reef rock outcrops and along the base of the reef slope at depths ranging from 9.5 to 12.8 m (**Figure 3**). **Table 1** lists coordinates of marker rod for each reattachment site.

Table 1. Reattachment site marker rod coordinates.

Reattachment Site	Latitude (N)	Longitude
1	13°27’45.46558”	144°38’52.07670”
2	13°27’45.25702”	144°38’52.43957”
3	13°27’44.79200”	144°38’51.66757”
4	13°27’43.11477”	144°38’51.36902”
5	13°27’43.25019”	144°38’51.19476”
6	13°27’43.52936”	144°38’51.00813”
7	13°27’43.62555”	144°38’50.81039”
8	13°27’43.57431”	144°38’50.51960”
9	13°27’43.66108”	144°38’50.45960”
10	13°27’43.31863”	144°38’50.30608”
11	13°27’43.52299”	144°38’51.79439”

Coordinate System: WGS 1984 UTM Zone 55N.

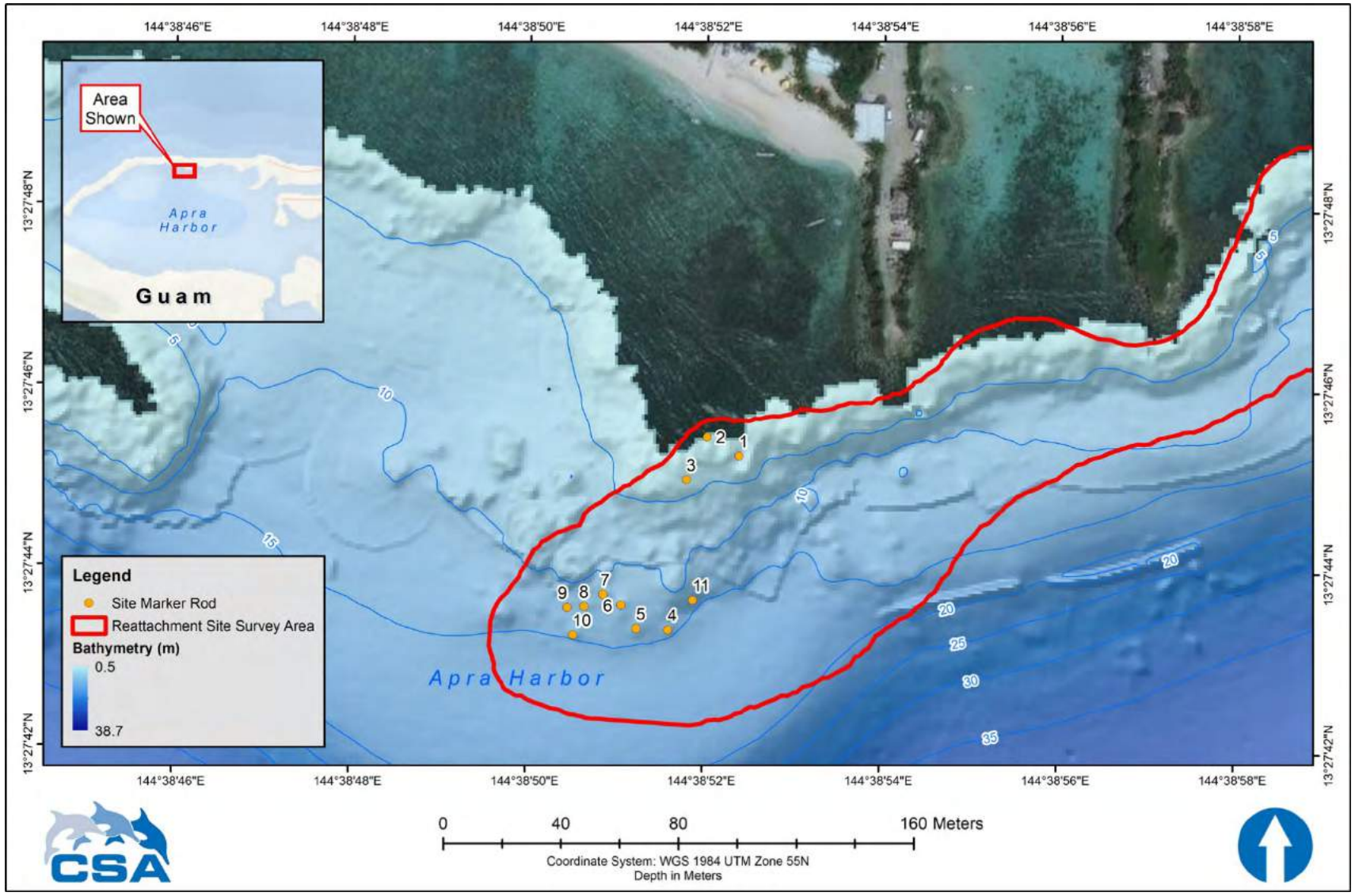

Figure 3. Locations of marker rods demarcating the approximate centers of selected coral reattachment sites.

2.3.2 Coral Removal and Transport

Coral colonies selected for relocation were removed by chipping the living portion of the colony from the point of attachment on the wharf face, debris, or rock substrate using a hammer and masonry chisel. Detached colonies were placed in perforated plastic collection crates that were cached on the bottom pending movement to the reattachment site. While transiting to the reattachment site the crates were covered with cloth sheets dampened with seawater to protect the corals from direct sunlight and overheating. Upon arrival at the reattachment sites the crates of corals were immediately returned to the water and cached on the seafloor by divers.

2.3.3 Coral Reattachment

Prior to attaching relocated corals, the specific reattachment surfaces were prepared by removing any loose sediment and surficial biota (i.e., algae and fouling organisms). A concrete mixture of Portland cement and sand was prepared in individual 5-gal buckets for reattaching corals. The concrete was mixed to yield a thick or "stiff" mixture to lessen the cement plume released in the water. Half-full buckets of concrete were lowered from the vessel to near bottom with lift lines and transported by divers to specific reattachment sites. Sufficient amounts of concrete were placed directly on the pre-cleaned substrate, and the coral to be reattached was pressed firmly into the concrete mixture until stable and secure. Reattached corals were intermittently checked during reattachment operations to ensure stability, address the aesthetic quality of the reattachment matrix, and dissipate cement residue that may have settled on adjacent biota. Coral colonies were reattached with a spatial distribution that mimicked the surrounding benthic habitat.

2.4 BASELINE MONITORING

Baseline and subsequent monitoring events will be used to determine the relative success of the coral relocation effort. During the future monitoring events, comparisons will be made between relocated and reference corals to determine the success of the relocation efforts. Baseline monitoring tasks included:

- Permanently marking center of reattachment and reference sites with fiberglass rods;
- Selection and tagging of relatively healthy monitored corals with uniquely numbered markers;
- Recording distance and compass bearing from central rods to all tagged corals;
- Assessment of relocated coral colony bonding status;
- Visual assessment of reattached and reference coral health conditions; and
- Collection of still photographs for all monitored corals.

Monitored coral colonies included an experimental group of 132 relocated corals and 101 reference corals. Reference corals were selected based on health condition, proximity to the reattachment site, and good representation of the relocated coral species. **Appendix A**, **Tables A-1** and **A-2** provide documented coral condition, size, and location during the baseline survey.

2.4.1 Site Establishment

Reattachment and reference sites were demarcated by permanently installed, geo-referenced site markers (fiberglass rods) to facilitate monitoring site reoccupation and to serve as a benchmark for mapping corals for monitoring activities. Monitored coral colonies were marked with a unique numeric

identification tag (width of 7.6 cm and length of 10.8 cm) and mapped by recording distances and compass bearings from the site marker rods (**Appendix**, **Tables A-1** and **A-2**).

2.4.2 Bonding Status of Relocated Colonies

Monitored coral colonies were visually assessed to determine reattachment status by inspecting the base for cracks or gaps between the coral colony and the natural rock substrate. If the attachment point (base of colony) appeared compromised in any way, it was manually tested (diver with gloved hand) for stability and attachment security.

2.4.3 Coral Condition

Direct *in situ* observations of relative conditions were made for relocated and reference coral colonies. For each coral colony, a visual assessment was made recording any adverse health or stress conditions. Some of the monitored coral colonies were affected by, and assigned, more than one condition during the assessment. However, only the primary condition that appeared to be responsible for the greatest percentage of affected tissue for each monitored coral was presented in coral health assessment comparisons and discussion. Additionally, the observer estimated the percentage of the entire colony (0% to 100%) covered by living tissue. Physical damage to the monitored corals, including abrasions and broken branches, was also noted.

2.4.4 Coral Size

Coral size was measured as the maximum length of living tissue on the colony. Size measurements were collected along the longest axis (vertical or horizontal) for each colony, depending on growth form. Most coral measurements were collected along a horizontal axis and notes were made for each monitored coral measured along a vertical axis to allow precise method replication during future monitoring events.

2.4.5 Photographs

Photographs were collected of all monitored coral colonies using a Nikon D810 high-resolution digital camera within an underwater housing unit with dual strobes. The camera was held perpendicular to the colony to collect a plan view image to qualitatively compare with imagery from future monitoring events. Additional photographs were collected at various oblique angles to document the condition of the colony or the proliferation of non-coral biota such as algae or sponges.

3.0 Results and Discussion

Field operations, including initial site survey, coral removal and relocation, and baseline monitoring were conducted from 19 to 27 March 2020. Weather conditions during the survey were good with winds ranging from about 5 to 15 kn, partly cloudy skies, and occasional showers. Sea state was relatively calm with small wind chop from the east. Subsurface visibility ranged from 10 to 15 m and was variable based on tidal exchange.

3.1 INITIAL SITE SURVEYS

Dive teams systematically assessed the face of Hotel Wharf from east to west, making notes relative to coral size, relative abundance, distribution, and species, and collecting video and still photographs. Hotel Wharf was fully utilized during the site survey and coral relocation timeframe, with four large barges as well as an offshore supply vessel tied alongside (**Photo 1**). This caused a nearly total shading of the face of the wharf and adjacent seafloor out at least 15 m from the base of the wharf, aside from small areas within two gaps between the barges/vessels.

During the assessment dive teams recorded areas of higher coral abundance for the subsequent focus of collection efforts. Higher densities of healthy stony corals occurred along the eastern and western ends of the wharf and adjacent shallow rock shelves than on the long southern wharf face. These healthy corals included *Pavona decussata*, *Pocillopora damicornis*, *Porites cylindrica*, *Porites rus*, and several species of "massive" *Porites*. Along the southern side of the wharf the density of living corals was much lower and dominant species included *Pocillopora damicornis*, *Astreopora cucullata*, A*streopora gracilis*, *Lobophyllia hemprichii*, *Lobophyllia corymbosa*, and several massive *Porites* species. The *P. damicornis* colonies were nearly all found within the upper 2 m depths on the wharf face. The *Astreopora* and massive *Porites* colonies were observed along the deeper sections of the wharf face and attached to debris on the surrounding seafloor, while the *Lobophyllia* occurred primarily on the deeper face of the wharf. More than 2 dozen dead or nearly dead colonies of *Lobophyllia* spp. were observed on the wharf face along with numerous other unidentified dead and bioeroded coral colonies. Most of these dead or dying colonies were covered with varying amounts of silt and encrusting sponges (**Photos 2** and **3**).

Photo 1. Barges and cranes tied up at Hotel Wharf during coral relocation project.

Photo 2. An 80% dead colony of *Lobophyllia hemprichii* on wharf face.

Photo 3. Unidentified dead coral encrusted with sponge.

A clump of the invasive octocoral *Carijoa riisei* was identified at the southeastern corner of the wharf below the upper ledge at about 1.5 m depth (**Photo 4**). As its distribution was limited to this specific area, divers carefully detached all visible pieces of the colonies, placed them in a fine-mesh bag, and delivered the colonies to DCA for appropriate disposal.

Photo 4. The invasive octocoral *Carijoa riisei* on southeastern corner of wharf.

Following the wharf assessment, dives to identify reattachment sites were conducted along the shallow reef to the immediate east, south, and then west of the Dog Leg Pier, two parallel rock jetties about 75 m apart and extending out approximately 152 m (east pier) and 170 m (west pier) from shore (**Figure 2**). Divers swam parallel to shore along the base of the reef at about 6 to 7.5 m depths as well as just offshore of the shallower reef crest at 3 to 5 m depths to identify potential coral reattachment sites.

Several widely separated small areas free of corals were observed in the vicinity of the eastern pier but there also was an abundance of surficial sediments along with significant amounts of the macroalgae *Padina* sp. at these locations, making them less than optimal reattachment sites. In the area between the ends of the piers a large amount of exposed rock and rubble bottom was present at depths of about 3 to 5 m, however, it appeared to be heavily disturbed and free of any attached epifauna. It was surmised this could be due to heavy use of personal watercraft (jet skis) and flyboarding in the area, which has the potential to scour bottom sediments. As the jet ski rental operations were closed due to the COVID-19 quarantine this could not be verified firsthand, although the dive vessel crew mentioned there was heavy jet ski usage in this area.

The Compensatory Mitigation Plan mentioned there was habitat suitable for the reattachment of the larger *Lobophyllia* sp. colonies, which were present in lower light areas at the base of the wharf, in slightly deeper waters just to the southwest of the western Dog Leg Pier. Dives in this area identified a series of small rock outcrops just south of the base of the reef ranging in size from about 3 m to 8 m diameter at water depths of 9 to 13 m. These outcrops harbored coral species similar to those identified on the wharf and could provide sufficient free space for the reattachment of a large number of the corals slated for removal. Additionally, three shallower locations were identified about 45 to 55 m to the northeast of these deeper outcrops that had available open space for the reattachment of the coral colonies to be removed from the upper sections of the wharf and from the two shallow rock ledges at the east and west ends of the wharf. These areas were marked with surface floats for use as reattachment sites.

3.2 CORAL RELOCATION

Dive teams carefully removed corals from the face of Hotel Wharf, starting at the eastern end and working to the west over a 2-day period. This was done both to ensure a complete and thorough removal of all acceptable corals as well as to lessen the impact to ongoing vessel and barge repair activities occurring along the wharf, as no repair work could be conducted in the vicinity of active dive operations. Divers detached all non-encrusting coral colonies that were greater than 10 cm diameter. Most colonies of small encrusting species such as *Leptastrea purpurea* could not be removed intact due to their very thin morphology, causing them to fracture and crumble. Following detachment, coral colonies were placed in perforated plastic crates on the seafloor, grouped by species, as possible.

After each collection of approximately 300 corals the crates were raised to the surface, placed on the deck of the vessel, and covered with cotton sheets dampened with seawater to prevent coral tissue damage from exposure to direct sunlight and desiccation. During the loading process and vessel transit to the reattachment site, corals were identified to species and counted. The corals were immediately returned to the water after the vessel anchored at the reattachment site, and the colonies were spread out over the available rock substrate prior to being attached. **Table 2** lists the number of colonies of each species relocated and reattached at the shallow sites 1 to 3 and the deeper sites 4 to 11.

Coral colonies removed from the shallow upper section of the wharf and from the shallow ledges at the eastern and western ends of the wharf were placed at reattachment Sites 1, 2, and 3, located in water depths of 2 to 4.5 m. These included approximately 228 colonies from the species *Favia favus*, *Pavona decussata*, *Pocillopora acuta*, *Pocillopora damicornis*, *Porites cylindrica*, *Porites lichen*, *Porites lobata*, *Porites lutea*, *Porites monticulosa*, *Porites murrayensis*, *Porites rus*, *Porites solida*, and *Psammocora nierstrozi* (**Table 2**). In addition to the relocated corals, more than 30 small colonies and fragments of

Porites cylindrica and *Porites rus* ("corals of opportunity") found broken loose at the three shallow reattachment sites were reattached to the reef.

Table 2. Number of coral colonies by species reattached at shallow versus deep reattachment sites, and numbers of reattached corals tagged for monitoring.

Coral Species	Coral Colonies Reattached at Sites 1–3	Coral Colonies Reattached at Sites 4–11	Total Reattached Corals	Reattached Coral Colonies Tagged for Monitoring
Pocillopora damicornis	149		149	17
Astreopora cucullata		62	62	11
Porites ~lutea	9	46	55	4
Lobophyllia hemprichii		44	44	12
Pavona decussata	43	1	44	10
Porites ~lobata	8	36	44	12
Lobophyllia corymbosa		35	35	7
Astreopora gracilis		29	29	6
Favia matthaii		27	27	8
Porites rus	2	24	26	5
Lobophyllia hataii		21	21	6
Porites ~solida	2	14	16	3
Pocillopora acuta	4	1	5	2
*Herpolitha limax**		4	4	3
Porites murrayensis	4		4	2
Leptoseris incrustans		3	3	3
Porites cylindrica	3		3	2
Porites horizontalata		2	2	2
Porites monticulosa (*convexa* sensu R&M 1983)	1	1	2	2
Porites sp (*P. lichen* sensu R&M 1983)	1	1	2	3
Astreopora elliptica		1	1	2
Astreopora listeri		1	1	1
Astreopora myriophthalma		1	1	1
Astreopora randalli		1	1	0
Cyphastrea chalcidicum		1	1	1
Favia favus	1		1	1
Leptastrea purpurea		3	3	3
Leptastrea transversa		1	1	0
Leptoseris mycetoseroides		1	1	0
Phymastrea valenciennesi (*Favites russelli* sensu R&M 1983)		1	1	1
Psammocora haimeana (*P. profundicella* sensu R&M 1983)		1	1	1
Psammocora neirstrazi	1		1	1
"Corals of opportunity" (*Porites cylindrica* and *Porites rus*)	30		30	
Total	**258**	**363**	**621**	**132**

* colonies were not cemented to reef (free-living species).

