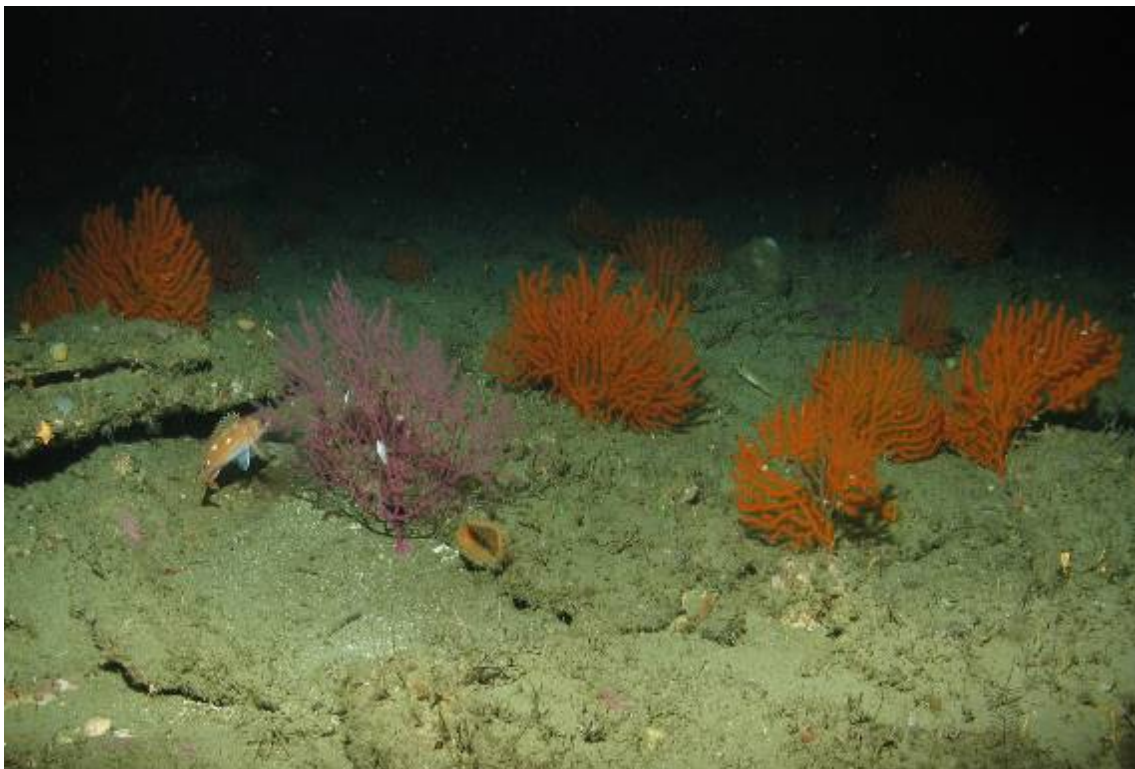

Cruise Report for ‘Patterns in Deep-Sea Corals’ Expedition 2016: NOAA ship *Shearwater* SW-16-08



NOAA Technical Memorandum
NOS NCCOS 233
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Cruise Report for ‘Patterns in Deep-Sea Corals’ Expedition 2016: NOAA ship *Shearwater* SW-16-08

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August 2017



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Cruise Report for ‘Patterns in Deep-Sea Corals’ Expedition 2016: NOAA ship *Shearwater* SW-16-08

1. Expedition Overview

The 2016 ‘Patterns in Deep-Sea Corals’ expedition set out aboard the NOAA Ship *Shearwater* in August to study the distribution, ecology, and health of deep-water (30-300 m) gorgonian corals in response to the 2015 El Niño event. The research team consisted of staff from NOAA National Centers for Coastal Ocean Science (NCCOS) and Marine Applied Research and Education (MARE; Table 1). The study used the remotely operated vehicle (ROV) *Beagle* to recover previously deployed temperature loggers (Caldow et al. 2015) and to conduct video transects for the purpose of density estimation and health assessments.

The primary scientific objectives of the expedition were to: 1) recover temperature loggers that were deployed in the spring and fall of 2015 in order to assess temperature anomalies; 2) characterize deep-sea coral ecosystems in newly mapped areas of the Channel Islands National Marine Sanctuary (CINMS) (Figures 1-4); and 3) collect live *Acanthogorgia* sp. corals for laboratory studies on temperature.

2. Narrative of Cruise Results

The expedition’s scientific objectives were successfully met thanks in large part to good weather and few technical difficulties. In addition to the scientific objectives, several outreach activities were completed during the expedition, including. A dockside presentation for six people in Santa Barbara Harbor, and an at sea day for seven people, during which they were able to come aboard the NOAA Ship *Shearwater* and participate in a ROV dive. The VIP party included representatives from Conservation International, Rockefeller Foundation, Coral Reef Watch, and others.

2.1 Objective 1: Recover previously deployed temperature loggers

The ROV recovered all four temperature loggers from depths ranging between 20-100 m. Data was successfully downloaded from each logger, and plotted across time (Figure 5 and Appendix A). Temperatures averaged between 14-15 °C at 20 m, with a maximum of 19 °C in July. Temperatures at 50 m exceeded 15 °C on average, but never reached the 19 °C threshold observed at 20 m. Temperatures showed little temporal variation at 100 m, and ranged between ~10-12 °C. In the future, this temperature data will be analyzed in more detail in order to identify trends and anomalies. This analysis will also incorporate temperature data collected from CTD casts near the Channel Islands, and other sources.

2.2 Objective 2: Conduct ROV seafloor surveys

Of the 14 ROV dives conducted over the course of the expedition, the majority took place over the newly mapped areas north and south of Santa Rosa Island (Figures 2-4; Table 3). The total bottom time was 17 hours and 51 minutes, during which 30 video transects were completed (Table 4). Video data collected during the ROV transects will be analyzed in order to determine species composition, health and densities of deep-water corals. This data will become publicly available within one year through the NOAA Deep Sea Coral Data Portal (<https://deepseacoraldata.noaa.gov/>).

2.3 Objective 3: Collect live *Acanthogorgia* sp. corals for laboratory studies

The team successfully collected two live colonies of *Acanthogorgia* sp. octocorals from 200 m. Upon

retrieval from the ROV, each colony was split into six fragments. Coral fragments were shipped to both the Claremont College in California, and the Deep Coral Ecology Laboratory in Charleston, SC. The live corals arrived at their respective institutions within 24 h of shipment, and were successfully acclimated into an aquarium environment (Figures 7-8). While the original goal was to collect four small colonies, the colonies collected were large enough to provide enough material for laboratory experimentation.

3. Discussion

The successful recovery of all temperature loggers is an important accomplishment, particularly since three of the four loggers were deployed from a ship. Additionally, we were able to successfully download data from all temperature loggers, indicating that they hold up well under the conditions and duration of our deployment. It is important to point out that the temperature logger deployed at the shallowest depth (20 m) had substantial overgrowth by encrusting fauna, whereas overgrowth was minimal in the other three loggers. Therefore, future deployments of these devices at depths shallower than 50 m should consider providing some means to deter fouling, with either external housing or anti-fouling paint.

The ROV dives focused on habitat characterization and dive time was split between transects and exploration. This split approach allowed the science team to obtain quantitative information on the coral communities during transects, as well as provided time to explore the newly-mapped environment more freely. The use of dedicated transects also facilitated the process of estimating octocoral density, by ensuring consistent speed, altitude, and direction.

The collection of live corals from deeper than 50 m is another important accomplishment of this expedition. One of the dives was dedicated exclusively for specimen collections, and this approach was critical in reducing undue stress to the organisms. Future collections of live material should consider a similar approach.

4. Acknowledgements

The authors would like to acknowledge the support and guidance of the Channel Islands National Marine Sanctuary staff especially Chris Caldwell, Julie Bursek, and Ryan Freedman. It is also important to note the skill and expertise of the crew of the NOAA Ship *Shearwater*, specifically Captain Terrance Shinn, First Mate Charles Lara, and Lieutenant junior grade Elizabeth Mackie. Equally as important were team members Steve Holz and Rick Botman of Marine Applied Research and Exploration for their critical support to this mission. These individuals were instrumental to the smooth deployment and operation of the ROV *Beagle* and the success of this expedition.

