Cruise Report for "Patterns in Deep-Sea Corals" Expedition: NOAA ship *Bell M. Shimada* SH-15-03

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NOS NCCOS 200
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Cover Image:

NOAA ship *Bell M. Shimada* surveyed deep-sea coral habitats in Southern California's Channel Islands National Marine Sanctuary using a remotely operated vehicle in March 2015. Image credit: Dr. Peter Etnoyer, NOAA National Centers for Coastal Ocean Science.

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Introduction

Less than 50% of the Channel Islands National Marine Sanctuary (CINMS) seafloor has been mapped using multibeam echosounders to produce habitat characterizations at a map resolution suitable for resource management (i.e., better than 10-30 meter resolution). This is important because deep-sea coral and sponge communities are known to occur within the Sanctuary (Whitmire & Clarke 2007; Yoklavich et al. 2013). The distribution of these ecosystems could be predicted using habitat suitability models (Guinotte & Davies 2014; Huff et al. 2013) but this has not been done at the level of detail required for the extent of the CINMS in particular. Deep-sea coral ecosystems are known to be fragile and vulnerable to fishing impacts, but their patterns of distribution are still poorly understood, particularly in terms of their habitat affinities, life histories (age and growth), and their vulnerability to impacts such as ocean acidification.

A research team from CINMS, National Centers for Coastal Ocean Science (NCCOS), Office of Coast Survey (OCS), Marine Applied Research and Education (MARE), and W.M. Keck Science Center of Claremont McKenna College, Pitzer College, and Scripps Colleges conducted mapping activities and benthic survey operations aboard NOAA ship *Bell M. Shimada* with Beagle ROV between March 13 and March 22, 2015 in order to address these data gaps (Table 1). Funding was provided by NCCOS, NOAA's Deep-Sea Coral Research and Technology Program, Office of Ocean Exploration and Research.

The primary objectives of the research expedition were:

1) to map the seafloor and identify survey targets with high suitability for deep-sea coral and sponges through the acquisition of high resolution bathymetry and acoustic backscatter;

2) to make CTD-niskin casts to collect water samples between 50 and 600 meters depth to characterize the seawater chemistry;

3) to characterize deep-water coral and fish assemblages using forward-looking oblique cameras mounted on an ROV; and

4) to collect biological samples of corals and sponges for the purposes of age and growth studies and husbandry for subsequent manipulative experiments related to ocean acidification.

The present report provides a brief summary of the preliminary results of the initial field effort relative to the above objectives. Additional quantitative data and interpretive results will be reported in future publications once samples have been processed.

Narrative of cruise results

Objective 1:

The research team mapped large areas of the sanctuary for the first time using the ship's ME70 multibeam system. Prior to this effort, the multibeam system was largely untested for characterizing deep coral habitats.

Objective 1: (*cont.*)

Six high-priority mapping areas were identified (Fig. 1). A total of 82 square miles were mapped, generating surfaces depicting bathymetric features and backscatter (Fig. 2). Algorithms developed by NCCOS Biogeography Branch were used to extract seafloor metrics from multibeam data which successfully predicted hard bottom areas. Subsequent ROV dives verified the presence of abundant octocorals and rockfish over complex hard bottom habitats. In addition to seafloor mapping, data on fish in the water column were collected using a split-beam fisheries echosounder (EK60). The mission found a wide variety of fish school types associated with various seafloor features. Habitat maps will be generated in 2015 and 2016 based on backscatter and seafloor characteristics, as well as maps of abundance and distribution of organisms in the water column and on the seafloor.

Objective 2:

A total of 36 water samples were collected from depths between 5 and 545 meters depth for evaluation of carbonate chemistry (Table 2 and 3). Water samples will be processed by NOAA Pacific Marine Environmental Laboratory in Seattle and NOAA NCCOS in Charleston. Three *Lophelia* coral monitoring sites were established near deep-coral aggregations on Footprint and Piggy Bank in CINMS. These were identified as large aggregations in previous surveys. Two CTD-niskin casts (to 280 m and 180 m) were adjacent to *Lophelia pertusa* coral aggregations on Piggy Bank and Footprint. One CTD-niskin (to 550 m) was made between these two sites (Fig. 3). High-precision Star-Oddi data loggers were deployed near 100 meters, 200 m, and 300 m depth to monitor temperature at 5-minute intervals for up to one year. Corals were imaged at high-resolution for a photo series to monitor coral health (Fig. 4).

Objective 3:

The research team completed 13 ROV dives between 50 and 300 meters depth over the course of 6 days from March 13 to 18, 2015, for a total of 20 hours and 48 minutes of bottom time (Table 4). The area of operations for ROV surveys included Anacapa Island (1 dive), the Footprint (5 dives), Piggy Bank (1 dive), San Miguel (3 dives), and Carrington Point (3 dives) within CINMS. *Lophelia pertusa* was observed for the first time on the north side of CINMS, near San Miguel Island at 75 meters depth (Fig. 5). This discovery has implications for habitat distribution models. *Lophelia* occurs in the NE Pacific as far north as Seattle. An extensive 'coral garden' with many rockfish was discovered at 60-80 m depth, also on the north side of CINMS, near Santa Rosa Island. Gorgonian corals *Eugorgia rubens, Adelogorgia phyllosclera,* and *Leptogorgia chilensis* were documented in high abundance (Fig. 6). Gorgonian 'coral gardens' are aggregations of large colonies that occur at high densities (1-9 colonies/ 10 sq m) over large areas (Henry & Roberts 2014).

Objective 4:

Samples of 8 deep-water sea fan colonies and 4 stony coral aggregations were collected and retrieved from 50 - 300 m depth for species identification age and growth studies (Table 5, Figs. 7& 8). The species collected included *Lophelia pertusa, Desmophyllum, Acanthorgorgia, Eugorgia, Adelogorgia* and an unidentified (potentially new) species of deep-water branching sponge. Sub-samples preserved in 95% ethanol will be shipped to Northwest Fisheries Science Center for genetic sequencing using COI+igr and MutS octocoral barcodes to confirm species ID. Whole colonies with a thick basal axis will be used to reveal patterns in deep-

Objective 4: (cont.)

sea coral growth. Sea fans and stony corals collected by the research team should prove useful for radio-isotope dating and growth analysis, and stable isotope studies to determine trophic ecology and nutrient sources to deep-sea coral assemblages in CINMS. Live *Lophelia pertusa* corals were collected and transported to NCCOS in Charleston for laboratory studies to test the effects of ocean acidification on deep-sea corals.

Media Outreach

The research expedition met with success on all primary objectives, thanks to fair weather and an excellent crew. The cruise was well documented by local media. A VIP day on board the ship *Bell M. Shimada* on March 18th, 2015 brought several reporters to The Footprint conservation area in Channel Islands National Marine Sanctuary. The results of those interviews were documented in the LA Times and the Santa Barbara Independent newspapers. See the links below for more information about the expedition.

http://www.latimes.com/science/great-reads/la-sci-c1-channel-islands-corals-20150401-story.html#page=1

http://www.independent.com/news/2015/mar/26/electric-coral-acid-test/

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Henry, L. A., & Roberts, J. M. (2014). Recommendations for best practice in deep-sea habitat classification: Bullimore et al. as a case study. *ICES Journal of Marine Science: Journal du Conseil*, 71(4), 895-898.