Corals removed from deeper areas on the wharf as well as from the adjacent seafloor were distributed on rock features subsequently marked as Sites 4 through 11 in water depths of 9.5 to 12.8 m. These included approximately 363 colonies dominated by *Astreopora cucullata*, *Porites lutea*, *Lobophyllia hemprichii*, *Porites lobata*, *Lobophyllia corymbosa*, *Astreopora gracilis*, *Favia matthaii*, *Porites rus*, *Lobophyllia hataii*, and *Porites solida*.

After corals were transported to the reattachment locations dive teams began the reattachment process, using wire brushes and metal scrapers to remove surficial sediments and any biofouling from the recipient rock surfaces to enhance cement adhesion. Divers also used the wire brushes to remove encrusting tunicates and sponges from the undersides of the coral colonies to be reattached. Colonies were reattached using methods described in **Section 2.3.3**. During the coral attachment process divers were careful to minimize concrete contact with living coral tissue on both the reattached colonies and on surrounding naturally-occurring corals. Any cement residue settling on corals was hand-fanned off at regular periods during the dives.

3.3 BASELINE MONITORING

After completion of coral reattachment activities, each of the reattachment sites was marked with a 2 cm diameter, 50 cm long, fiberglass rod cemented into the reef rock at the approximate center of each distinct site (**Photo 5**). Coral colonies representative of the species and relative numbers relocated were then selected and tagged for subsequent monitoring. Department of Agriculture Special Permit for Scientific Coral Relocation, License No. SC-20-003, specified the number of coral colonies of each relocated species to be monitored. For coral species with 50 or more individual colonies relocated, 20% were to be monitored; for species with 10 to 50 individual colonies relocated, 10% were to be monitored; and for species with less than 10 individuals, 100% were to be monitored.

A total of 149 small colonies of *Pocillopora damicornis,* nearly 24% of the total number of relocated corals, were removed from the shallow areas on the wharf and adjacent shallow hard bottom substrate and relocated. Because of the higher than expected number of colonies of this species, which is a relatively fast growing early colonizer, the number of *P. damicornis* colonies selected for monitoring was reduced from 30 colonies (20% of the total relocated) down to 17 colonies (11.4%). This allowed additional numbers of colonies of slightly less abundant and more rare species such as *Lobophyllia corymbosa*, *L. hataii*, and *L. hemprichii* to be selected for monitoring.

Additionally, the species *Porites lutea* may be under-represented in the monitoring, with only 4 colonies tagged of the estimated 55 relocated colonies. This was due to the visual similarity of this species to the species *Porites lobata* in small-sized colonies. The specified 11 colonies of *P. lutea* (20% of the total 55 colonies) were initially tagged, but upon closer inspection during the health assessment it was determined that 7 of these colonies were more likely to be the species *P. lobata*. As a result there are 12 colonies of what appear to be *P. lobata* and only 4 colonies of what may be *P. lutea* in the set of monitored relocated corals. Colonies from three species, *Astreopora randalli*, *Leptastrea transversa*, and *Leptoseris mycetoserioides*, each represented by only single small colonies, could not be relocated to be tagged for monitoring following reattachment.

A total of 132 relocated corals (**Table 2**) and 101 reference corals of similar species were tagged using colored plastic livestock ear tags secured to the substrate adjacent to the monitored colonies (**Photo 5**). Complete listings of monitored reference corals and relocated corals along with health assessment data are presented in **Appendix A**. Photographs of each tagged and monitored reference and relocated coral

colony are provided in **Appendices B** and **C**. Relocated corals were marked with light blue tags while reference coral tags were yellow. Distance and compass bearings were then recorded from the center rod to each tagged coral at each of the monitoring sites to allow easier location of monitored colonies during subsequent monitoring surveys.

Baseline monitoring of reattached and reference corals included attachment status (secureness) of relocated corals, measurement of maximum diameter (length or height) of colony (living tissue), and a health assessment including level of tissue paling or bleaching, recent tissue loss, sponge or macroalgae overgrowth, predation, and disease. Photographs were also taken of each tagged coral.

Photo 5. Marker rod embedded in rock at Site 7 along with corals tagged for monitoring.

3.3.1 Relocated Colony Bonding Status

Divers visually assessed all relocated corals to determine reattachment status by inspecting the base for cracks or gaps between the coral colony and the cement/substratum. All monitored relocated corals and numbered monitoring tags were noted as secure during the survey.

3.3.2 Coral Size and Condition

In situ observations of coral health identified six conditions as potential sources of coral stress (**Table 3**). Algal overgrowth or encroachment was the most commonly observed condition during the survey, recorded in similar frequency on 82 relocated corals (62.1%) and 69 reference corals (68.3%). It was unclear whether the algae were causing partial coral mortality, or merely growing over previously dead portions of coral colonies, and in most cases the growth was relatively minor. Algal overgrowth observed on coral colonies was typically comprised of turf algae species or in some cases the leafy brown algae *Padina*.

Table 3. Number of monitored coral colonies affected by the observed coral conditions recorded during the Baseline Monitoring Survey.

Condition	Coral Type	
	Relocated Number/ (% of total)	Reference Number/ (% of total)
Algal overgrowth	82 (62.1%)	69 (68.3%)
Paling	52 (39.4%)	22 (21.8%)
Bioerosion (fish grazing or *Lithophaga* intrusion)	36 (27.3%)	24 (23.8%)
Sponge overgrowth	12 (9.1%)	24 (23.8%)
Tissue loss	6 (4.6%)	4 (4.0%)
Tunicate overgrowth	3 (2.3%)	3 (3.0%)

Paling tissue was the second most frequently recorded condition on monitored corals and was observed on 52 relocated corals (39.4%) and only 22 reference corals (21.8%). The paling was most commonly observed as isolated areas on colony tissues (**Photo 6**), although large portions of nearly all of the *Pocillopora damicornis* reference colonies in shallow water were pale (**Photo 7**).

Photo 6. A reattached colony of *Favia matthai* with patches of pale tissue.

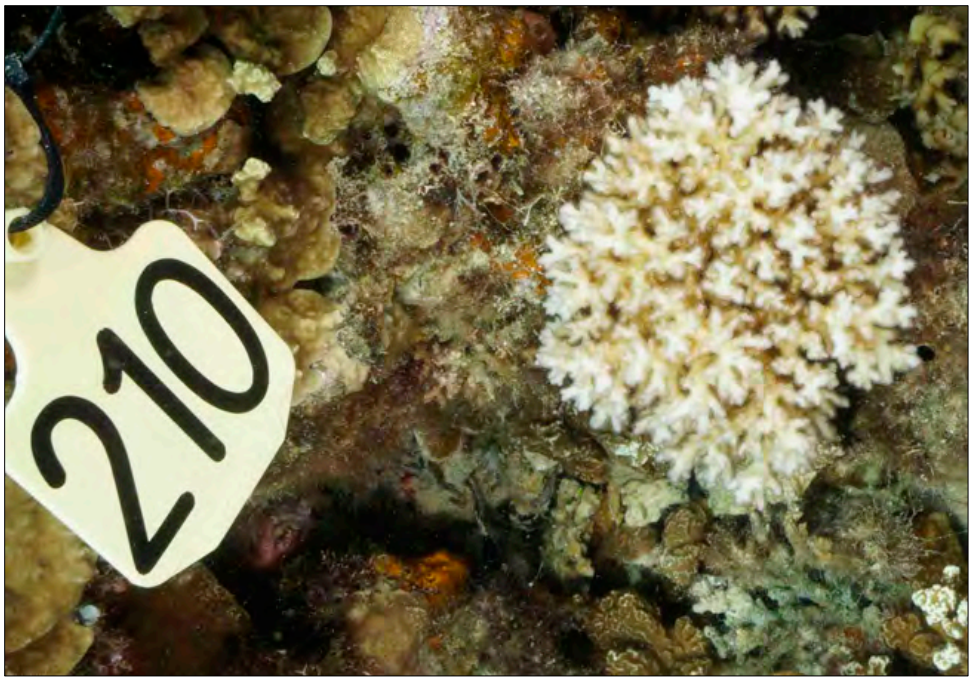

Photo 7. A reference colony of paling *Pocillopora damicornis* in shallow water.

Bioerosion included two different types of damage - the grazing of coral tissue by parrotfish and the intrusion of the boring bivalve *Lithophaga* sp. Relocated colonies of *P. damicornis* were noticeably impacted by parrotfish nipping the tips off of branches shortly after reattachment (**Photo 8**). *Lithophaga* was observed in nearly all colonies of massive *Porites* sp. greater than approximately 15 to 20 cm diameter, with abundance generally increasing with colony size (**Photos 9** and **10**).

Photo 8. A reattached colony of *Pocillopora damicornis* with branch tips eaten by parrotfish.

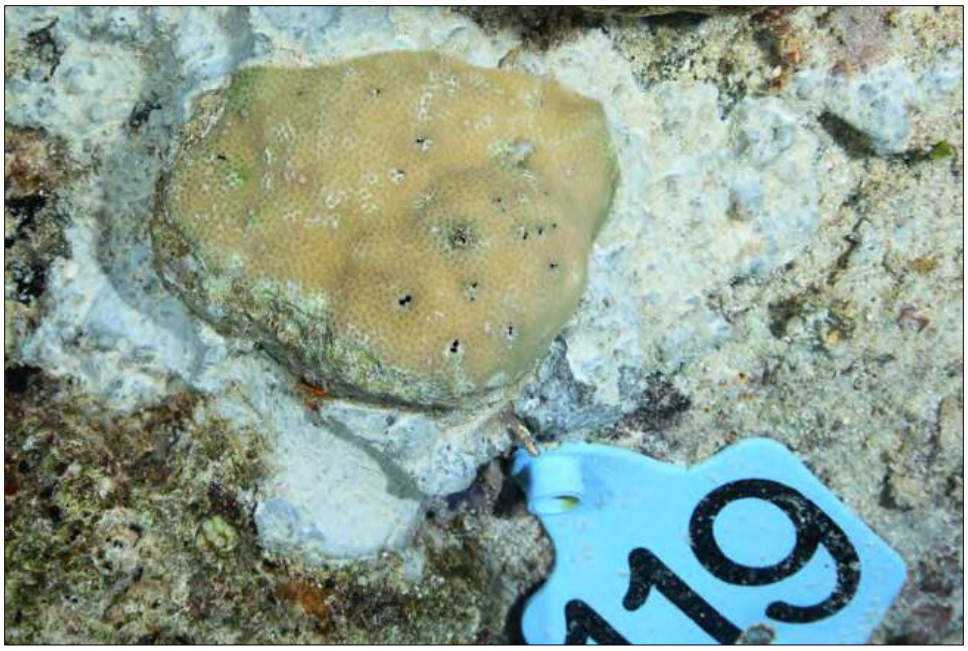

Photo 9. A small colony of *Porites lobata* with the boring bivalve *Lithophaga s*p. (small dark dumbbell-shaped holes).

Photo 10. A large colony (71 cm diameter) of *Porites lobata* with high abundance of *Lithophaga* sp.

Sponge overgrowth was twice as prevalent in reference colonies as in relocated colonies. As encrusting sponges were abundant on the face of the wharf, this difference could be partially due to those sponges encroaching on the relocated corals either not being collected along with the coral colony during detachment or being removed by wire brushes prior to reattachment. The sponge *Clathria eurypa* was

observed in high abundance on reef substrate at the deeper reattachment sites, in many cases overgrowing healthy coral colonies (**Photo 11**).

Photo 11. The sponge *Clathria eurypa* (brown) overgrowing the top of a colony of *Porites lobata*.

Tissue loss was primarily due to branch or column breakage/fragmenting during the removal process. In most cases the branch fragments were also relocated. Tunicate overgrowth was observed but uncommon for both relocated and reference corals. Reference coral #294 (**Photo 12**) exhibited sponge (*Liosina granularis*) and algae (*Caulerpa serrulata*) overgrowth, as well as the yellow tunicate (*Phallusia julinea*).

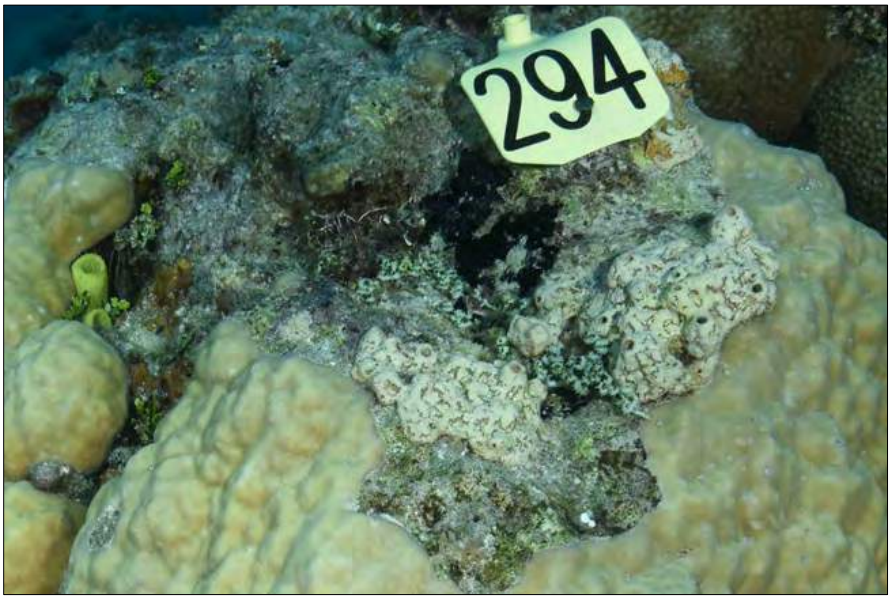

Photo 12. The coral *Porites lutea* with a yellow tunicate (*Phallusia julinea*; left), the beige-colored sponge *Liosina granularis* (right), and the green algae *Caulerpa serrulata* (center).

Percent living tissue on monitored relocated colonies ranged from as low as 40% up to 100%, with 97 of the 132 relocated colonies (73.5%) having 90% or greater living tissue. The average percent living tissue for all monitored relocated corals was 89.7%. Percent living tissue observed on reference corals ranged from 10% up to 100%, with 64 of 101 tagged corals (63.4%) having 90% or greater living tissue. The average percent living tissue for all reference corals was 82.3%. A total of eight reference corals with less than 50% living tissue were selected for monitoring due to the rarity of individuals of several species occurring naturally in the vicinity of the reattachment sites. If these 8 colonies are excluded, the average percent living tissue for reference corals was 87.0%.

4.0 Summary

4.1 CORAL RELOCATION

All relatively healthy coral colonies greater than 10 cm diameter, as well as several smaller healthy colonies, were removed from the face of Hotel Wharf and from the seafloor and debris within 3 m of the base of the wharf, and relocated to reattachment areas to the southwest of Dog Leg Pier. This included a total of approximately 591 coral colonies, as well as more than 30 "corals of opportunity" found detached or broken loose at the shallow reattachment sites. The corals were reattached at a total of 11 sites – 3 sites located in shallow depths of 2 to 4.5 m and 8 sites in depths of 9.5 to 12.8 m. A total of 132 relocated coral colonies and 101 reference coral colonies were identified, tagged, and mapped for subsequent health monitoring.

The invasive octocoral *Carijoa riisei* was identified from the shallow southeastern corner of the wharf. All colonies of the species were carefully removed from the wharf, taking care to collect all visible pieces, and delivered to DCA for disposal.

4.2 CORAL HEALTH

Overall, the baseline monitoring observations of the conditions of the relocated and reference corals showed similar levels of both minor algae overgrowth and bioerosion; with the bioerosion either by parrotfish predation on *P. damicornis* branch tips or intrusion by the boring bivalve *Lithophaga* on massive *Porites* sp.

A higher percentage of the tagged relocated corals showed tissue paling (39.4%) compared to the tagged reference corals (21.8%). This could be partially due to declining health conditions of the corals removed from the southward-facing side of the wharf where four large barges and an offshore supply vessel have been tied off for an extended period, causing a significant reduction in sunlight reaching corals. The shading caused by the vessels, and possible resultant stress to shaded corals, could be a contributing factor in the lower number of corals identified and relocated from the project area compared to the higher number estimated as available for relocation in the Compensatory Mitigation Plan. There were several dozen nearly dead colonies observed on the wharf face, especially from mid-depths down to the seafloor, which were not relocated because of their poor condition. Many other dead colonies, fouled with silt, encrusting sponges and algae, were also observed on the face of the wharf.

