

Permit MULTI-2019-018 Report to National Marine Sanctuaries
Tom Laidig SWFSC, NOAA

As part of the EXPRESS (Expanding Pacific Research and Exploration of Submerged Systems) Campaign from October 7 to November 7, 2019, a team of researchers from NMFS, USGS, and CINMS conducted a cruise from Southern Washington to Catalina Basin in Southern California that targeted deep-water areas off California, Oregon, and Washington aboard NOAA's *R/V Reuben Lasker*

Goals of the cruise were to:

- Collect Essential Fish Habitat baseline information at five sites proposed for modification by the Pacific Fishery Management Council.
- Revisit previously surveyed sites to document if changes have occurred over time
- Survey two areas off California that are proposed wind energy lease sites.
- Collect samples to help in identifying west coast corals and sponges

The cruise was supported by NMFS' Deep Sea Coral Research and Technology Program and was jointly planned by NOAA (NMFS, NOS), BOEM, OAR, and USGS. Research conducted during this cruise is part of the four-year West Coast Deep Sea Coral Initiative.

A bottom-tracking Autonomous Underwater Vehicle (AUV) (Fig. 1) was used to conduct photographic surveys of the seafloor. The primary payload on the AUV was three digital still cameras lighted by a strobe. The AUV descended and traveled ~2.5 m above the sea floor taking images every 6-8 seconds for quantitative surveys and returned to the surface. We used the Global Foundation for Ocean Exploration's (GFOE) Remotely Operated Vehicle (ROV) system of *Guru* and *Yogi* (Fig. 2) for quantitative video surveys of the seafloor and to collect biological, sea water, and geological samples. The ROV *Yogi*'s primary sensor payload was a forward 4K video camera (and 4 other cameras that were not commonly recorded), a forward GoPro still camera, a manipulator arm (with slurp capability) and bio-box for samples, and two 1.7-liter Niskin bottles that could be triggered by the manipulator arm (Niskin samples primarily used for environmental DNA [eDNA]). *Yogi* was also reconfigured for two dives replacing the biobox with a bottom core sampling system (but neither dive occurred within a sanctuary). The ROV was used to conduct 15-min visual transects of the seafloor and to collect samples. During sampling, the ROV above the seafloor or gently set down in a muddy area to reduce the chance of damage to the ROV, corals, and/or sponges. Water column data was collected using the ship's CTD outfitted with 20 Niskin sampling bottles that collected water samples at discreet depths (Fig. 1).



Figure 1. AUV getting ready for launch and the CTD rosette.



Figure 2. The GFOE ROV, *Yogi*, being deployed off the NOAA vessel *Reuben Lasker*.

Surveys were conducted at fifteen sites along the coast, six of which were conducted within national marine sanctuary boundaries (Fig. 3). Survey tracks of the ROV and AUV dives within the sanctuaries are shown in Figures 4-7. A total of seven AUV dives and 8 ROV dives were completed within sanctuary boundaries; with two surveys conducted within CBNMS, two within GFNMS, six within MBNMS and three within CINMS (Table 1). All dives within MBNMS boundaries were inside proposed EFH modification areas slated to be opened to fishing.

The ROV primarily sampled corals and sponges, but geological and water samples were also collected (Table 2). Biological samples were identified to the lowest possible taxa, but if they were not specifically identifiable, the samples were described by morphology and color. Sub-samples of corals were sent to the California Academy of Sciences for archiving and additional identification. Other biological samples will be sent to experts for identification (especially the sponge samples). Genetic barcode sequences will be generated for all coral and sponge samples, and submitted to Genbank. Water samples were filtered at sea and will be analyzed for eDNA and organic carbon.

Water samples were also taken using Niskin bottles mounted on the CTD rosette. These samples were filtered at sea and the resultant material will be analyzed for organic carbon, nutrients, isotopes, alkalinity, and pH by USGS and for eDNA by the NWFSC (Table 3).

No major problems were encountered during operations in national marine sanctuaries and no equipment was left on seafloor of any sanctuary. Dive sites were moved in the Anacapa dive location due to the presence of underwater transmission cables. The ROV team would not dive near the cables due to the possibility of snagging and damaging or losing one or both of the ROVs. Dive sites were moved up slope of the original transect lines to accommodate the ROV

team’s concerns. No shipwrecks or historical artifacts were observed within sanctuary boundaries. No collections were conducted within any state or federal marine reserves.



