RESTORE MT17 Mesophotic Cruise. Ship: R/V Manta. ROV: Mohawk

Santiago Herrera
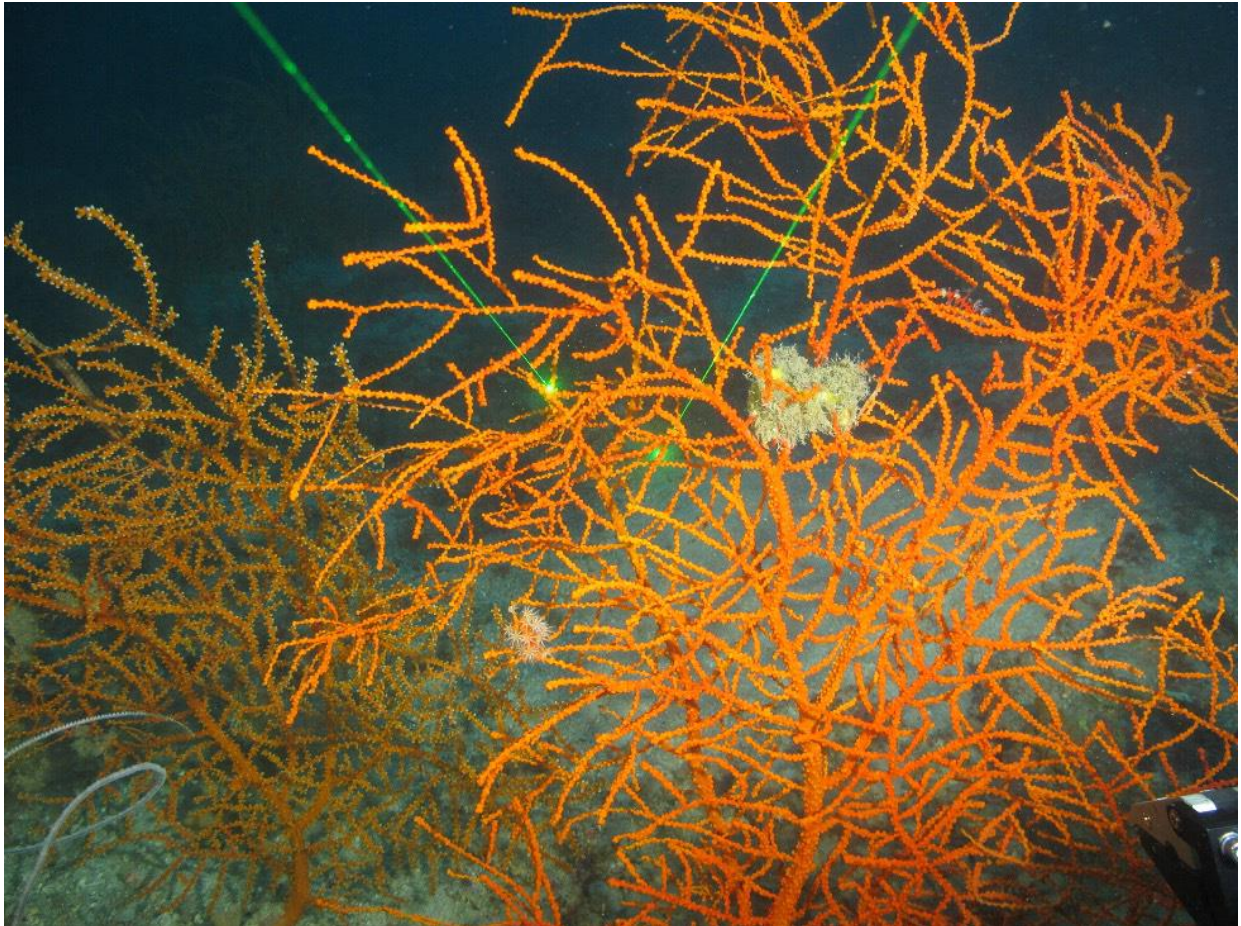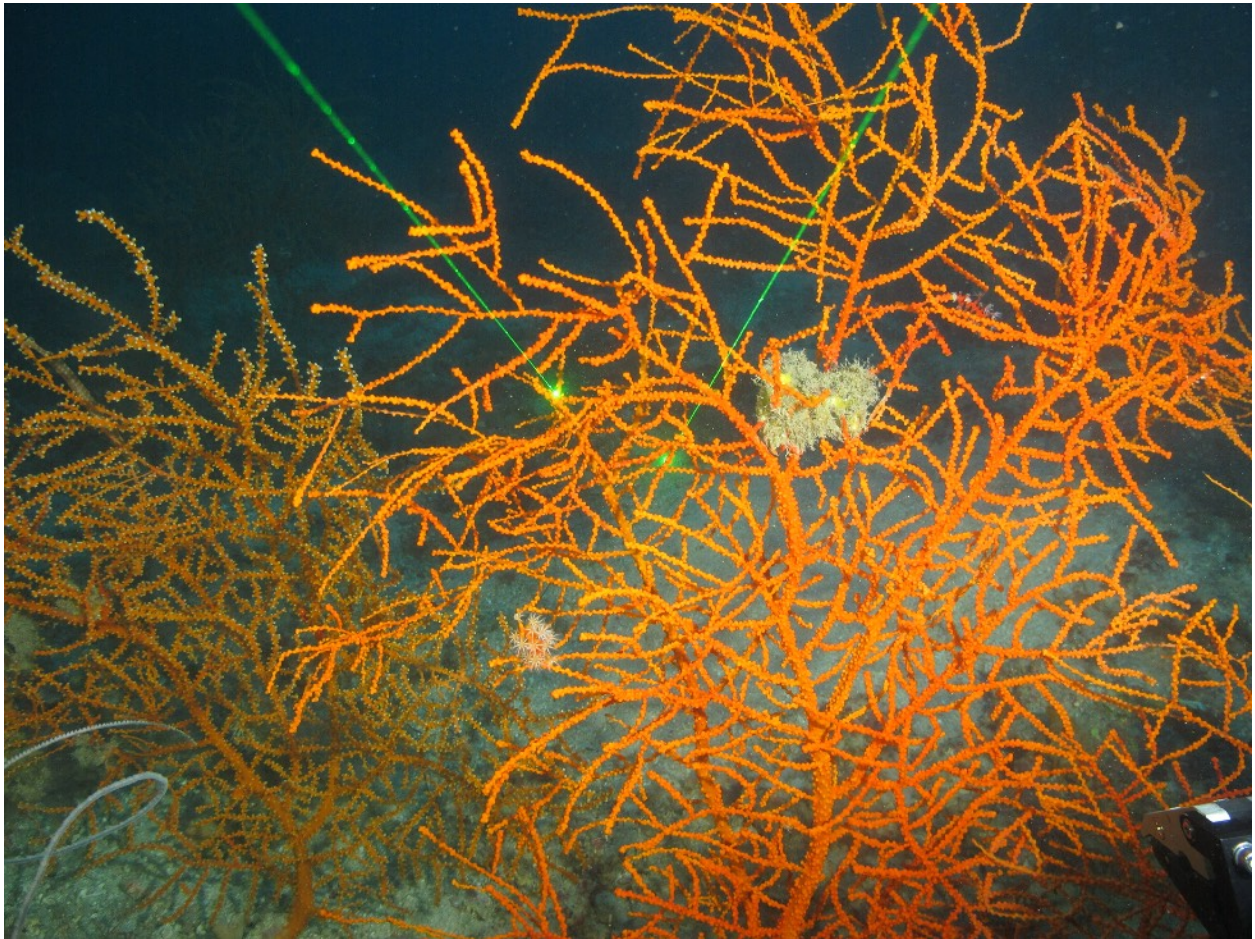
RESTORE MT17

Mesophotic Cruise

Ship: R/V Manta

ROV: Mohawk

Chief Scientist: Santiago Herrera, PhD[1]

Dates: October 8 - 13, 2017

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INTRODUCTION

The Gulf of Mexico (GoM) has experienced numerous environmental catastrophes (oil spills, anoxic events) in recent history. With continued anthropogenic threats coupled with the pervasive threat of global ocean change, there is an urgent need to make decisions that will lead to the effective management and conservation of vulnerable marine ecosystems in the GoM. Deepwater corals (living deeper than 50 m) play a foundational role in such ecosystems by generating three-dimensional structures that provide habitats for diverse and abundant invertebrate and fish communities, including refuge and prey for commercially valuable fisheries. As such, the GoM Fishery Management Council (GMFMC) is currently considering designating a number of deepwater coral areas in the northern GoM as Habitat Areas of Particular Concern. Furthermore, the Flower Garden Banks National Marine Sanctuary (FGBNMS) has proposed to expand the boundaries of current protected areas to encompass additional mesophotic and deepwater coral sites. The establishment of Marine Protected Areas is one of the key restoration strategies for deep benthic communities impacted by human disturbances (PDARP, 2016).
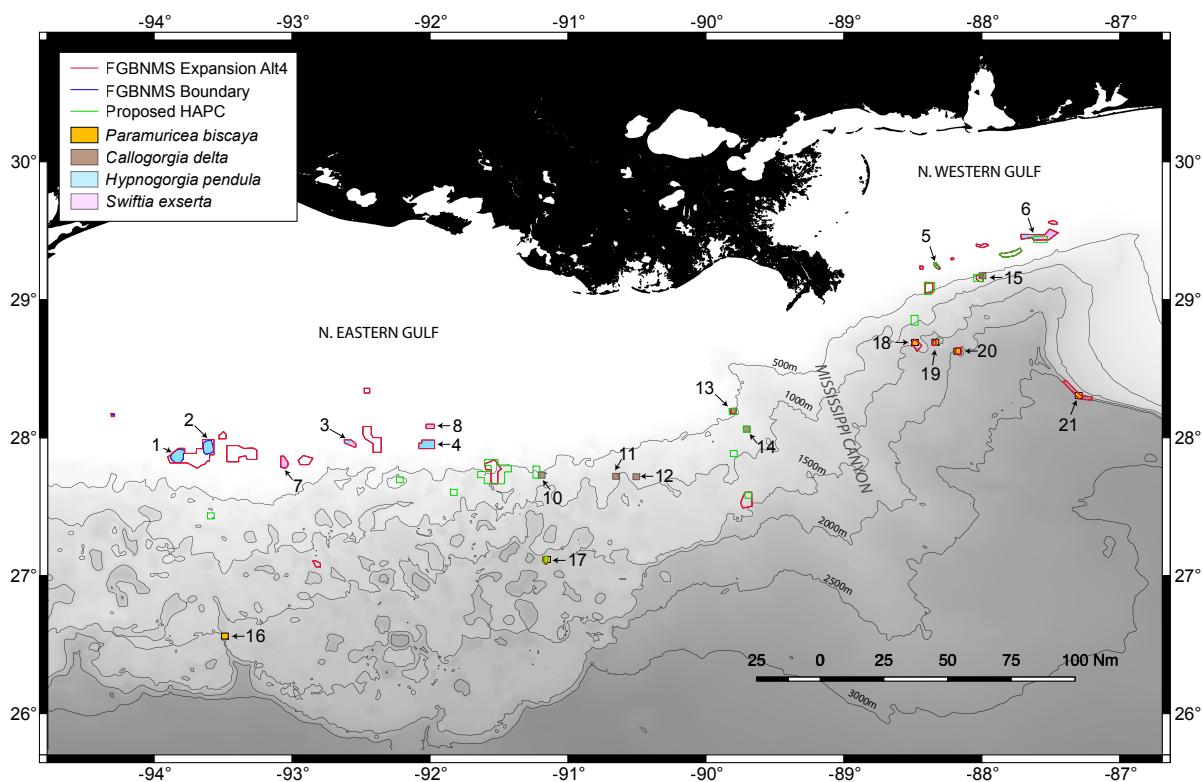