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5.0 Literature Cited

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Appendices

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Appendix A

Coral Baseline Health Assessment Data

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Table A-1. Coral baseline health assessment data for relocated and reference colonies.

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
1	Relocated	*Porites cylindrica*	90	A	15.6	Shallow	3	2.5	018	cyanobacteria and coral overgrowth at base
2	Relocated	*Porites cylindrica*	95	A	12.5	Shallow	3	2.7	010	dead at tips of some branches; do not assess *Pavona* sp. portion
3	Relocated	*Porites* aff. *lichen*	95	P,Bio	16.4	Shallow	3	3.3	020	dead around perimeter; *Lithophaga*; pale tissue throughout; not *P. lichen*; but in Randall & Meyers 1983 as *P. lichen*
4	Relocated	*Porites monticulosa*	95	A,TL,Bio	62.0	Shallow	3	3.1	032	assess large colony only; several broken branches; *Lithophaga*
5	Relocated	*Porites monticulosa*	85	A,TL	23.2	Shallow	3	3.4	060	one broken branch
6	Relocated	*Porites* cf. *murrayensis*	98	P,Bio	13.7	Shallow	3	4.5	025	pale tissue throughout; *Lithophaga*; do not assess dead area around edge of colony; could also be *P. lutea*
7	Relocated	*Porites* cf. *murrayensis*	90	P,A,Bio	24.5	Shallow	1	4.5	245	*Lithophaga*; pale tissue throughout; could also be *P. lutea*
8	Relocated	*Porites rus*	95	A,P	25.4	Shallow	2	2.6	355	pale tissue around edge
9	Relocated	*Porites rus*	98	P,TL	12.4	Shallow	2	1.9	050	assess large colony only; broken branch; pale tissue at edge
10	Relocated	*Porites rus*	85	A	17.0	Shallow	2	2.3	225	--
11	Relocated	*Porites lobata*	85	A,P,Bio	28.6	Shallow	1	3.8	213	pale tissue in areas; *Lithophaga*; grazing scars
12	Relocated	*Psammocora neirstrazi*	90	TL,A	7.5	Shallow	1	4.0	162	broken branches

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
13	Relocated	*Porites solida*	98	Bio,P	23.5	Shallow	1	1.6	165	pale tissue spots; *Lithophaga*; grazing scars
14	Relocated	*Porites solida*	65	A,Bio,P	36.8	Shallow	1	5.9	210	bivalves
15	Relocated	*Porites lobata*	98	TL,Bio,P	22.9	Shallow	1	6.1	205	*Lithophaga*
16	Relocated	*Porites lobata*	99	P,A	16.5	Shallow	1	4.2	180	vertical measurement; grazing scars
17	Relocated	*Porites lobata*	99	A,Bio	12.4	Shallow	1	4.1	225	grazing scars
18	Relocated	*Porites lutea*	60	A,P,Bio	16.4	Shallow	1	4.1	212	*Lithophaga*; grazing scars
19	Relocated	*Pocillopora damicornis*	97	P,Bio	26.4	Shallow	1	1.5	265	grazing scars
20	Relocated	*Pocillopora damicornis*	100	P	20.5	Shallow	1	1.3	318	--
21	Relocated	*Pocillopora damicornis*	98	P,Bio	17.9	Shallow	1	1.6	318	grazing scars
22	Relocated	*Pocillopora damicornis*	100	P	15.9	Shallow	1	5.7	045	--
23	Relocated	*Pocillopora damicornis*	98	P,Bio	19.6	Shallow	1	5.9	042	grazing scars
24	Relocated	*Pocillopora damicornis*	95	A,P	15.8	Shallow	1	5.5	038	--
25	Relocated	*Pavona decussata*	60	A	17.6	Shallow	1	1.8	095	--
26	Relocated	*Pavona decussata*	95	A	10.2	Shallow	1	1.8	115	--
27	Relocated	*Pavona decussata*	70	A	24.9	Shallow	1	1.9	125	--
28	Relocated	*Pavona decussata*	95	A,P	15.5	Shallow	1	2.6	140	pale tissue throughout
29	Relocated	*Pocillopora damicornis*	90	A,Bio	12.3	Shallow	1	3.9	155	grazing scars
30	Relocated	*Pocillopora damicornis*	95	A,P,Bio	17.0	Shallow	1	4.7	152	grazing scars
31	Relocated	*Pocillopora damicornis*	95	Bio,P	15.8	Shallow	1	4.8	162	assess large colony only; grazing scars; pale tissue throughout
32	Relocated	*Pocillopora damicornis*	97	Bio	11.4	Shallow	1	4.7	175	grazing scars

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
33	Relocated	*Porites lutea*	50	A,P,Bio	20.0	Shallow	3	3.4	075	pale tissue in spots; *Lithophaga*; worm tubes
34	Relocated	*Porites lutea*	99	P,Bio	11.1	Shallow	3	3.1	072	pale tissue in spots; *Lithophaga*; could be *F. murrayensis*
35	Relocated	*Favia favus*	70	A,Bio	18.0	Shallow	3	2.7	260	assess large colony only; *Lithophaga*; worm tubes; could be *F. murrayensis*
36	Relocated	*Pocillopora acuta*	99	P,Bio	24.2	Shallow	3	4.6	250	grazing scars
37	Relocated	*Pocillopora acuta*	80	A,P,Bio	14.2	Shallow	3	5.1	238	grazing scars
38	Relocated	*Pocillopora damicornis*	98	A,Bio,P	15.4	Shallow	3	4.0	248	grazing scars
39	Relocated	*Pocillopora damicornis*	95	A,P,Bio	25.5	Shallow	3	3.6	248	grazing scars
40	Relocated	*Pocillopora damicornis*	98	Bio	24.7	Shallow	3	1.8	238	grazing scars
41	Relocated	*Pocillopora damicornis*	98	Bio,P	8.4	Shallow	3	1.3	242	grazing scars
42	Relocated	*Pocillopora damicornis*	95	A,Bio	18.5	Shallow	3	0.5	210	grazing scars
43	Relocated	*Pocillopora damicornis*	100	-	12.3	Shallow	3	2.7	350	--
44	Relocated	*Pocillopora damicornis*	99	Bio	17.2	Shallow	3	3.7	335	grazing scars
45	Relocated	*Pavona decussata*	98	P,A	17.6	Shallow	3	3.6	015	--
46	Relocated	*Pavona decussata*	90	A,P	20.3	Shallow	3	6.9	012	--
47	Relocated	*Pavona decussata*	85	A	15.8	Shallow	2	6.4	218	--
48	Relocated	*Pavona decussata*	98	A	14.7	Shallow	2	0.6	230	*Padina* algae
49	Relocated	*Pavona decussata*	60	A	12.6	Shallow	2	1.7	025	do not assess base of colony
50	Relocated	*Porites lutea*	95	A,P,Bio	32.8	Deep	4	1.2	335	pale tissue in spots; *Lithophaga*
51	Relocated	*Porites solida*	95	A	19.9	Deep	4	0.4	340	assess large colony only

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
52	Relocated	*Leptoseris incrustans*	90	A,S	21.6	Deep	4	0.9	315	--
53	Relocated	*Porites rus*	98	A,P	14.8	Deep	4	1.3	315	pale tissue at edge
54	Relocated	*Favia matthaii*	95	A,P	14.2	Deep	5	1.7	140	--
55	Relocated	*Lobophyllia hemprichii*	85	A	24.4	Deep	5	1.7	150	--
56	Relocated	*Lobophyllia hemprichii*	85	A,S	17.6	Deep	5	0.3	090	--
57	Relocated	*Pavona decussata*	95	A	26.5	Deep	5	1.7	332	*Halimeda* algae
58	Relocated	*Astreopora cucullata*	90	A	18.1	Deep	5	1.5	028	--
59	Relocated	*Favia matthaii*	40	A	23.3	Deep	5	5.7	125	--
60	Relocated	*Favia matthaii*	100	-	4.6	Deep	5	5.7	135	assess large colony only
61	Relocated	*Astreopora cucullata*	90	A	24.3	Deep	4	7.2	332	--
62	Relocated	*Astreopora listeri*	100	P	12.2	Deep	4	7.3	340	assess large colony only, pale tissue throughout
63	Relocated	*Lobophyllia hemprichii*	55	A	36.2	Deep	4	6.9	345	encrusting red algae
64	Relocated	*Lobophyllia hemprichii*	95	A	15.8	Deep	4	6.5	340	--
65	Relocated	*Leptastrea* cf. *purpurea*	90	A,P	14.2	Deep	4	6.8	335	pale tissue throughout; likely L. purpurea
66	Relocated	*Lobophyllia hemprichii*	75	A	18.6	Deep	6	2.4	088	--
67	Relocated	*Porites horizontalata*	99	A,P	8.7	Deep	6	1.9	118	pale tissue throughout
68	Relocated	*Lobophyllia hemprichii*	98	A	35.0	Deep	6	0.5	110	--
69	Relocated	*Favia matthaii*	75	A	16.6	Deep	6	0.5	062	--
70	Relocated	*Lobophyllia corymbosa*	95	A	15.2	Deep	6	0.8	228	dead area in center of colony

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
71	Relocated	*Lobophyllia hemprichii*	100	-	17.7	Deep	6	1.3	348	--
72	Relocated	*Favia matthaii*	100	-	11.4	Deep	6	1.6	355	tunicate at base of colony
73	Relocated	*Porites ~lichen*	98	A,P	15.3	Deep	6	1.7	345	assess colony above (southeast) tag; two colonies; combined; not *P. lichen* but in Randall & Meyers 1983 as *P. lichen*
74	Relocated	*Herpolitha limax**	100,100,100	-	10.5,14.4,30.2	Deep	6	2.0	328	three colonies, assess all
75	Relocated	*Astreopora gracilis*	85	A	23.3	Deep	6	2.3	000	three colonies around tag; two small, one large
76	Relocated	*Lobophyllia hemprichii*	65	A	24.5	Deep	6	3.0	358	pink tissue coloration; turf algae on dead areas
77	Relocated	*Lobophyllia corymbosa*	90	A	31.0	Deep	6	3.5	015	turf algae on dead areas
78	Relocated	*Astreopora cucullata*	95	-	10.0	Deep	6	3.3	020	--
79	Relocated	*Lobophyllia hataii*	95	A	16.2	Deep	6	2.9	028	turf algae on dead areas
80	Relocated	*Lobophyllia corymbosa*	100	-	17.8	Deep	6	3.0	045	--
81	Relocated	*Porites lobata*	75	Bio	9.5	Deep	6	3.9	042	a few *Lithophaga*
82	Relocated	*Astreopora gracilis*	75	-	26.5	Deep	6	2.0	015	tissue paling in areas; tissue growing over dead areas
83	Relocated	*Lobophyllia hemprichii*	65	A	28.0	Deep	7	2.1	122	turf algae on dead areas
84	Relocated	*Leptoseris incrustans*	97	-	15.5	Deep	7	1.8	138	areas of green endolithic algae
85	Relocated	*Lobophyllia hemprichii*	85	-	26.8	Deep	7	2.4	155	--
86	Relocated	*Astreopora myriophthalma*	100	-	12.5	Deep	7	0.2	225	--
87	Relocated	*Favia matthaii*	98	A	10.6	Deep	7	0.4	002	turf algae and *Halimeda*

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
88	Relocated	*Astreopora cucullata*	98	P	12.0	Deep	7	0.8	060	small area of pale tissue
89	Relocated	*Lobophyllia corymbosa*	80	S,T	22.5	Deep	7	1.0	060	sponge; tunicates; bivalves
90	Relocated	*Favia matthaii*	95	A,P	14.5	Deep	7	1.0	072	turf algae; some pale tissue
91	Relocated	*Lobophyllia hemprichii*	90	S	21.2	Deep	7	1.1	100	--
92	Relocated	*Porites lobata*	100	Bio	13.8	Deep	7	1.3	090	*Lithophaga*
93	Relocated	*Cyphastrea chalcidicum*	65	-	8.2	Deep	7	1.4	008	--
94	Relocated	*Favia matthaii*	95	S,A	24.5	Deep	7	3.0	005	turf algae around edge of colony
95	Relocated	*Astreopora gracilis*	90	-	10.0	Deep	7	2.8	010	--
96	Relocated	*Astreopora cucullata*	90	A	19.0	Deep	7	4.0	342	turf algae on dead areas
97	Relocated	*Astreopora cucullata*	75	S,A	24.6	Deep	7	3.8	330	--
98	Relocated	*Lobophyllia hemprichii*	98	-	19.6	Deep	7	7.0	342	--
99	Relocated	*Astreopora cucullata*	90	S	13.5	Deep	7	6.4	346	encrusting sponge on side of colony
100	Relocated	*Astreopora cucullata*	100	P	11.9	Deep	7	0.6	317	pale tissue throughout
101	Relocated	*Phymastrea valenciennesi*	60	A,T	27.9	Deep	8	0.4	228	assess entire complex
102	Relocated	*Lobophyllia hataii*	100	-	14.6	Deep	8	0.8	225	--
103	Relocated	*Astreopora elliptica*	100	P	11.6	Deep	8	1.2	125	pale tissue throughout
104	Relocated	*Porites lobata*	90	A,P,Bio	17.9	Deep	8	0.9	175	*Lithophaga*; pale tissue in spots

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
105	Relocated	*Astreopora cucullata*	90	A,S	14.9	Deep	8	1.7	240	--
106	Relocated	*Astreopora gracilis*	80	A,T	19.3	Deep	8	1.7	265	--
107	Relocated	*Astreopora elliptica*	100	P	16.2	Deep	8	1.7	298	pale tissue in spots
108	Relocated	*Astreopora gracilis*	95	A	11.6	Deep	8	1.5	328	--
109	Relocated	*Astreopora gracilis*	65	A	23.7	Deep	8	1.3	330	--
110	Relocated	*Astreopora cucullata*	80	A	16.2	Deep	8	2.5	022	--
111	Relocated	*Astreopora cucullata*	95	A,P	17.6	Deep	8	0.1	270	pale tissue in spots
112	Relocated	*Porites lobata*	100	P,Bio	21.1	Deep	8	1.1	032	pale tissue in spots; *Lithophaga*
113	Relocated	*Lobophyllia corymbosa*	85	S,A	22.4	Deep	10	2.4	260	assess entire complex; yellow sponge
114	Relocated	*Lobophyllia corymbosa*	70	S,A	23.7	Deep	10	2.0	320	black sponge
115	Relocated	*Lobophyllia corymbosa*	65	A,S	30.1	Deep	10	1.0	346	assess entire complex; black sponge
116	Relocated	*Porites horizontalata*	90	A,P	22.1	Deep	9	0.8	158	pale tissue in spots
117	Relocated	*Porites lobata*	95	A,P	12.4	Deep	9	0.6	085	pale tissue in spots
118	Relocated	*Leptastrea purpurea*	100	-	10.1	Deep	9	1.9	040	--
119	Relocated	*Porites lobata*	90	A,P	9.0	Deep	9	1.5	115	pale tissue throughout
120	Relocated	*Porites lobata*	100	P	9.6	Deep	9	2.0	115	some tissue discoloration
121	Relocated	*Lobophyllia hataii*	85	TL,P	13.9	Deep	8	1.2	135	recent tissue loss and tissue paling
122	Relocated	*Lobophyllia hataii*	100	-	11.4	Deep	8	1.5	280	--

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
123	Relocated	*Porites* aff. *lichen*	97	A,P,Bio	34.6	Deep	8	2.7	010	pale tissue in spots; *Lithophaga*; not *P. lichen*, but in Randall & Meyers 1983 as *P. lichen*
124	Relocated	*Porites rus*	98	A	10.9	Deep	7	6.4	022	--
125	Relocated	*Psammocora profundicella*	98	A	9.4	Deep	6	7.6	210	*Halimeda* algae; sensu Randall & Meyers 1983 - Veron still accepts this ID, but has recently been redone and this beast is not *P. haimeana*
126	Relocated	*Leptastrea purpurea*	90	S,A,P	21.5	Deep	6	5.3	200	some pale tissue; boring sponge
127	Relocated	*Leptoseris incrustans*	90	A	22.9	Deep	6	6.0	200	--
128	Relocated	*Lobophyllia hataii*	90	A	16.1	Deep	6	7.6	205	--
129	Relocated	*Lobophyllia hataii*	100	-	16.4	Deep	6	8.5	208	sponge at base of colony; perhaps Burdick's *L.* cf. *hataii*
130	Relocated	*Porites lobata*	95	A,Bio,P	19.8	Deep	6	1.6	298	*Lithophaga*; pale grazing scars
Reference										
200	Reference	*Pocillopora damicornis*	100	P, A	12.5	Shallow	2	3.8	292	--
201	Reference	*Pocillopora damicornis*	98	P,A	4.8	Shallow	2	2.0	310	--
202	Reference	*Pocillopora damicornis*	100	P	10.8	Shallow	2	4.9	345	--
203	Reference	*Pocillopora damicornis*	100	P	6.8	Shallow	2	5.7	012	--
204	Reference	*Pocillopora damicornis*	100	P	12.2	Shallow	2	5.3	010	--