5. References

Caldow, C., P. J. Etnoyer, L. Kracker. 2015. Cruise Report for 'Patterns in Deep-Sea Corals' Expedition: NOAA ship *Bell M. Shimada* SH-15-03. NOAA Technical Memorandum NOS NCCOS 200. 15 pp. Silver Spring, MD.

OSPAR. 2010. Background Document for Coral Gardens. Publication number 486. OSPAR Biodiversity Series. <https://www.ospar.org/documents?v=7217>

6. Tables

Table 1. List of science participants for the ‘Patterns in Deep-Sea Coral’ Expedition in August 2016.

Name	Title	Affiliation
Botman, Rick	ROV operator	Marine Applied Research and Exploration Group
Etnoyer, Peter	Chief Scientist	NOAA National Centers for Coastal Ocean Science
Frometa, Janessy	Marine Biologist	NOAA Contractor with JHT, Inc.
Holz, Steve	ROV Operator	Marine Applied Research and Exploration Group
Lauermann, Andy	ROV operator	Marine Applied Research and Exploration Group
Rosen, Dirk	ROV operator	Marine Applied Research and Exploration Group
Shuler, Andrew	Marine Biologist	NOAA Contractor with JHT, Inc.

Table 2. List of samples collected during the expedition using the ROV *Beagle*, including previously deployed temperature loggers and live coral samples.

Locality	Collection date (GMT)	Collection Time (GMT)	Sample ID	Depth (m)	Latitude	Longitude
Anacapa (AI-1)	August 2, 2016	0:41:44	Logger P	20	34.01736	-119.44072
Anacapa (AI-1)	August 2, 2016	0:48:45	Logger B	20	34.01736	-119.44072
Anacapa (AI-1)	August 2, 2016	2:12:05	Logger D	52	34.02115	-119.44729
Anacapa (Footprint)	August 2, 2016	3:12:00	Logger C	100	33.96468	-119.48490
Anacapa (Footprint)	August 4, 2016	22:03	<i>Acanthogorgia</i> sp.	201	33.95948	-119.47541
Anacapa (Footprint)	August 4, 2016	22:10	<i>Acanthogorgia</i> sp.	200	33.95948	-119.47541

Table 3. Table of waypoints (wpt) visited during the ‘Patterns in Deep-Sea Coral’ 2016 Expedition, aboard NOAA Ship *Shearwater*. Two differing coordinates are associated with Logger C, including the location reported in Caldwell et al. (2015) (wpt. 1) and the location from the NOAA Ship *Shearwater*’s onboard navigation system (wpt 2).

Locality	Date (GMT)	MAREDi ve #	DCEL Dive #	Site	wpt	Latitude	Longitude
Anacapa (AI-1)	August 2, 2016	25	16-213A	Loggers B/P	1	34.0174	-119.4407
Anacapa (AI-1)	August 2, 2016	26	16-213B	Logger D	1	34.0212	-119.4473
Anacapa (Footprint)	August 2, 2016	27	16-213C	Logger C	1	33.9635	-119.4896
Anacapa (Footprint)	August 2, 2016	27	16-213C	Logger C	2	33.9647	-119.4849
North Santa Rosa	August 2, 2016	28	16-214A	NS-A1	1	34.0820	-120.2810
North Santa Rosa	August 2, 2016	28	16-214A	NS-A1	2	34.0750	-120.2840
North Santa Rosa	August 2, 2016	28	16-214A	NS-A1	3	34.0700	-120.2920
North Santa Rosa	August 2, 2016	28	16-214A	NS-A1	4	34.0660	-120.2910
North Santa Rosa	August 2, 2016	29	16-214B	NS-2	1	34.0750	-120.2460
North Santa Rosa	August 2, 2016	29	16-214B	NS-2	2	34.0660	-120.2530
North Santa Rosa	August 2, 2016	29	16-214B	NS-2	3	34.0620	-120.2450
North Santa Rosa	August 2, 2016	29	16-214B	NS-2	4	34.0600	-120.2500
North Santa Rosa	August 2, 2016	30	16-214C	NS-B3	1	34.0830	-120.2170
North Santa Rosa	August 2, 2016	30	16-214C	NS-B3	2	34.0690	-120.2080
South Santa Rosa	August 3, 2016	31	16-215A	SS-1	1	33.8310	-120.0390
South Santa Rosa	August 3, 2016	31	16-215A	SS-1	2	33.8450	-120.0560
South Santa Rosa	August 3, 2016	32	16-215B	SS-4	1	33.8520	-120.0810
South Santa Rosa	August 3, 2016	32	16-215B	SS-4	2	33.8580	-120.0620
South Santa Rosa	August 3, 2016	33	16-215C	SS-A2	1	33.8470	-120.0250
South Santa Rosa	August 3, 2016	33	16-215C	SS-A2	2	33.8520	-120.0250
South Santa Rosa	August 3, 2016	33	16-215C	SS-A2	3	33.8550	-120.0190
South Santa Rosa	August 3, 2016	33	16-215C	SS-A2	4	33.8570	-120.0180
South Santa Rosa	August 3, 2016	34	16-215D	SS-A6	1	33.8450	-120.0380
South Santa Rosa	August 3, 2016	34	16-215D	SS-A6	2	33.8520	-120.0320
South Santa Rosa	August 4, 2016	35	16-216A	SS-A9	1	33.8370	-120.0580
South Santa Rosa	August 4, 2016	35	16-216A	SS-A9	2	33.8400	-120.0540
South Santa Rosa	August 4, 2016	36	16-216B	SS-A7	1	33.8680	-119.9580
South Santa Rosa	August 4, 2016	36	16-216B	SS-A7	2	33.8750	-119.9710
Anacapa (Footprint)	August 4, 2016	37	16-216C	Footprint	1	33.9595	-119.4754
Anacapa (Footprint)	August 5, 2016	VIP	NA	NMFS sled	1	33.9647	-119.4849

Table 4. Inventory of ROV transects conducted during the 2016 ‘Patterns in Deep-Sea Coral’ Expedition aboard NOAA Ship *Shearwater*.