Figure 1. Map showing current and proposed expansion boundaries for the FGBNMS (Alternative 4), priority areas under consideration for protection as HAPCs by the GoM Fishery Management Council, and locations of significant populations of target coral species. Data for HAPCs under evaluation as of 2016 provided M. Kilgour, Fishery Biologist, GoM FMC. Data for expansion boundaries for the FGBMNS as of 2016 provided by E. Hickerson. 1. West Flower Garden Bank, 2. East Flower Garden Bank, 3. Geyer Bank, 4. Parker Bank, 5. Alabama Alps, 6. Roughtongue Reef, 7. McGrail Bank, 8. Alderdice Bank, 9. Diaphus Bank, 10. GC235, 11. GC246, 12. GC249, 13. MC751, 14. MC885, 15. VK826, 16. KC405, 17. GC852, 18. MC294, 19. MC297, 20. MC344, 21 DC673.

To help guide management decisions, this project '**Research Priority: Population Connectivity of Deepwater Corals in the Northern Gulf of Mexico**', funded by the NOAA RESTORE Science Program, aims to address crucial gaps in the understanding of the processes that shape population connectivity patterns in habitat-forming deepwater and mesophotic corals in the GoM, including species directly impacted by the Deepwater Horizon oil spill. This project addresses the fundamental question: To what degree are populations of deepwater corals connected in the northern GoM? Target coral species occur at three depth ranges: mesophotic (50-150 m), upper continental slope (400-1100 m), and lower continental slope (1300-2400 m). Specifically, this project aims to: 1) Define spatial scales of coral population genetic structure and differentiation; 2) Infer directionality and relative rate of genetic exchange among coral populations to establish source/sink relationships. This project integrates field sampling, state-of-the-art population genomic analyses and physical oceanographic modeling approaches to achieve these aims. This collaborative effort explicitly links basic research that will enhance the understanding of GoM ecosystems with concrete restoration and conservation initiatives to ensure recovery of degraded deepwater coral communities.

This research expedition, RESTORE MT17, was the second expedition of the project. Deepwater corals were collected between October 8 - 13, 2017, using the R/V Manta, owned and operated by the FGBNMS; and the ROV Mohawk, operated by the University of North Carolina–Wilmington's Undersea Vehicle Program and owned by the National Marine Sanctuaries Foundation (NMSF). Operations were conducted 12h/day.

PRIMARY OBJECTIVES

The objectives of this expedition were to locate and sample biological specimens from mesophotic coral habitats in the FGBNMS (Figure 1) between 50 (150 ft) and 100 meters (300 ft). Two octocoral species were targeted in this expedition: *Hypnogorgia pendula* and *Swiftia exserta*. Populations of these species were impacted by the DWH oil spill (Etnoyer et al., 2016; Silva et al., 2016). Samples were preserved onboard for population genetic studies. Specifically, the primary objectives of this expedition were to:

(1) locate known populations of mesophotic coral species in the areas protected by the FGBNMS;
(2) collect deepwater coral specimens for population genetic analyses and DNA barcoding;

SECONDARY OBJECTIVES

This expedition provided the opportunity to support additional ongoing projects that aim to increase our understanding of the biology and ecology of deepwater coral species and associated fauna in the Gulf of Mexico. The secondary objectives of this expedition was to:

(3) collect video and image data of deepwater coral benthic communities;
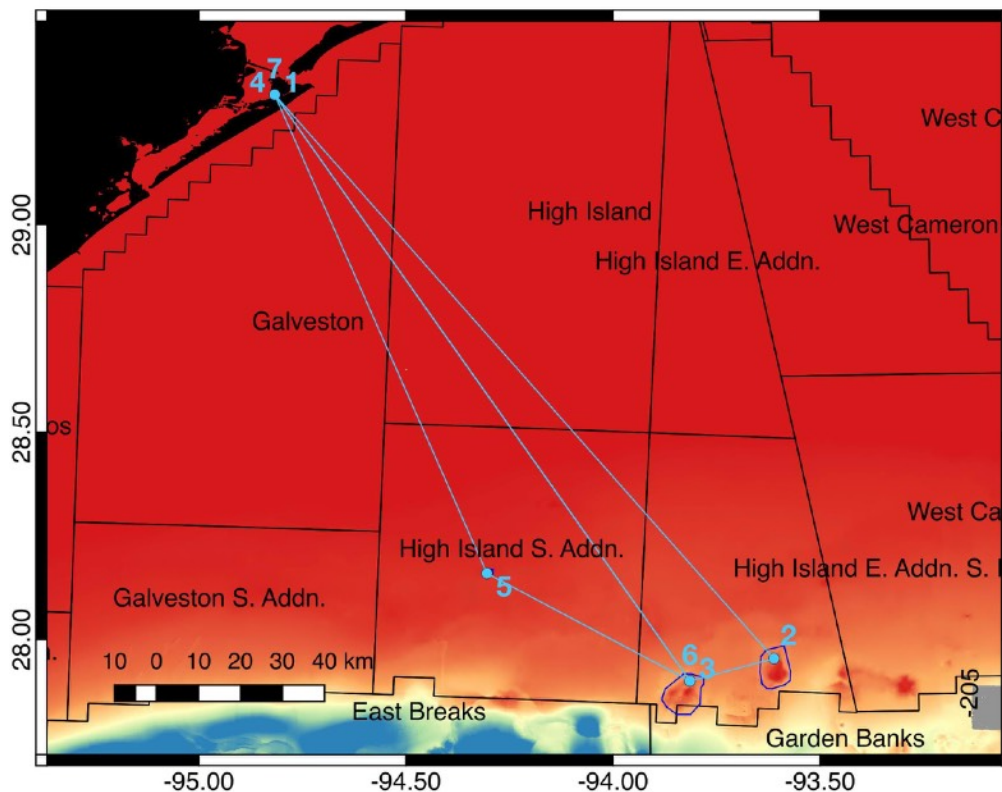
EXPEDITION MAP

Figure 2. Map showing the operational area of the expedition aboard the R/V Manta (RESTORE MT17: October 8 - 13, 2017) that sampled mesophotic coral ecosystems in the northern Gulf of Mexico using ROV Mohawk. Blue lines indicate the cruise track. Numbers indicate the order of the sites visited during the expedition: 1,4,7 Galveston, TX; 2 East Flower Garden Bank; 3,6 West Flower Garden Bank; 5 Stetson Bank.

METHODOLOGY

ROV sample collections

The primary purpose of ROV operations was to make non-lethal collections of tissue samples from coral colonies belonging to the species *Hypnogorgia pendula* and *Swiftia exserta*. Tissue samples from up to thirty (30) individuals from the primary target species were collected at each visited site.

The ROV utilized in this operations was the ROV Mohawk (manufactured by Sub-Atlantic, owned by the National Marine Sanctuary Foundation and operated by UNCW-undersea vehicles program). The ROV was launched at each dive site from the ship using an A-frame and lowered on a cable using a power winch. Imagery and documentation of species associations was also conducted during the ROV dives using a High-

Definition video camera and a digital stills camera mounted on the front of the ROV. A pair of lasers spaced 10cm apart were utilized as size scale.

During ROV deployment, an acoustic telemetry system was used to track the ROV underwater. The acoustic tracking system was an ultra-short baseline (USBL) telemetry system. The tracking system consists of a transponder unit mounted on the ROV (LinkQuest TN1505b transponder omni-directional, 31-43.2 kHz, 25 Watts, 185dB re 1μPa@1m) and receiving beacon mounted on the ship (LinkQuest TrackLink 1500HA USBL acoustic tracking system: Directionality 120-150 degrees, 31 – 43.2 kHz, 190dB re 1μPa@1m). The receiving beacon responds by sending an acoustic signal back to the hydrophone (transponder), which is used to determine the location of the ROV. The hydrophone (transponder) sends out a signal every two seconds to track the ROV's location. The transponder system transmits an omni-directional signal in the mid-frequency range (8-34 kHz) with short pulses (ranging from 1-15 milliseconds (ms) per pulse) and a sound pressure level of 190 decibels (dB re 1μPa at 1m) at about one meter from the source. The receiving beacon also transmits signals in the mid-frequency range (21.5 to 43.2 kHz) with a sound pressure level of 183 dB at the source. The ROV also had a high-frequency imaging sonar (Imagenex 881 sonar – 675 kHz) and an altimeter (Tritech PA500/6-S altimeter: directionality 6 degrees conical downward, 500 kHz).

The ROV was equipped with one 5-function arm manipulator equipped with a coral cutter blade in the claw. In addition, the ROV was outfitted with one hydraulically retractable tray located under the ROV's frame. The sample was outfitted with a biobox subdivided into 5 compartments where samples were stored during collections. The ROV was also outfitted with a suction sampler that could be manipulated withe the arm. The suction sampler fed into a chamber carousel (5 independent chamber) outfitted with a mesh to retain and store collected samples during the dive.