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
205	Reference	*Pocillopora damicornis*	55	A,P	20.4	Shallow	2	4.8	330	--
206	Reference	*Pocillopora damicornis*	100	P,A	16.0	Shallow	2	7.7	315	--
207	Reference	*Pocillopora damicornis*	100	A	17.5	Shallow	2	2.3	152	located in a hole
208	Reference	*Pocillopora damicornis*	100	P	7.5	Shallow	2	3.3	155	--
209	Reference	*Pocillopora damicornis*	100	-	18.0	Shallow	2	2.6	140	--
210	Reference	*Pocillopora damicornis*	100	P	13.6	Shallow	2	8.4	195	--
211	Reference	*Pocillopora damicornis*	100	-	12.9	Shallow	2	7.5	198	on vertical wall
212	Reference	*Pocillopora damicornis*	100	P	9.6	Shallow	2	8.2	185	--
213	Reference	*Porites cylindrica*	100	-	19.4	Shallow	3	4.3	082	--
214	Reference	*Porites cylindrica*	100	-	15.5	Shallow	3	4.4	122	*P. monticulosa* overgrowth
215	Reference	*Astreopora cucullata*	90	Bio,A	43.5	Deep	5	2.8	235	bivalves; *Lithophaga*
216	Reference	*Porites monticulosa*	100	-	56.0	Shallow	3	3.7	105	--
217	Reference	*Porites monticulosa*	100	A	19.4	Shallow	3	2.8	272	vertical measurement
218	Reference	*Porites rus*	100	A	11.5	Shallow	3	4.2	240	--
219	Reference	*Porites rus*	100	-	11.3	Shallow	3	5.6	252	--
220	Reference	*Psammocora neirstrazi*	90	A	22.6	Shallow	3	2.0	118	--
221	Reference	*Porites lutea*	99	S	19.5	Shallow	3	1.8	045	sponge at edge of colony
222	Reference	*Porites lutea*	95	A	21.2	Shallow	3	3.2	018	--
223	Reference	*Porites lutea*	100	-	35.5	Shallow	3	3.7	002	--
224	Reference	*Porites lutea*	99	A	40.5	Shallow	3	5.0	015	--

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
225	Reference	*Porites lutea*	75	Bio,A,P	38.0	Shallow	3	5.8	010	vertical measure; heavy *Lithophaga*; some algal cover; slight paling
226	Reference	*Porites murrayensis*	80	A,Bio	25.5	Shallow	2	3.7	335	cyanobacteria film; *Lithophaga*
227	Reference	*Porites murrayensis*	30	A	33.0	Shallow	2	4.5	008	seven areas of living tissue
228	Reference	*Porites solida*	100	Bio	20.0	Shallow	2	2.9	152	brown color colony, located under another colony; vertical measurement; *Lithophaga*
229	Reference	*Porites solida*	98	A	37.5	Shallow	3	3.1	120	--
230	Reference	*Astreopora cucullata*	95	A,Bio	24.0	Deep	5	2.0	228	*Lithophaga*; vertical measurement
231	Reference	*Astreopora gracilis*	100	-	16.9	Deep	5	1.9	190	--
232	Reference	*Porites lutea*	95	A,Bio	22.2	Deep	5	2.1	172	*Lithophaga*
233	Reference	*Leptastrea purpurea*	60	TL,A	18.8	Deep	5	1.8	105	vertical measurement; recovering dead area
234	Reference	*Astreopora gracilis*	95	A,Bio,P	23.8	Deep	5	1.5	010	some pale tissue; *Lithophaga*
235	Reference	*Astreopora cucullata*	100	-	19.6	Deep	5	2.3	010	--
236	Reference	*Astreopora cucullata*	98	A	14.7	Deep	4	2.1	060	assess large colony only
237	Reference	*Astreopora gracilis*	100	-	15.4	Deep	4	2.4	050	--
238	Reference	*Astreopora myriophthalma*	70	A,Bio,S	60.5	Deep	4	2.3	045	*Lithophaga*; bivalves; *Clathria* sponge
239	Reference	*Astreopora gracilis*	99	A,Bio,P	15.5	Deep	4	0.7	335	some pale tissue and discoloration; *Lithophaga*
240	Reference	*Porites rus*	70	A,S,T	55.8	Deep	4	1.8	332	--

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
241	Reference	*Astreopora cucullata*	70	A,Bio	25.7	Deep	4	1.4	305	bivalves; *Lithophaga*
242	Reference	*Porites horizontalata*	60	A,TL,P	25.0	Deep	4	0.9	288	--
243	Reference	*Porites lutea*	90	A,Bio	17.4	Deep	4	0.6	262	*Lithophaga*
244	Reference	*Porites lobata*	60	A,Bio	71.0	Deep	4	2.5	210	cyanobacteria
245	Reference	*Leptoseris incrustans*	100	-	11.2	Deep	4	2.9	202	--
246	Reference	*Astreopora cucullata*	97	A	34.4	Deep	4	0.9	120	--
247	Reference	*Porites* aff. *lichen*	100	Bio	24.0	Deep	4	6.6	332	*Lithophaga*; not *P. lichen*, but in Randall & Meyers 1983 as *P. lichen*
248	Reference	*Porites* aff. *lichen*	99	Bio	22.3	Deep	4	6.7	342	*Lithophaga*; previous damage to rock; not *P. lichen*, but in Randall & Meyers 1983 as *P. lichen*
249	Relocated	*Porites horizontalata*	90	S,Bio	23.8	Deep	5	1.1	190	*Lithophaga*
250	Reference	*Psammocora profundicella*	30	A,S	14.7	Deep	5	0.9	282	sensu Randall & Meyers 1983 - Veron still accepts this identification, but has recently been redone and this is not *P. haimeana*
251	Reference	*Phymastrea valenciennesi*	50	A	11.0	Deep	6	7.0	208	assess area to right (southwest) of tag
252	Reference	*Astreopora cucullata*	98	A	29.5	Deep	6	7.5	200	--
253	Reference	*Astreopora cucullata*	50	A,S	41.7	Deep	6	2.0	205	--
254	Reference	*Lobophyllia corymbosa*	20	A,S	49.0	Deep	6	2.9	226	appears part of larger dead colony; assess as portion of original colony

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
255	Reference	*Astreopora cucullata*	95	A,Bio	24.2	Deep	6	3.4	040	*Lithophaga*
256	Reference	*Lobophyllia hemprichii*	99	A,P	16.0	Deep	9	1.8	045	pale tissue throughout
257	Reference	*Lobophyllia hemprichii*	90	A,S	19.6	Deep	9	2.6	020	--
258	Reference	*Lobophyllia corymbosa*	40	A,S	40.5	Deep	10	7.4	302	living tissue around perimeter of original colony
259	Reference	*Leptastrea transversa*	60	A,S	26.4	Deep	10	4.6	105	assess entire end of rock edge
260	Reference	*Lobophyllia corymbosa*	95	A,S,T	49.9	Deep	6	11.7	200	--
261	Reference	*Herpolitha limax*	100	P	12.5	Deep	8	0.1	118	near site stake; "J" shaped
262	Reference	*Favia favus*	80	A	12.5	Deep	8	0.8	185	assess large colony under tag only
263	Reference	*Porites lutea*	100	-	37.8	Deep	7	7.6	355	--
264	Reference	*Porites lobata*	65	A,TL	31.8	Deep	7	7.8	355	areas of sedimentation within colony
265	Reference	*Porites lobata*	95	A	29.4	Deep	7	6.9	000	reattached *Porites rus* colony on top; *Lithophaga*, cyanobacteria
266	Reference	*Porites lutea*	65	A,P	31.2	Deep	7	5.4	010	--
267	Reference	*Porites lobata*	90	A	38.6	Deep	6	1.4	225	assess end of rock near tag
268	Reference	*Astreopora listeri*	85	A,S	59.4	Deep	6	1.0	090	--
269	Reference	*Astreopora cucullata*	98	A,Bio	34.5	Deep	6	2.4	058	*Lithophaga*
270	Reference	*Porites solida*	98	P	49.5	Deep	6	2.5	050	pale tissue spots
271	Reference	*Lobophyllia corymbosa*	100	-	36.0	Deep	11	7.5	185	--
272	Reference	*Leptastrea purpurea*	60	A,S	30.0	Deep	11	7.6	195	turf algae

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
273	Reference	*Lobophyllia hemprichii*	100	-	18.3	Deep	11	1.7	215	--
274	Reference	*Favia favus*	25	S	26.0	Deep	11	8.0	055	--
275	Reference	*Favia matthaii*	10	S,A	5.0, 8.0, 9.5	Deep	11	6.6	042	three colonies; 22 cm of colony dead with sponge and algal cover
276	Reference	*Lobophyllia hemprichii*	50	A	24.5	Deep	11	10.4	025	--
277	Reference	*Lobophyllia corymbosa*	95	S,A	73.0	Deep	11	21.8	005	--
278	Reference	*Astreopora gracilis*	45	A	16.5	Deep	11	2.5	235	turf algae; cyanobacteria
279	Reference	*Lobophyllia hemprichii*	100	-	6.0	Deep	11	1.7	235	located under ledge
280	Reference	*Astreopora cucullata*	95	A	22.5	Deep	11	3.5	230	turf algae; cyanobacteria
281	Reference	*Astreopora gracilis*	90	A	20.0	Deep	11	4.1	250	turf algae; *Porites monticulosa* overgrowth
282	Reference	*Favia* cf. *matthaii*	20	A	14.5	Deep	11	3.0	028	turf algae and cyanobacteria on mostly dead original coral colony; primary septa are more enlarged than normal for *F. matthaii* giving star-like appearance
283	Reference	*Porites lobata*	100	P	43.0	Deep	4	2.8	215	pale tissue spots; grazing scars; sponge at base of colony
284	Reference	*Astreopora cucullata*	60	A,Bio	29.6	Deep	4	3.1	215	*Lithophaga*
285	Reference	*Astreopora gracilis*	100	-	23.2	Deep	4	1.0	225	--

Table A-1. (Continued).

Tag	Type	Taxa	Coral Condition			Coral Location				Notes
			Percent Living Tissue	Stress Condition	Maximum Diameter (cm)	Depth Zone	Stake Number	Distance (m)	Bearing (°)	
286	Reference	*Astreopora cucullata*	60	A,S	36.7	Deep	5	3.5	075	assess area to left (north) of tag
287	Reference	*Astreopora cucullata*	70	A	51.0	Deep	5	4.0	355	--
288	Reference	*Porites lobata*	50	S,P	25.3	Deep	5	3.3	015	*Clathria* sponge; pale tissue spots
289	Reference	*Astreopora cucullata*	60	A,S	37.5	Deep	5	3.0	018	--
290	Reference	*Astreopora cucullata*	90	A,Bio	31.5	Deep	6	2.3	112	*Lithophaga*
291	Reference	*Porites lutea*	90	A,TL,P	51.8	Deep	6	2.3	125	recent tissue loss; black coloration at edge of colony
292	Reference	*Astreopora gracilis*	50	A	33.0	Deep	6	1.6	105	assess entire rock
293	Reference	*Astreopora cucullata*	70	A	35.2	Deep	6	2.0	060	assess area to north of tag
294	Reference	*Porites lutea*	60	A,S,T	77.5	Deep	6	1.2	035	--
295	Reference	*Porites lobata*	99	A,Bio	26.5	Deep	7	2.0	155	*Lithophaga*
296	Reference	*Astreopora cucullata*	90	S,A,Bio	26.6	Deep	7	0.7	238	vertical measurement; bivalves
297	Reference	*Porites lobata*	95	Bio,P,A	59.5	Deep	7	2.1	305	*Porites rus* colony on top; pale tissue spots; *Lithophaga*
298	Reference	*Porites lobata*	85	A,S,Bio	49.4	Deep	7	6.2	005	bivalves; *Lithophaga*
299	Reference	*Porites lutea*	50	A,S	82.5	Deep	10	1.3	218	assess entire rock; *Astreopora* colony attached
300	Reference	*Astreopora cucullata*	85	A,Bio,S	35.5	Deep	10	1.9	200	vertical measurement; bivalves; *Lithophaga*

* three colonies of *Herpolitha limax* at Tag 74.
-- = no stress condition observed.

Appendix B

Photographs of Tagged Relocated Corals

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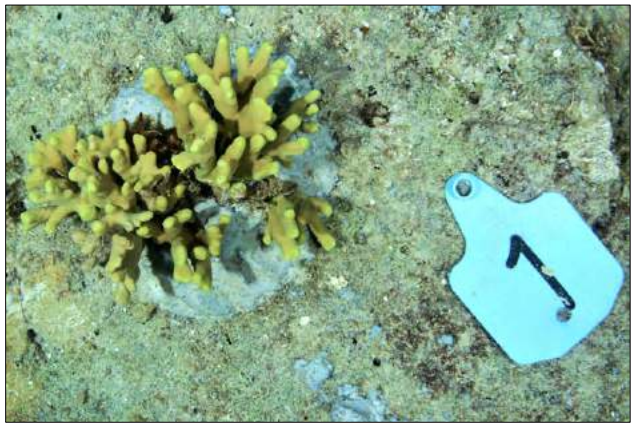