Huff, D. D., Yoklavich, M. M., Love, M. S., Watters, D. L., Chai, F., & Lindley, S. T. (2013). Environmental factors that influence the distribution, size, and biotic relationships of the Christmas tree coral *Antipathes dendrochristos* in the Southern California Bight. *Marine Ecology Progress Series*, *494*, 159-177.

Whitmire, C. E., & Clarke, M. E. (2007). State of deep coral ecosystems of the US Pacific Coast: California to Washington. *The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3. Silver Spring MD*, 109-154.

Yoklavich, M.M., Laidig T., Taylor A., Watters, D.L., Krigsman, L., & Love, M. (2013). A characterization of the Christmas tree black coral (*Antipathes dendrochristos*) community on three seamounts in the Southern California Bight from a survey using a manned submersible. Report to NOAA Deep-Sea Coral Research and Technology Program, Silver Spring, Maryland. 82 p.

Table 1. List of participants for the "Patterns in Deep-Sea Corals" Expedition in March, 2015.

Name	Title	Affiliation
Annis, Michael	Hydrographer	NOAA Office of Coast Survey
Botman, Rick	ROV Operator	Marine Applied Research and Education Group
Caldow, Chris	Marine Biologist	NOAA National Marine Sanctuaries
Etnoyer, Peter	Marine Biologist	NOAA National Centers for Coastal Ocean Science
Holz, Steve	ROV Operator	Marine Applied Research and Education Group
Kracker, Laura	Geographer	NOAA National Centers for Coastal Ocean Science
Lauermann, Andy	ROV Operator	Marine Applied Research and Education Group
Parks, Devyn	Marine Biologist	W.M Keck Science Center of Claremont McKenna College, Pitzer College, and Scripps Colleges
Raskin, Sarah	Teacher	Oxnard Unified School District
Rosen, Dirk	ROV Operator	Marine Applied Research and Education Group
Sautter, Will	Physical Scientist	NOAA Contractor with CSS-Dynamac
Shuler, Andrew	Marine Biologist	NOAA Contractor with JHT, Inc.
Weller, Erin	Hydrographer	NOAA Office of Coast Survey
Wickes, Leslie	Marine Biologist	NOAA Contractor with JHT, Inc.
Williams, Branwen	Biological Oceanographer	W.M Keck Science Center of Claremont McKenna College, Pitzer College, and Scripps Colleges

Table 2. CTD cast summary for Channel Islands 2015 research expedition SH-15-03. DIC = dissolved inorganic carbon, TA = total alkalinity, pH = negative log of the hydrogen ion concentration.

EventID	BottleID	Date	Time	Depth (m)	Oxygen (ml/l)	Salinity	Temp (C)	DIC	TA	pH
CTD 1	1-1	3/14/15	4:24:36	313	0.91	34.24	8.19	Y	Y	Y
CTD 1	1-2	3/14/15	4:26:00	276	1.23	34.20	8.50	Y	Y	Y
CTD 1	1-3	3/14/15	4:27:05	251	1.40	34.17	8.62	Y	Y	Y
CTD 1	1-4	3/14/15	4:28:07	226	1.57	34.14	8.78	Y	Y	Y
CTD 1	1-5	3/14/15	4:29:10	200	1.97	34.06	9.08	Y	Y	Y
CTD 1	1-6	3/14/15	4:30:08	175	2.27	33.99	9.21	Y	Y	Y
CTD 1	1-7	3/14/15	4:30:54	150	2.61	33.86	9.46	Y	Y	Y
CTD 1	1-8	3/14/15	4:31:46	125	3.09	33.74	9.74	Y	Y	Y
CTD 1	1-9	3/14/15	4:32:41	100	3.64	33.55	10.31	Y	Y	Y
CTD 1	1-10	3/14/15	4:33:33	75	4.36	33.35	11.42	Y	Y	Y
CTD 1	1-11	3/14/15	4:34:59	30	5.76	33.27	15.48	Y	Y	Y
CTD 1	1-12	3/14/15	4:36:12	6	5.68	33.30	16.87	Y	Y	Y
CTD 2	2-1	3/15/15	1:56:40	167	1.88	34.10	8.98	Y	Y	Y
CTD 2	2-2	3/15/15	1:57:12	160	1.95	34.07	9.05	N	Y	Y
CTD 2	2-3	3/15/15	1:57:47	150	2.16	34.02	9.19	Y	Y	Y
CTD 2	2-4	3/15/15	1:58:50	125	2.96	33.74	9.73	N	Y	Y
CTD 2	2-5	3/15/15	2:00:13	121	3.08	33.74	9.73	Y	Y	Y
CTD 2	2-6	3/15/15	2:01:18	106	3.06	33.75	9.71	N	Y	Y
CTD 2	2-7	3/15/15	2:02:14	91	3.65	33.59	10.20	Y	Y	Y
CTD 2	2-8	3/15/15	2:03:02	75	4.02	33.40	11.00	N	Y	Y
CTD 2	2-9	3/15/15	2:04:10	50	4.80	33.26	12.48	Y	Y	Y
CTD 2	2-10	3/15/15	2:04:50	36	5.72	33.23	15.15	Y	Y	Y
CTD 2	2-11	3/15/15	2:05:37	21	5.77	33.28	15.98	Y	Y	Y
CTD 2	2-12	3/15/15	2:06:35	6	5.79	33.29	16.39	Y	Y	Y
CTD 3	3-1	3/18/15	14:57:15	545	0.30	34.31	6.62	Y	Y	N
CTD 3	3-2	3/18/15	14:58:32	498	0.34	34.30	6.78	Y	Y	N
CTD 3	3-3	3/18/15	14:59:52	449	0.44	34.29	7.14	Y	Y	N
CTD 3	3-4	3/18/15	15:01:21	399	0.51	34.28	7.36	Y	Y	N
CTD 3	3-5	3/18/15	15:03:52	300	0.93	34.23	8.21	Y	Y	N
CTD 3	3-6	3/18/15	15:06:20	200	1.86	34.08	9.02	Y	Y	N
CTD 3	3-7	3/18/15	15:07:43	150	2.44	33.93	9.39	Y	Y	N
CTD 3	3-8	3/18/15	15:08:34	125	2.74	33.85	9.52	Y	Y	N
CTD 3	3-9	3/18/15	15:09:29	100	3.37	33.65	9.97	Y	Y	N
CTD 3	3-10	3/18/15	15:10:32	75	3.99	33.46	10.69	Y	Y	N
CTD 3	3-11	3/18/15	15:11:26	50	4.71	33.28	12.42	Y	Y	N
CTD 3	3-12	3/18/15	15:12:59	5	5.56	33.26	17.06	Y	Y	N

Table 3. Event Log for CTD and temperature logger deployments.