Dive sites were selected based on known high-density locations of populations for each of the target octocoral species. These locations were selected from published records (Etnoyer et al 2016) and sanctuary dive records.
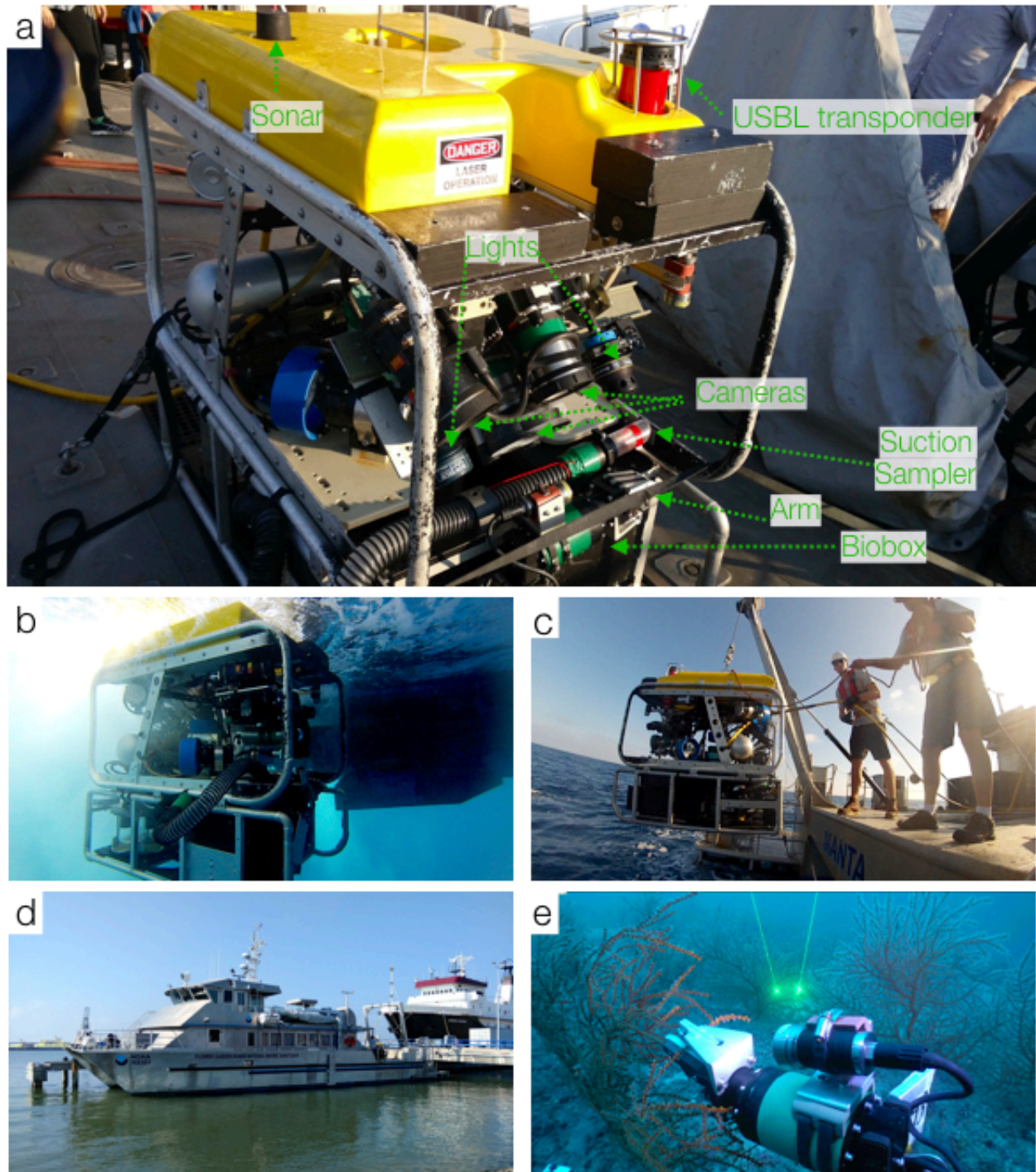
Figure 3. Images showing the ship and ROV equipment utilized during the expedition (RESTORE MT17: October 8 - 13, 2017) that sampled deepwater corals in the northern Gulf of Mexico. a) Front of ROV Mohawk showing the main instruments and tools; b) Starboard view of ROV Mohawk in the water, showing additional detail; c) Port view of ROV Mohawk during a deployment; d) Port view of R/V Manta; e) HD camera view of manipulator arm during *Swiftia exserta* sample collection.

Once on the bottom, the ROV was driven in a search pattern at ~0.5 knots, approximately 0.5-1 m above the seafloor. Real-time annotations were collected during each dive. When a high-density coral community was located, a physical marker was deployed (in addition to a virtual navigation marker) for spatial reference. The construction of the marker consists of a two pound dive weight attached to synthetic rope and a labeled syntactic foam marker. This design has been successfully used for many years by multiple groups in the Gulf of Mexico. Once the marker was deployed, the ROV was set down on the bottom near a set of coral colonies for collections. A new virtual marker was deployed on the navigation system every time the ROV sat down on the seafloor to perform a collection. Before each collection, a container was opened and a digital still of the coral colony was taken. Sample collections were be made using the coral cutters in the ROV claw mounted on the 5-function starboard manipulator. Approximately 3-4 inches were cut from distal branches of each coral colony to avoid mortality. Each sample was placed in a biobox container. Alternatively, samples were also in slurp chambers through suctioning of individual coral fragments (after cutting). A digital still of the coral colony was taken after sampling. For each collected specimen, the date, time, latitude, longitude, and depth were recorded at the time of collection. Physical marker was recovered after each set of collections was completed.

Once the ROV was brought back onto the deck of the ship, the biobox container and suction chambers were dismounted from the ROV and brought into the main lab. Containers were immediately opened and samples were placed in pre-labelled containers filled with chilled seawater. Samples were quickly processed for preservation. All specimens were examined for commensal organisms, labeled, photographed and inventoried into a database containing all relevant metadata. Any associated organisms found on the specimens were separated from the sample and processed separately. Each coral and associate sample was preserved in liquid nitrogen and chilled 95% ethanol.

While the samples were being processed, the ship was relocated to the next dive site and the ROV was prepared for diving. Once the ship arrived to the next site, the ROV was re-deployed.

PERMITS

The expedition was conducted under scientific research permit FGBNMS-2017-007 issued to Santiago Herrera by the Flower Garden Banks National Marine Sanctuary. Prior to the expedition, the chief scientist, Santiago Herrera, also completed a consultation with the NOAA National Marine Fisheries Service under section 7 of the Endangered Species Act (ESA) that addressed potential impacts of cruise activities on ESA-listed species and critical habitat. NMFS issued a letter of acknowledgement (LOA) on July 19, 2017 stating that the activities of the expedition would not adversely affect ESA-listed species, and would have insignificant effects on critical habitat. The National Centers for Coastal Ocean Science - National Ocean Service also issued a memorandum on May 8, 2017 stating that the activities of the project qualified to be categorically excluded from further National Environmental Policy Act review.

FUNDING

EXPEDITION EVENT LOG

Table 1. Timeline of events during the expedition RESTORE MT17 that sampled deep-sea coral ecosystems in the Northern Gulf of Mexico on October 8 - 13, 2017.

Event	Start Time (CST)	Duration	Locality	Summary
Mobilization	2017-10-08 17:00	1d 2h	Galveston	
Transit	2017-10-09 20:00	10h	Transit	ROV preparation continued. Transit to EFGB
ROV preparation	2017-10-10 6:00	1h 30m	EFGB	Drift tests indicated that current was acceptable to put ROV in water (1 knot).
Dive 553	2017-10-10 7:35	1h 9m	EFGB	Dive occurred. No problems with the ROV. Had poor visibility. Did not collect any samples or deployed any markers.
Transit	2017-10-10 8:44	16m	Transit	Transit to E3, Swiftia field target
Dive 554	2017-10-10 9:00	2h 13m	EFGB	Dive successful. No problems with the ROV. Had good visibility. Collected 10 samples of Swiftia (one had a ophiuroid associate) at Station 1. Deployed and recovered Marker S43.
Transit	2017-10-10 11:13	18m	Transit	Transit to area between E3 and E4
Dive 555	2017-10-10 11:31	1h 42m	EFGB	Dive successful. No problems with the ROV. Had good visibility. Collected 10 samples of Swiftia at Station 2. Deployed and recovered Marker S43.
Transit	2017-10-10 13:13	43m	Transit	Transit to E4. Lunch break
Dive 556	2017-10-10 13:56	1h 34m	EFGB	Dive successful. No problems with the ROV. Had good visibility. Collected 10 samples of Swiftia at Station 3. Deployed and recovered Marker S43.
Transit	2017-10-10 15:30	26m	Transit	Transit to E8
Dive 557	2017-10-10 15:56	34m	EFGB	Dive occurred. No problems with the ROV. Had moderate visibility. Did not collect any samples or deployed any markers.
Transit	2017-10-10 16:30	13m	Transit	Transit to new waypoint E14 on a promontory
Dive 558	2017-10-10 16:43	1h 45m	EFGB	Dive occurred. No problems with the ROV. Had moderate visibility. Collected 2 Hypnogorgia samples. Did not deploy markers.
Transit	2017-10-10 18:28	1h 32m	Transit	Transit to WFGB

Event	Start Time (CST)	Duration	Locality	Summary
Overnight	2017-10-10 20:00	10h	Overnight	Tied ship to mooring and overnighted
Weather/ Technical Issue	2017-10-11 6:00	4h	WFGB	Waves greater than 4ft, not good for diving. Also there was a problem with the computer that controls the ROV manipulator. Needed software download for the backup computer, but this required internet. Decided to head back to Galveston to get internet and fix the issue
Transit	2017-10-11 10:00	8h	Transit	Transit to Galveston
Problem fix	2017-10-11 18:00	1h	Galveston	Download of data and tests. Obtained permission and associated permit amendment to sample in Stetson Bank
Transit	2017-10-11 19:00	11h	Transit	Transit to Stetson Bank
ROV preparation	2017-10-12 6:00	1h 21m	Stetson	Drift tests indicated that current was acceptable to put ROV in water.
Dive 559	2017-10-12 7:21	2h 29m	Stetson	Dive successful. No problems with the ROV. Had poor visibility. Collected 13 samples of Hypnogorgia (5 of the white morph, 6 of the white morph and 2 of the purple morph). Did not deploy or use physical marker.
ROV preparation	2017-10-12 9:50	28m	Stetson	Remained in same area to collect more Hypnogorgia
Dive 560	2017-10-12 10:18	2h 14m	Stetson	Dive successful. No problems with the ROV. Had poor visibility. Collected 11 samples of Hypnogorgia (9 of the white morph, 1 of the white morph and 1 of the red/ orange). Did not deploy or use physical marker.
ROV preparation	2017-10-12 12:32	51m	Stetson	Remained in same area to collect more Hypnogorgia
Dive 561	2017-10-12 13:23	53m	Stetson	Dive successful. No problems with the ROV. Had poor visibility. Collected 6 samples of Hypnogorgia, all of the white morph. Did not deploy or use physical marker.
Transit	2017-10-12 14:16	2h 9m	Transit	Transit to WFGB
Dive 562	2017-10-12 16:25	2h 43m	WFGB	Dive successful. No problems with the ROV. Had moderately good visibility. Observed one white Hypnogorgia and collected it. Observed and collected 8 Swifitia. Did not deploy or use physical marker.
Transit	2017-10-12 19:08	10h 22m	Transit	Transit to Galveston
Demobilizat ion	2017-10-13 5:30	5h	Galveston	