DCEL Dive #	Transect ID	Locality	Date (GMT)	Start Time (GMT)	Start Latitude	Start Longitude	End Latitude	End Longitude	Min. Depth (m)	Max Depth (m)
16-214A	SW-16-214A-15min-NS-A1-a	North Santa Rosa	August 2, 2016	18:05:25	34.08213	-120.28100	34.08001	-120.28183	81	83
16-214A	SW-16-214A-15min-NS-A1-b	North Santa Rosa	August 2, 2016	18:24:30	34.08001	-120.28183	34.07779	-120.28281	77	81
16-214A	SW-16-214A-15min-NS-A1-c	North Santa Rosa	August 2, 2016	18:48:45	34.07779	-120.28281	34.07643	-120.28507	75	76
16-214A	SW-16-214A-15min-NS-A1-d	North Santa Rosa	August 2, 2016	19:15:55	34.07643	-120.28507	34.07613	-120.28815	73	75
16-214B	SW-16-214B-15min-NS-2-a	North Santa Rosa	August 2, 2016	20:22:45	34.07613	-120.28815	34.08021	-120.24213	74	73
16-214B	SW-16-214B-15min-NS-2-b	North Santa Rosa	August 2, 2016	20:45:00	34.08021	-120.24213	34.07573	-120.24557	67	74
16-214B	SW-16-214B-15min-NS-2-c	North Santa Rosa	August 2, 2016	21:03:40	34.07573	-120.24557	34.07309	-120.24756	64	67
16-214B	SW-16-214B-15min-NS-2-d	North Santa Rosa	August 2, 2016	21:20:00	34.07309	-120.24756	34.07064	-120.24952	60	64
16-214C	SW-16-214C-15min-NS-3B-a	North Santa Rosa	August 2, 2016	22:20:48	34.07064	-120.24952	34.08171	-120.21714	70	60
16-214C	SW-16-214C-15min-NS-3B-b	North Santa Rosa	August 2, 2016	22:39:55	34.08171	-120.21714	34.07905	-120.21570	67	70
16-214C	SW-16-214C-15min-NS-3B-c	North Santa Rosa	August 2, 2016	22:58:10	34.07905	-120.21570	34.07617	-120.21357	62	67
16-214C	SW-16-214C-15min-NS-3B-d	North Santa Rosa	August 2, 2016	23:15	34.07617	-120.21357	34.07365	-120.21219	60	62
16-215A	SW-16-215A-15min-SS-1-a	South Santa Rosa	August 3, 2016	15:53:20	33.83155	-120.03971	33.83383	-120.04236	97	99
16-215A	SW-16-215A-15min-SS-1-b	South Santa Rosa	August 3, 2016	16:14:40	33.83463	-120.04373	33.83592	-120.04499	95	94
16-215A	SW-16-215A-15min-SS-1-c	South Santa Rosa	August 3, 2016	16:30:50	33.83596	-120.04507	33.83754	-120.04682	88	94
16-215A	SW-16-215A-15min-SS-1-d	South Santa Rosa	August 3, 2016	16:50:35	33.83789	-120.04735	33.83937	-120.04906	81	86
16-215A	SW-16-215A-15min-SS-1-e	South Santa Rosa	August 3, 2016	17:19:10	33.84072	-120.05092	33.84204	-120.05291	94	92
16-215B	SW-16-215B-15min-SS-4-a	South Santa Rosa	August 3, 2016	18:26:20	33.85217	-120.08044	33.85346	-120.07667	100	104
16-215B	SW-16-215B-15min-SS-4-b	South Santa Rosa	August 3, 2016	18:42:45	33.85345	-120.07629	33.85459	-120.07298	97	99
16-215B	SW-16-215B-15min-SS-4-c	South Santa Rosa	August 3, 2016	19:02	33.85499	-120.07164	33.85610	-120.06866	92	95
16-215C	SW-16-215C-15min-SS-A2-a	South Santa Rosa	August 3, 2016	20:39:45	33.84766	-120.02549	33.85002	-120.02514	79	80.9
16-215C	SW-16-215C-15min-SS-A2-b	South Santa Rosa	August 3, 2016	21:31:10	NA	NA	NA	NA	NA	NA
16-215C	SW-16-215C-15min-SS-A2-c	South Santa Rosa	August 3, 2016	21:59:15	NA	NA	NA	NA	NA	NA
16-215D	SW-16-215D-15min-SS-A6-a	South Santa Rosa	August 3, 2016	23:11:10	33.84518	-120.03800	33.84720	-120.03633	81	87
16-215D	SW-16-215D-15min-SS-A6-b	South Santa Rosa	August 3, 2016	23:29:02	33.84751	-120.03616	33.84919	-120.03456	84	82
16-215D	SW-16-215D-15min-SS-A6-c	South Santa Rosa	August 3, 2016	23:45:31	33.84950	-120.03442	33.85094	-120.03295	82	83
16-216A	SW-16-216A-15min-SS-A9-a	South Santa Rosa	August 4, 2016	15:19:45	33.83725	-120.05805	33.83798	-120.05682	91	98
16-216A	SW-16-216A-15min-SS-A9-b	South Santa Rosa	August 4, 2016	15:37:30	33.83809	-120.05662	33.83888	-120.05544	86	92
16-216B	SW-16-216B-15min-SS-A7-a	South Santa Rosa	August 4, 2016	16:52:10	33.86799	-119.95872	33.86901	-119.96047	76	83
16-216B	SW-16-216B-15min-SS-A7-b	South Santa Rosa	August 4, 2016	17:14:20	33.86964	-119.96113	33.87170	-119.96495	77	80

7. Figures

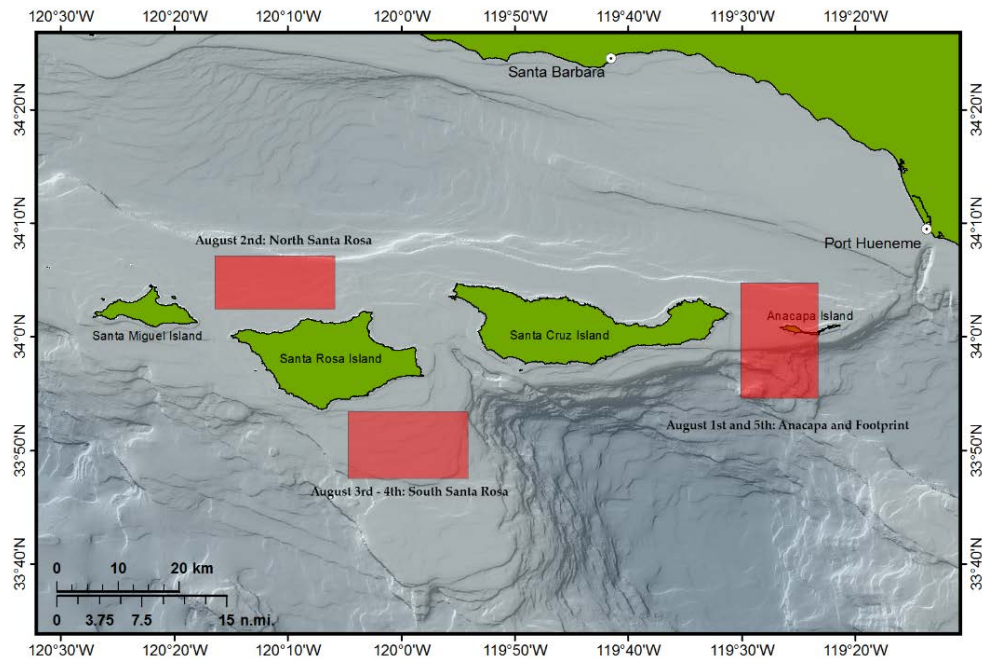


Figure 1. Overview map of areas surveyed by the NOAA Ship *Shearwater* with ROV *Beagle* aboard the 'Patterns in Deep-Sea Coral' Expedition, August 1-5, 2016.

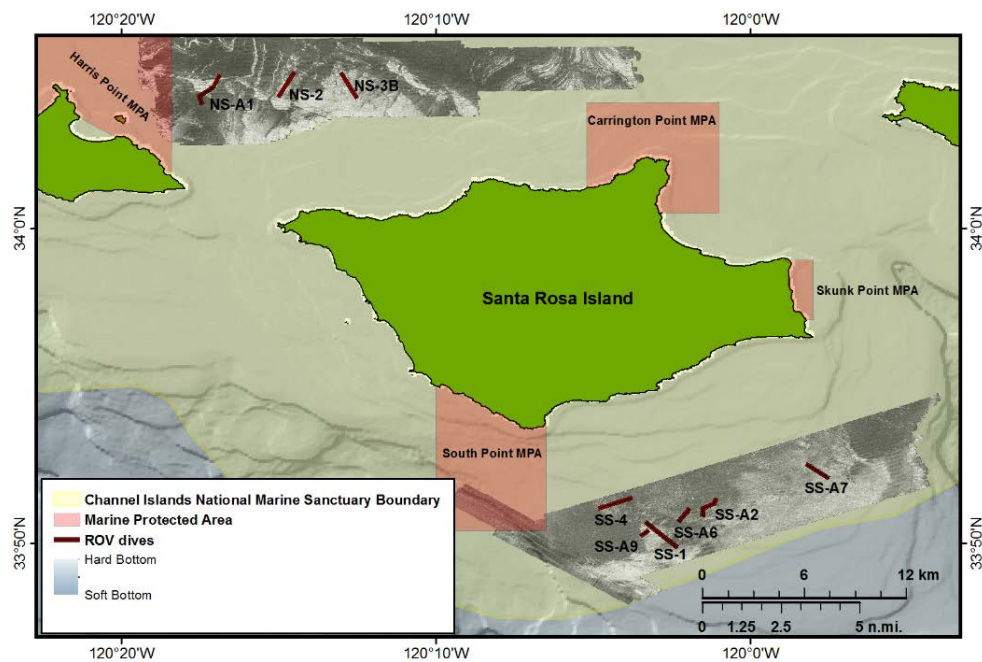


Figure 2. Overview maps of ROV dives 16-213A to 16-216B near Santa Rosa Island overlaid on multibeam echosounder maps generated during *Bell M. Shimada* cruise SH-15-03 and reported in Caldwell *et al.*, 2015, which identifies hard-bottom features from 8-m resolution backscatter data.

