



EXHIBIT 1. Photographs of ocean discharge diffusers in Hilo Bay off the Hilo Wastewater Treatment Plant (top) and off Sandy Beach off the East Honolulu Wastewater Treatment Plant (bottom). Both diffusers are at a water depth of approximately 35-40 feet. Concentrated streams of treated effluent of high nutrient concentration, low salinity, and elevated temperature relative to receiving water can be clearly seen in both photos. Note presence of live corals on both outfall structures, lack of presence of filamentous algae, and clarity of water. Both ocean outfalls have been in operation since the 1970's. All photographs taken by S. Dollar in 2014.



EXHIBIT 2. Satellite image of Kahekili Beach and offshore reef showing locations of nine water sampling transects. Water samples were collected at the ocean surface, mid-way through the water column, and just above the sea floor at eight locations along each transect (white circles). Locations of the North and South seep groups (NSG, SSG) are also shown as yellow circles. CRAMP monitoring stations are shown as red circles.

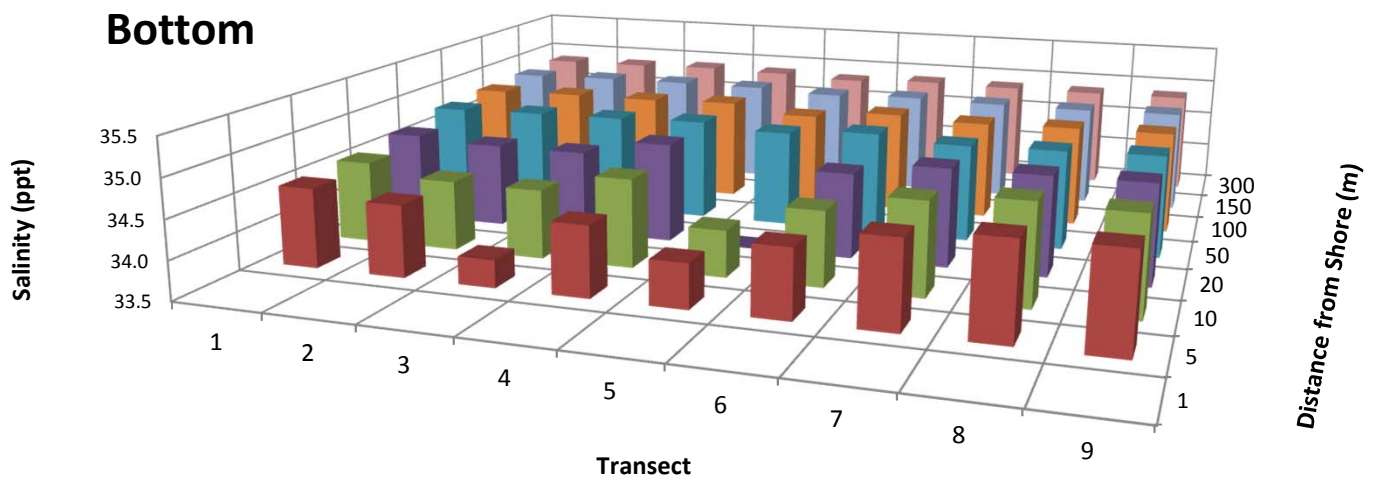
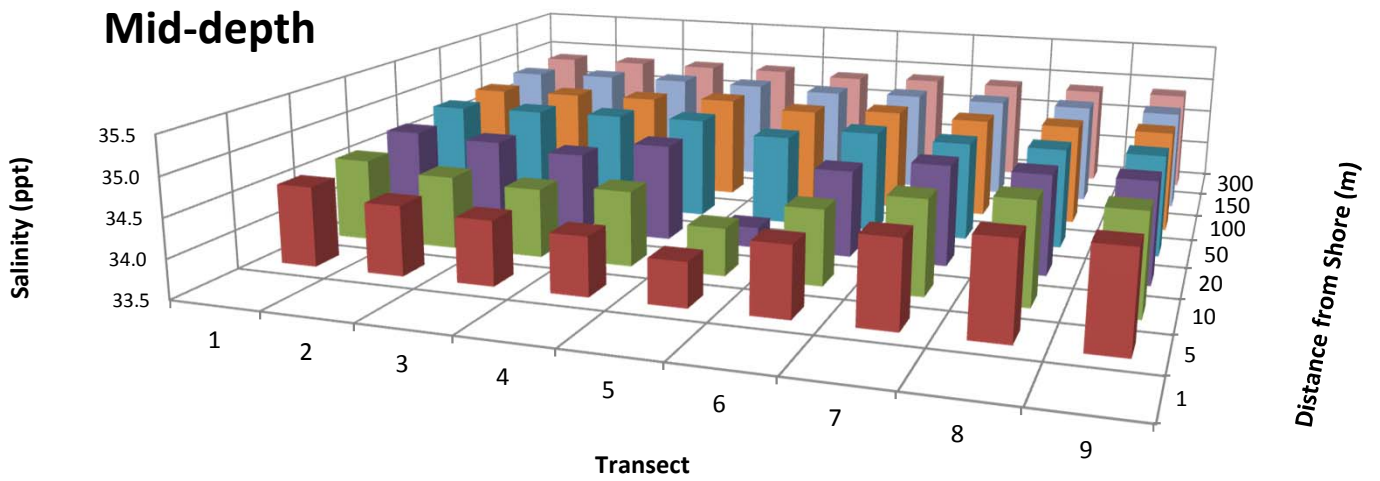
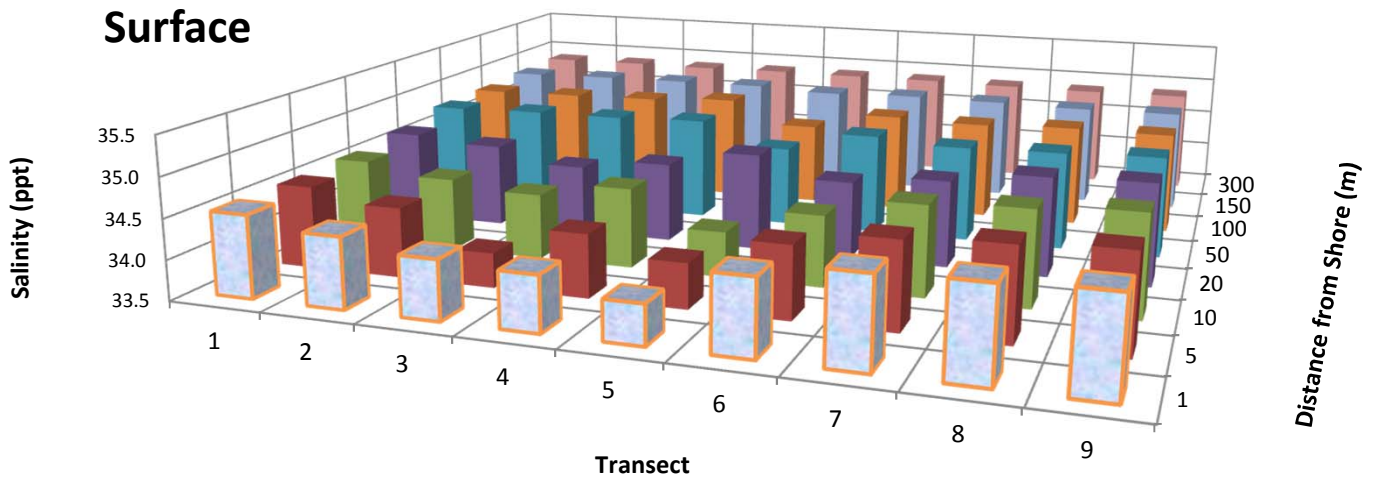
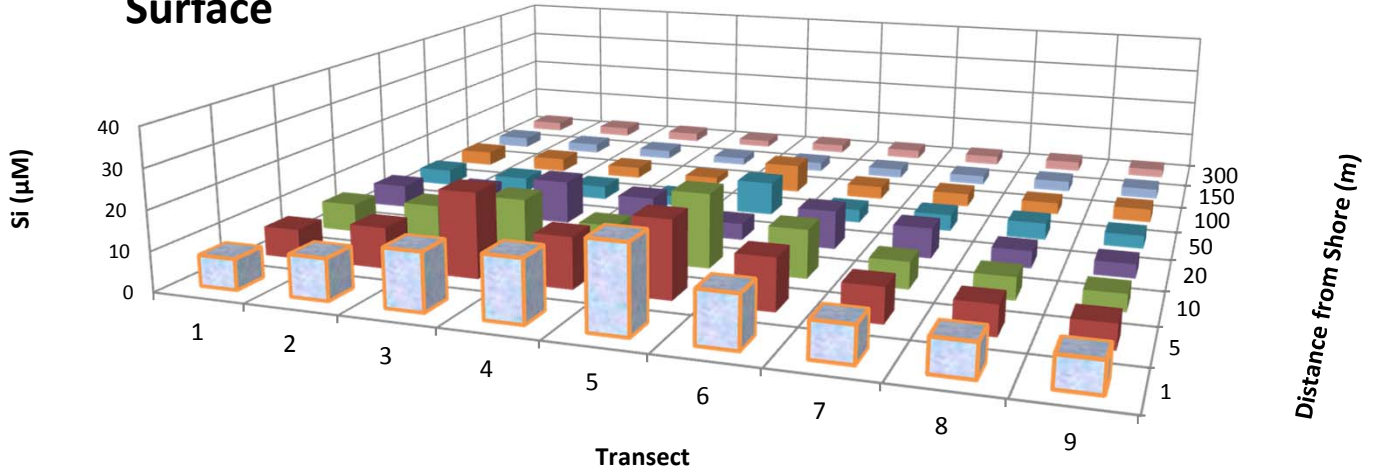
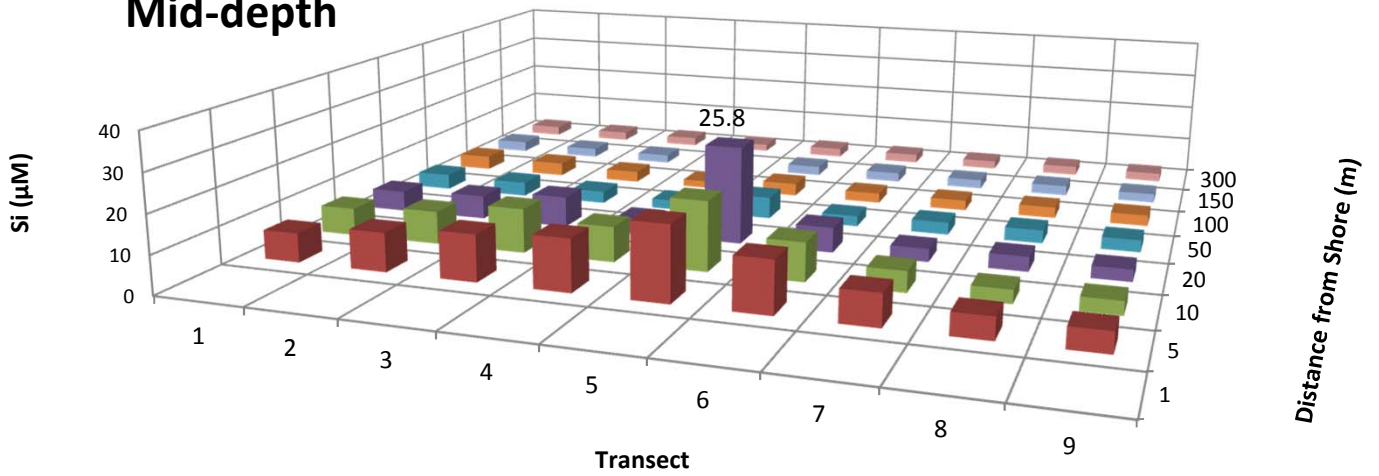