Event	Date	Time UTC	Latitude	Longitude	Depth (m)
Logger A	March 14, 2015	2:58:05	33.91868	-119.47193	294
Logger B	March 14, 2015	17:11:20	33.95948	-119.47541	172
Logger C	March 14, 2015	20:45:00	33.96352	-119.48956	102
CTD 1	March 14, 2015	4:24:36	33.91755	-119.47099	313
CTD 2	March 15, 2015	1:56:40	33.95948	-119.47530	167
CTD 3	March 18, 2015	14:57:15	33.93782	-119.48631	106

Table 4. Dive Log for CINMS 2015 Expedition SH-15-03. Event ID is the dive number identifier. UTC is Universal Timecode. "Time min" is duration on bottom in minutes.

Locality	#	Event ID	Date	Start UTC	End UTC	Start Latitude	Start Longitude	End Latitude	End Longitude	Depth min	Depth max	Time min
Anacapa Island	1	15-072A	03/13	22:49	0:38	33.9894	-119.4359	33.9874	-119.4324	64	80	110
Piggy Bank	2	15-072B	03/14	1:58	3:55	33.9195	-119.4711	33.9186	-119.4722	187	295	117
Footprint	3	15-073A	03/14	16:30	17:53	33.9594	-119.4740	33.9595	-119.4749	168	175	83
Footprint	4	15-073B	03/14	18:58	21:26	33.9640	-119.4892	33.9643	-119.4895	92	106	144
Footprint	5	15-073C	03/14	22:15	23:24	33.9565	-119.4663	33.9586	-119.4665	184	192	69
Footprint	6	15-074A	03/15	19:17	21:20	33.9545	-119.4652	33.9557	-119.4670	209	217	117
Carrington Point	7	15-074B	03/16	1:04	2:22	34.0871	-120.0549	34.0886	-120.0566	54	80	78
Carrington Point	8	15-074C	03/16	3:19	4:51	34.0878	-120.0587	34.0853	-120.0632	59	70	90
Carrington Point	9	15-075A	03/16	16:55	18:16	34.0912	-120.0703	34.0877	-120.0689	63	73	81
Carrington Point	10	15-075B	03/16	19:40	21:36	34.0821	-120.0912	34.0752	-120.0916	55	74	116
San Miguel Pass	11	15-076A	03/17	17:32	18:21	34.0826	-120.1877	34.0887	-120.1922	75	77	53
San Miguel Pass	12	15-076B	03/17	19:42	21:48	34.0828	-120.2402	34.0910	-120.2434	56	74	126
Footprint	13	15-077A	03/18	19:23	20:38	33.9612	-119.4782	33.9595	-119.4760	165	165	61

Table 5. Sample log for cruise SH-15-03. Samples in ethanol and RNA Later are used for species identification. Samples in formalin are used for reproductive studies. Dried specimens are used for stable isotopes, age, and growth studies.

Row	AphiaID	Phylum	Scientific Name	Sample No.	Date (local)	Time (UTC)	Latitude	Longitude	Depth (m)	Preserved	Storage type	with no.	owner
1	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-A	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	15ml tube	14	Etnoyer
2	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-B	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	15ml tube	14	Etnoyer
3	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-C	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	15ml tube	14	Etnoyer
4	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-D	3/14/15	3:10:41	33.91882	-119.47188	293	RNA Later	15ml tube	14	Etnoyer
5	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-E	3/14/15	3:10:41	33.91882	-119.47188	293	RNA Later	15ml tube	14	Etnoyer
6	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-F	3/14/15	3:10:41	33.91882	-119.47188	293	RNA Later	15ml tube	14	Etnoyer
7	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-G	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	16oz. jar	14	Etnoyer
8	135161	Cnidaria	*Lophelia pertusa*	CINMS-014-H	3/14/15	3:10:41	33.91882	-119.47188	293	Formalin	8oz. jar	14	Etnoyer
9	135161	Cnidaria	*Lophelia pertusa*	CINMS-14-I	3/14/15	3:10:41	33.91882	-119.47188	293	Dried	Rubbermaid	14	Etnoyer
10	123084	Echinodermata	Ophiuroidea	CINMS-15	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	50ml tube	14	Etnoyer
11	138584	Mollusca	*Calliostoma* sp.	CINMS-16	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	50ml tube	14	Etnoyer
12	883	Annelida	Polychaete	CINMS-17	3/14/15	3:10:41	33.91882	-119.47188	293	Ethanol	50ml tube	14	Etnoyer
13	135161	Cnidaria	*Lophelia pertusa*	CINMS-18-A	3/15/15	17:29:53	33.95952	-119.47530	170	Ethanol	15ml tube	18	Etnoyer
14	135161	Cnidaria	*Lophelia pertusa*	CINMS-18-B	3/15/15	17:29:53	33.95952	-119.47530	170	Ethanol	15ml tube	18	Etnoyer
15	135161	Cnidaria	*Lophelia pertusa*	CINMS-18-C	3/15/15	17:29:53	33.95952	-119.47530	170	RNA Later	15ml tube	18	Etnoyer
16	135161	Cnidaria	*Lophelia pertusa*	CINMS-18-D	3/15/15	17:29:53	33.95952	-119.47530	170	RNA Later	15ml tube	18	Etnoyer
17	135161	Cnidaria	*Lophelia pertusa*	CINMS-18-E	3/15/15	17:29:53	33.95952	-119.47530	170	Formalin	8oz. Jar	18	Etnoyer
18	135161	Cnidaria	*Lophelia pertusa*	CINMS-18-F	3/15/15	17:29:53	33.95952	-119.47530	170	Dried	Ziploc Bag	18	Williams
19	135161	Cnidaria	*Desmophyllum* sp.	CINMS-19	3/15/15	17:29:53	33.95952	-119.47530	170	Dried	Ziploc Bag	18	Williams
20	123084	Echinodermata	Ophiuroidea	CINMS-20	3/15/15	17:29:53	33.95952	-119.47530	170	Ethanol	50ml tube	18	Etnoyer
21	882	Annelida	Worm Tube	CINMS-21	3/15/15	17:29:53	33.95952	-119.47530	170	Ethanol	15ml tube	18	Etnoyer
22	558	Porifera	Sponge	CINMS-22-A	3/15/15	17:29:53	33.95952	-119.47530	170	Ethanol	50ml tube	18	Etnoyer
23	558	Porifera	Sponge	CINMS-22-B	3/15/15	17:29:53	33.95952	-119.47530	170	Dried	Sealed Bag	18	Etnoyer
24	882	Annelida	Worm	CINMS-23	3/15/15	17:29:53	33.95952	-119.47530	170	Ethanol	15ml tube	22	Etnoyer
25	135161	Cnidaria	*Lophelia pertusa*	CINMS-24-A	3/15/15	21:10:21	33.96357	-119.48955	92	Ethanol	15ml tube	24	Etnoyer
26	135161	Cnidaria	*Lophelia pertusa*	CINMS-24-B	3/15/15	21:10:21	33.96357	-119.48955	92	Ethanol	15ml tube	24	Etnoyer
27	135161	Cnidaria	*Lophelia pertusa*	CINMS-24-C	3/15/15	21:10:21	33.96357	-119.48955	92	Ethanol	15ml tube	24	Etnoyer
28	135161	Cnidaria	*Lophelia pertusa*	CINMS-24-D	3/15/15	21:10:21	33.96357	-119.48955	92	RNA Later	15ml tube	24	Etnoyer
29	135161	Cnidaria	*Lophelia pertusa*	CINMS-24-E	3/15/15	21:10:21	33.96357	-119.48955	92	RNA Later	15ml tube	24	Etnoyer
30	135161	Cnidaria	*Lophelia pertusa*	CINMS-24-F	3/15/15	21:10:21	33.96357	-119.48955	92	RNA Later	15ml tube	24	Etnoyer