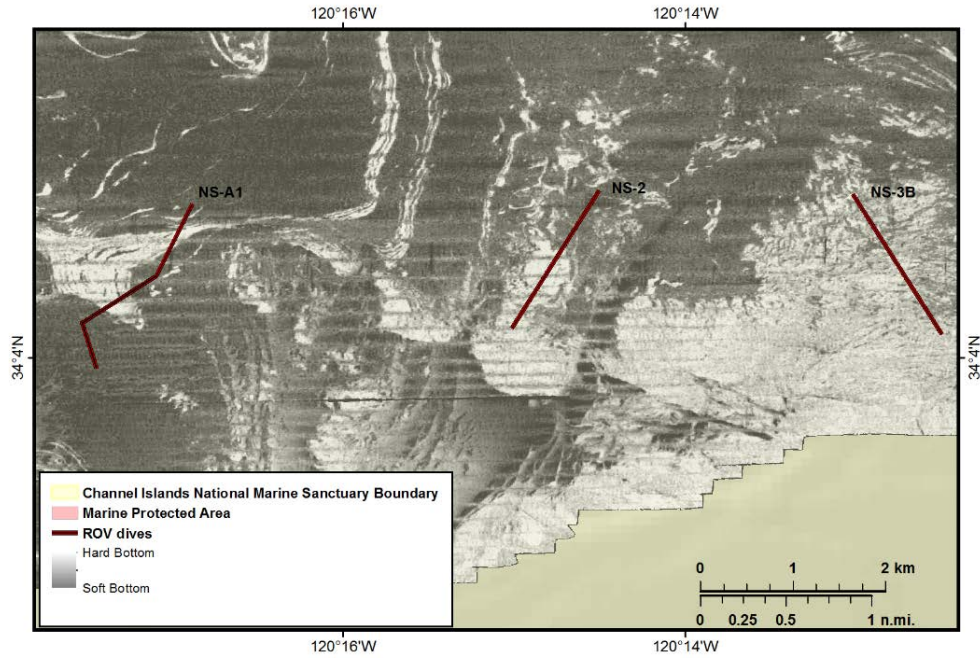


Figure 3. Map of ROV dives 16-214A, 16-214B and 16-214C north of Santa Rosa Island overlaid on multibeam echosounder maps generated during *Bell M. Shimada* cruise SH-15-03 and reported in Caldow *et. al*, 2015, which identifies hard-bottom features from 8-m resolution backscatter data.

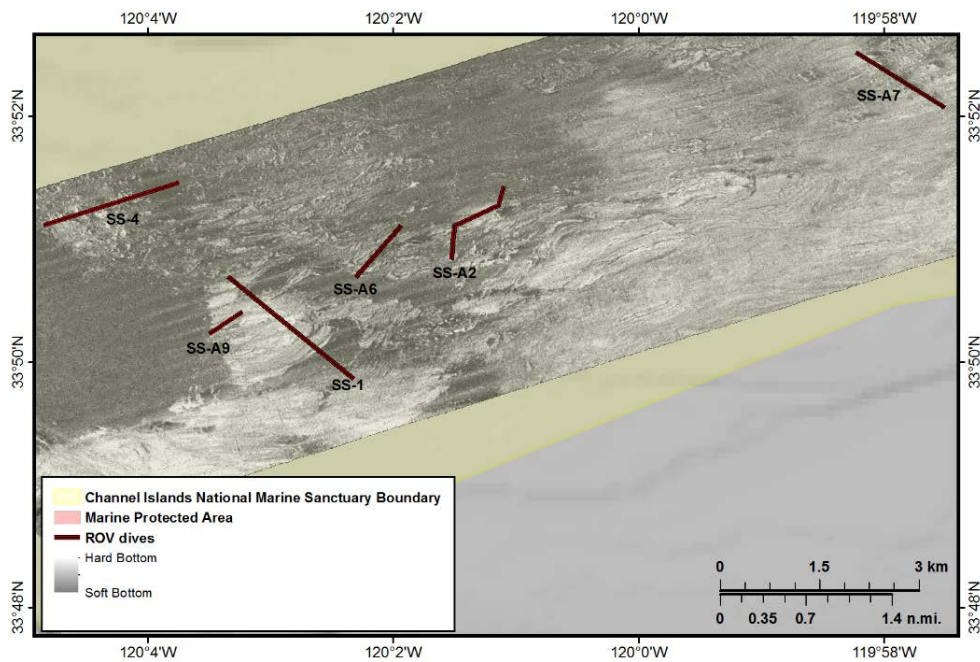


Figure 4. Map of ROV dives 16-215A to 16-216B south of Santa Rosa Island overlaid on multibeam echosounder maps generated during *Bell M. Shimada* cruise SH-15-03 and reported in Caldow *et. al*, 2015, which identifies hard-bottom features from 8-m resolution backscatter data.

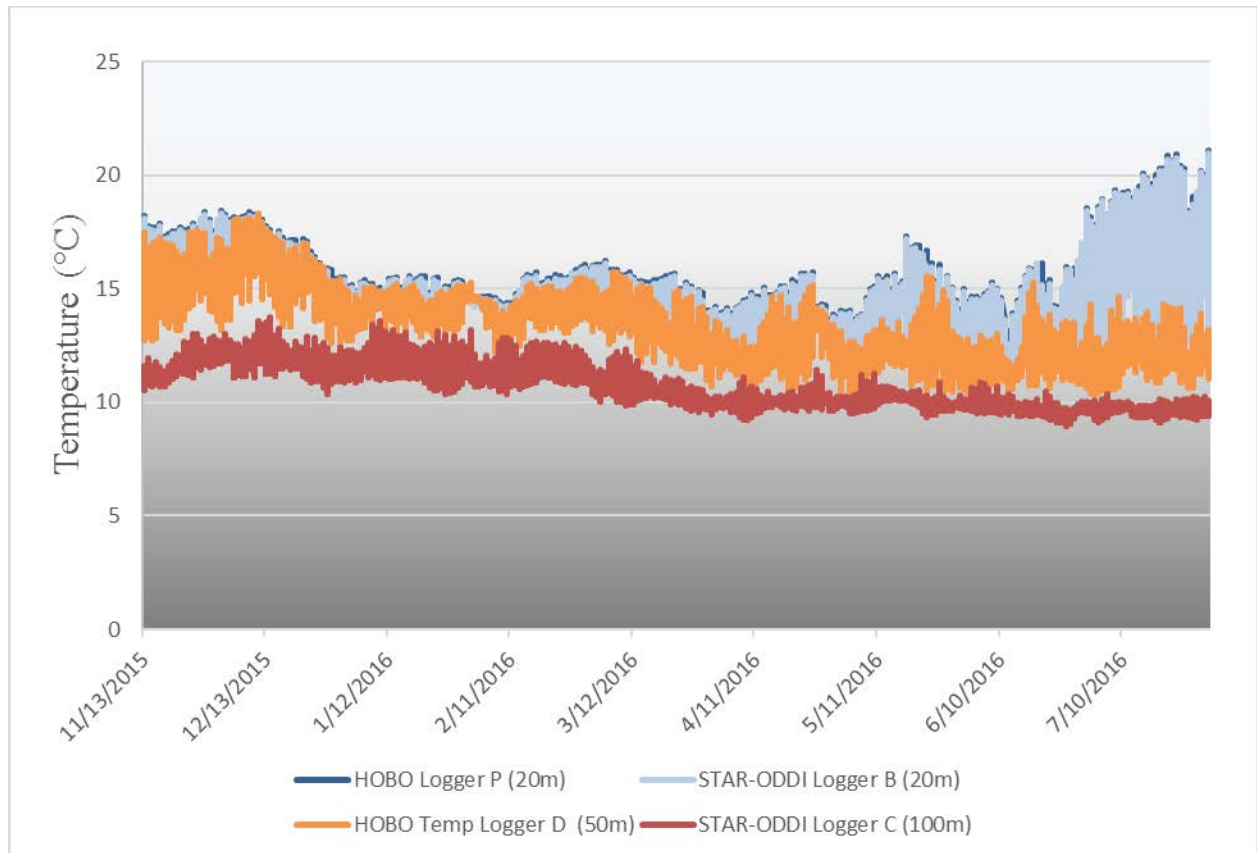


Figure 5. Line graph of temperature data collected from two HOBO and two STAR-ODDI temperature loggers deployed at depths ranging from 20 to 100 m in Southern California’s Channel Islands. Temperatures shown here are limited to an 8-month period from the fall of 2015 to summer 2016.