Table 1. The date, location and depth of each AUV and ROV dive within National Marine Sanctuary boundaries.

Dive#	Date	StartLat	StartLon	Depth (m)	Vehicle	Sanctuary/EFH
7	10/23/2019	37.976	123.516	0-1500	ROV	CBNMS
8	10/24/2019	38.19114	-123.39948	244-449	AUV	CBNMS
8	10/24/2019	37.976	123.516	1040-1200	ROV	CBNMS
9	10/25/2019	37.84731	-123.41931	457-640	AUV	CBNMS
9	10/25/2019	37.85128	-123.38387	158-457	AUV	GFNMS
9	10/25/2019	37.8231	123.4262	850-1200	ROV	CBNMS/GFNMS
10	10/26/2019	36.89941	-122.21927	104-390	AUV	MBNMS/Cabrillo Can.
10	10/27/2019	36.8684	122.3191	1162-1232	ROV	MBNMS/Cabrillo Can.
12	10/28/2019	36.52036	-122.03273	358-601	AUV	MBNMS/Carmel Can.
11	10/28/2019	36.5596	122.0764	1008-1245	ROV	MBNMS/Carmel Can.
13	10/29/2019	36.26378	-121.97034	57-400	AUV	MBNMS/Sur Slot Can.
12	10/29/2019	36.1565	122.0073	961-1200	ROV	MBNMS/Sur Slot Can.
15	11/3/2019	33.8898	119.7848	715-1212	ROV	CINMS
18	11/4/2019	33.96393	-119.44847	423-586	AUV	CINMS
16	11/4/2019	33.9814	119.3601	190-598	ROV	CINMS

Table 2. Biological, Geological and water samples taken by the ROV and disposition of those samples (A – In alcohol at NWFSC; B – USGS; C – California Academy of Sciences)