Table 5. Sample log for cruise SH-15-03 *(cont.)*

Row	AphiaID	Phylum	Scientific Name	Sample No.	Date (local)	Time (UTC)	Latitude	Longitude	Depth (m)	Preserved	Storage type	with no.	owner
31	135161	Cnidaria	*Lophellia pertusa*	CINMS-24-G	3/15/15	21:10:21	33.96357	-119.48955	92	Formalin	8oz. Jar	24	Etnoyer
32	135161	Cnidaria	*Lophellia pertusa*	CINMS-24-H	3/15/15	21:10:21	33.96357	-119.48955	92	Formalin	8oz. Jar	24	Etnoyer
33	135161	Cnidaria	*Lophellia pertusa*	CINMS-24-I	3/15/15	21:10:21	33.96357	-119.48955	92	dried	16oz. Jar	24	Etnoyer
34	135161	Cnidaria	*Lophellia pertusa*	CINMS-24-J	3/15/15	21:10:21	33.96357	-119.48955	92	dry	Ziploc Bag	24	Williams
35	138584	Mollusca	*Calliostoma* sp.	CINMS-25	3/15/15	21:10:21	33.96357	-119.48955	92	95% etoh	50ml tube	24	Etnoyer
36	135093	Cnidaria	*Desmophyllum*	CINMS-26	3/15/15	21:10:21	33.96357	-119.48955	92	dry	Ziploc Bag	24	Williams
37	123084	Echinodermata	Ophiuroidea	CINMS-27	3/15/15	21:10:21	33.96357	-119.48955	92	95% etoh	50ml tube	24	Etnoyer
38	283836	Cnidaria	*Coryonactis* sp.	CINMS-28	3/15/15	21:10:21	33.96357	-119.48955	92	95% etoh	50ml tube	24	Etnoyer
39	123084	Echinodermata	Ophiuroidea	CINMS-29	3/15/15	21:10:21	33.96357	-119.48955	92	95% etoh	15ml tube	24	Etnoyer
40	1803	Brachiopoda	Brachiopoda	CINMS-30	3/15/15	21:10:21	33.96357	-119.48955	92	95% etoh	50ml tube	24	Etnoyer
41	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-31-A	3/16/15	20:01:43	33.95471	-119.46636	203	95% etoh	50ml tube	31	Etnoyer
42	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-31-B	3/16/15	20:01:43	33.95471	-119.46636	203	95% etoh	15ml tube	31	Etnoyer
43	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-31-C	3/16/15	20:01:43	33.95471	-119.46636	203	dry	Sealed bag	31	Etnoyer
44	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-31-D	3/16/15	20:01:43	33.95471	-119.46636	203	dry	Large bag	31	Etnoyer
45	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-32-A	3/16/15	20:32:11	33.95498	-119.46677	203	95% etoh	50ml tube	32	Etnoyer
46	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-32-B	3/16/15	20:32:11	33.95498	-119.46677	203	95% etoh	15ml tube	32	Etnoyer
47	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-32-C	3/16/15	20:32:11	33.95498	-119.46677	203	dry	Large bag	32	Williams
48	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-33-A	3/16/15	20:55:03	33.95534	-119.46715	203	95% etoh	50ml tube	33	Etnoyer
49	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-33-B	3/16/15	20:55:03	33.95534	-119.46715	203	95% etoh	15ml tube	33	Etnoyer
50	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-33-C	3/16/15	20:55:03	33.95534	-119.46715	203	dry	Large bag	33	Williams
51	105693	Chordata	Shark egg case	CINMS-34	3/16/15	20:01:43	33.95471	-119.46636	203	95% etoh	50ml tube	31	Etnoyer
52	289935	Cnidaria	*Eugorgia rubens*	CINMS-35-A	3/17/15	18:13:57	34.08747	-120.06872	61	dried	Large Bag	35	Williams
53	289935	Cnidaria	*Eugorgia rubens*	CINMS-35-B	3/17/15	18:13:57	34.08747	-120.06872	61	95% etoh	50ml tube	35	Etnoyer
54	289935	Cnidaria	*Eugorgia rubens*	CINMS-35-C	3/17/15	18:13:57	34.08747	-120.06872	61	95% etoh	15ml tube	35	Etnoyer
55	1082	Arthropoda	Cirripedia	CINMS-36	3/17/15	18:13:57	34.08747	-120.06872	61	95% etoh	15ml tube	35	Etnoyer
56	149668	Arthropoda	Mysid shrimp	CINMS-37	3/17/15	18:13:57	34.08747	-120.06872	61	95% etoh	15ml tube	35	Etnoyer
57	267204	Cnidaria	*Adelogorgia* sp.	CINMS-38-A	3/17/15	20:14:36	34.07923	-120.09187	68	dry	Large bag	38	Williams
58	267204	Cnidaria	*Adelogorgia* sp.	CINMS-38-B	3/17/15	20:14:36	34.07923	-120.09187	68	95% etoh	50ml tube	38	Etnoyer
59	267204	Cnidaria	*Adelogorgia* sp.	CINMS-38-C	3/17/15	20:14:36	34.07923	-120.09187	68	95% etoh	15ml tube	38	Etnoyer
60	267204	Cnidaria	*Adelogorgia* sp.	CINMS-39-A	3/17/15	20:43:36	34.07670	-120.09193	63	dry	Large bag	39	Williams