PARTICIPANTS

Scientific Party

The scientific party consisted of 6 participants, including Principal Investigators, Postdoctoral Researchers, and technicians from Lehigh University and NOAA.
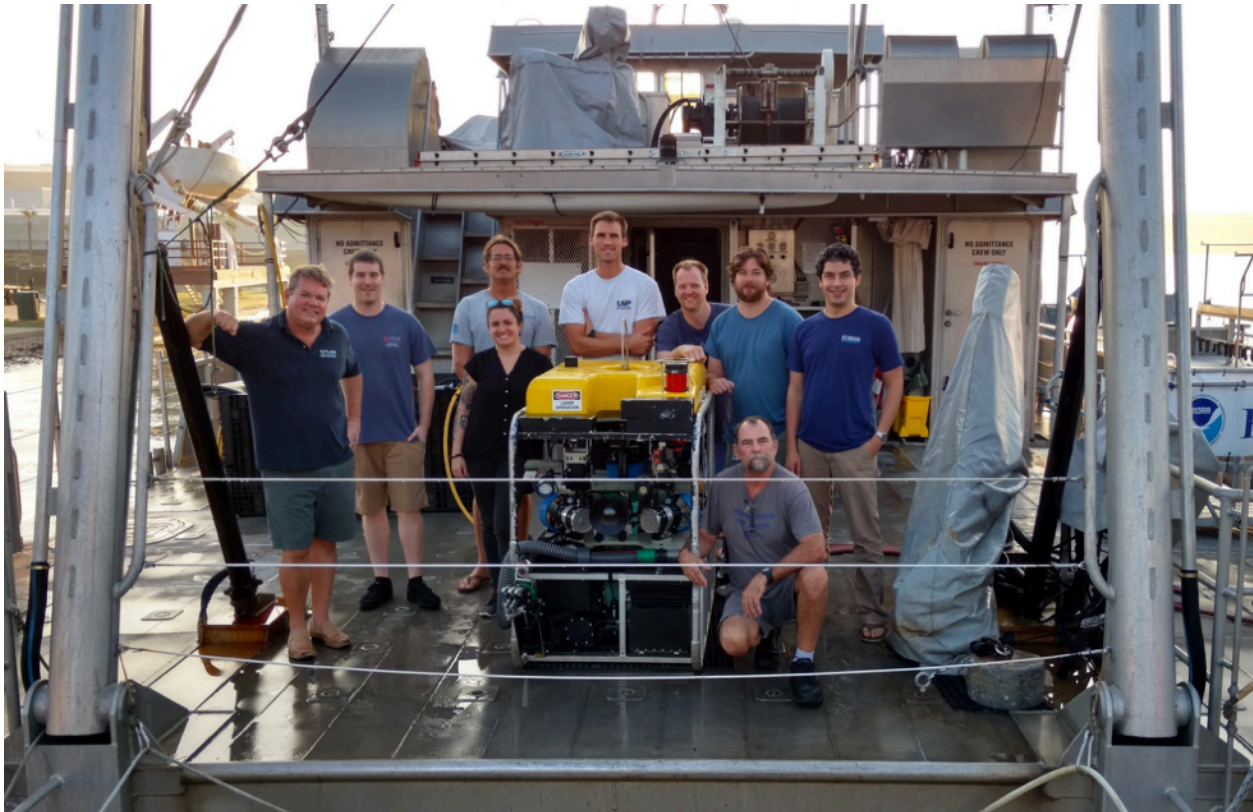
Crew and ROV personnel

There were 4 crew (employees or contractors of FGBNMS), and 3 ROV operators from the University of North Carolina–Wilmington's Undersea Vehicle Program.

Table 2. List of participants of the expedition RESTORE MT17 that sampled deep-sea coral ecosystems in the Northern Gulf of Mexico on October 8 - 13, 2017.

Name	Role	Affiliation	Email
Santiago Herrera	Chief Scientist	Lehigh University	sah516@lehigh.edu
Matt Galaska	Specimen Processing	Lehigh University	mag917@lehigh.edu
Janessy Frometa	Technical Monitor	NOAA RESTORE	janessy.frometa@noaa.gov
Peter Etnoyer	co-PI	NOAA NCCOS	peter.etnoyer@noaa.gov
Andrew Shuler	Data Manager	JHT Inc and NOAA	andrew.shuler@noaa.gov
Kris Benson	Resource Specialist	NOAA	kristopher.benson@noaa.gov

Name	Role	Affiliation	Email
Seth Leo	Capitain	FGBNMS	
Michael Allison	Mate	FGBNMS	
Rachel Sellers	Galleyhand	FGBNMS	
Gerry Amador	Deckhand	FGBNMS	
Jason White	ROV Operator	UNCW	
Lance Horn	ROV Operator	UNCW	
Eric Glidden	ROV Operator	UNCW	

SUMMARY STATISTICS

ROV dives

A total of 10 ROV dives were conducted during the expedition, yielding a total bottom time of 15h 9min. 3 different sites were visited: East Flower Garden Bank, West Flower Garden Bank, and Stetson Bank. Depth ranges during the ROV dives ranged from 53 to 99 m.

Sample collections

A total of 71 samples were collected during the expedition. *Hypnogorgia pendula* was not found in high densities at WFGB and EFGB during the dives. *Swiftia exserta* was not found in high densities at WFGB during the dives. These samples will be sequenced for DNA barcodes and RAD-seq loci for population genomic analyses to infer genetic connectivity among banks.

Table 3. Numbers of samples of octocoral species collected during the expedition RESTORE MT17 that sampled deep-sea coral ecosystems in the Northern Gulf of Mexico on October 8 - 13, 2017.

Site	*Swiftia exserta* (50-150 m)
West Flower Garden Bank	8
East Flower Garden Bank	30
	Hypnogorgia pendula (50-150 m)
West Flower Garden Bank	1
East Flower Garden Bank	2
Stetson Bank	30

DIVE SUMMARY TABLE

Table 4. Summary information for the dives of the ROV Mohawk conducted during the expedition RESTORE MT17 that sampled deep-sea coral ecosystems in the Northern Gulf of Mexico on October 8 - 13, 2017.

Dive #	Locality	Start Date (CST)	Start Time (CST)	On bottom lat/lon (deg)	On bottom depth (m)	Off bottom lat/lon (deg)	Off bottom depth (m)	Bottom time (h:mm)	# Specimens collected
Dive553	EFGB	10/10/17	15:36	27.9712 -93.5940	98.5	27.9713 -93.5941	98.4	40m	0
Dive554	EFGB	10/10/17	21:11	27.9678 -93.6128	73.9	27.9680 -93.6129	68.8	2h	11
Dive555	EFGB	10/10/17	12:30	27.9683 -93.6132	76.9	27.9683 -93.6132	70.3	1h	10
Dive556	EFGB	10/10/17	13:35	27.9685 -93.6133	78	27.9684 -93.6133	74.5	1h	10
Dive557	EFGB	10/10/17	17:21	27.9541 -93.6115	82.6	27.9545 -93.6119	81.5	24m	0
Dive558	EFGB	10/10/17	6:39	27.9537 -93.6004	62.2	27.9569 -93.6006	78.3	1h	2
Dive559	Stetson Bank	10/12/17	14:39	28.1573 -94.3024	56.4	28.1570 -94.3026	53.5	2h	13
Dive560	Stetson Bank	10/12/17	13:35	28.1569 -94.3030	57.1	28.1569 -94.3032	55.5	2h	11
Dive561	Stetson Bank	10/12/17	16:25	28.1567 -94.3036	59.2	28.1574 -94.3032	52.9	41m	6
Dive562	WFGB	10/12/17	4:39	27.8998 -93.8142	79.8	27.8976 -93.8176	71.6	2h	9

OUTREACH/EDUCATION

The activities conducted during this cruise were shared through social media accounts:

- https://www.facebook.com/RESTOREdeepcorals/

- https://twitter.com/RESTOREdcorals

- https://www.instagram.com/restoredeepcorals/

The work from this project has been featured in the following news article:

- https://coastalscience.noaa.gov/news/genomics-guides-coral-restoration-gulf-following-deepwater-horizon-oil-spill/

ACKNOWLEDGEMENTS

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APPENDIX 1: DIVE SUMMARIES

Dive summaries are grouped by locality. Include maps showing the ROV tracks at each site visited during the expedition RESTORE MT17 (October 8 - 13, 2017), narrative description of the dive, and representative images from the locality.