Dive	Location	Sample Number	Date	Time (U C)	Latitude	Longitude	Depth (m)	Type	Disposition
ROV_8	Deeper Cordell	RL-19-05-041	25-Oct-19	4 04	37 978	-123 517	1185	Swi tia sp (torryei?) with orange polyps	A B C
ROV 8	Deeper Cordell	RL-19-05-042	25-Oct-19	4 05	37 978	-123 517	1185	Water sample or eDNA and Chemistry	A B
ROV 8	Deeper Cordell	RL-19-05-043	25-Oct-19	4 15	37 978	-123 517	1187	White vase glass sponge	A B
ROV 8	Deeper Cordell	RL-19-05-044	25-Oct-19	5 01	37 979	-123 517	1124	iny sea pen Funiculina?	A C
ROV 8	Deeper Cordell	RL-19-05-045	25-Oct-19	6 20	37 96	-123 515	1100	Water sample or eDNA and Chemistry	A B
ROV 9	CBNMS/GFNMS	RL-19-05-046	25-Oct-16	7 00	37 981	-123 513	1046	Alternatipathes or Heteropathes	A B C
ROV 9	CBNMS/GFNMS	RL-19-05-047	26-Oct-19	0 52	37 825	-123 426	1108	Small sea pen possibly Kophobelemnon	A C
ROV 9	CBNMS/GFNMS	RL-19-05-048	26-Oct-19	3 05	37 827	-123 425	1013	Globular sponge on a small rock	A B
ROV 9	CBNMS/GFNMS	RL-19-05-049	26-Oct-19	3 24	37 828	-123 425	1002	Gersemia c juliepackaredae	A B C
ROV 9	CBNMS/GFNMS	RL-19-05-050	26-Oct-19	3 30	37 828	-123 425	1000	Asbestopluma stick orm	A
ROV 9	CBNMS/GFNMS	RL-19-05-051	26-Oct-19	4 04	37 828	-123 426	981	Water sample or eDNA and Chemistry	A B
ROV 9	CBNMS/GFNMS	RL-19-05-052	26-Oct-19	5 28	37 83	-123 424	872	ube type Farrea	A B
ROV 9	CBNMS/GFNMS	RL-19-05-053	26-Oct-19	5 40	37 83	-123 424	870	Water sample or eDNA and Chemistry	A B
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-054	28-Oct-19	6 19	36 867	-122 318	1242	thin highly branched pink coral Plexauridae	A B C
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-055	28-Oct-19	6 30	36 318	-122 867	1237	Large heavy dead Bamboo coral branch	B
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-056	28-Oct-19	6 43	36 867	-122 318	1225	Branched Asbestopluma	A B
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-057	28-Oct-19	6 51	36 867	-122 318	1225	ube shaped sponge	A B
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-058	28-Oct-19	6 57	36 867	-122 318	1201	Water sample or eDNA and Chemistry	A
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-059	28-Oct-19	7 07	36 318	-122 867	1210	Unknown Gorgonian	A B C
ROV 10	Cabrillo Canyon EFHCA	RL-19-05-060	28-Oct-19	7 58	36 868	-122 319	1162	Water sample or eDNA and Chemistry	A B
ROV 11	Carmel Canyon EFHCA	RL-19-05-061	29-Oct-19	3 37	36 558	-122 075	1160	Small ? Funiculina? pen	A B C
ROV 11	Carmel Canyon EFHCA	RL-19-05-062	29-Oct-19	4 30	36 558	-122 074	1134	he Elusive iny White ?Pennatula	A C
ROV 11	Carmel Canyon EFHCA	RL-19-05-063	29-Oct-19	6 22	36 556	-122 073	1095	Sea pen Stachytilium/Protoptilium	A B C
ROV 11	Carmel Canyon EFHCA	RL-19-05-064	29-Oct-19	6 28	36 556	-122 073	1095	Water sample or eDNA and Chemistry	A B
ROV 11	Carmel Canyon EFHCA	RL-19-05-065	29-Oct-19	7 07	36 557	-122 07	1012	Water sample or eDNA and Chemistry	A B
ROV 12	Sur Slot Canyon	RL-19-05-066	30-Oct-19	3 10	36 593	-122 089	1138	Water sample or eDNA and Chemistry	A B
ROV 12	Sur Slot Canyon	RL-19-05-067	30-Oct-19	5 08	36 166	-122 009	976	Water sample or eDNA and Chemistry	A B
ROV 12	Sur Slot Canyon	RL-19-05-068	30-Oct-19	5 13	36 166	-122 009	973	Funiculina quadrangularis	A B C
ROV 15	South Santa Cruz Island	RL-19-05-093	4-Nov-19	4 01	33 893	-119 785	1047	Lightbulb sponge	A B
ROV 15	South Santa Cruz Island	RL-19-05-094	4-Nov-19	4 13	33 893	-119 789	1043	Swi tia simplex	A B
ROV 15	South Santa Cruz Island	RL-19-05-095	4-Nov-19	4 18	33 893	-119 789	1043	Farrea sp	A B
ROV 15	South Santa Cruz Island	RL-19-05-096	4-Nov-19	4 20	33 893	-119 789	1043	Water sample or eDNA and Chemistry	A B
ROV 15	South Santa Cruz Island	RL-19-05-097	4-Nov-19	5 10	33 894	-119 785	959	Staurocalyptus sp	A B
ROV 15	South Santa Cruz Island	RL-19-05-098	4-Nov-19	5 16	33 894	-119 785	959	Alcyonium Sp	
ROV 15	South Santa Cruz Island	RL-19-05-099	4-Nov-19	5 39	33 894	-119 785	947	Staurocalyptus sp	A B
ROV 15	South Santa Cruz Island	RL-19-05-100	4-Nov-19	6 30	33 896	-119 786	851	Stachytilium/Protoptilium	A B
ROV 15	South Santa Cruz Island	RL-19-05-101	4-Nov-19	6 49	33 897	-119 787	831	Hyalanema populi erum	A B
ROV 15	South Santa Cruz Island	RL-19-05-102	4-Nov-19	7 42	33 899	-119 789	747	Water sample or eDNA and Chemistry	A B

ROV 16	Anacapa South	RL-19-05-103	5-Nov-19	1 44	33 982	-119 36	601	Slup o small clams at seep	B
ROV 16	Anacapa South	RL-19-05-104	5-Nov-19	4 05	33 985	-119 363	465	Paragorgia sp	A B
ROV 16	Anacapa South	RL-19-05-105	5-Nov-19	4 24	33 985	-119 363	454	nteresting sponge unrecognised	A B
ROV 16	Anacapa South	RL-19-05-106	5-Nov-19	4 45	33 985	-119 363	436	Water sample or eDNA and Chemistry	A B
ROV 16	Anacapa South	RL-19-05-107	5-Nov-19	4 56	33 985	-119 363	430	Callogorgia (d'd on video as Narella)	A B C
ROV 16	Anacapa South	RL-19-05-108	5-Nov-19	5 30	33 986	-119 363	360	Stoloni eran Coral Probably Anthothela	A B C
ROV 16	Anacapa South	RL-19-05-109	5-Nov-19	6 05	33 987	-119 363	326	White vase sponge interesting morphology	A B
ROV 16	Anacapa South	RL-19-05-110	5-Nov-19	7 24	33 987	-119 363	298	Water sample or eDNA and Chemistry	A B

Table 3. Water samples taken by CTD rosette Niskin bottles and analyses to be conducted on those samples (POM: particulate organic material, Chemistry: nutrients, water isotopes, alkalinity, and pH eDNA: environmental DNA).