Table 5. Sample log for cruise SH-15-03 *(cont.)*

Row	AphiaID	Phylum	Scientific Name	Sample No.	Date (local)	Time (UTC)	Latitude	Longitude	Depth (m)	Preserved	Storage type	with no.	owner
61	267204	Cnidaria	*Adelogorgia* sp.	CINMS-39-B	3/17/15	20:43:36	34.07670	-120.09193	63	95% etoh	50ml tube	39	Etnoyer
62	267204	Cnidaria	*Adelogorgia* sp.	CINMS-39-C	3/17/15	20:43:36	34.07670	-120.09193	63	95% etoh	15ml tube	39	Etnoyer
63	289935	Cnidaria	*Eugorgia rubens*	CINMS-40-A	3/17/15	21:23:06	34.07521	-120.09156	63	dry	Large bag	40	Williams
64	289935	Cnidaria	*Eugorgia rubens*	CINMS-40-B	3/17/15	21:23:06	34.07521	-120.09156	64	95% etoh	50ml tube	40	Etnoyer
65	289935	Cnidaria	*Eugorgia rubens*	CINMS-40-C	3/17/15	21:23:06	34.07521	-120.09156	64	95% etoh	15ml tube	40	Etnoyer
66	149668	Arthropoda	Mysid shrimp	CINMS-41	3/17/15	21:23:06	34.07521	-120.09156	64	95% etoh	15ml tube	40	Etnoyer
67	558	Porifera	Branching sponge	CINMS-42	3/18/15	21:31:21	34.09125	-120.24343	77	95% etoh	Sealed bag	42	Etnoyer
68	135161	Cnidaria	*Lophellia pertusa*	CINMS-43	3/19/15	20:19:58	33.95939	-119.47568	174	95% etoh	15ml tube	43	Etnoyer
69	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-44-A	3/19/15	20:30:10	33.95946	-119.47561	174	dry	Large bag	44	Williams
70	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-44-B	3/19/15	20:30:10	33.95946	-119.47561	174	95% etoh	50mL tube	44	Etnoyer
71	125293	Cnidaria	*Acanthogorgia* sp.	CINMS-44-C	3/19/15	20:30:10	33.95946	-119.47561	174	Formalin	15mL tube	44	Etnoyer

Figures

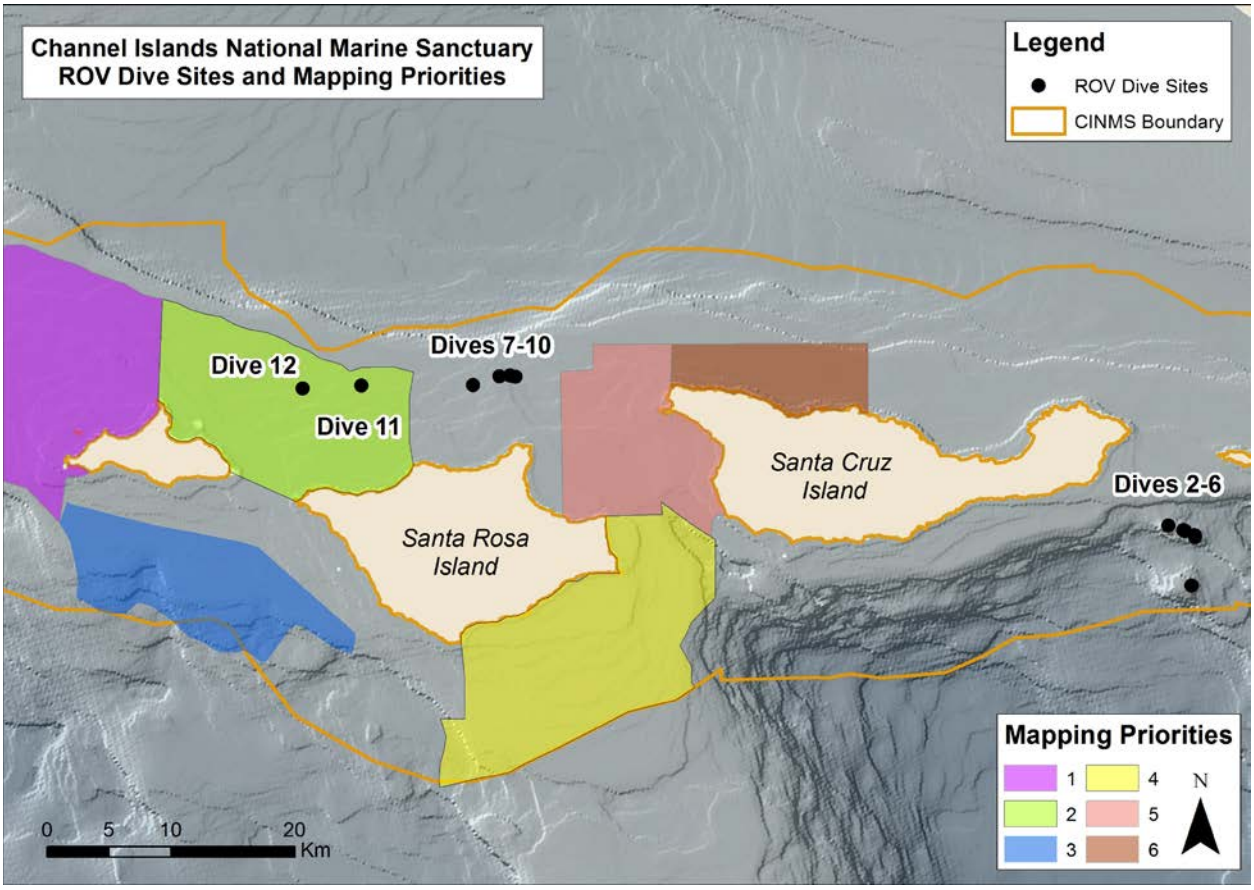

Figure 1. Priority areas identified for mapping in Channel Islands National Marine Sanctuary (colored in order of priority 1-6) and the locations of ROV dives during the "Patterns in Deep-Sea Corals Expedition" aboard NOAA ship *Bell M. Shimada* in March 2015.

Figures (continued)