Photo B-1. *Porites cylindrica*

Photo B-2. *Porites cylindrica*

Photo B-3 *Porites* aff. *lichen*

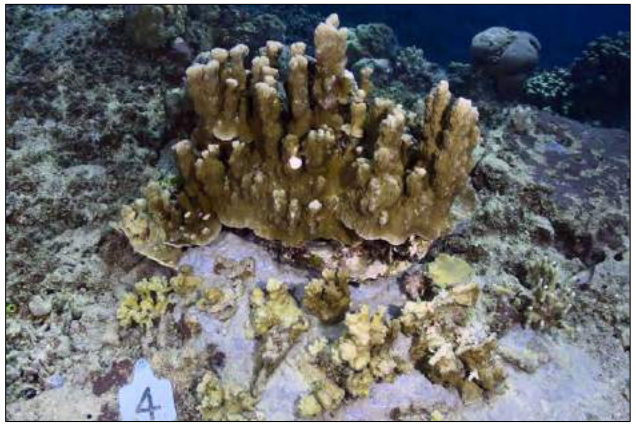

Photo B-4. *Porites monticulosa*

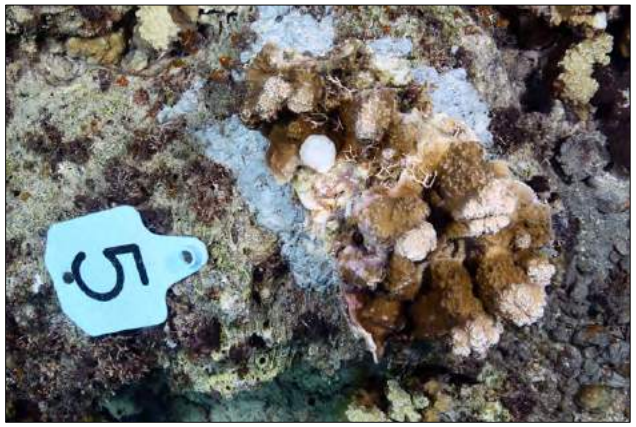

Photo B-5. *Porites monticulosa*

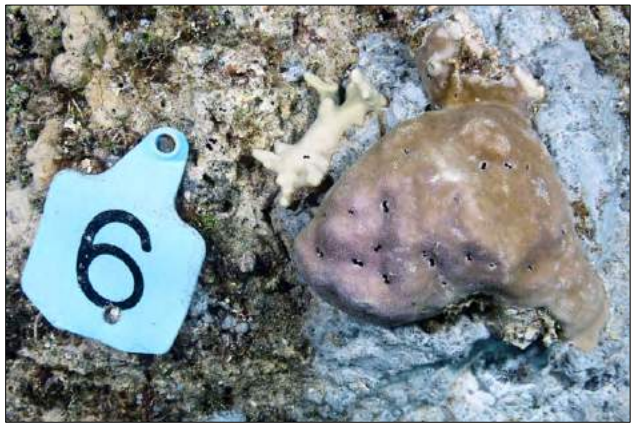

Photo B-6. *Porites* cf. *murrayensis*

Photo B-7. *Porites* cf. murrayensis

Photo B-8. *Porites rus*

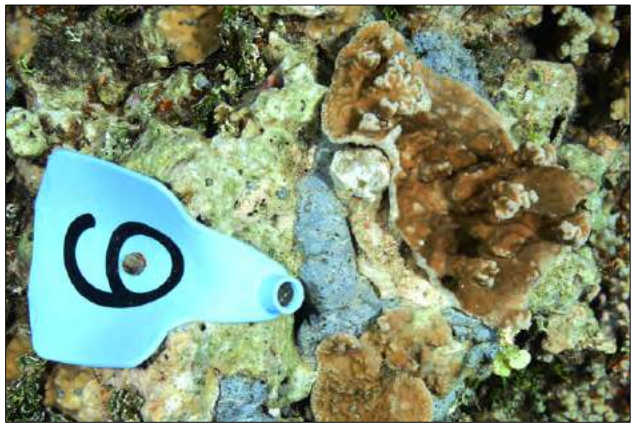

Photo B-9. *Porites rus*

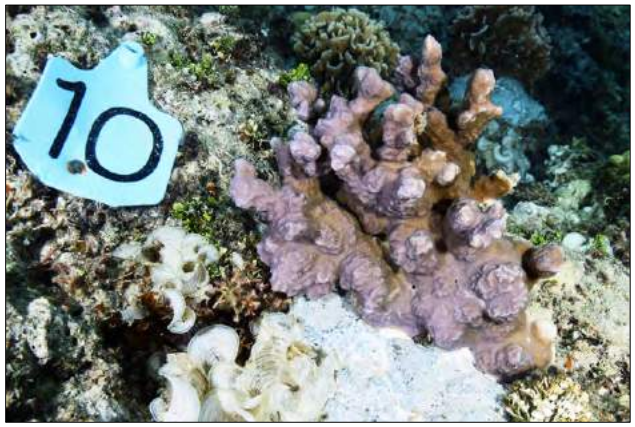

Photo B-10. *Porites rus*

Photo B-11. *Porites lobata*

Photo B-12 *Psammocora neirstrazi*

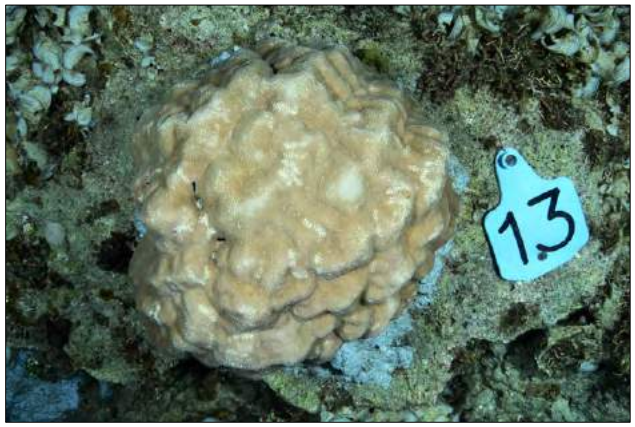

Photo B-13. *Porites solida*

Photo B-14. *Porites solida*

Photo B-15. *Porites lobata*

Photo B-16. *Porites lobata*

Photo B-17. *Porites lobata*

Photo B-18. *Porites lutea*

Photo B-19. *Pocillopora damicornis*

Photo B-20. *Pocillopora damicornis*

Photo B-21. *Pocillopora damicornis*

Photo B-22. *Pocillopora damicornis*

Photo B-23. *Pocillopora damicornis*

Photo B-24. *Pocillopora damicornis*

Photo B-25. *Pavona decussata*

Photo B-26. *Pavona decussata*

Photo B-27. *Pavona decussata*

Photo B-28. *Pavona decussata*

Photo B-29. *Pocillopora damicornis*

Photo B-30. *Pocillopora damicornis*

Photo B-31. *Pocillopora damicornis*

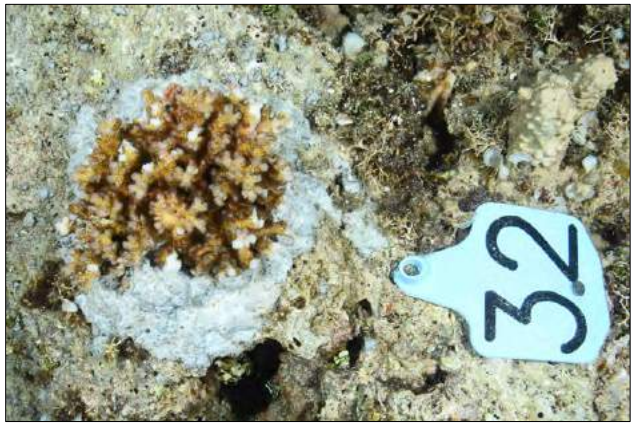

Photo B-32. *Pocillopora damicornis*

Photo B-33. *Porites lutea*

Photo B-34. *Porites lutea*

Photo B-35. *Favia favus*

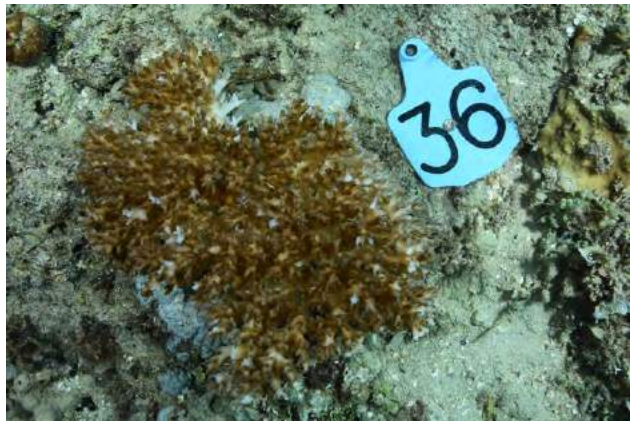

Photo B-36. *Pocillopora acuta*

Photo B-37. *Pocillopora acuta*

Photo B-38. *Pocillopora damicornis*

Photo B-39. *Pocillopora damicornis*

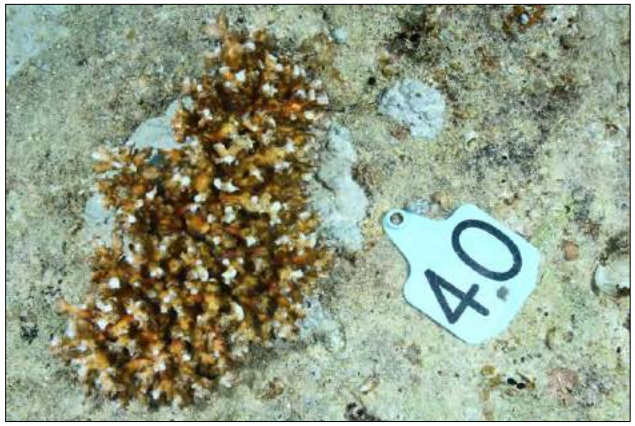

Photo B-40. *Pocillopora damicornis*

Photo B-41. *Pocillopora damicornis*

Photo B-42. *Pocillopora damicornis*

Photo B-43. *Pocillopora damicornis*

Photo B-44. *Pocillopora damicornis*

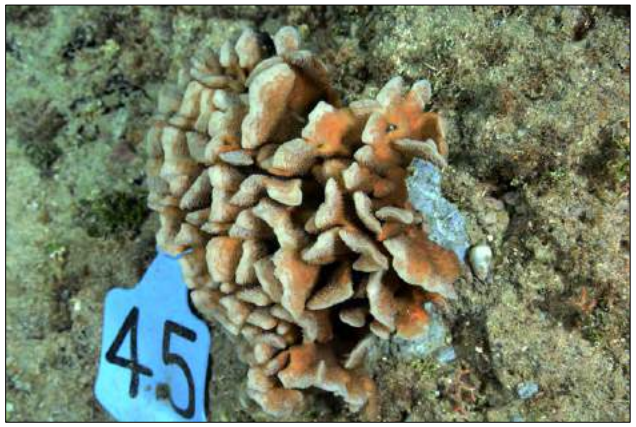

Photo B-45. *Pavona decussata*

Photo B-46. *Pavona decussata*

Photo B-47. *Pavona decussata*

Photo B-48. *Pavona decussata*

Photo B-49. *Pavona decussata*

Photo B-50. *Porites lutea*

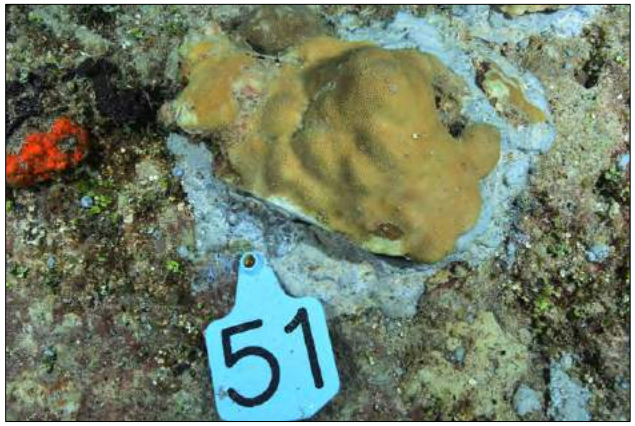

Photo B-51. *Porites solida*

Photo B-52. *Leptoseris incrustans*