CTD	Niskin	Location	Date (local)	Time (local)	Lat	Long	Depth (m)	Analysis(es)
16	1	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1699	Chemistry, POM, eDNA
16	2	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1699	Chemistry, POM
16	3	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1600	Chemistry
16	4	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1500	Chemistry
16	5	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1400	Chemistry
16	6	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1300	Chemistry
16	7	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1200	Chemistry
16	8	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1100	Chemistry
16	9	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	1000	Chemistry
16	10	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	900	Chemistry
16	11	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	800	Chemistry
16	12	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	700	Chemistry
16	17	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	600	Chemistry
16	18	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	500	Chemistry
16	19	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	400	Chemistry
16	20	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	300	Chemistry
16	21	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	200	Chemistry
16	22	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	100	Chemistry
16	23	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	5	Chemistry, POM
16	24	Deeper Cordell	10/23/2019	16:52	37.95683	-123.38233	5	Chemistry, POM
17	1	Deeper Cordell	10/24/2019	16:11	37.9655	-123.5395	1484	Chemistry, POM, eDNA
17	2	Deeper Cordell	10/24/2019	16:11	37.9655	-123.5395	1484	Chemistry, POM
17	3	Deeper Cordell	10/24/2019	16:11	37.9655	-123.5395	5	Chemistry, POM

17	4	Deeper Cordell Deeper	10/24/2019	16:11	37.9655	-123.5395	5	Chemistry, POM
18	1	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	1077	Chemistry, POM, eDNA
18	2	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	1077	Chemistry, POM
18	3	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	1000	Chemistry
18	4	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	1000	Chemistry
18	5	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	900	Chemistry
18	6	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	800	Chemistry
18	7	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	700	Chemistry
18	8	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	600	Chemistry
18	9	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	500	Chemistry
18	10	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	400	Chemistry
18	11	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	300	Chemistry
18	12	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	200	Chemistry
18	17	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	100	Chemistry
18	18	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	100	Chemistry
18	19	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	50	Chemistry
18	20	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	50	Chemistry
18	21	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	50	Chemistry
18	22	Cordell/Farallones Deeper	10/25/2019	21:05	37.82333	-123.42433	5	Chemistry, POM
18	23	Cordell/Farallones	10/25/2019	21:05	37.82333	-123.42433	5	Chemistry, POM
19	1	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	1197	Chemistry, POM, eDNA
19	2	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	1197	Chemistry, POM
19	4	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	1000	Chemistry
19	5	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	1000	Chemistry
19	6	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	800	Chemistry
19	7	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	800	Chemistry
19	8	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	600	Chemistry
19	9	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	600	Chemistry
19	10	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	400	Chemistry

19	11	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	400	Chemistry
19	12	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	200	Chemistry
19	17	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	200	Chemistry
19	18	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	100	Chemistry
19	19	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	100	Chemistry
19	20	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	50	Chemistry
19	21	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	50	Chemistry
19	22	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	5	Chemistry
19	23	Cabrillo Canyon	10/26/2019	22:32	36.86443	-122.322	5	Chemistry, POM
19	23	Cabrillo Canyon	10/26/2019	23:32	36.86443	-122.322	5	Chemistry, POM
20	1	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	671	Chemistry, POM, eDNA
20	2	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	671	Chemistry, POM
20	3	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	671	Chemistry, POM
20	4	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	400	Chemistry
20	5	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	400	Chemistry
20	6	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	50	Chemistry
20	7	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	50	Chemistry
20	8	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	5	Chemistry, POM
20	9	Cabrillo Canyon	10/27/2019	16:35	36.87433	-122.33	5	Chemistry, POM
21	1	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1239	Chemistry, POM, eDNA
21	2	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1239	Chemistry, POM
21	3	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1239	Chemistry
21	4	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1100	Chemistry
21	5	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1100	Chemistry
21	6	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1000	Chemistry
21	7	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	1000	Chemistry
21	8	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	800	Chemistry
21	9	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	800	Chemistry
21	10	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	600	Chemistry
21	11	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	600	Chemistry
21	12	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	400	Chemistry
21	17	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	400	Chemistry
21	18	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	200	Chemistry
21	19	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	200	Chemistry
21	20	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	100	Chemistry
21	21	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	50	Chemistry
21	22	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	50	Chemistry