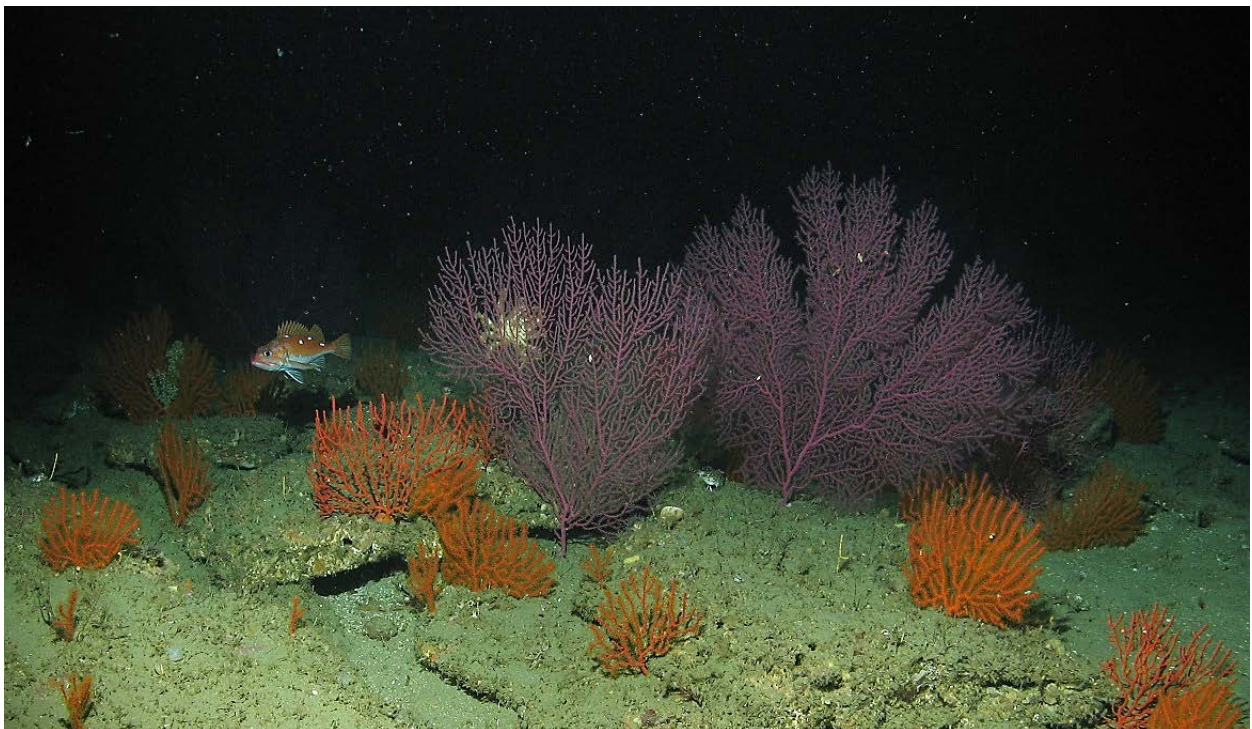


Figure 6. Healthy coral garden surveyed off South Santa Rosa Island on August 3, 2016.



Figure 7. Live *Acanthogorgia* sp. octocoral at 200 m depth at Footprint ridge collected for laboratory assays.



Figure 8. Live *Acanthogorgia* sp. octocoral from Footprint ridge in aquaria in Charleston, SC.

8. Appendices

Appendix A: Operational notes

July 31, 2016. Mobilization began at 0830 at Santa Barbara Harbor. JHT/NOAA staff members loaded science gear and purchased food. MARE staff members loaded and set up the ROV and associated equipment. After mobilization was complete, Rosen and Etnoyer provided an outreach event for six current and potential MARE donors on the NOAA Ship *Shearwater* dock, which included a presentation of the mission goals.

August 1, 2016. The expedition got off to a rough start, as the vessel hit a piling and bent the tracking pivot irreparably. Ed Liquorek, the brother of a local angler, fabricated a new pivot. The NOAA Ship *Shearwater* left the dock at 1300 and transited to the north side of Anacapa Island, arriving by 1530. The ROV was deployed by 1630 to retrieve temperature loggers at 20 m. The ROV encountered a large black seabass as soon as the ROV reached bottom. The team retrieved two temperature loggers (B and P) during the first dive. A large air bubble seeped into the main tether compensator overnight. Lauermann and Rosen had purged the bubble prior to the ROV deployment, but it reappeared after the 20 m dive, 55 m dive (logger D retrieval), and 110 m dive (logger C retrieval at NMFS sled site). This marked the first use of HD video for the live feed from the ROV. The focus was acceptable, but the color appeared washed out at times. Overall, it was much improved over standard definition. The final ROV dive of the day was completed by 2000 and the manipulator skid was removed since all temperature loggers had been recovered. The NOAA Ship *Shearwater* transited to South Santa Rosa to anchor overnight.

August 2, 2016. The tether compensator was purged of air in transit to the north side of Santa Rosa. The ROV was first deployed at 0800. Three dives were conducted through the course of the day, for a total of 12 transects of 15-minute duration each, in addition to general exploration at three different sites. The three dives were at 80 m, 70 m and 65 m. The tether needed to be purged after each dive, because the piston completely bottomed out after each dive. To improve the quality of the HD feed and video, the white balance was adjusted using white plastic bags on the clump shroud. This improved the color of the video. During the dives, some *Adelogorgia* gorgonians were noted on ridges, along with an abundance of *Eugorgia* gorgonians, both of which appeared healthy. In addition to these corals, the team noted a few spots with many lingcod, copper, starry, and a few gopher rockfish, bocaccio and sheephead. ROV pilots noted that moving the vertical thruster forward this winter helped make the ROV perform better straight up and down, and moving the altimeter forward improved auto-altitude function over moderate terrain. The HMI lights on the ROV became erratic through the course of the day and did not stay on. With the low light HD camera, and the reds of the tungsten light still allowing for good photos to be captured, the need for the HMIs was questionable. The ROV team used a new AA Beacon, and it performed adequately down to 70 m. The ROV was recovered and operations were concluded by 1800. The NOAA Ship *Shearwater* anchored at Johnsons' Lee, Santa Rosa for the evening. Elephant seals were heard billowing throughout the night.

August 3, 2016. The weather remained good allowing for continued exploration of new SE Santa Rosa sites. The ROV was first deployed at South Santa Rosa at 0800 and conducted four dives with 14 transects of 15-minute duration at four different localities at depths of 95m, 105m, 85m and 90m.. Many corals were observed, several at densities consistent with Coral Gardens (1/m² over distances of at least 100 m) (OSPAR 2010). There was some noticeable injury to gorgonians from zooanthids, some toppled colonies were documented, as well as two white nudibranchs, and a crab photographed

utilizing sponges. These dives also documented several ledges and uplifted shelves that made great coral habitat. Fish documented on these dives included two cowcod, a wolf eel, and many rockfish. The last dive of the day had good visibility (30 m) at 0200. During dive operations there was one ROV power outage, however, the team recovered from this within 2 min. The main pressure balance oil filled junction was still taking in air, but not as much as previous days, though the piston bottomed out each dive. The use of HMIs was abandoned. Weather deteriorated throughout the day.

August 4, 2016. Deployed ROV at South Santa Rosa at 0800. ROV *Beagle* completed dives over areas that had previously been mapped with backscatter and contained substantial hard-bottom habitats. One dive started at 85 m, and another dive at 110 m. Conducted four transects of 15-minutes duration near South Santa Rosa during these two dives. A few potential coral gardens were identified, but several of these showed signs of injury and yellow zooanthid overgrowth. Then the ship moved to 220 m to collect two live *Acanthogorgia* sp. colonies. The ROV camera flooded with oil and as a result the first attempt was aborted. The ROV team then replaced the flooded HD camera with a Sidus standard definition video camera and finished the job. The second attempt resulted in the collection of two *Acanthogorgia* colonies. Upon successful collection of these colonies, the ROV was recovered and back aboard by 1500. The NOAA Ship *Shearwater* transited to Ventura Harbor and arrived at 1700.