Photo B-53. *Porites rus*

Photo B-54. *Favia matthaii*

Photo B-55. *Lobophyllia hemprichii*

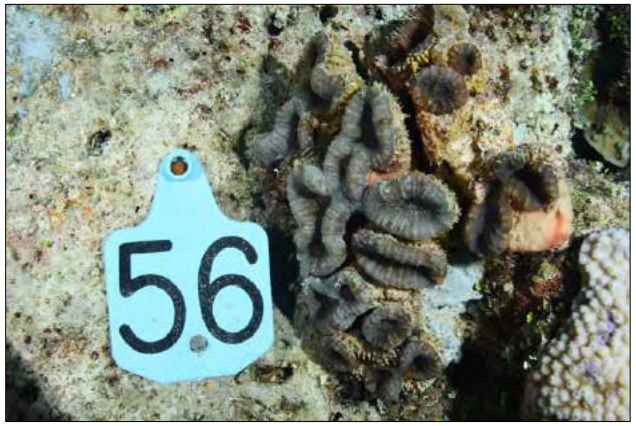

Photo B-56. *Lobophyllia hemprichii*

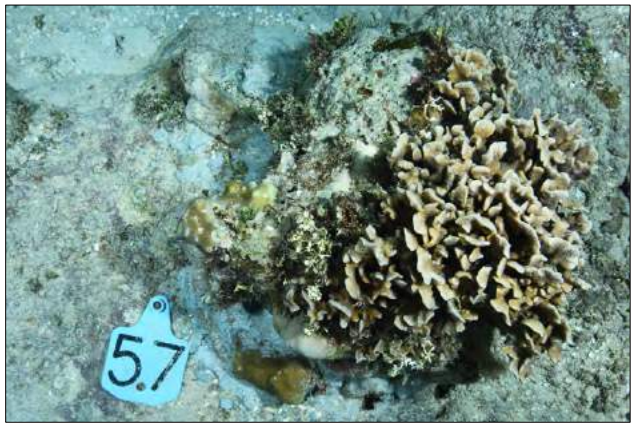

Photo B-57. *Pavona decussata*

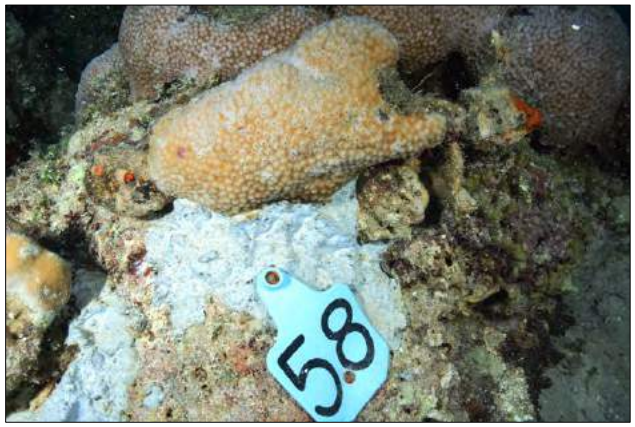

Photo B-58. *Astreopora cucullata*

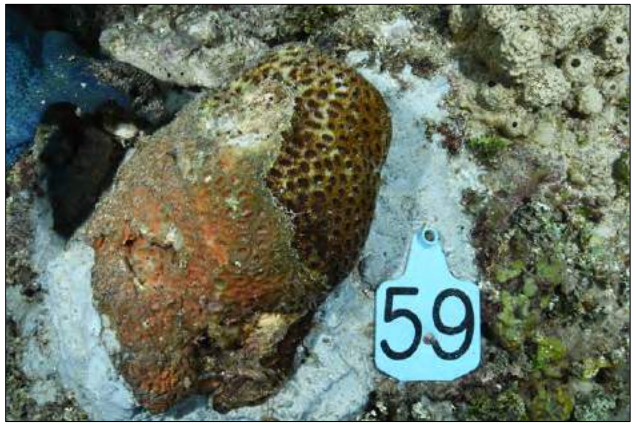

Photo B-59. *Favia matthaii*

Photo B-60. *Favia matthaii*

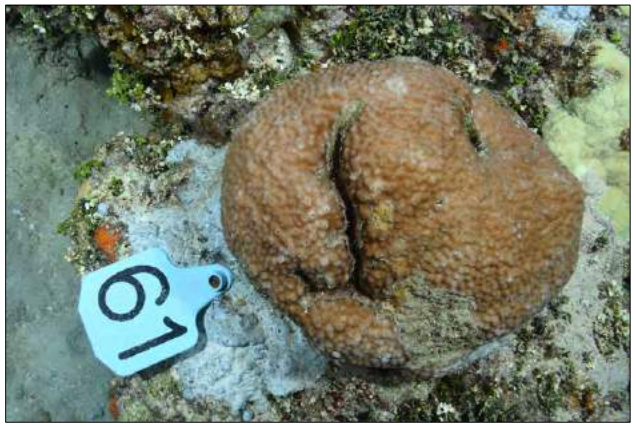

Photo B-61. *Astreopora cucullata*

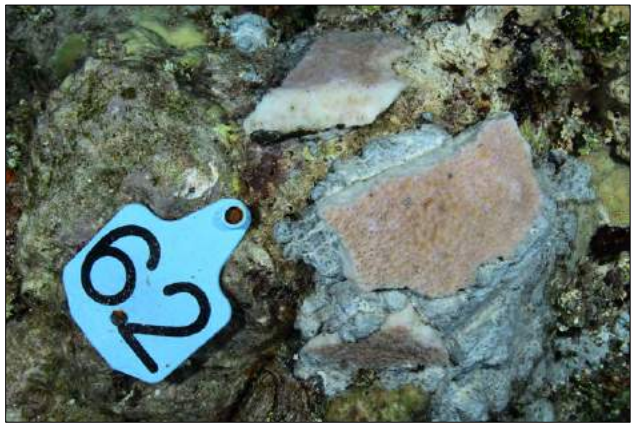

Photo B-62. *Astreopora listeri*

Photo B-63. *Lobophyllia hemprichii*

Photo B-64. *Lobophyllia hemprichii*

Photo B-65. *Leptastrea* cf. *purpurea*

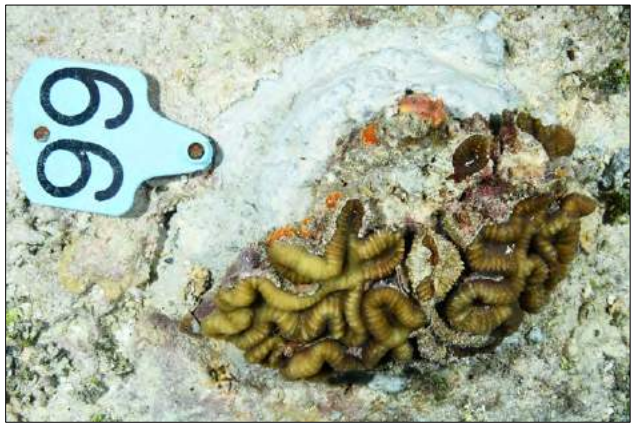

Photo B-66. *Lobophyllia hemprichii*

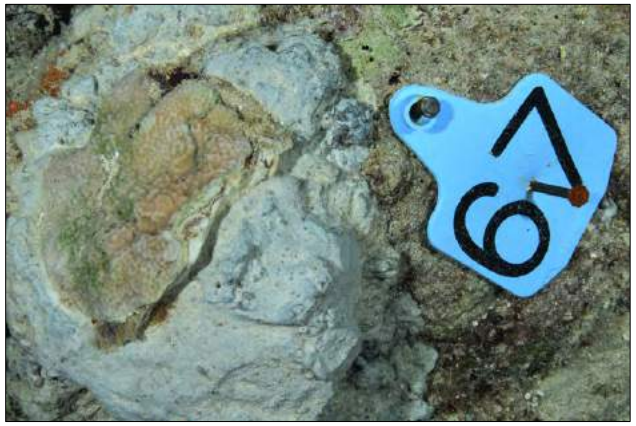

Photo B-67. *Porites horizontalata*

Photo B-68. *Lobophyllia hemprichii*

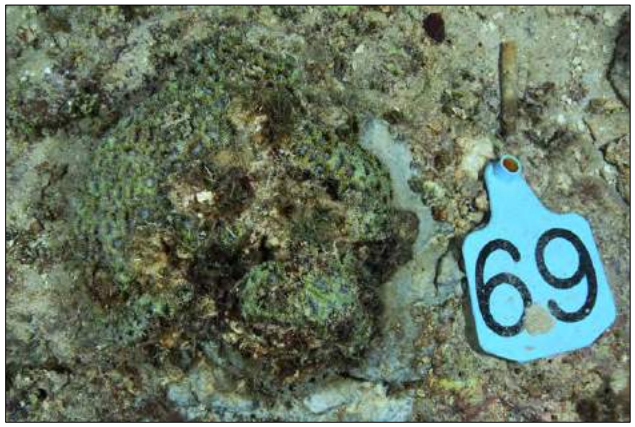

Photo B-69. *Favia matthaii*

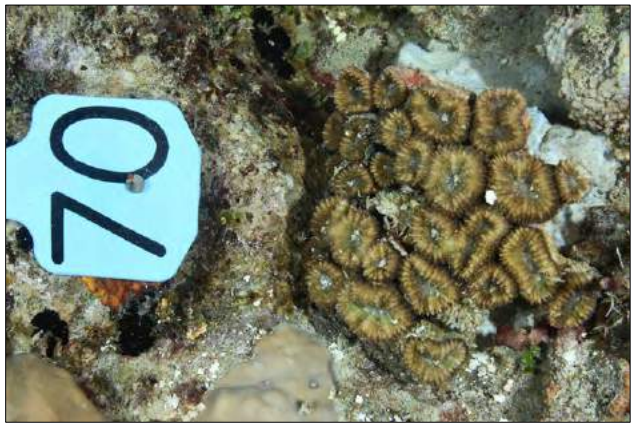

Photo B-70. *Lobophyllia corymbosa*

Photo B-71. *Lobophyllia hemprichii*

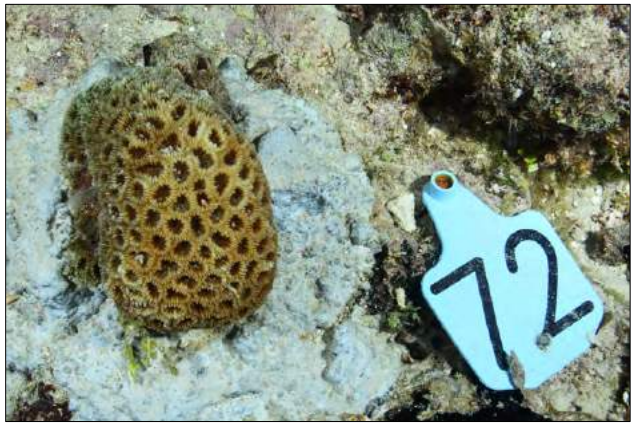

Photo B-72. *Favia matthaii*

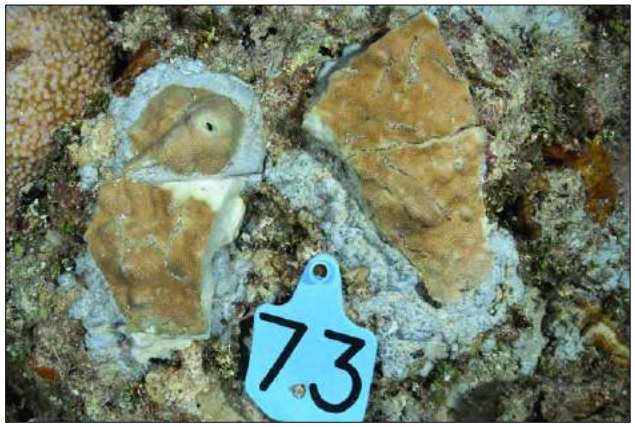

Photo B-73. *Porites ~lichen*

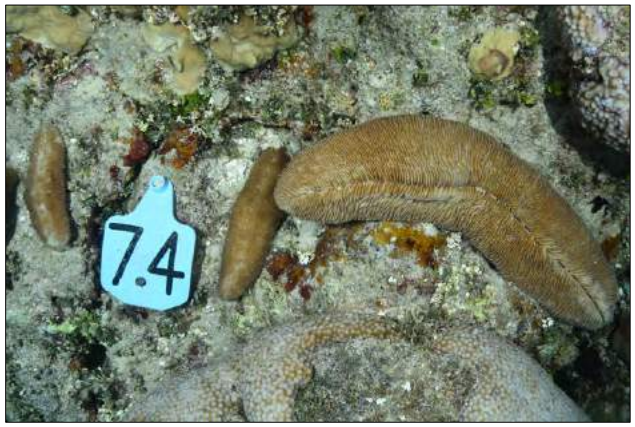

Photo B-74. *Herpolitha limax*

Photo B-75. *Astreopora gracilis*

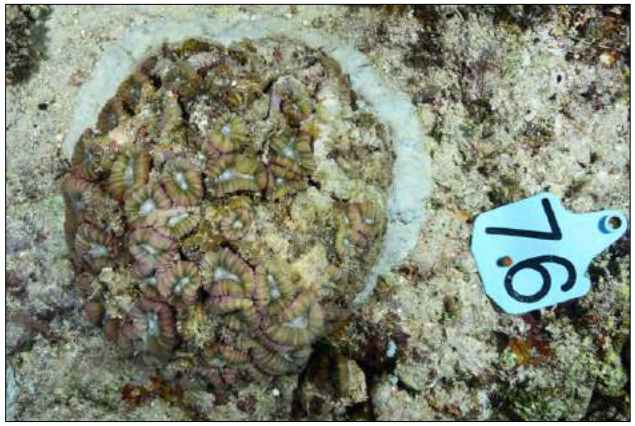

Photo B-76. *Lobophyllia hemprichii*

Photo B-77. *Lobophyllia corymbosa*

Photo B-78. *Astreopora cucullata*

Photo B-79. *Lobophyllia hataii*

Photo B-80. *Lobophyllia corymbosa*

Photo B-81. *Porites lobata*

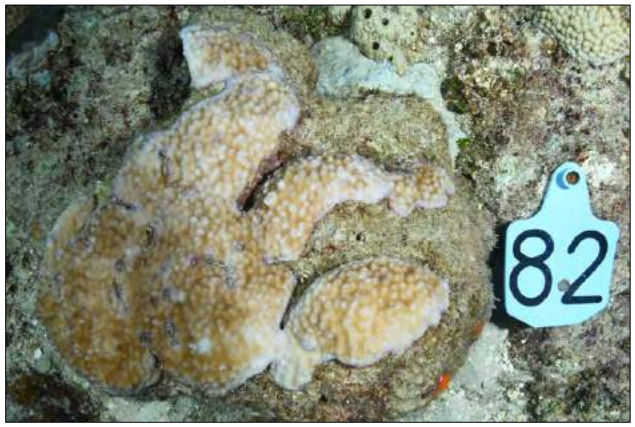

Photo B-82. *Astreopora gracilis*

Photo B-83. *Lobophyllia hemprichii*

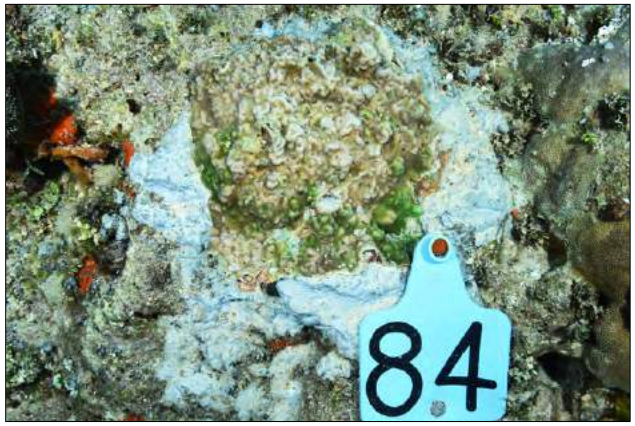

Photo B-84. *Leptoseris incrustans*

Photo B-85. *Lobophyllia hemprichii*

Photo B-86. *Astreopora myriophthalma*

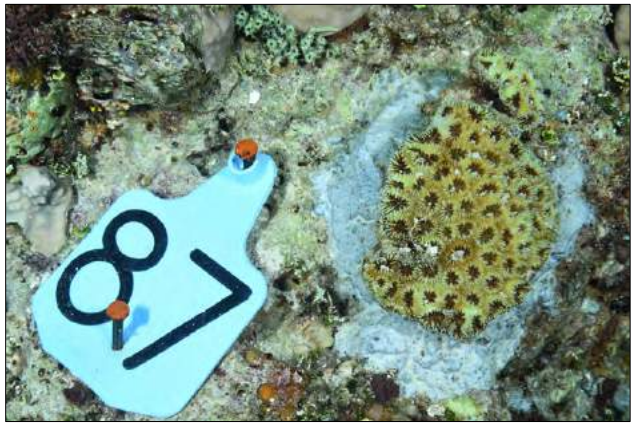

Photo B-87. *Favia matthaii*

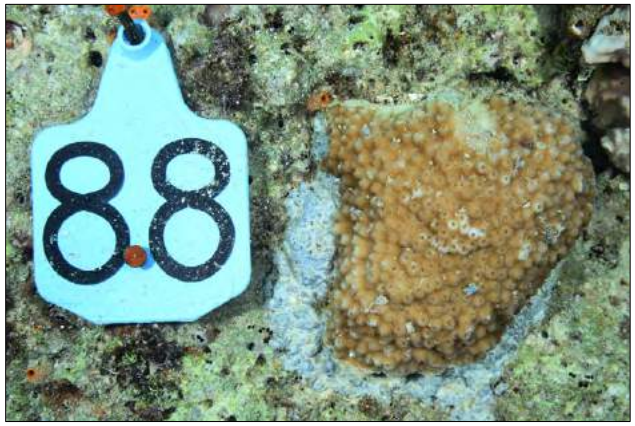

Photo B-88. *Astreopora cucullata*

Photo B-89. *Lobophyllia corymbosa*

Photo B-90. *Favia matthaii*

Photo B-91. *Lobophyllia hemprichii*

Photo B-92. *Porites lobata*

Photo B-93. *Cyphastrea chalcidicum*

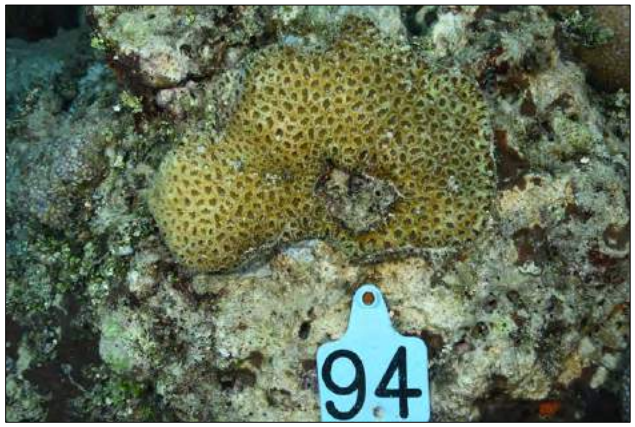