21	23	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	5	Chemistry, POM
21	24	Carmel Canyon	10/28/2019	12:54	36.56383	-122.08	5	Chemistry, POM
22	1	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	1106	Chemistry, POM, eDNA
22	2	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	1106	Chemistry, POM
22	3	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	1106	Chemistry, POM
22	4	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	900	Chemistry
22	5	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	900	Chemistry
22	6	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	600	Chemistry
22	7	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	600	Chemistry
22	8	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	300	Chemistry
22	9	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	300	Chemistry
22	10	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	100	Chemistry
22	11	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	100	Chemistry
22	12	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	50	Chemistry
22	17	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	50	Chemistry
22	18	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	5	Chemistry, POM
22	19	Sur Slot Canyon	10/29/2019	16:07	36.15933	-122.00633	5	Chemistry, POM
28	1	Anacapa	11/4/2019	15:36	33.98317	-119.36333	520	Chemistry, POM, eDNA
28	2	Anacapa	11/4/2019	15:36	33.98317	-119.36333	520	Chemistry, POM
28	3	Anacapa	11/4/2019	15:36	33.98317	-119.36333	520	Chemistry, POM
28	4	Anacapa	11/4/2019	15:36	33.98317	-119.36333	500	Chemistry
28	5	Anacapa	11/4/2019	15:36	33.98317	-119.36333	500	Chemistry
28	6	Anacapa	11/4/2019	15:36	33.98317	-119.36333	400	Chemistry
28	7	Anacapa	11/4/2019	15:36	33.98317	-119.36333	400	Chemistry
28	8	Anacapa	11/4/2019	15:36	33.98317	-119.36333	300	Chemistry
28	9	Anacapa	11/4/2019	15:36	33.98317	-119.36333	300	Chemistry
28	10	Anacapa	11/4/2019	15:36	33.98317	-119.36333	200	Chemistry
28	11	Anacapa	11/4/2019	15:36	33.98317	-119.36333	200	Chemistry
28	12	Anacapa	11/4/2019	15:36	33.98317	-119.36333	100	Chemistry
28	17	Anacapa	11/4/2019	15:36	33.98317	-119.36333	100	Chemistry
28	18	Anacapa	11/4/2019	15:36	33.98317	-119.36333	50	Chemistry
28	19	Anacapa	11/4/2019	15:36	33.98317	-119.36333	50	Chemistry
28	20	Anacapa	11/4/2019	15:36	33.98317	-119.36333	5	Chemistry, POM
28	21	Anacapa	11/4/2019	15:36	33.98317	-119.36333	5	Chemistry, POM