August 5, 2016. In an effort to further the outreach efforts of the expeditions, VIPs Boltz, Hannah, Teplitz, Ledvina, Graham, Chacin, Robertson, and MARE Director of Donor Relations Phil Stevens, boarded the ship by 0800, and departed for Anacapa Island to explore the Anacapa/Footprint essential fish habitat (EFH) by 0900. The team deployed the ROV at Footprint and conducted an approximately two hour dive up to the NMFS sled, then moved to the lee side of Anacapa, near the net in order to let the VIPs operate the ROV under supervision of the ROV team. Each guest steered the ROV for 4-5 min, which received an enthusiastic response. The NOAA Ship *Shearwater* returned to Ventura by 1700 to drop off the VIPs, and then the vessel returned to Santa Barbara for its next expedition.

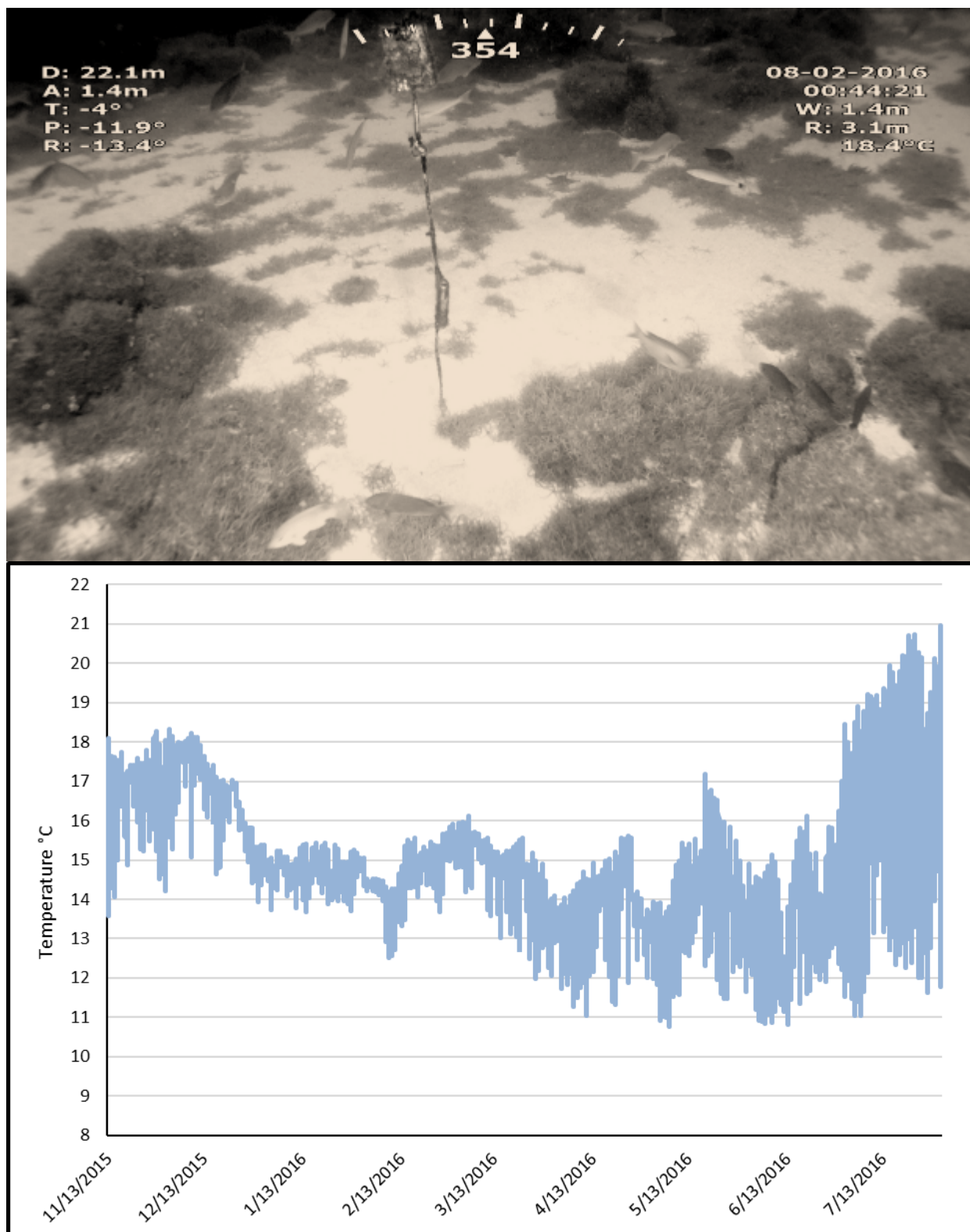
Appendix B: Individual temperature logger site information, images and data.

Shallow target: Loggers B (Star-Oddi logger, silver) and P (Hobo logger, black)