Photo B-94. *Favia matthaii*

Photo B-95 *Astreopora gracilis*

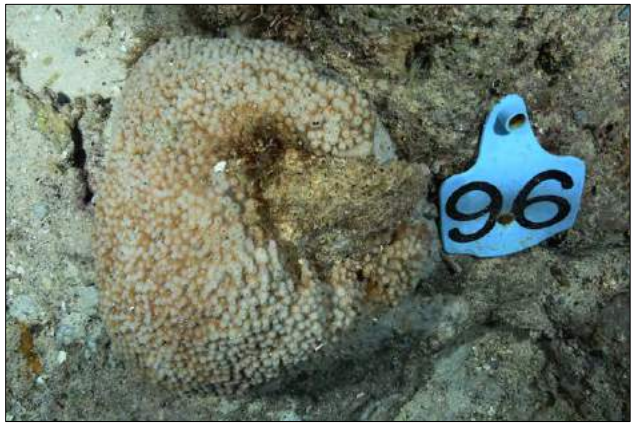

Photo B-96 *Astreopora cucullata*

Photo B-97. *Astreopora cucullata*

Photo B-98. *Lobophyllia hemprichii*

Photo B-99. *Astreopora cucullata*

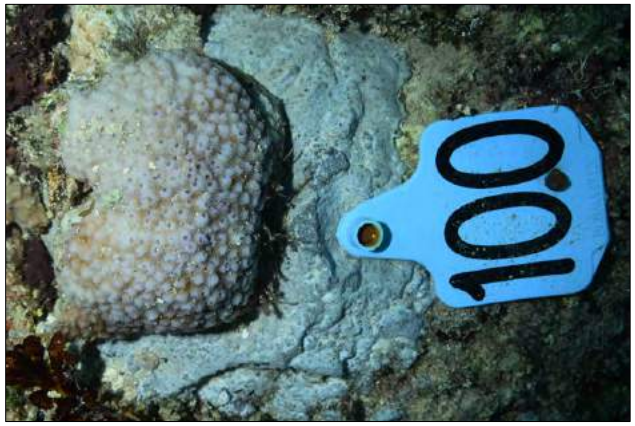

Photo B-100. *Astreopora cucullata*

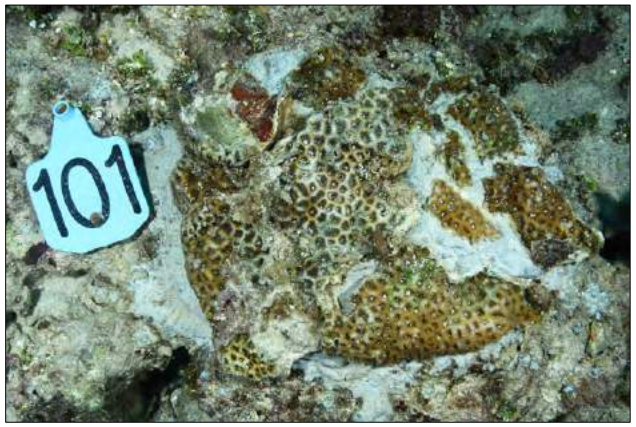

Photo B-101. *Phymastrea valenciennesi*

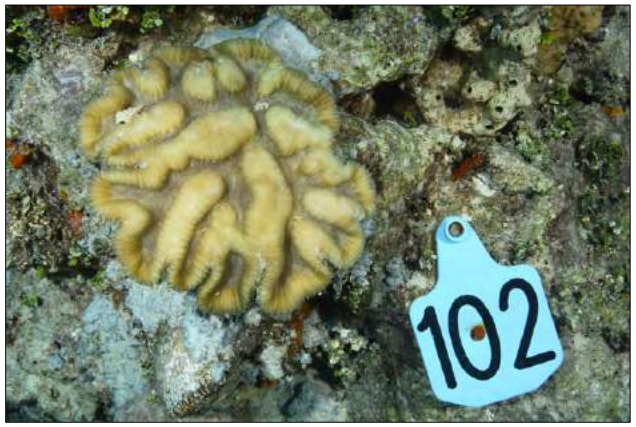

Photo B-102. *Lobophyllia hataii*

Photo B-103. *Astreopora elliptica*

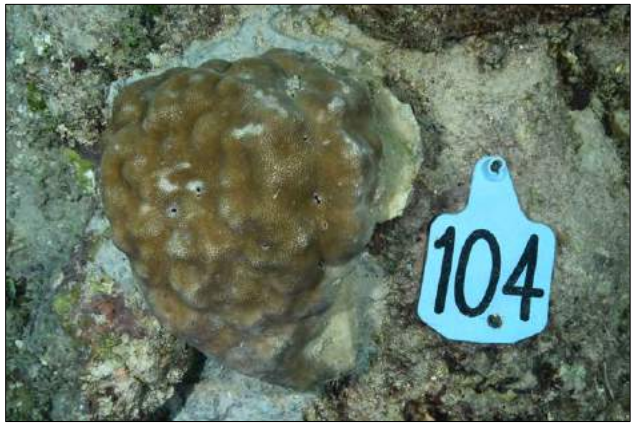

Photo B-104. *Porites lobata*

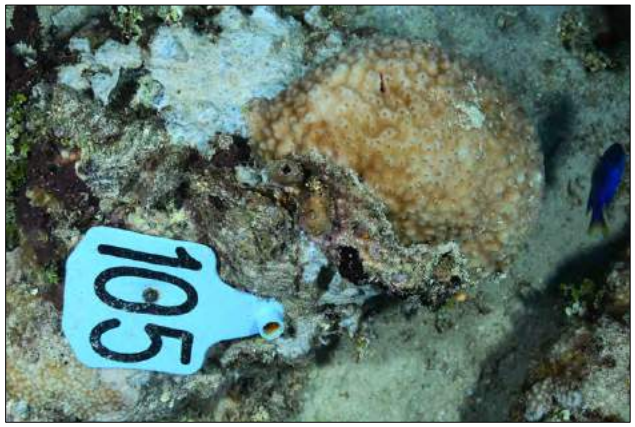

Photo B-105. *Astreopora cucullata*

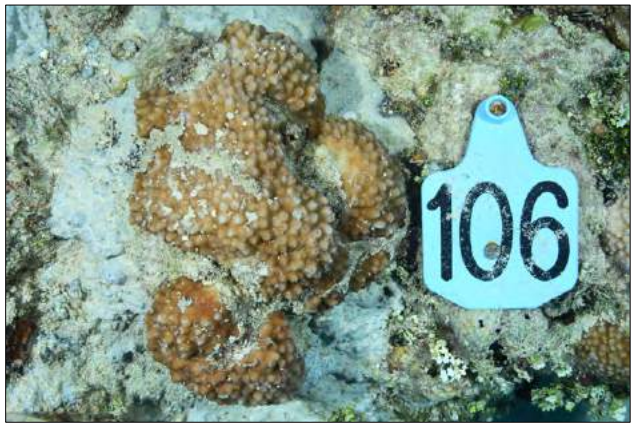

Photo B-106. *Astreopora gracilis*

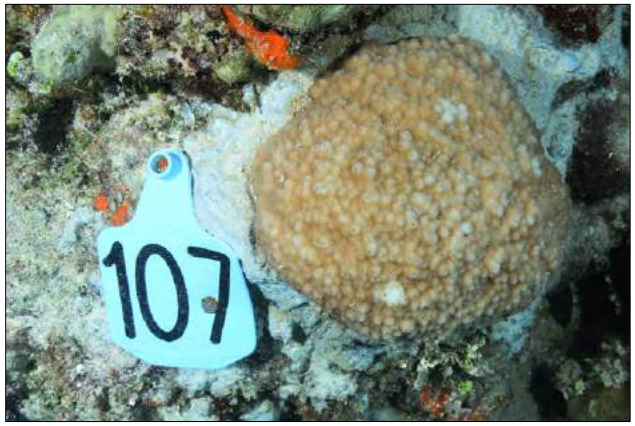

Photo B-107. *Astreopora elliptica*

Photo B-108. *Astreopora gracilis*

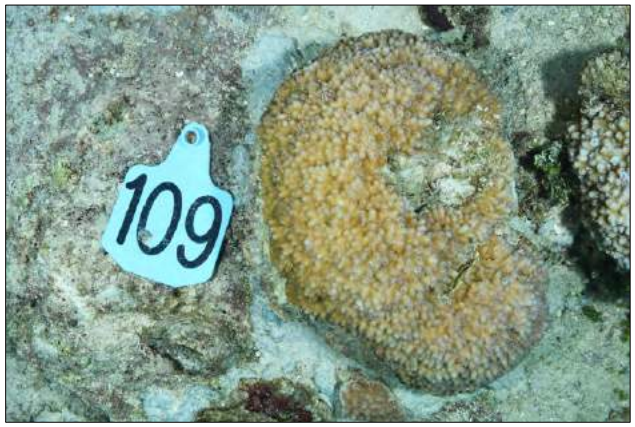

Photo B-109. *Astreopora gracilis*

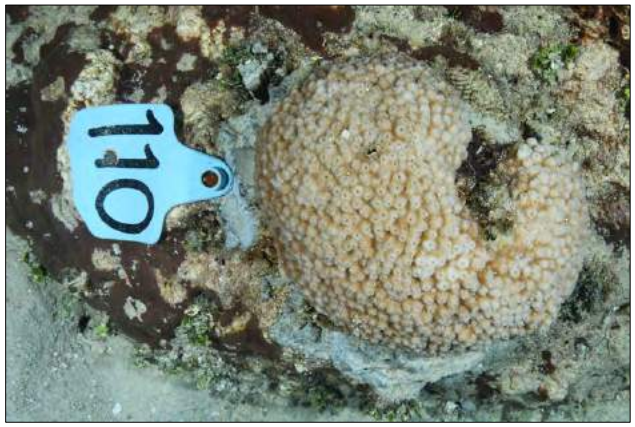

Photo B-110. *Astreopora cucullata*

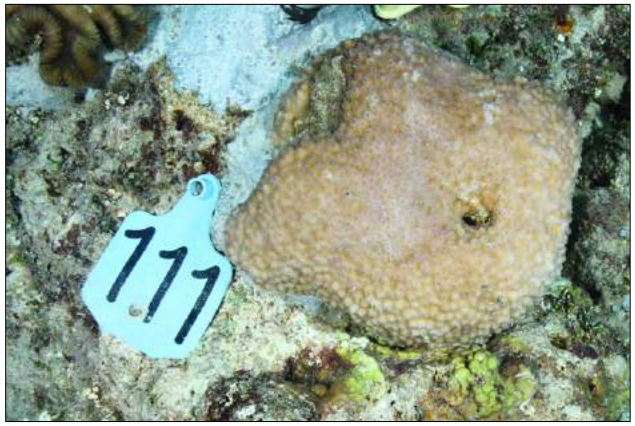

Photo B-111. *Astreopora cucullata*

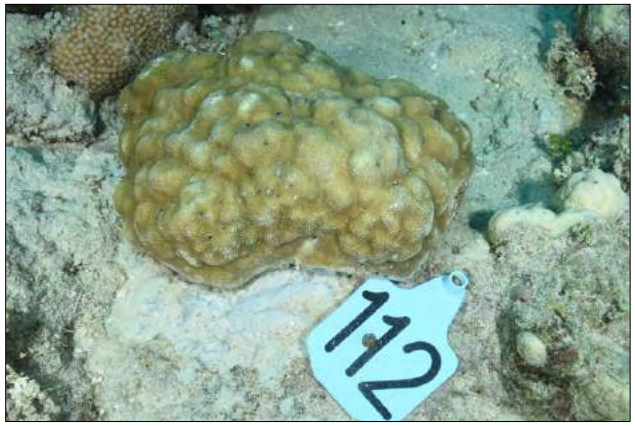

Photo B-112. *Porites lobata*

Photo B-113. *Lobophyllia corymbosa*

Photo B-114. *Lobophyllia corymbosa*

Photo B-115. *Lobophyllia corymbosa*

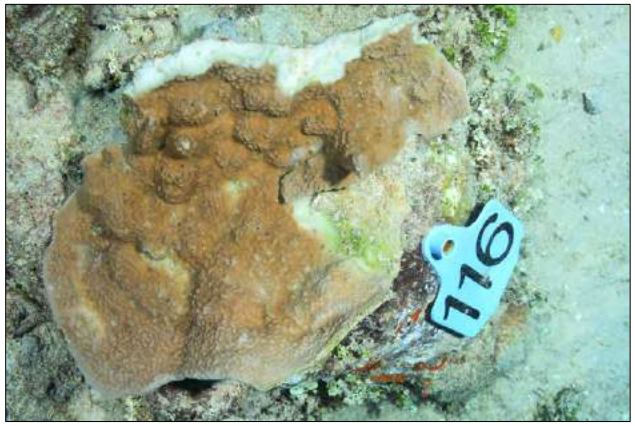

Photo B-116. *Porites horizontalata*

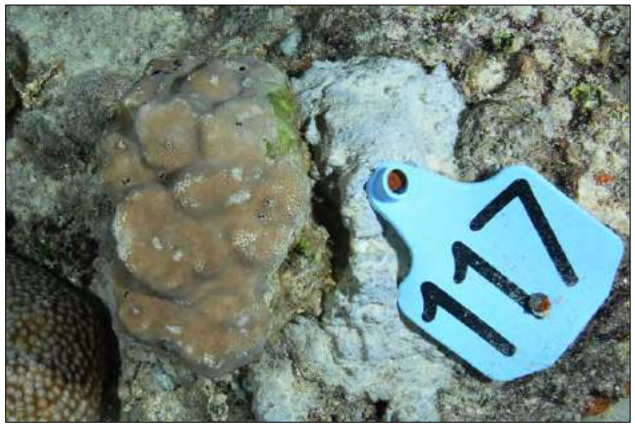

Photo B-117. *Porites lobata*

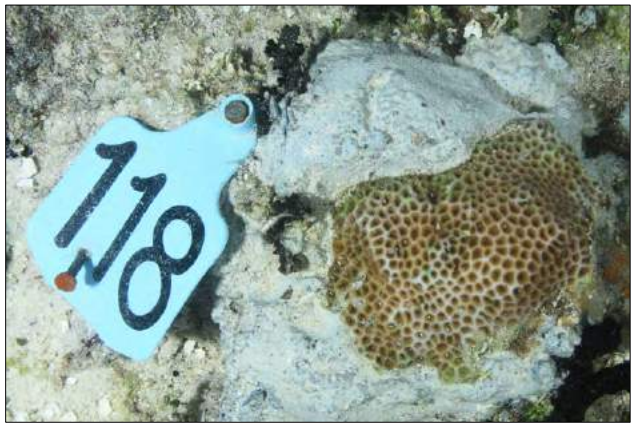

Photo B-118. *Leptastrea purpurea*

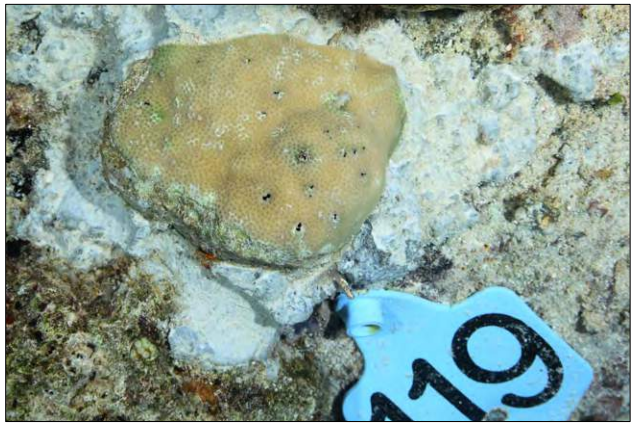

Photo B-119. *Porites lobata*

Photo B-120. *Porites lobata*

Photo B-121. *Lobophyllia hataii*

Photo B-122. *Lobophyllia hataii*

Photo B123. *Porites* aff. *lichen*

Photo B-124. *Porites rus*

Photo B-125. *Psammocora profundicella*

Photo B-126. *Leptastrea purpurea*

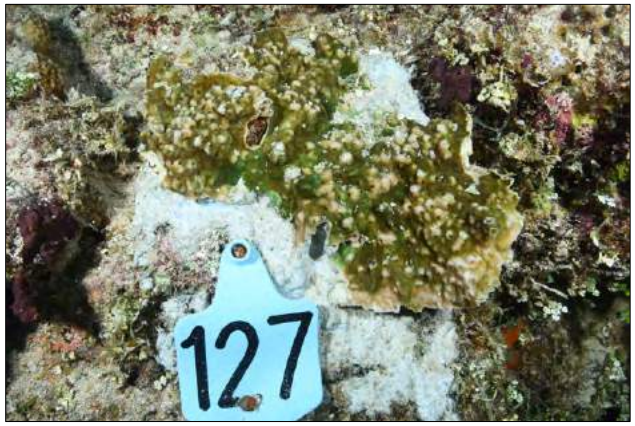

Photo B-127. Leptoseris incrustans

Photo B-128. Lobophyllia hataii

Photo B-129. *Lobophyllia hataii*

Photo B-130. *Porites lobata*

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Appendix C

Photographs of Tagged Reference Corals

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Photo C-200. *Pocillopora damicornis*