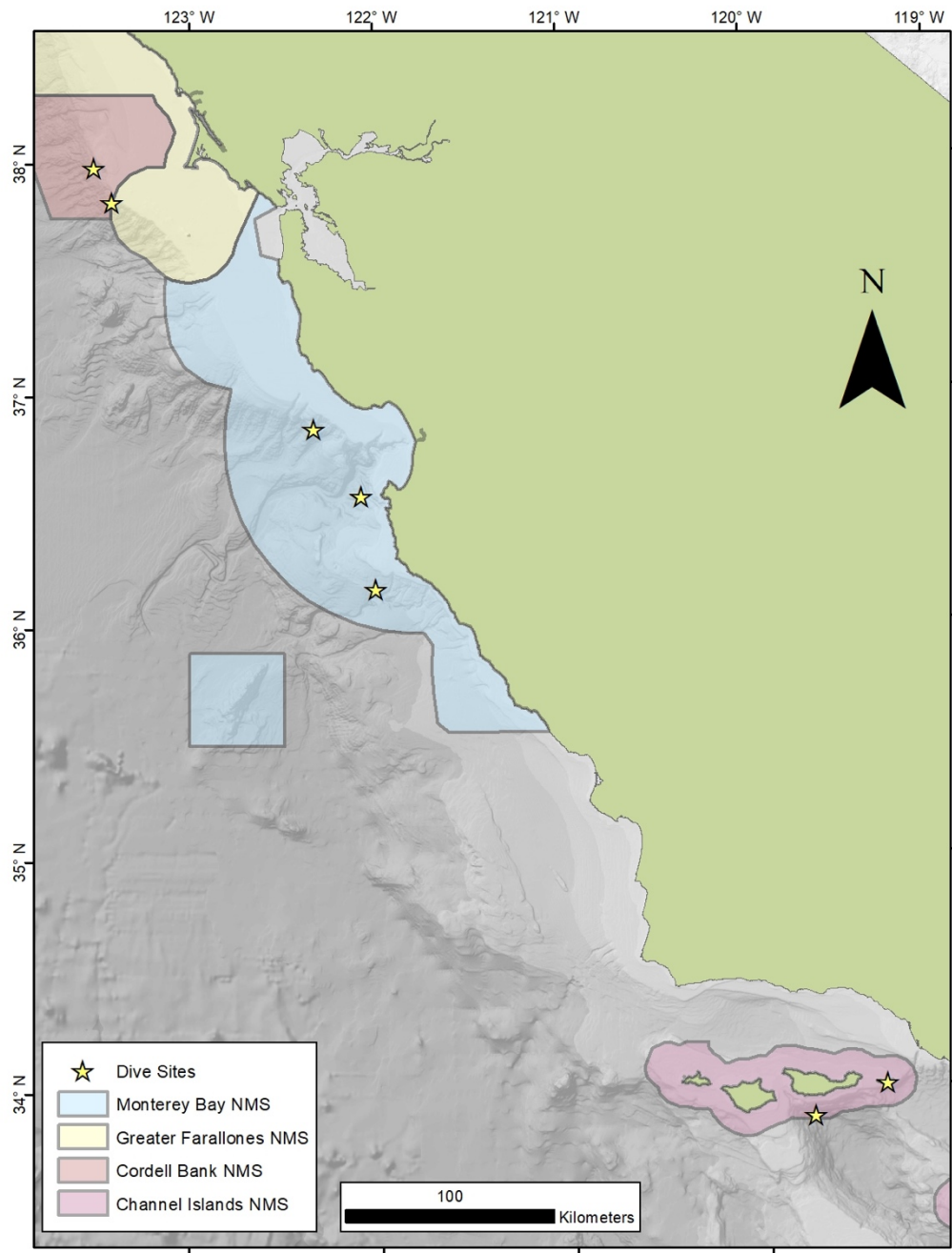


Figure 3. ROV dive sites completed during the deep-sea coral EXPRESS expedition in fall 2019 aboard the NOAA vessel *Reuben Lasker* in four national marine sanctuaries along the California coast.

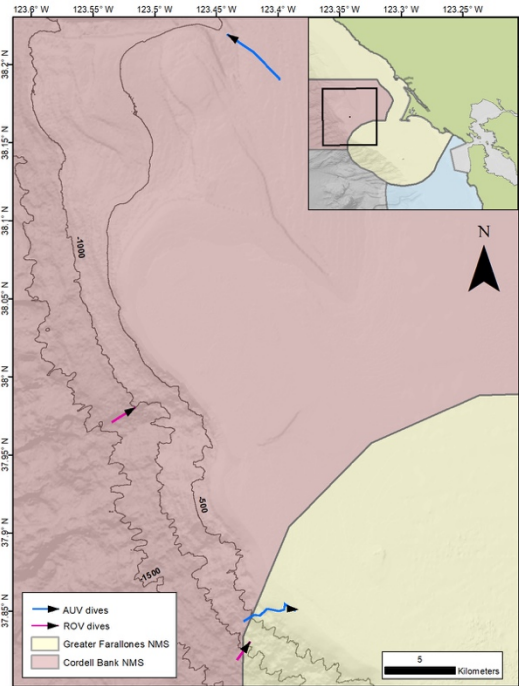


Figure 4. ROV (red arrows) and AUV (blue arrows) track lines completed during the deep-sea coral EXPRESS expedition aboard the NOAA research vessel *Reuben Lasker* in October 2019 in Cordell Bank and Greater Farallones National Marine Sanctuaries.