EXHIBIT 5. Three-dimensional histograms of concentrations of salinity at the surface, mid-depth in the water column and just above the bottom at 72 sampling locations off of Kahekili Beach. Axis across front of plot shows sampling transect number; axis from front to back of page shows distance offshore from the shoreline. Plot of surface values includes sampling points at the shoreline shown as gray bars. For locations of sampling transects, see Exhibit 2.

Surface



Mid-depth



Bottom

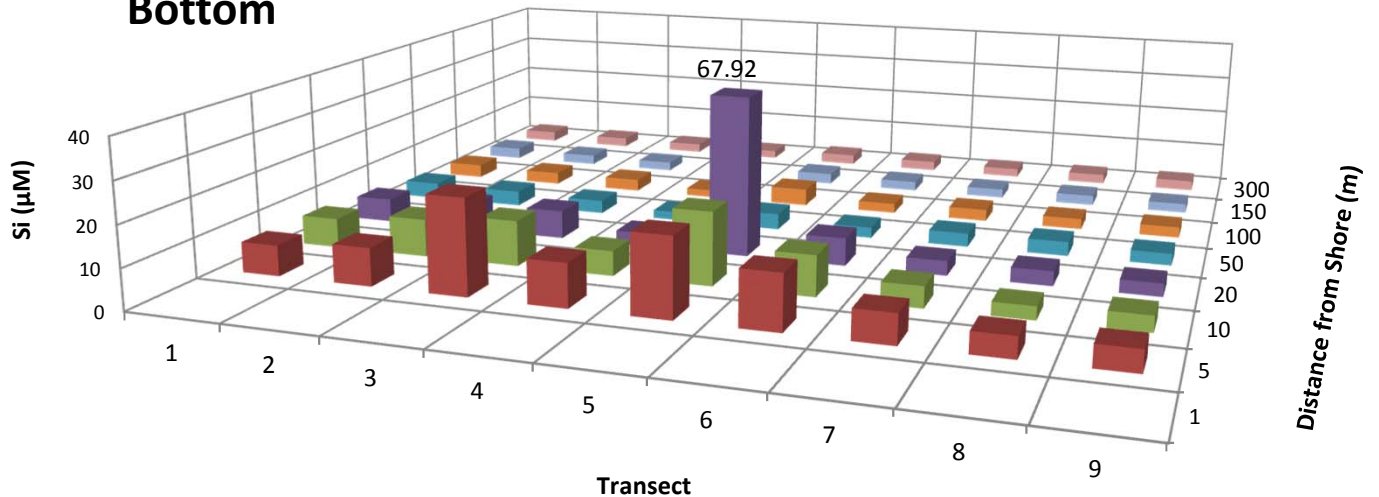
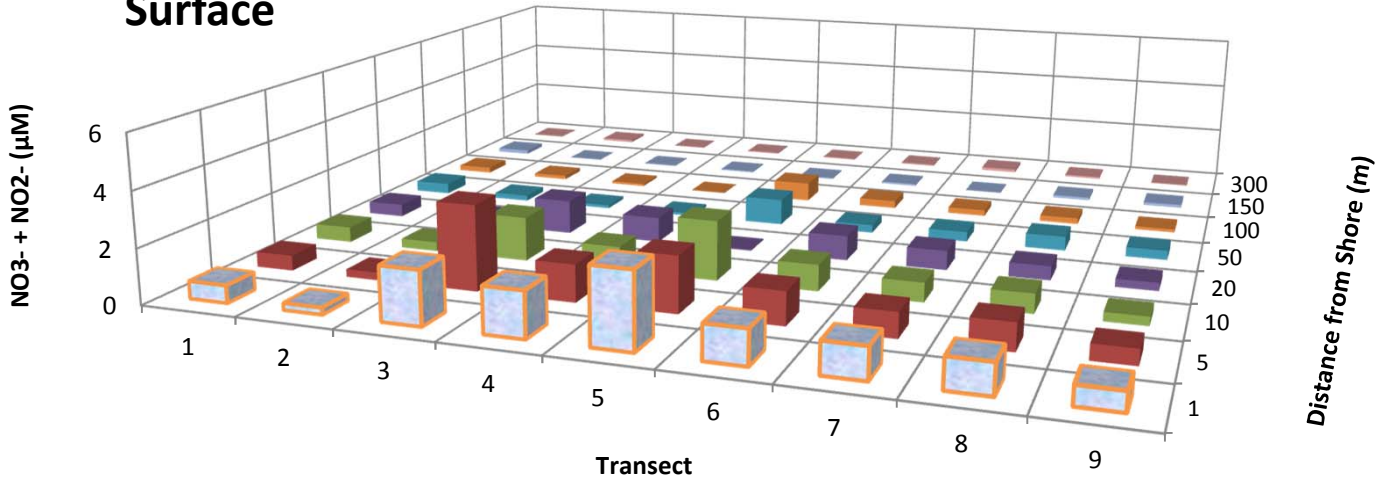
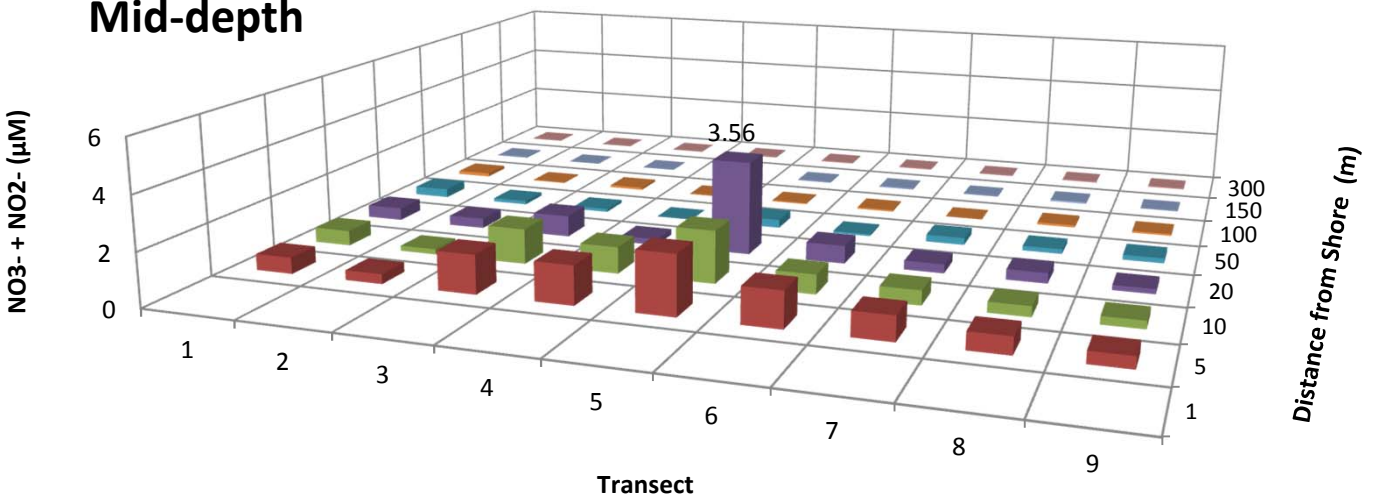