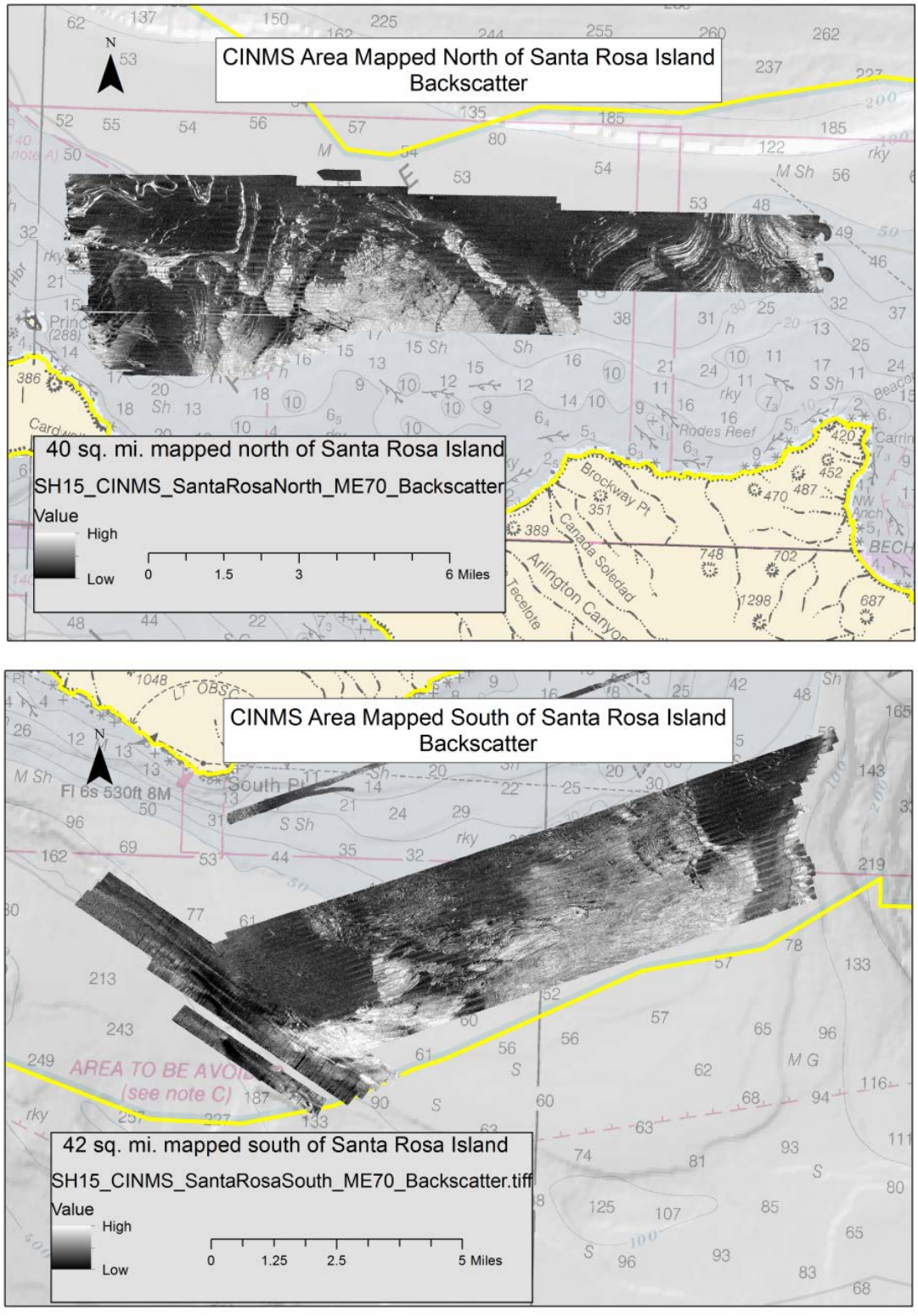

Figure 2. Priority areas mapped north (top, area 2) and south (bottom, area 4) of Santa Rosa Islands.

Figures (continued)

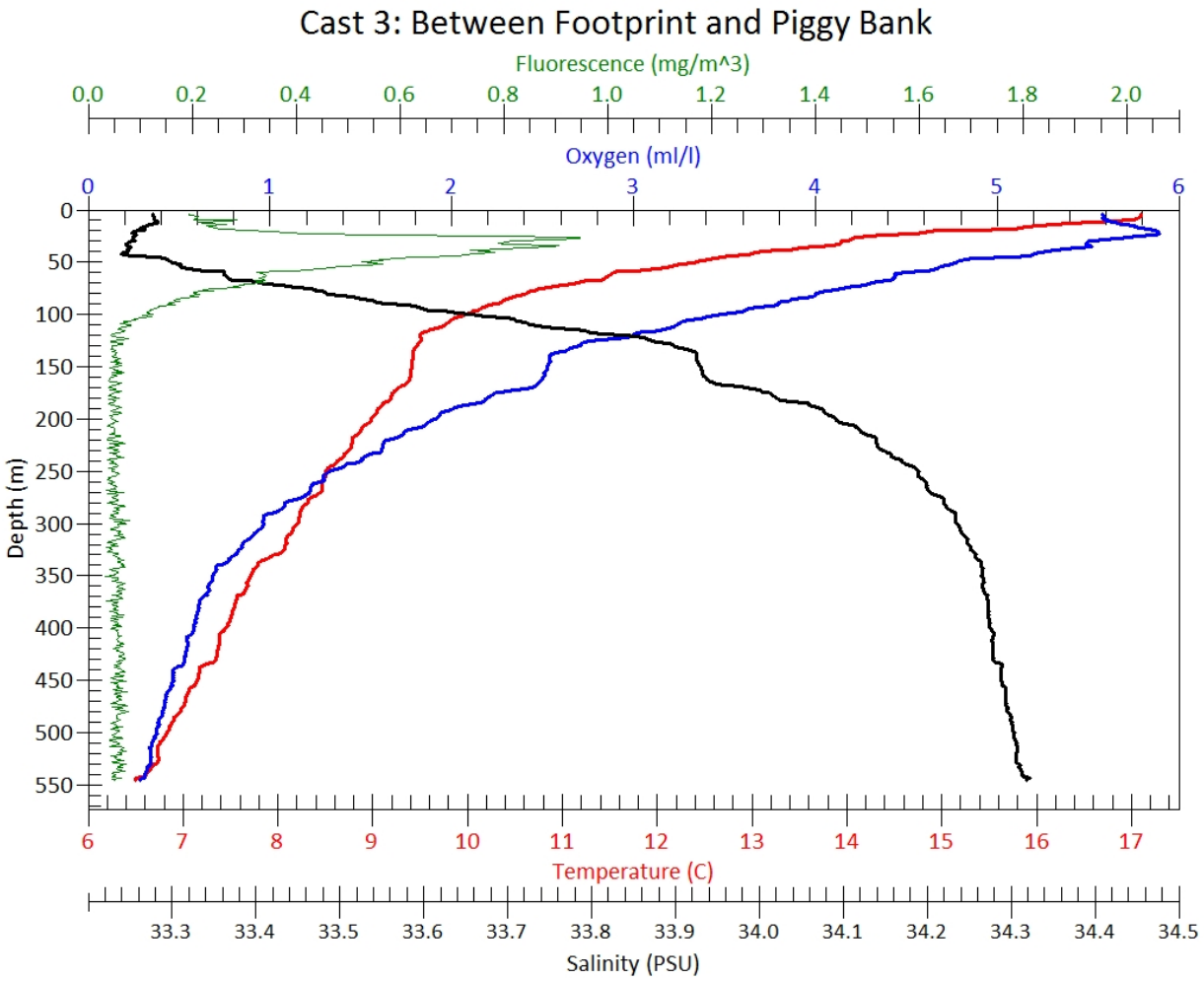

Figure 3. A plot showing water column salinity, temperature, oxygen, and fluorescence to a depth of 550 meters between Piggy Bank and The Footprint in the Channel Islands on March 19, 2015.