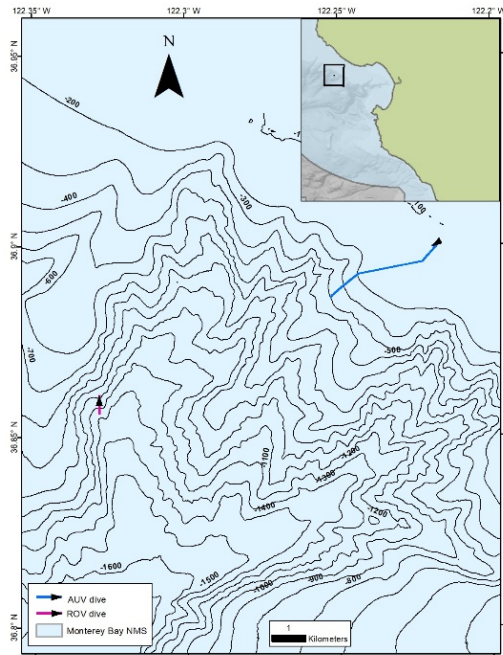


Figure 5. ROV (red arrows) and AUV (blue arrows) track lines completed during the deep-sea coral EXPRESS expedition aboard the NOAA research vessel *Reuben Lasker* in October 2019 in Monterey Bay National Marine Sanctuary at Lower Portion of Cabrillo Canyon EFH modification area.

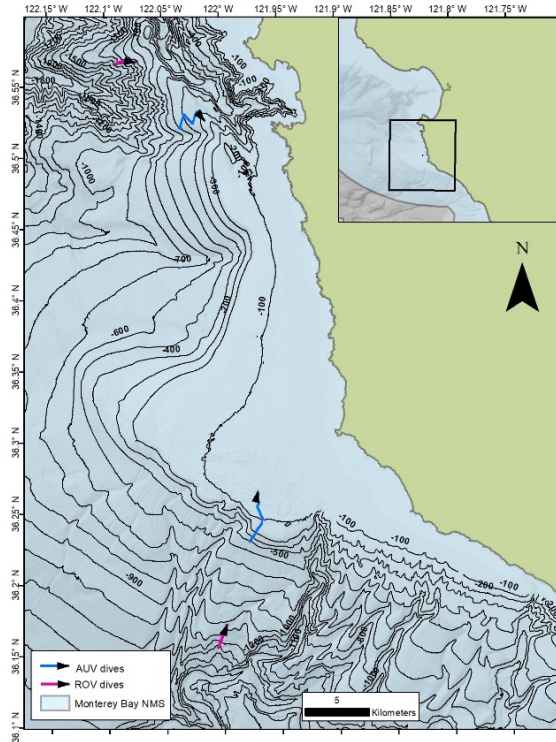


Figure 6. ROV (red arrows) and AUV (blue arrows) track lines completed during the deep-sea coral EXPRESS expedition aboard the NOAA research vessel *Reuben Lasker* in October 2019 in Monterey Bay National Marine Sanctuary at West of Carmel and Sur Slot Canyons EFH modification areas.

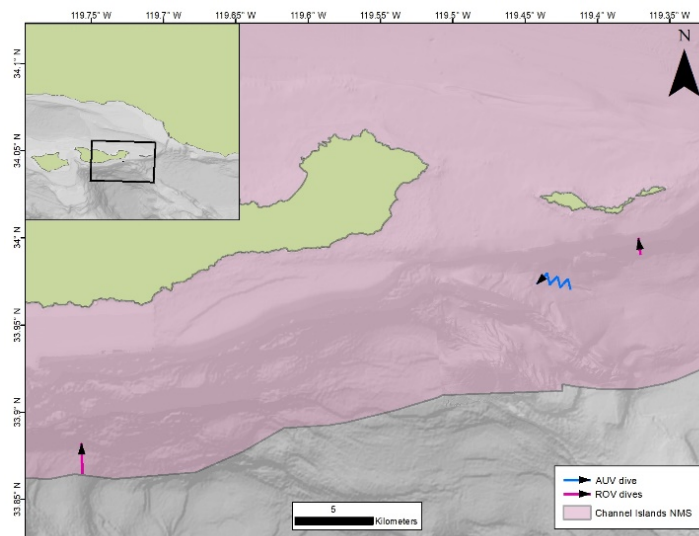


Figure 7. ROV (red arrows) and AUV (blue arrows) track lines completed during the deep-sea coral EXPRESS expedition aboard the NOAA research vessel *Reuben Lasker* in November 2019 in Channel Islands National Marine Sanctuary.