Photo C-201. *Pocillopora damicornis*

Photo C-202. *Pocillopora damicornis*

Photo C-203. *Pocillopora damicornis*

Photo C-204. *Pocillopora damicornis*

Photo C-205. *Pocillopora damicornis*

Photo C-206. *Pocillopora damicornis*

Photo C-207. *Pocillopora damicornis*

Photo C-208. *Pocillopora damicornis*

Photo C-209. *Pocillopora damicornis*

Photo C-210. *Pocillopora damicornis*

Photo C-211. *Pocillopora damicornis*

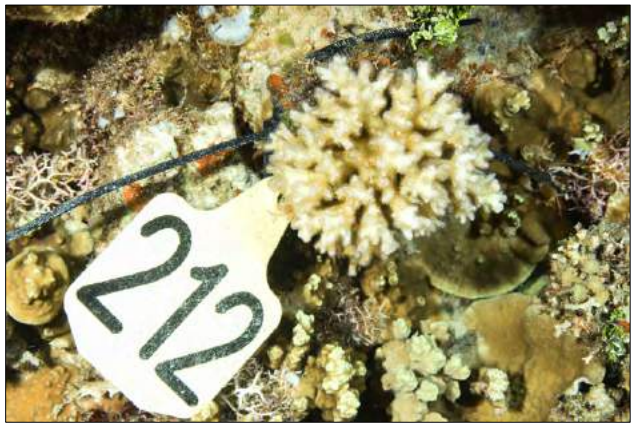

Photo C-212. *Pocillopora damicornis*

Photo C-213. *Porites cylindrica*

Photo C-214. *Porites cylindrica*

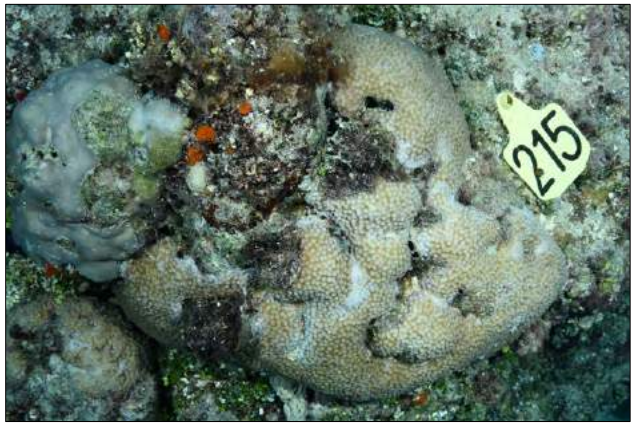

Photo C-215. *Astreopora cucullata*

Photo C-216. *Porites monticulosa*

Photo C-217. *Porites monticulosa*

Photo C-218. *Porites rus*

Photo C-219. *Porites rus*

Photo C-220. *Psammocora neirstrazi*

Photo C-221. *Porites lutea*

Photo C-222. *Porites lutea*

Photo C-223. *Porites lutea*

Photo C-224. *Porites lutea*

Photo C-225. *Porites lutea*

Photo C-226. *Porites murrayensis*

Photo C-227. *Porites murrayensis*

Photo C-228. *Porites solida*

Photo C-229. *Porites solida*

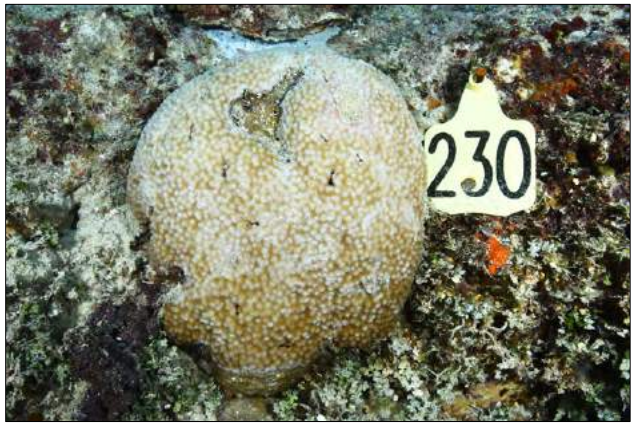

Photo C-230. *Astreopora cucullata*

Photo C-231. *Astreopora gracilis*

Photo C-232. *Porites lutea*

Photo C-233. Leptastrea purpurea

Photo C-234. *Astreopora gracilis*

Photo C-235. *Astreopora cucullata*

Photo C-236. *Astreopora cucullata*

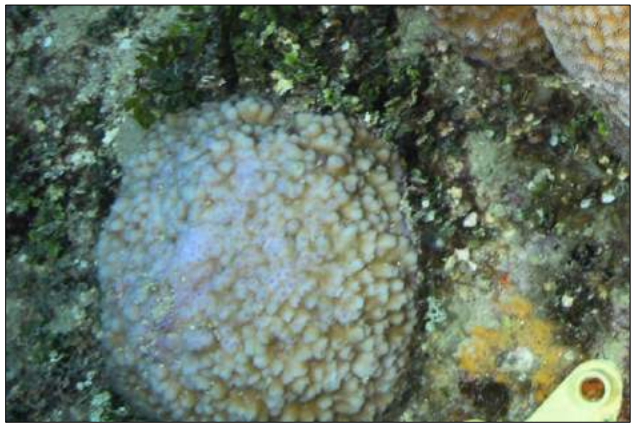

Photo C-237. *Astreopora gracilis*

Photo C-238. *Astreopora myriophthalma*

Photo C-239. *Astreopora gracilis*

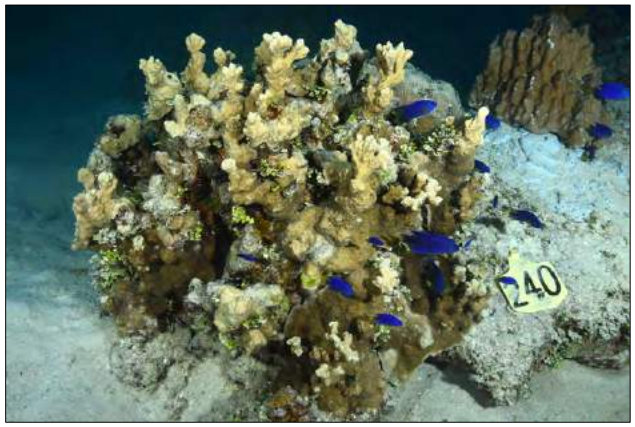

Photo C-240. *Porites rus*

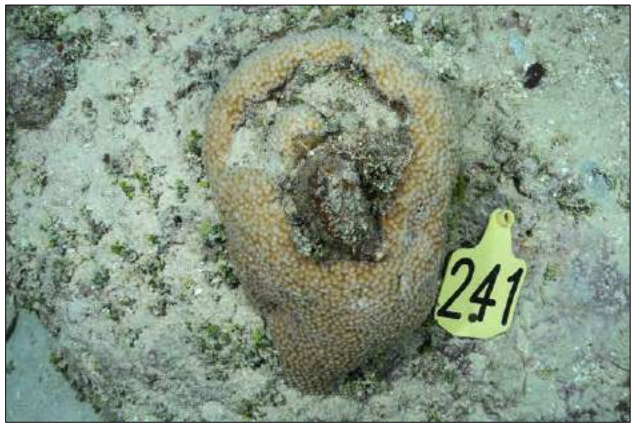

Photo C-241. *Astreopora cucullata*

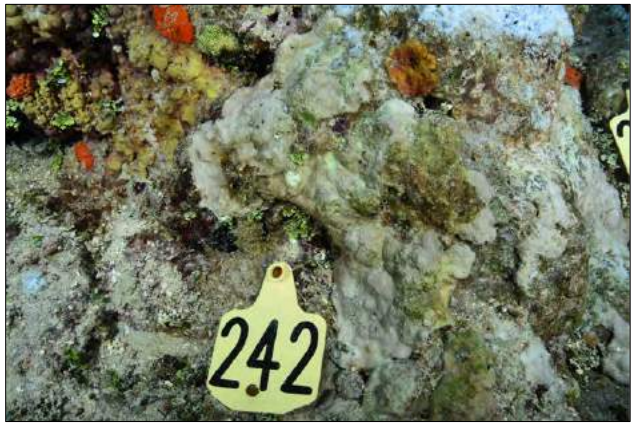

Photo C-242. *Porites horizontalata*

Photo C-243. *Porites lutea*

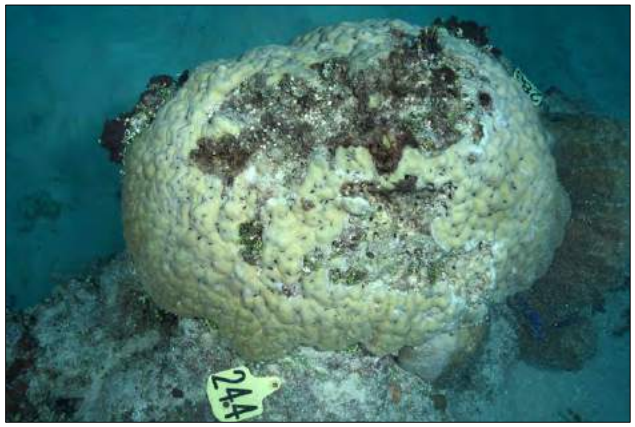

Photo C-244. *Porites lobata*

Photo C-245. *Leptoseris incrustans*

Photo C-246. *Astreopora cucullata*

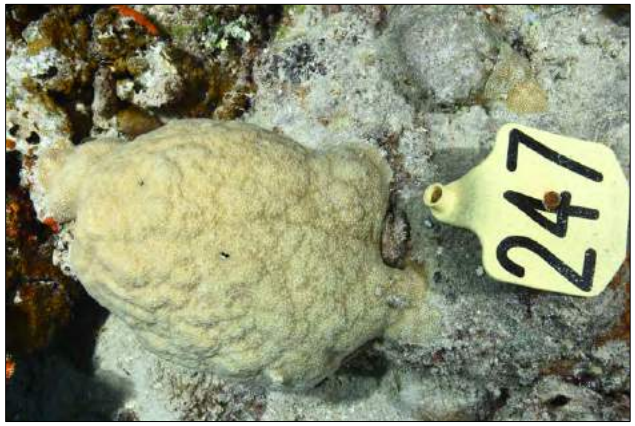

Photo C-247. *Porites* aff. *lichen*

Photo C-248. *Porites* aff. *lichen*

Photo C-249. *Porites horizontalata*

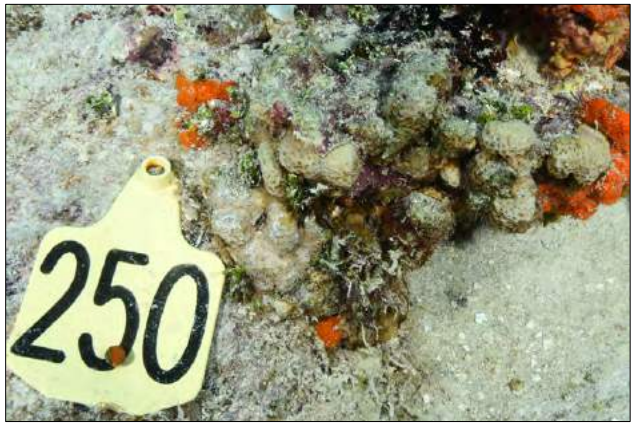

Photo C-250. *Psammocora profundicella*

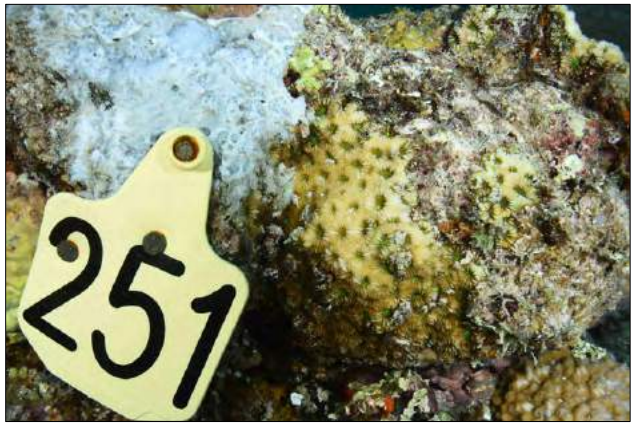

Photo C-251. *Phymastrea valenciennesi*

Photo C-252. *Astreopora cucullata*

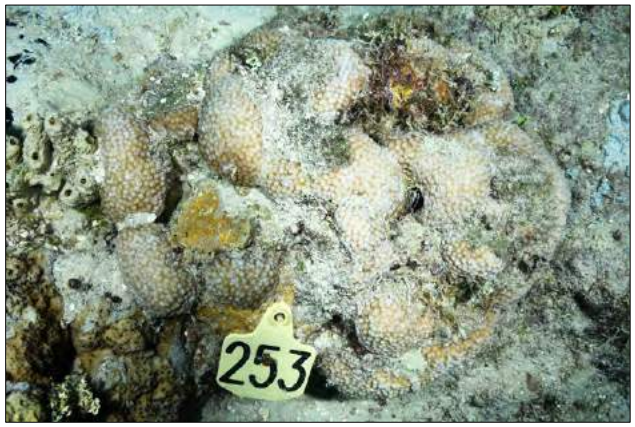

Photo C-253. *Astreopora cucullata*

Photo C-254. *Lobophyllia corymbosa*

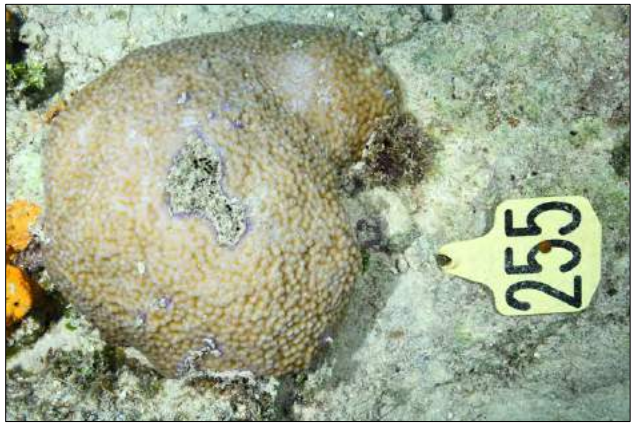

Photo C-255. *Astreopora cucullata*

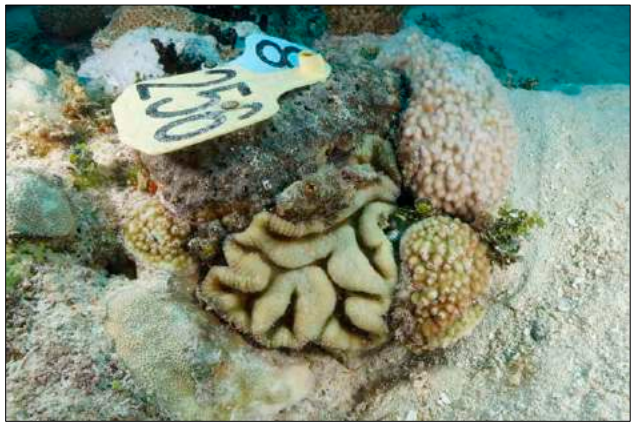

Photo C-256. *Lobophyllia hemprichii*

Photo C-257. *Lobophyllia hemprichii*

Photo C-258. *Lobophyllia corymbosa*

Photo C-259. *Leptastrea transversa*

Photo C-260. *Lobophyllia corymbosa*

Photo C-261. *Herpolitha limax*

Photo C-262. *Favia favus*

Photo C-263. *Porites lutea*

Photo C-264. *Porites lobata*

Photo C-265. *Porites lobata*

Photo C-266. *Porites lutea*

Photo C-267. *Porites lobata*

Photo C-268. *Astreopora listeri*

Photo C-269. *Astreopora cucullata*

Photo C-270. *Porites solida*

Photo C-271. *Lobophyllia corymbosa*

Photo C-272. *Leptastrea purpurea*

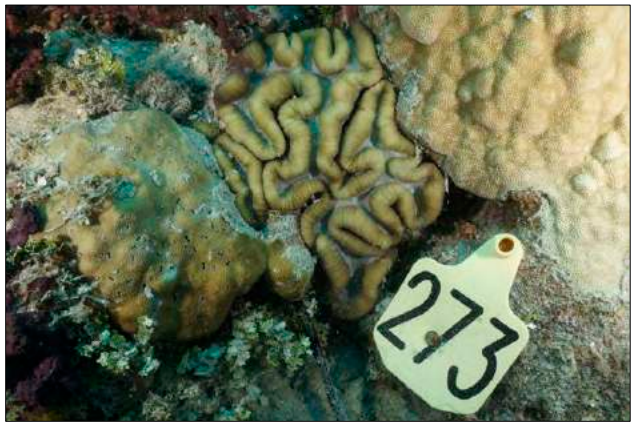

Photo C-273. *Lobophyllia hemprichii*

Photo C-274. *Favia favus*

Photo C-275. *Favia matthaii*

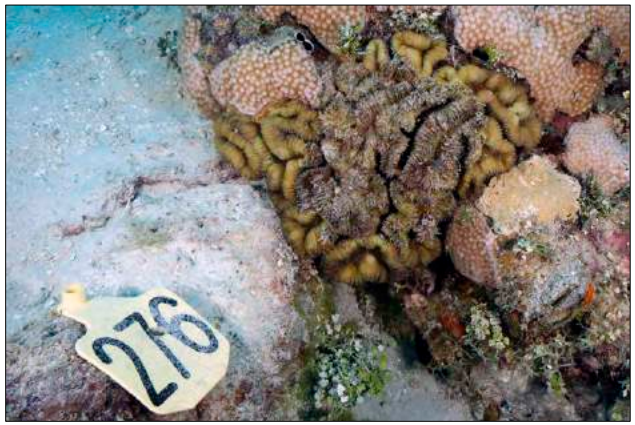

Photo C-276. *Lobophyllia hemprichii*

Photo C-277. *Lobophyllia corymbosa*

Photo C-278. *Astreopora gracilis*

Photo C-279. *Lobophyllia hemprichii*

Photo C-280. *Astreopora cucullata*

Photo C-281. *Astreopora gracilis*

Photo C-282. *Favia* cf. *matthaii*

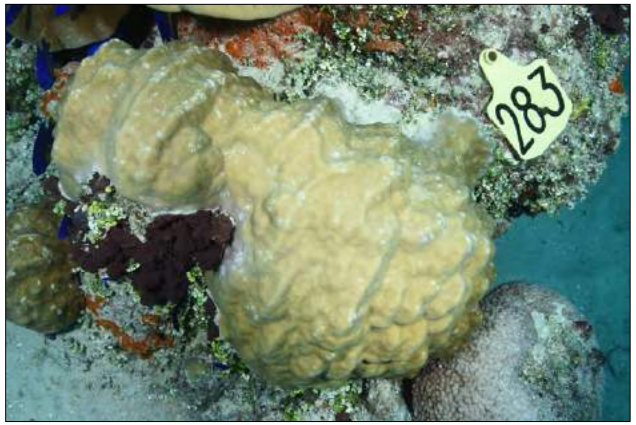

Photo C-283. *Porites lobata*

Photo C-284. *Astreopora cucullata*

Photo C-285. *Astreopora gracilis*

Photo C-286. *Astreopora cucullata*

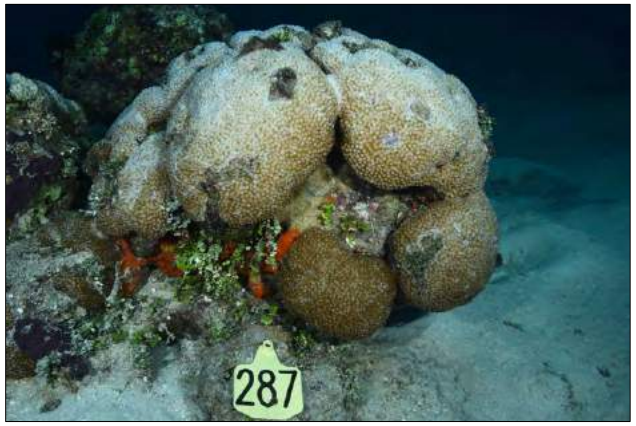

Photo C-287. *Astreopora cucullata*

Photo C-288. *Porites lobata*

Photo C-289. *Astreopora cucullata*

Photo C-290. *Astreopora cucullata*

Photo C-291. *Porites lutea*

Photo C-292. *Astreopora gracilis*

Photo C-293. *Astreopora cucullata*

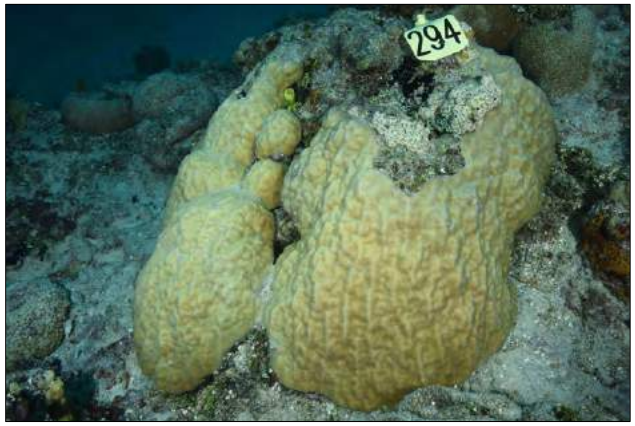

Photo C-294. *Porites lutea*

Photo C-295. P*orites lobata*

Photo C-296. *Astreopora cucullata*

Photo C-297. *Porites lobata*

Photo C-298. *Porites lobata*

Photo C-299. *Porites lutea*

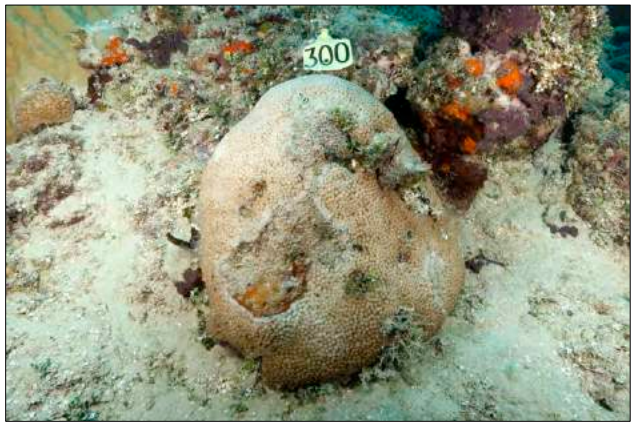

Photo C-300. *Astreopora cucullata*