East Flower Garden Bank

East
Flower
Garden
Bank

Legend

— Dive 557
— Dive 558

High Island E. Addn. S. Ext.
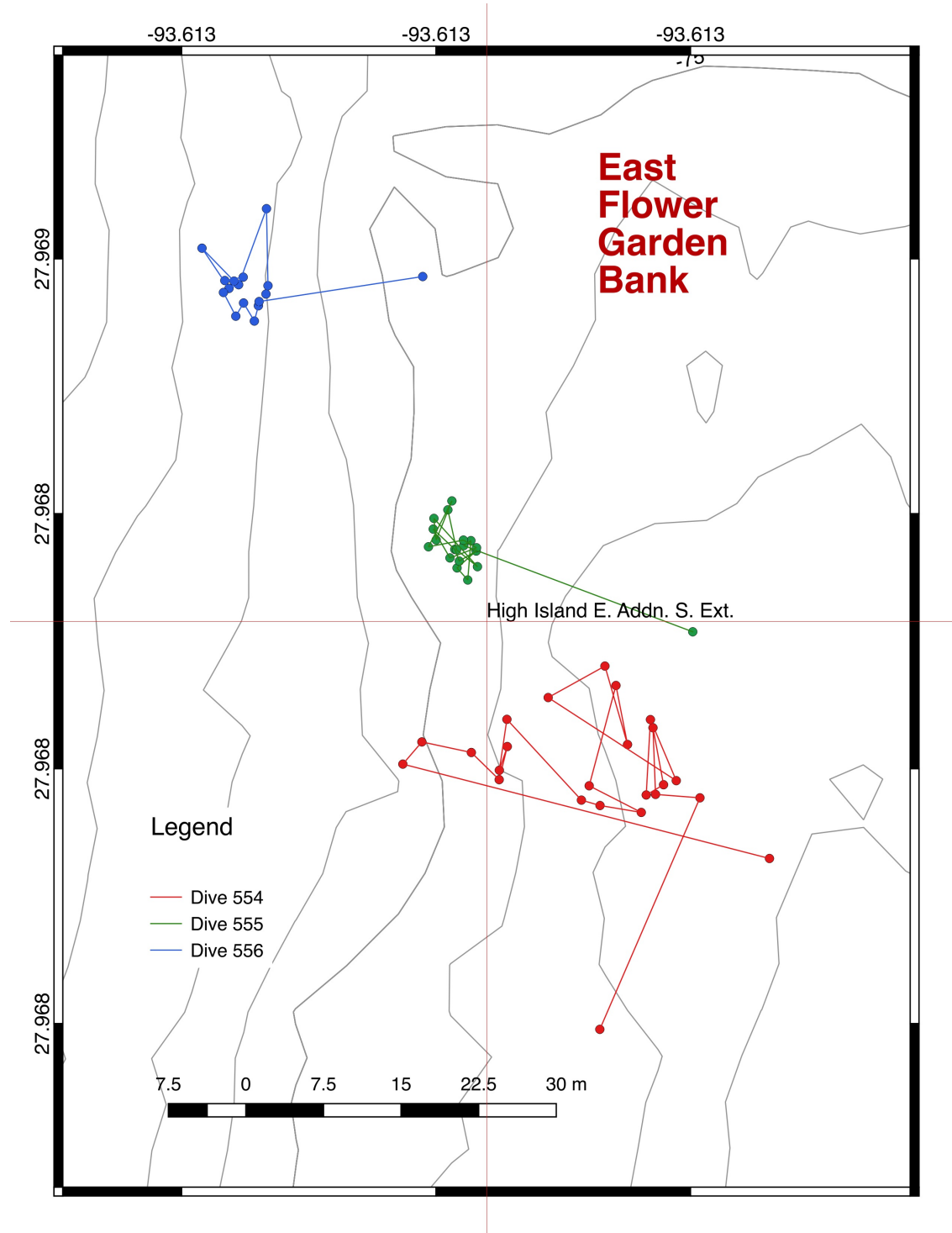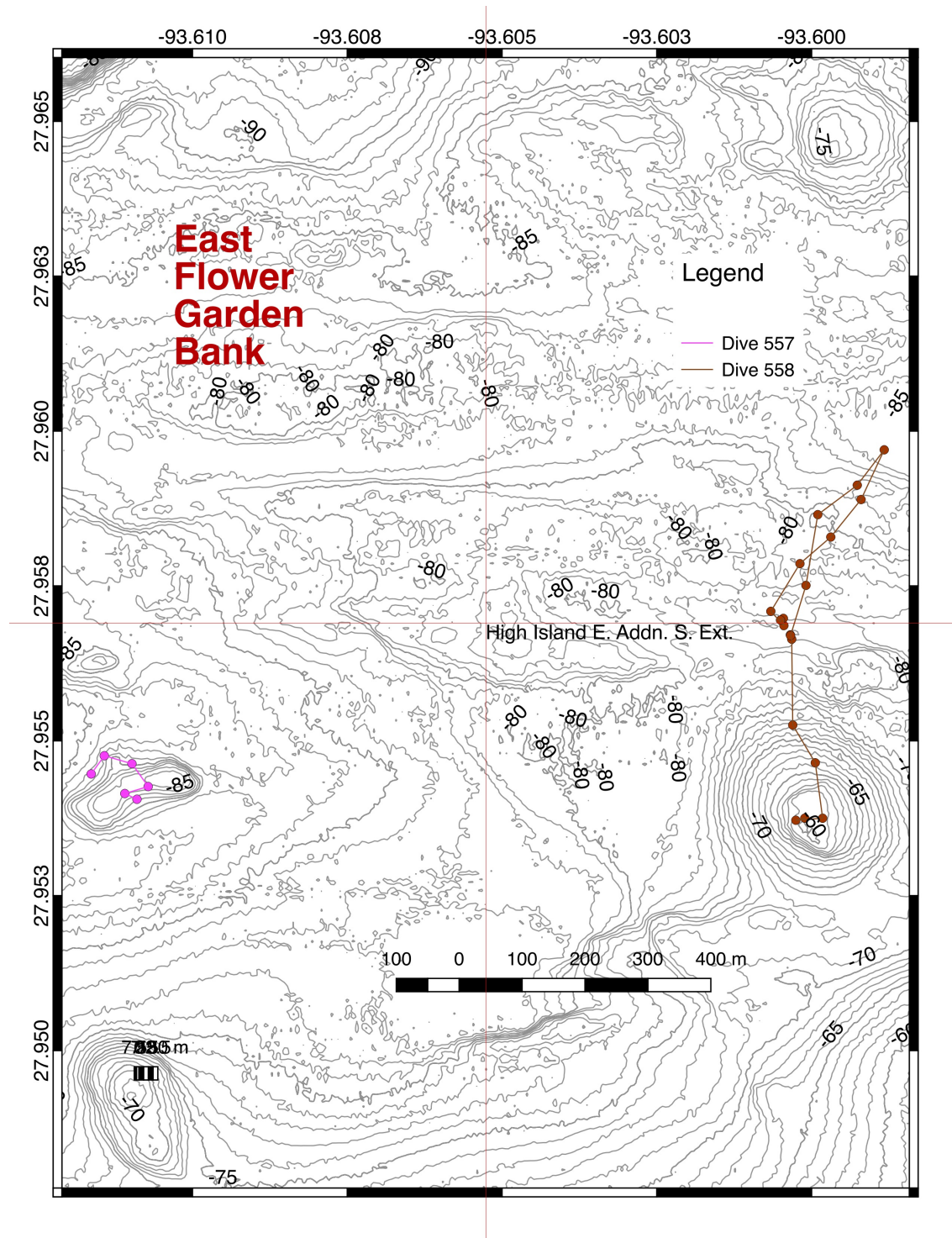
MT17_DIVE553

Start time: 2017-10-10 7:35
End Time: 2017-10-10 8:44
Description: Dive ocurred. No problems with the ROV. Had poor visibility. Landed E1 and moved around . This was an area of steep slope, with outcrops and walls, partially covered with a thin layer of coarse sand, observed many whip corals *Stichopathes* and large fans of *Aphanipathes*. Did not collect any samples or deployed any markers. Did not observe any *Swiftia* or *Hypnogorgia* colonies.

MT17_DIVE554

Start time: 2017-10-10 9:00
End Time: 2017-10-10 11:13
Description: Dive successful. No problems with the ROV. Had good visibility. Landed on E3 and found field of *Swiftia*. This was a flat area, with no outcrops or walls, partially covered with a thin layer of coarse sand. Collected 10 samples of *Swiftia* (one had a ophiuroid associate) at Station 1. Deployed and recovered Marker S43. Did not observe any *Hypnogorgia* colonies.

MT17_DIVE555

Start time: 2017-10-10 11:31
End Time: 2017-10-10 13:13
Description: Dive successful. No problems with the ROV. Had good visibility. Landed between E3 and E4 and found field of *Swiftia*. This was a flat area, with no outcrops or walls, partially covered with a thin layer of coarse sand. Collected 10 samples of *Swiftia* at Station 2. Deployed and recovered Marker S43. Did not observe any *Hypnogorgia* colonies. ROV accidentally knocked over a whole colony of *Swiftia*. Observed a couple of lionfish

MT17_DIVE556

Start time: 2017-10-10 13:56
End Time: 2017-10-10 15:30
Description: Dive successful. No problems with the ROV. Had good visibility. Landed at E4 and found field of *Swiftia*. This was a flat area, with no outcrops or walls, partially covered with a thin layer of coarse sand. Collected 10 samples of *Swiftia* at Station 3. Deployed and recovered Marker S43. Did not observe any *Hypnogorgia* colonies.

MT17_DIVE557

Start time: 2017-10-10 15:56
End Time: 2017-10-10 16:30
Description: Dive ocurred. No problems with the ROV. Had moderate visibility. Landed E8 and moved around, headed to E7 and explore the area (*Hypnogorgia* targets). Did not find any *Hypnogorgia*. This was an area of low slope, mostly sandy with some carbonate outcrops, observed many whip corals *Elisella* and small black corals. Did not collect any samples or deployed any markers. Did not observe any *Swiftia* colonies.
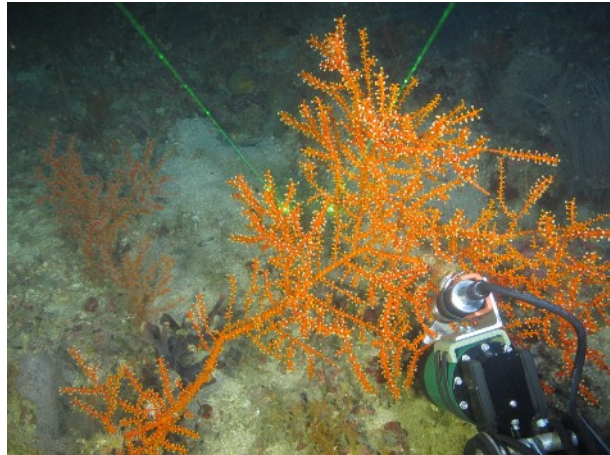
MT17_DIVE558