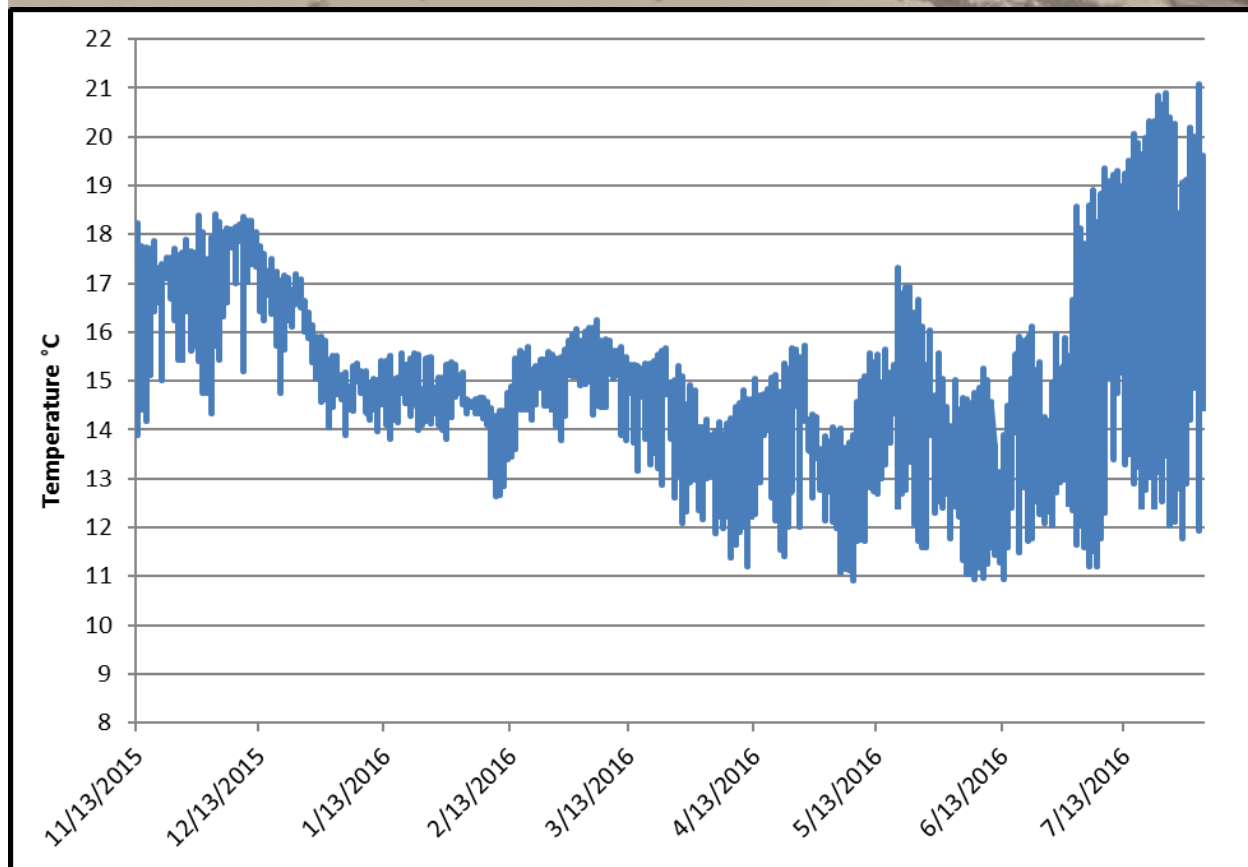
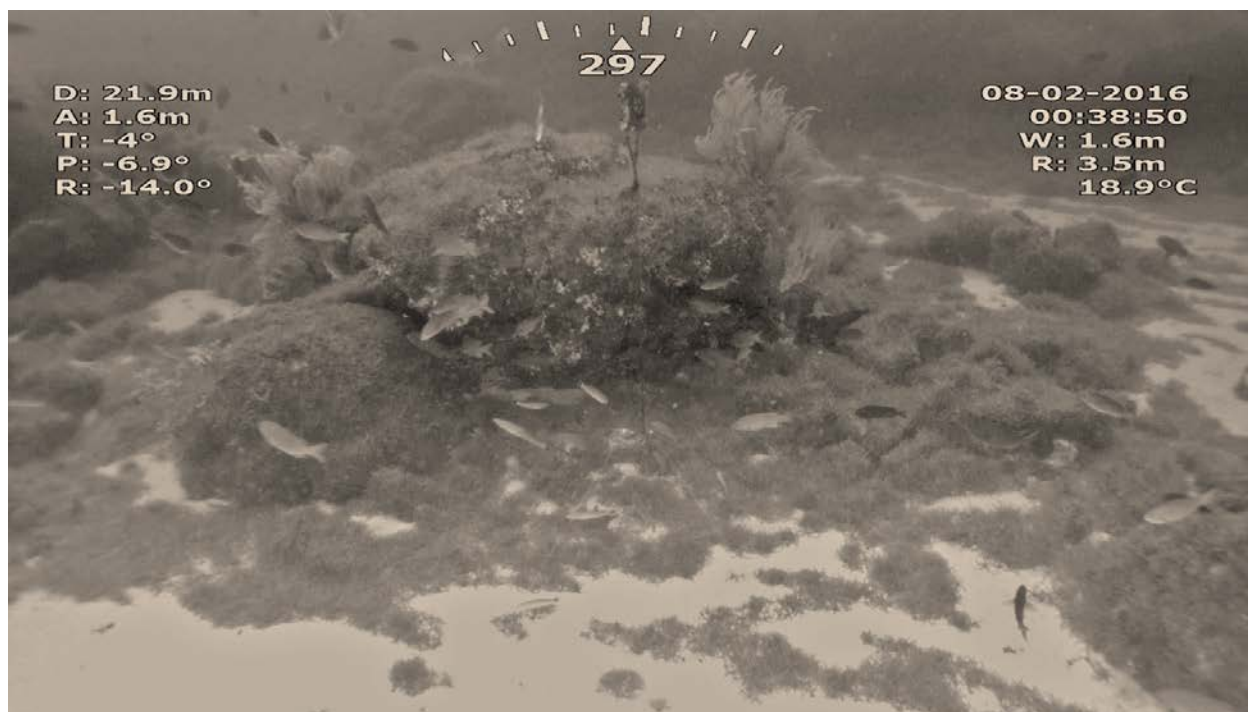
Site: AI-1
Line: 100
Depth: 21 m
Latitude: 34.017364
Longitude: -119.440728
Deployment Method: Shiptside
Deployment Date: November 12, 2015



Appendix B: Figure 1. Dense *Leptogorgia chilensis* aggregation taken near proposed site location. Photo taken by Marine Applied Research and Exploration.



Appendix B: Figure 2. Black and white in-situ image of temperature logger B (top) and graph of temperature data collected from site AI-1 at the shallow target of 21 m depth (bottom).



Appendix B: Figure 3. Black and white in-situ image of temperature logger P (top) and graph of temperature data collected from site AI-1 at the shallow target of 21 m depth (bottom).

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Deep target: Logger D (Hobo logger, black)

Site: AI-1

Line: 710

Depth: 52.5 m

Latitude: 34.021159

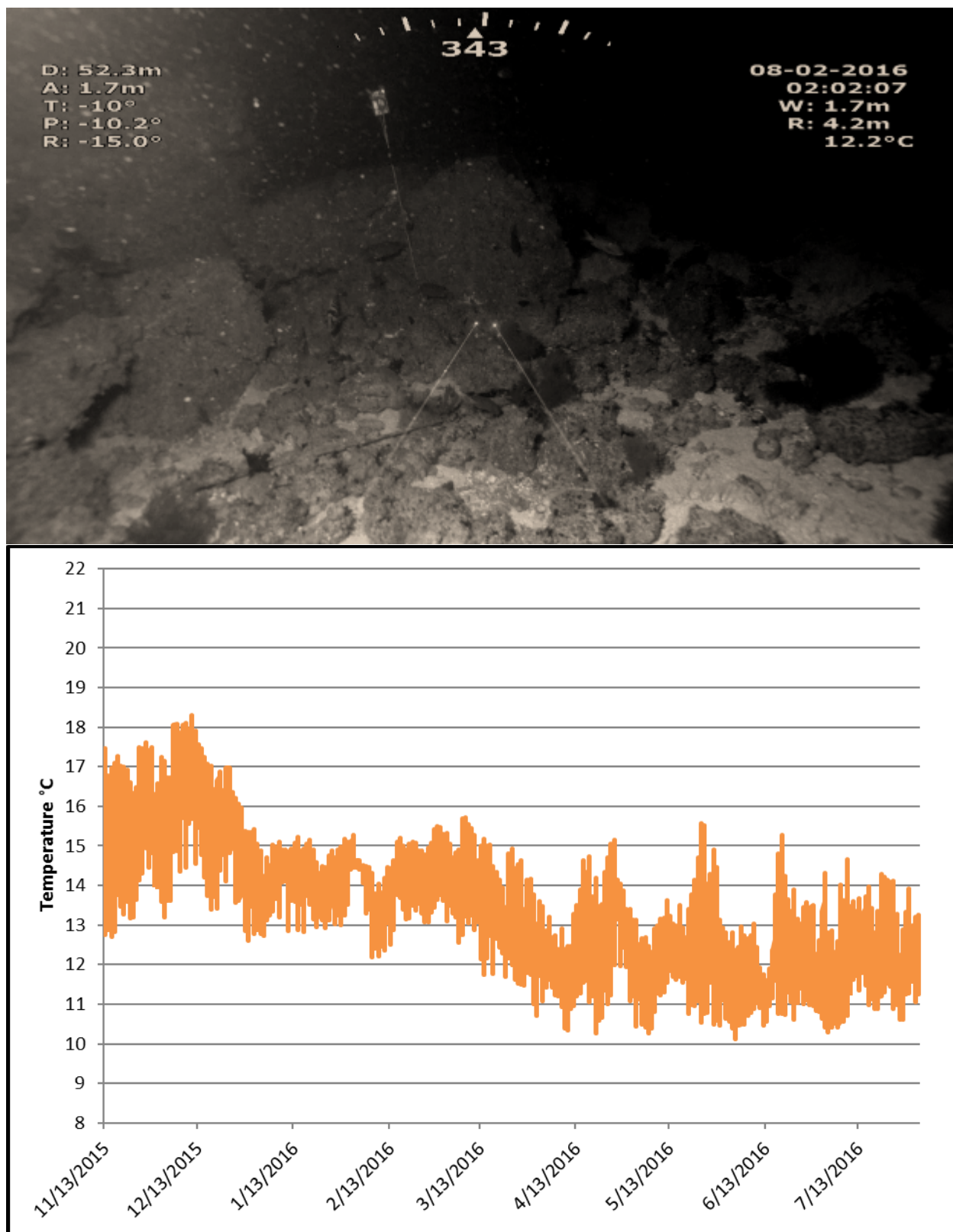
Longitude: -119.447291

Deployment Method: Shiptside

Deployment Date: November 12, 2015



Appendix B: Figure 4. *Eugorgia rubens* aggregation taken near proposed site location. Photo taken by Marine Applied Research and Exploration.



Appendix B: Figure 5. Black and white in-situ image of temperature logger D (top) and graph of temperature data collected from site AI-1 at the shallow target of 52.5 m depth (bottom).