Figures (continued)

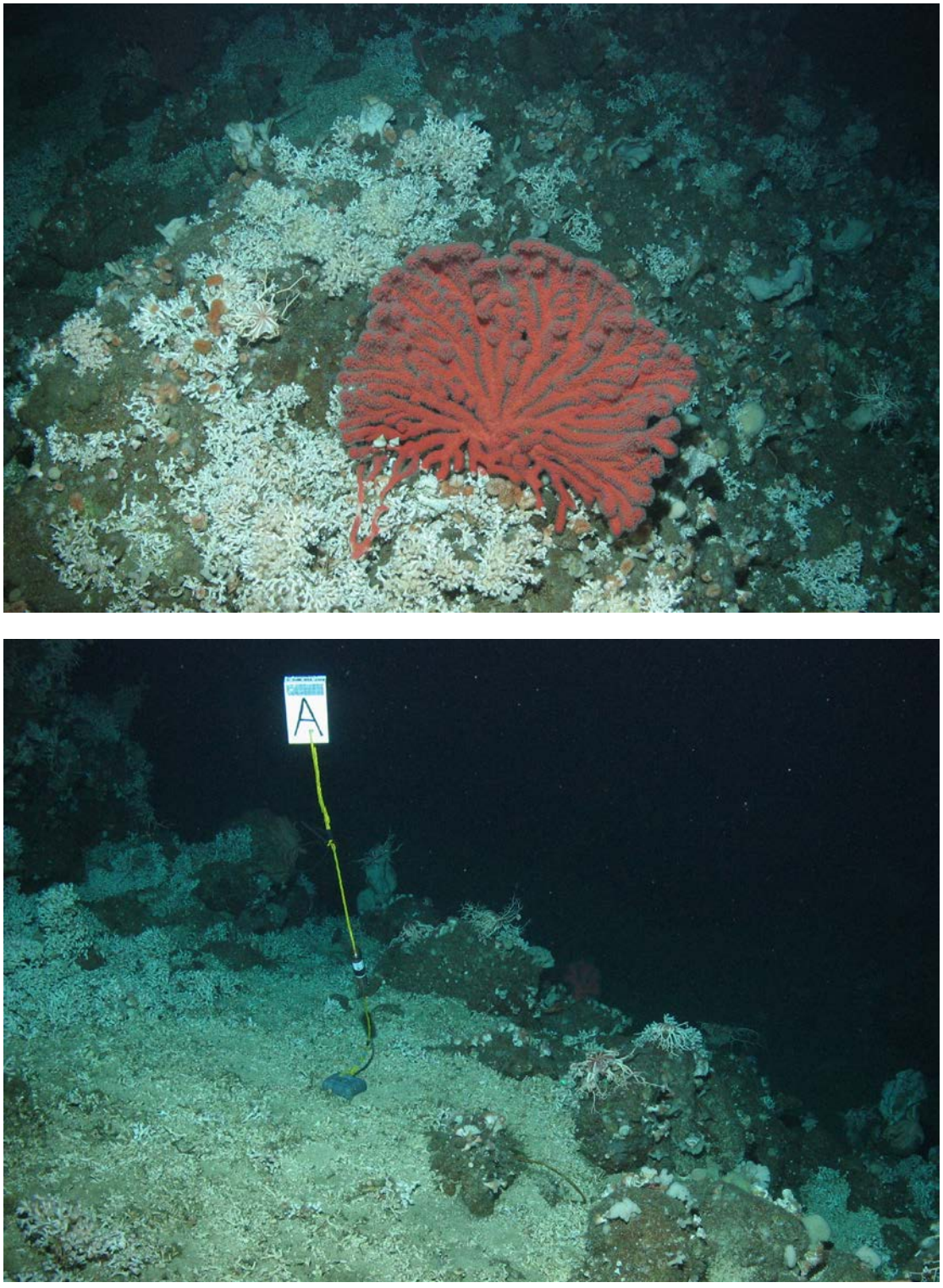

Figure 4. Monitoring station at Piggy Bank. The top panel shows for *Lophelia pertusa* and *Paragorgia arborea* colonies. The bottom panel shows a high-precision temperature logger deployed in 2015.

Figures (continued)

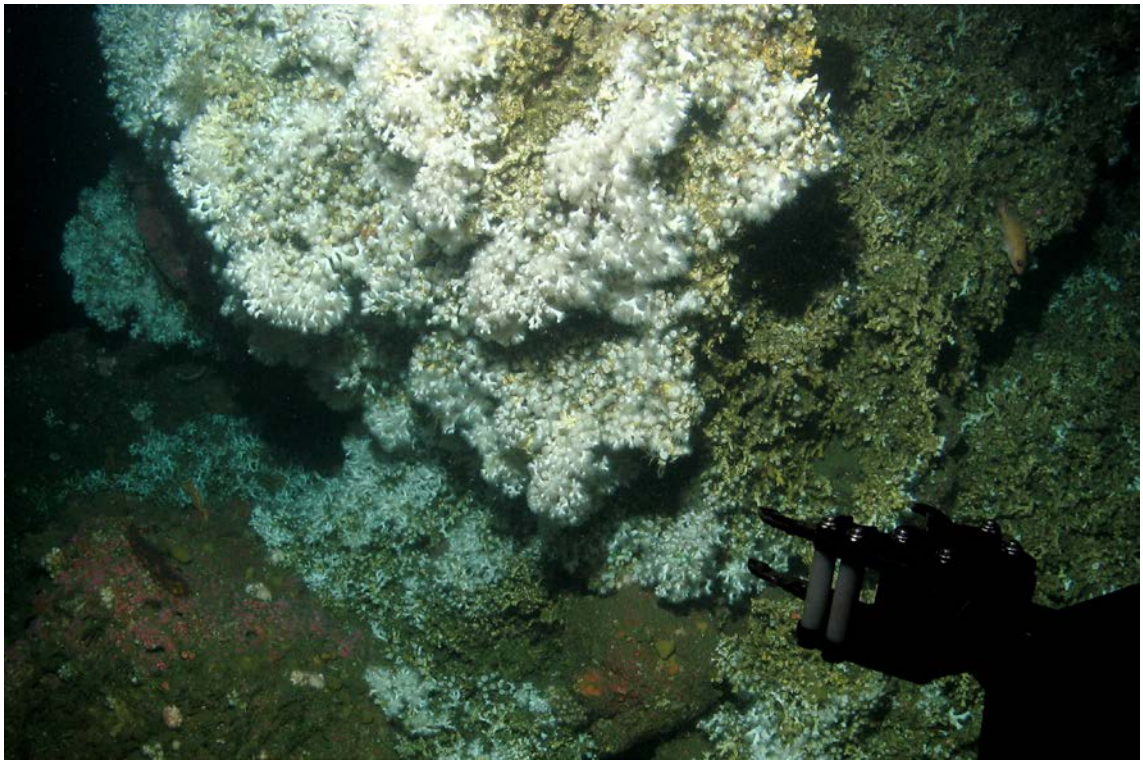

Figure 5. *Lophelia pertusa* on the North Side of San Miguel Pass at 75 meters depth.