Start time: 2017-10-10 16:43
End Time: 2017-10-10 18:28
Description: Dive occurred. No problems with the ROV. Had moderate visibility. Landed E14 and moved around, headed to E6 and explore the area (*Hypnogorgia* target). Found two *Hypnogorgia* colonies in between waypoints, separated by 20 meters (Stations 4 and 5).This was an area of low slope, mostly sandy with some carbonate outcrops and flat areas, observed many whip corals *Elisella* and small black corals. Collected 2 *Hypnogorgia* samples. Did not deploy markers. Did not observe any Swiftia colonies.
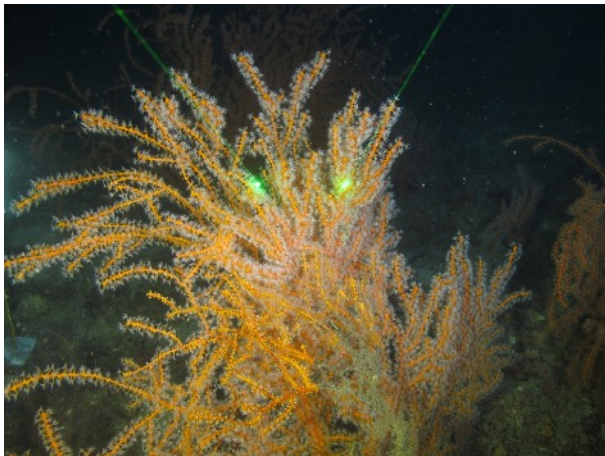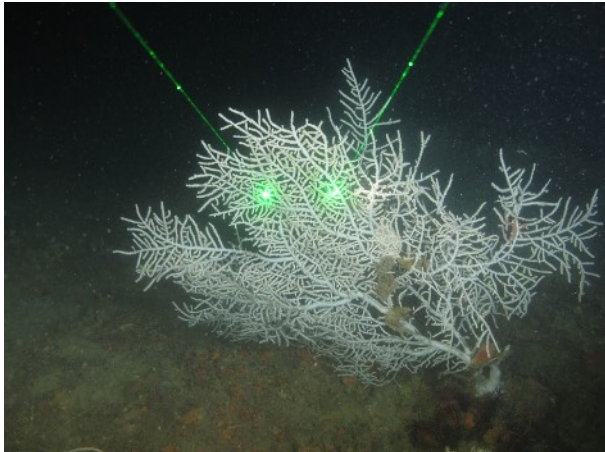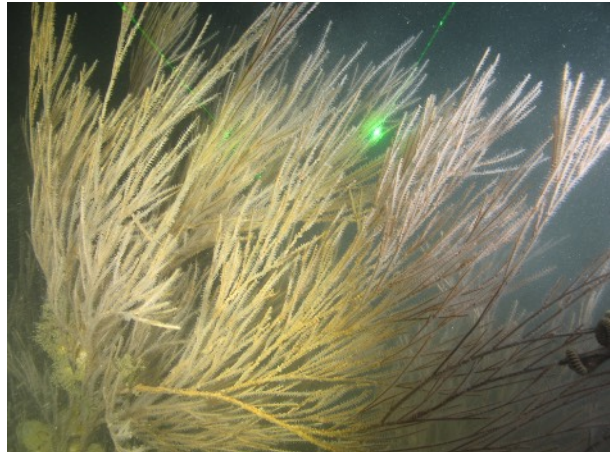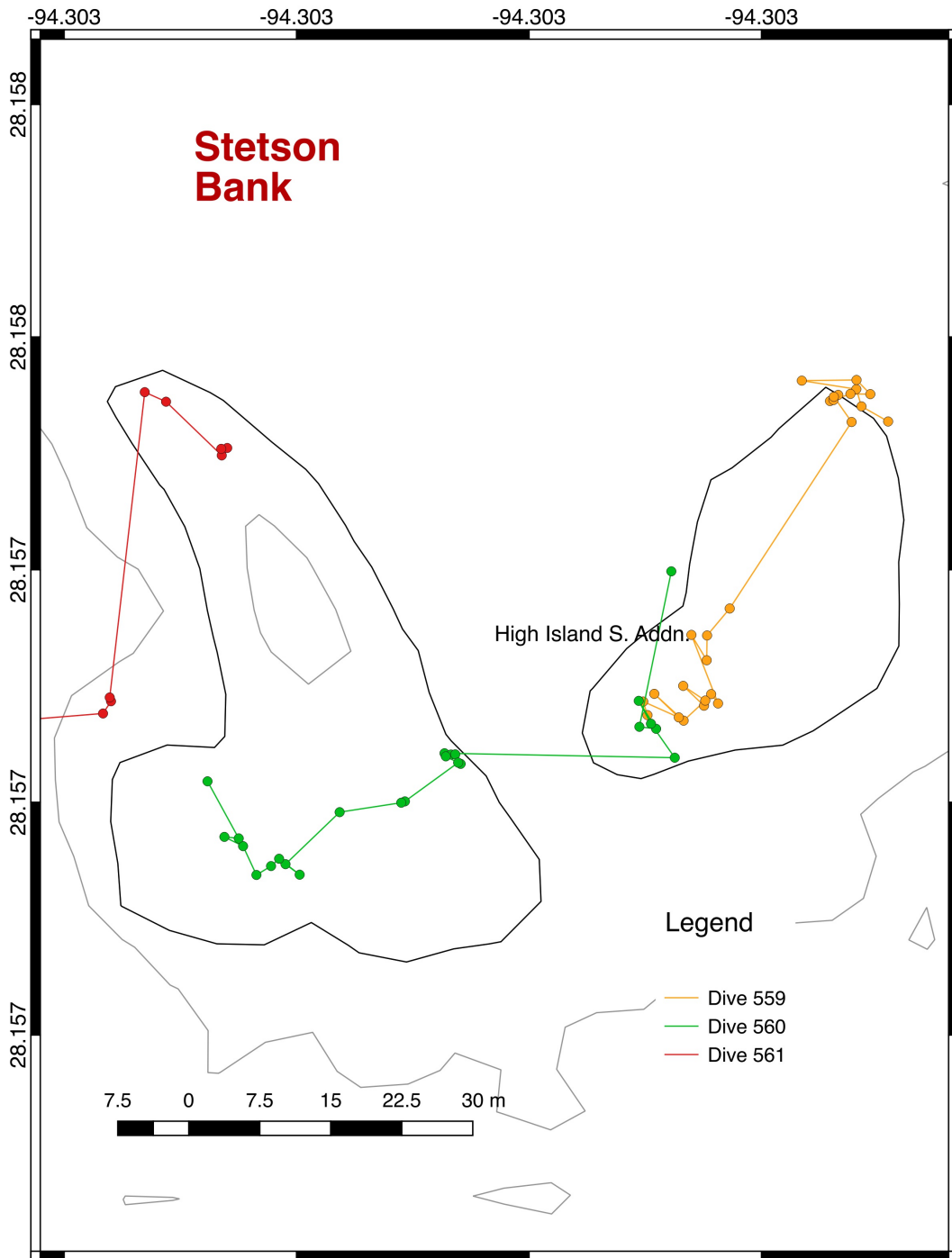
a.

b.

c.

d.

e.

f.

Representative Images of EFGB. a-d. *Swiftia exserta* (red) colonies; e. *Hypnogorgia pendula* (white) colony with basketstar associates; f. *Aphanipathes* colony. Green lasers are 10 cm apart.

Stetson Bank

MT17_DIVE559

Start time: 2017-10-12 7:21
End Time: 2017-10-12 9:50
Description: Dive successful. No problems with the ROV. Had poor visibility. Landed on spot identified from 2016 dive images found several of *Hypnogorgia*. In addition to the white morph, observed several large fans of a purple morph. Peter Etnoyer indicated that this was known as *Muricea pendula*, but that SEM and barcoding analyses indicate that this is very likely a phenotype of *Hypnogorgia pendula*. Similarly encountered yellow morphs. This was a very muddy area with scattered large rocky outcrops where corals were found. Moderate current predominantly from south. Collected 13 samples of *Hypnogorgia* (5 of the white morph, 6 of the white morph and 2 of the purple morph). One of the purple morph collections was an entire large colony found laying sideways on the mud (ROV hadn't visited this area beforehand so it hand). Collections took place at Stations 6, 7, 8 and 9. Did not deploy or use physical marker. Did not observe any *Swiftia* colonies.

MT17_DIVE560

Start time: 2017-10-12 10:18
End Time: 2017-10-12 12:32
Description: Dive successful. No problems with the ROV. Had poor visibility. Continued diving on area identified from 2016 dive images found several of *Hypnogorgia*. In addition to the white, yellow and purple morphs, observed several large fans of a red/orange morph. This was a very muddy area with scattered large rocky outcrops where corals were found. Collected 11 samples of *Hypnogorgia* (9 of the white morph, 1 of the white morph and 1 of the red/orange). Collections took place at Stations 10, 11, 12, 13, 14, 15, 16 and 17. Did not deploy or use physical marker. Did not observe any *Swiftia* colonies.
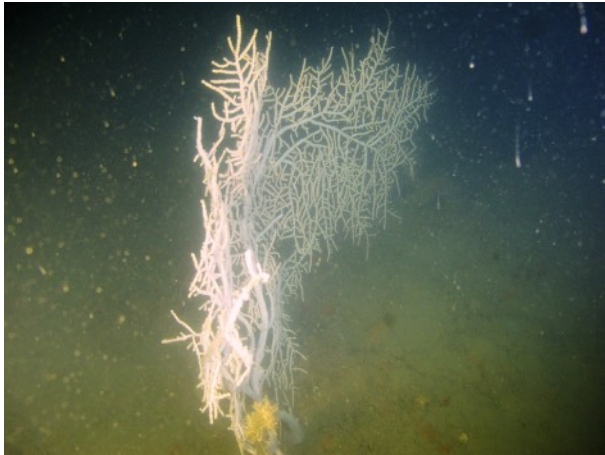
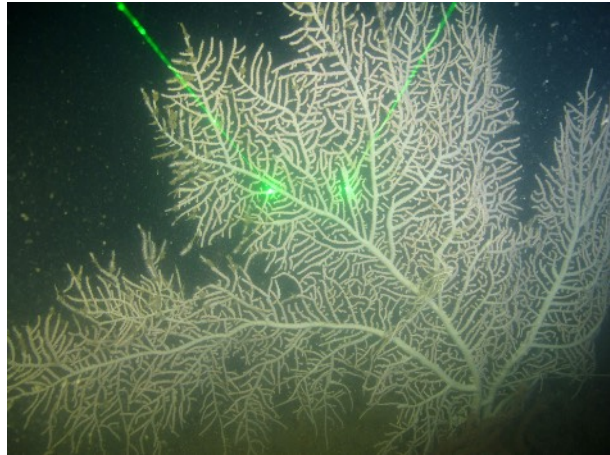### MT17_DIVE561