Deep target: Logger C (Star Oddi, Silver)

Site: AI-1

Line: NA

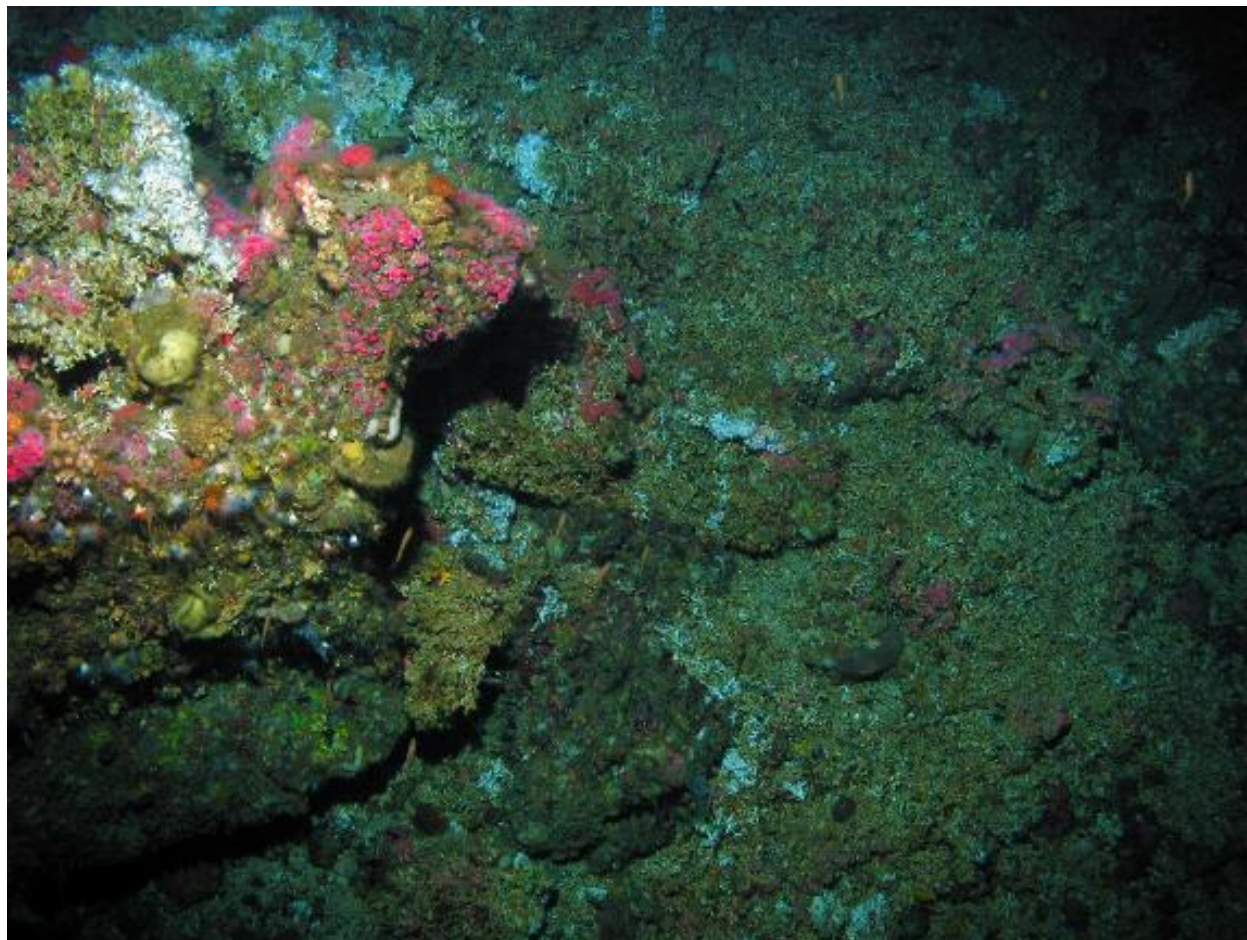
Depth: 104 m

Latitude: 33.96468

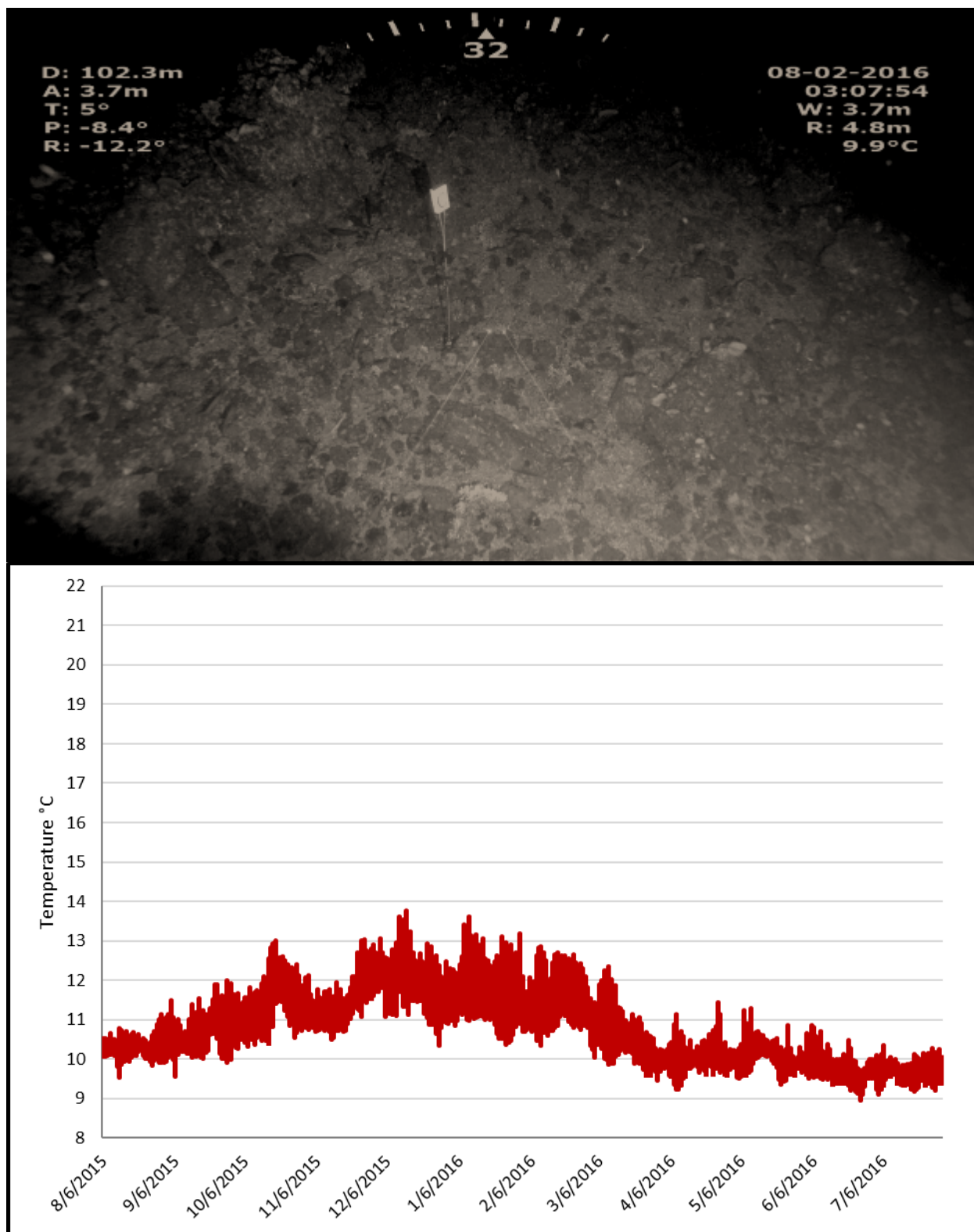
Longitude: -119.48490

Deployment Method: ROV

Deployment Date: August 4, 2015



Appendix B: Figure 6. *Lophelia pertusa* aggregation taken near proposed site location. Photo taken by Marine Applied Research and Exploration.



Appendix B: Figure 7. Black and white in-situ image of temperature logger C (top) and graph of temperature data collected from site AI-1 at the deep target location of 104 m depth (bottom).

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