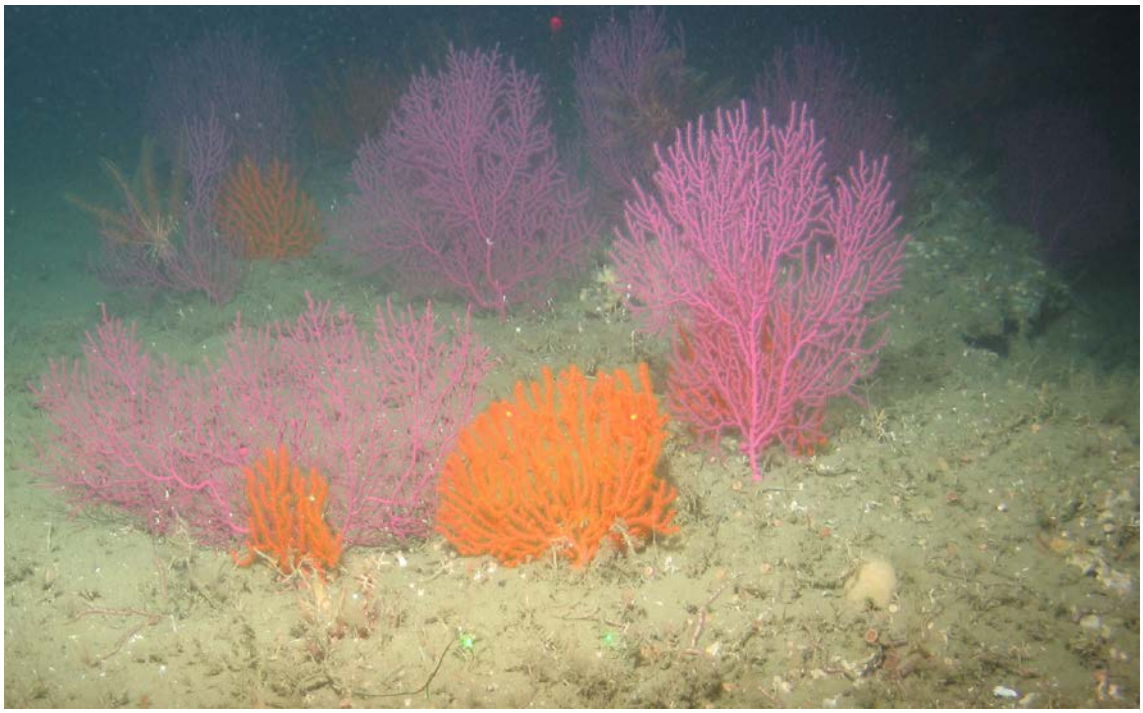

Figure 6. High density of sea fans *Eugorgia* and *Adelogorgia* at Carrington Point.

Figures (continued)

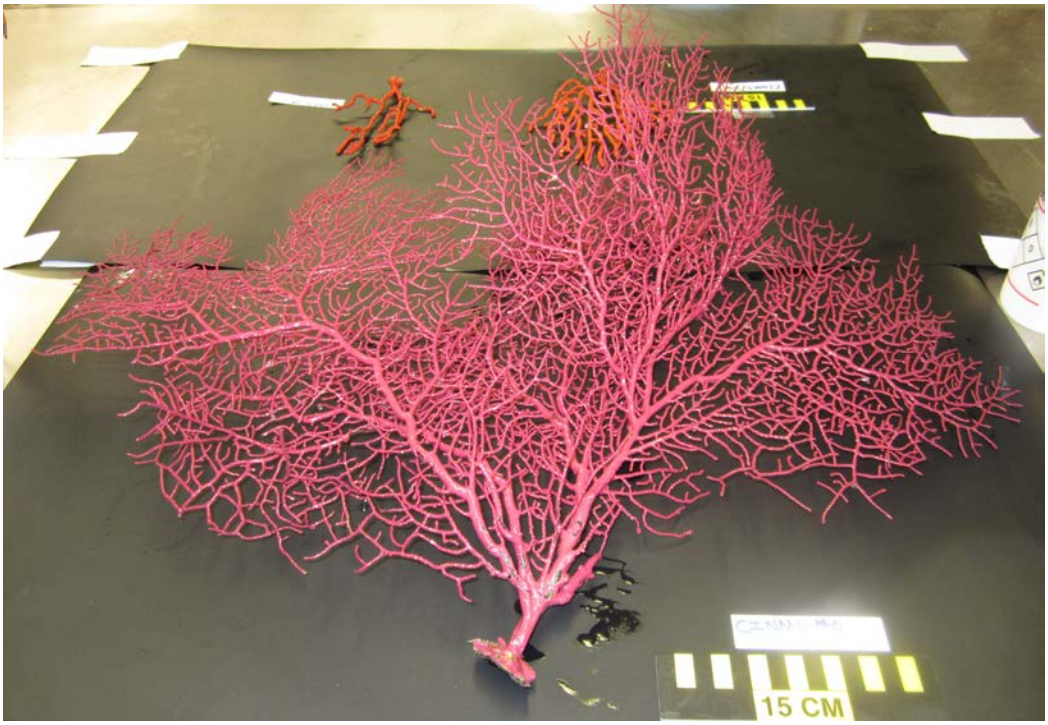

Figure 7. Sample CINMS-40-A, *Eugorgia* colony collected for age, growth, and nutrition studies.

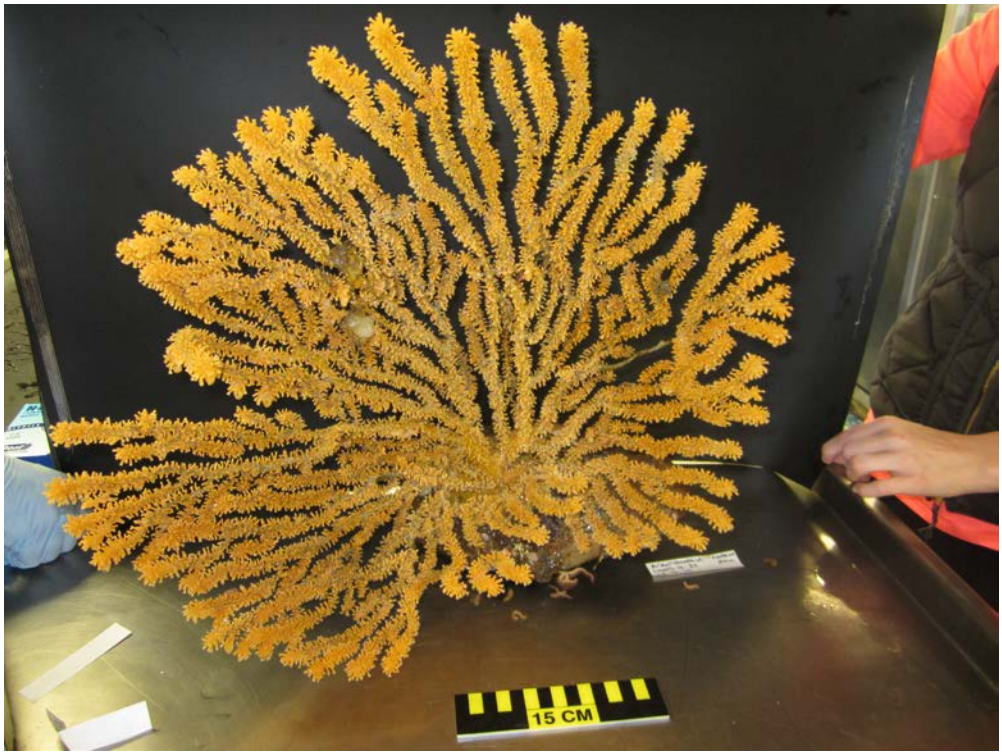

Figure 8. Sample CINMS-32-C, *Acanthogorgia* colony collected for age, growth, and nutrition studies.

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