Start time: 2017-10-12 13:23
End Time: 2017-10-12 14:16
Description: Dive successful. No problems with the ROV. Had poor visibility. Continued diving on area identified from 2016 dive images found several of *Hypnogorgia*. Observed several large fans of the white, yellow, red/orange and purple morphs. This was a very muddy area with scattered large rocky outcrops where corals were found. Collected 6 samples of *Hypnogorgia*, all of the white morph. Collections took place at Stations 18, 19 and 20. Did not deploy or use physical marker. Did not observe any *Swiftia* colonies.

a.

b.

c.

d.

e.

f.
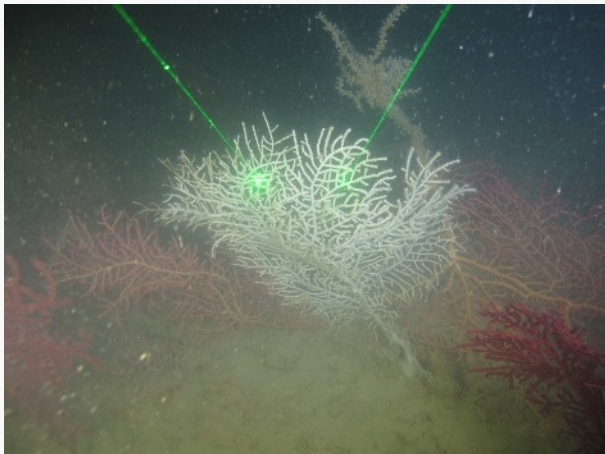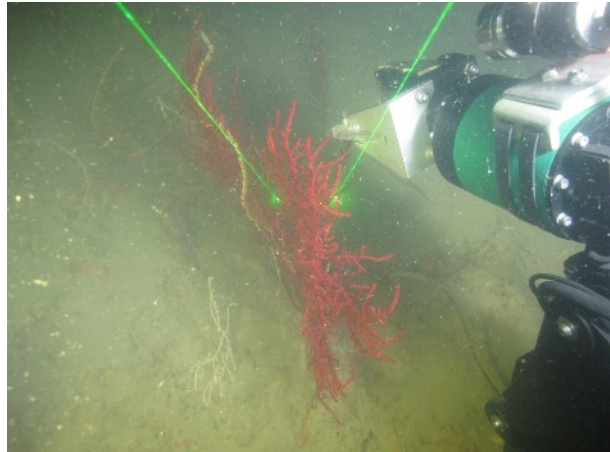
Representative Images of Stetson Bank. a-b. *Hypnogorgia pendula* (white) colonies; c. *H. pendula* colony next to purple *Hypnogorgia/Muricea pendula* colonies; d. Yellow and purple *Hypnogorgia/Muricea pendula* colonies; and e-f. Red/orange *Hypnogorgia/Muricea pendula* colonies. Green lasers are 10 cm apart.

West Flower Garden Bank

West
Flower
Garden
Bank

High Island E. Addn. S. Ext.

Legend

—— Dive 562

25   0   25   50   75   100 m
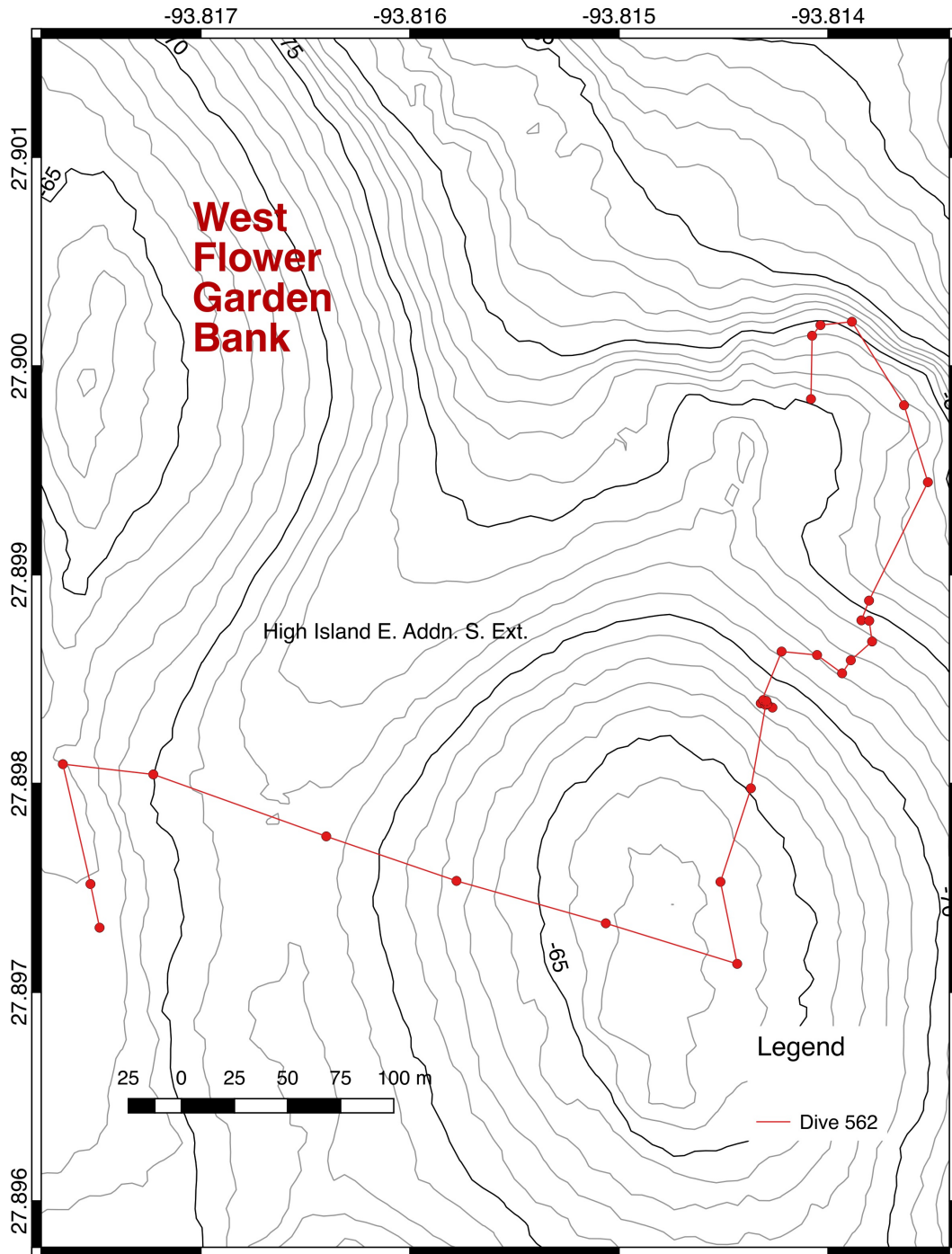
MT17_DIVE562

Start time: 2017-10-12 16:25
End Time: 2017-10-12 19:08
Description: Dive successful. No problems with the ROV. Had moderately good visibility. Dove on area identified from dive annotations for *Hypnogorgia* and *Swiftia*. Observed very few corals. This was a moderate slope area covered with ~10cm diameter rhodoliths. Explored for more than 2 hours. Ended on ridge area with large rocky outcrops but very few corals. Observed one white *Hypnogorgia* and collected it. Observed and collected 8 *Swifitia*. Collections took place at Stations 21, 22, 23, 24, 25 and 26. Did not deploy or use physical marker. Observed several Lionfish.

a.
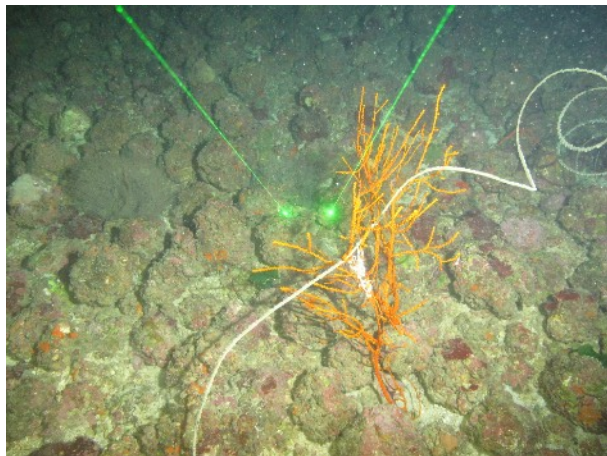
b.
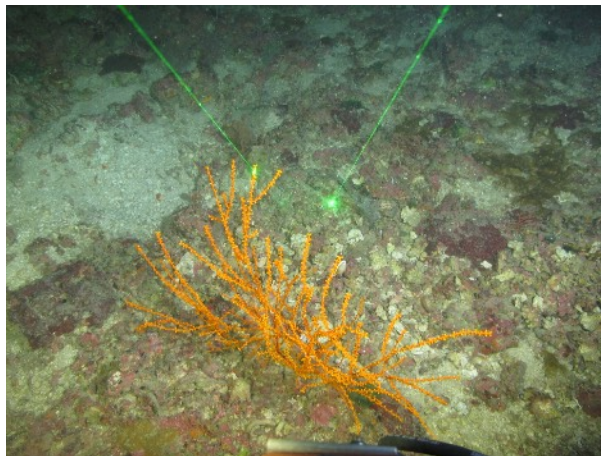
c.

d.

Representative Images of WFGB. a-c. *Swiftia exserta* colonies with basket star associates; and

d. Hydrocarbon seepage area and sulphate-reducing bacteria, *Beggiotoa.*

APPENDIX 2: SAMPLES

Inventory of specimens collected during the expedition RESTORE MT17 that sampled deep-sea coral ecosystems in the Northern Gulf of Mexico on October 8 - 13, 2017. (Destination SH=Santiago Herrera)

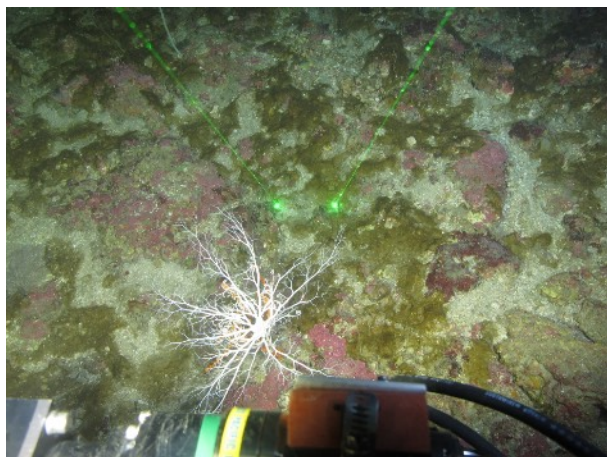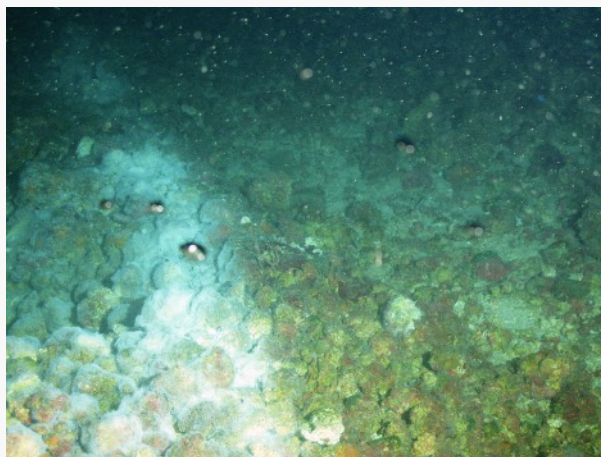| Sample ID	Scientific Name	Date (CST)	Time (CST)	Locality	Latitude	Depth (m)	Destination
MT17_001	*Swiftia exserta*	10/10/17	9:25	EFGB	27.96800 -93.61280	73	SH
MT17_002	*Swiftia exserta*	10/10/17	9:39	EFGB	27.96801 -93.61277	73	SH
MT17_003	*Swiftia exserta*	10/10/17	9:47	EFGB	27.96799 -93.61272	73	SH
MT17_004	*Swiftia exserta*	10/10/17	9:56	EFGB	27.96800 -93.61283	73	SH
MT17_005	*Swiftia exserta*	10/10/17	10:11	EFGB	27.96794 -93.61287	73	SH
MT17_005B	*Gorgonocephalus*	10/10/17	10:11	EFGB	27.96794 -93.61287	73	SH
MT17_006	*Swiftia exserta*	10/10/17	10:25	EFGB	27.96797 -93.61285	73	SH
MT17_007	*Swiftia exserta*	10/10/17	10:38	EFGB	27.96801 -93.61295	73	SH
MT17_008	*Swiftia exserta*	10/10/17	10:46	EFGB	27.96803 -93.61299	73	SH
MT17_009	*Swiftia exserta*	10/10/17	10:53	EFGB	27.96799 -93.61298	73	SH
MT17_010	*Swiftia exserta*	10/10/17	11:00	EFGB	27.96801 -93.61303	73	SH
MT17_011	*Swiftia exserta*	10/10/17	11:44	EFGB	27.96819 -93.61294	74	SH
MT17_012	*Swiftia exserta*	10/10/17	11:49	EFGB	27.96820 -93.61297	74	SH
MT17_013	*Swiftia exserta*	10/10/17	12:05	EFGB	27.96821 -93.61300	74	SH
MT17_014	*Swiftia exserta*	10/10/17	12:13	EFGB	27.96823 -93.61300	74	SH
MT17_015	*Swiftia exserta*	10/10/17	12:23	EFGB	27.96824 -93.61300	74	SH
MT17_016	*Swiftia exserta*	10/10/17	12:31	EFGB	27.96822 -93.61298	74	SH

Sample ID	Scientific Name	Date (CST)	Time (CST)	Locality	Latitude	Depth (m)	Destination
MT17_017	*Swiftia exserta*	10/10/17	12:39	EFGB	27.96825 -93.61298	74	SH
MT17_018	*Swiftia exserta*	10/10/17	12:45	EFGB	27.96826 -93.61301	74	SH
MT17_019	*Swiftia exserta*	10/10/17	12:53	EFGB	27.96823 -93.61299	74	SH
MT17_020	*Swiftia exserta*	10/10/17	12:58	EFGB	27.96820 -93.61297	74	SH
MT17_021	*Swiftia exserta*	10/10/17	14:14	EFGB	27.96850 -93.61317	76	SH
MT17_022	*Swiftia exserta*	10/10/17	14:25	EFGB	27.96849 -93.61319	76	SH
MT17_023	*Swiftia exserta*	10/10/17	14:34	EFGB	27.96848 -93.61320	76	SH
MT17_024	*Swiftia exserta*	10/10/17	14:38	EFGB	27.96847 -93.61320	76	SH
MT17_025	*Swiftia exserta*	10/10/17	14:47	EFGB	27.96848 -93.61320	76	SH
MT17_026	*Swiftia exserta*	10/10/17	14:51	EFGB	27.96847 -93.61321	76	SH
MT17_027	*Swiftia exserta*	10/10/17	14:57	EFGB	27.96844 -93.61319	76	SH
MT17_028	*Swiftia exserta*	10/10/17	15:03	EFGB	27.96846 -93.61320	76	SH
MT17_029	*Swiftia exserta*	10/10/17	15:11	EFGB	27.96845 -93.61320	76	SH
MT17_030	*Swiftia exserta*	10/10/17	15:18	EFGB	27.96845 -93.61318	76	SH
MT17_031	*Hypnogorgia pendula*	10/10/17	17:20	EFGB	27.95671 -93.60049	79	SH
MT17_032	*Hypnogorgia pendula*	10/10/17	18:22	EFGB	27.95696 -93.60058	78	SH
MT17_033	*Hypnogorgia pendula*	10/12/17	7:38	Stetson Bank	28.15743 -94.30240	56	SH
MT17_034	*Hypnogorgia pendula*	10/12/17	7:54	Stetson Bank	28.15744 -94.30239	56	SH
MT17_035	*Muricea pendula*	10/12/17	8:00	Stetson Bank	28.15744 -94.30241	56	SH

Sample ID	Scientific Name	Date (CST)	Time (CST)	Locality	Latitude	Depth (m)	Destination
MT17_036	*Hypnogorgia pendula*	10/12/17	8:17	Stetson Bank	28.15741 -94.30240	56	SH
MT17_037	*Hypnogorgia pendula*	10/12/17	8:24	Stetson Bank	28.15743 -94.30241	56	SH
MT17_038	*Hypnogorgia pendula*	10/12/17	8:40	Stetson Bank	28.15720 -94.30256	56	SH
MT17_039	*Hypnogorgia pendula (yellow)*	10/12/17	8:50	Stetson Bank	28.15719 -94.30258	56	SH
MT17_040	*Hypnogorgia pendula (yellow)*	10/12/17	8:59	Stetson Bank	28.15711 -94.30255	56	SH
MT17_041	*Hypnogorgia pendula (yellow)*	10/12/17	9:11	Stetson Bank	28.15712 -94.30258	56	SH
MT17_042	*Hypnogorgia pendula*	10/12/17	9:16	Stetson Bank	28.15711 -94.30257	56	SH
MT17_043	*Hypnogorgia pendula*	10/12/17	9:29	Stetson Bank	28.15710 -94.30260	56	SH
MT17_044	*Hypnogorgia pendula*	10/12/17	9:37	Stetson Bank	28.15709 -94.30259	56	SH
MT17_045	*Muricea pendula*	10/12/17	9:42	Stetson Bank	28.15708 -94.30260	56	SH
MT17_046	*Hypnogorgia pendula*	10/12/17	10:30	Stetson Bank	28.15710 -94.30263	55	SH
MT17_047	*Hypnogorgia pendula*	10/12/17	10:43	Stetson Bank	28.15710 -94.30264	55	SH
MT17_048	*Hypnogorgia pendula*	10/12/17	10:56	Stetson Bank	28.15705 -94.30283	56	SH
MT17_049	*Hypnogorgia pendula (orange)*	10/12/17	11:13	Stetson Bank	28.15706 -94.30284	56	SH
MT17_050	*Hypnogorgia pendula*	10/12/17	11:19	Stetson Bank	28.15706 -94.30285	56	SH
MT17_051	*Hypnogorgia pendula*	10/12/17	11:28	Stetson Bank	28.15701 -94.30290	55	SH
MT17_052	*Hypnogorgia pendula*	10/12/17	11:36	Stetson Bank	28.15699 -94.30297	56	SH
MT17_053	*Hypnogorgia pendula*	10/12/17	11:57	Stetson Bank	28.15693 -94.30300	56	SH

Sample ID	Scientific Name	Date (CST)	Time (CST)	Locality	Latitude	Depth (m)	Destination
MT17_054	*Hypnogorgia pendula (yellow)*	10/12/17	12:08	Stetson Bank	28.15693 -94.30306	56	SH
MT17_055	*Hypnogorgia pendula*	10/12/17	12:16	Stetson Bank	28.15698 -94.30307	56	SH
MT17_056	*Hypnogorgia pendula*	10/12/17	12:24	Stetson Bank	28.15702 -94.30311	56	SH
MT17_057	*Hypnogorgia pendula*	10/12/17	13:36	Stetson Bank	28.15710 -94.30320	57	SH
MT17_058	*Hypnogorgia pendula*	10/12/17	13:42	Stetson Bank	28.15711 -94.30320	57	SH
MT17_059	*Hypnogorgia pendula*	10/12/17	13:51	Stetson Bank	28.15743 -94.30314	55	SH
MT17_060	*Hypnogorgia pendula*	10/12/17	13:55	Stetson Bank	28.15740 -94.30313	55	SH
MT17_061	*Hypnogorgia pendula*	10/12/17	14:00	Stetson Bank	28.15735 -94.30309	55	SH
MT17_062	*Hypnogorgia pendula*	10/12/17	14:07	Stetson Bank	28.15738 -94.30307	55	SH
MT17_063	*Hypnogorgia pendula*	10/12/17	16:44	WFGB	27.90021 -93.81404	83	
MT17_064	*Swiftia exserta*	10/12/17	17:08	WFGB	27.89881 -93.81386	79	SH
MT17_065	*Swiftia exserta*	10/12/17	17:12	WFGB	27.89879 -93.81383	79	SH
MT17_066	*Swiftia exserta*	10/12/17	17:16	WFGB	27.89879 -93.81385	79	SH
MT17_067	*Swiftia exserta*	10/12/17	17:22	WFGB	27.89862 -93.81385	77	SH
MT17_068	*Swiftia exserta*	10/12/17	17:28	WFGB	27.89857 -93.81393	76	
MT17_069	*Swiftia exserta*	10/12/17	17:48	WFGB	27.89838 -93.81432	73	SH
MT17_070	*Swiftia exserta*	10/12/17	17:55	WFGB	27.89837 -93.81430	73	SH
MT17_071	*Swiftia exserta*	10/12/17	18:12	WFGB	27.89838 -93.81428	73	SH