EXHIBIT 6. Three-dimensional histograms of concentrations of silicate (Si) at the surface, mid-depth in the water column and just above the bottom at 72 sampling locations off of Kahekili Beach. Axis across front of plot shows sampling transect number; axis from front to back of page shows distance offshore from the shoreline. Plot of surface values includes sampling points at the shoreline shown as gray bars. For locations of sampling transects, see Exhibit 2.

Surface



Mid-depth



Bottom

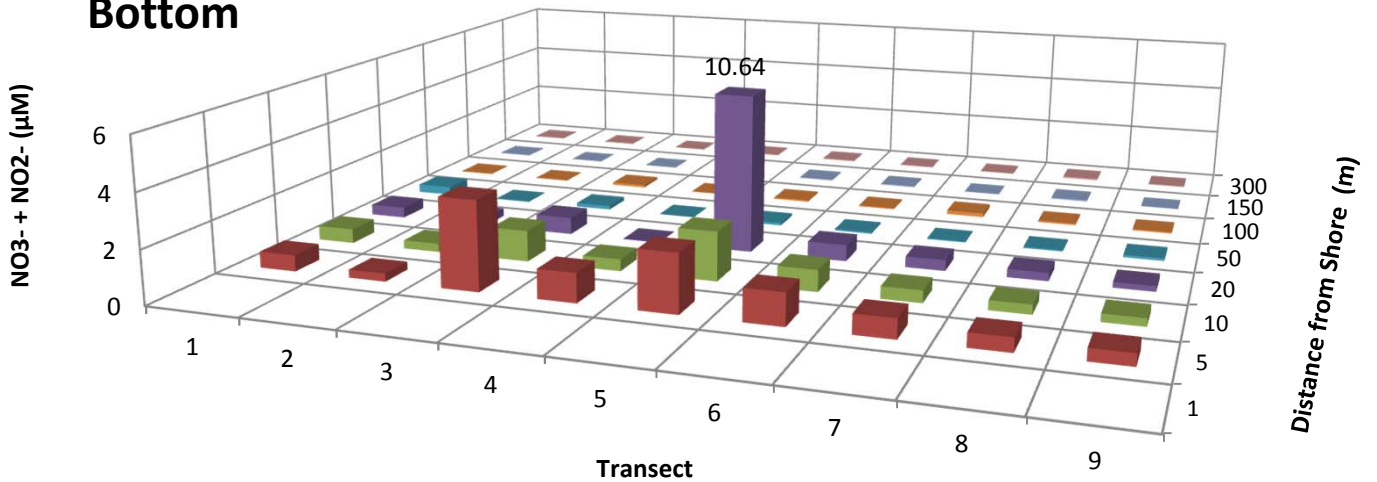
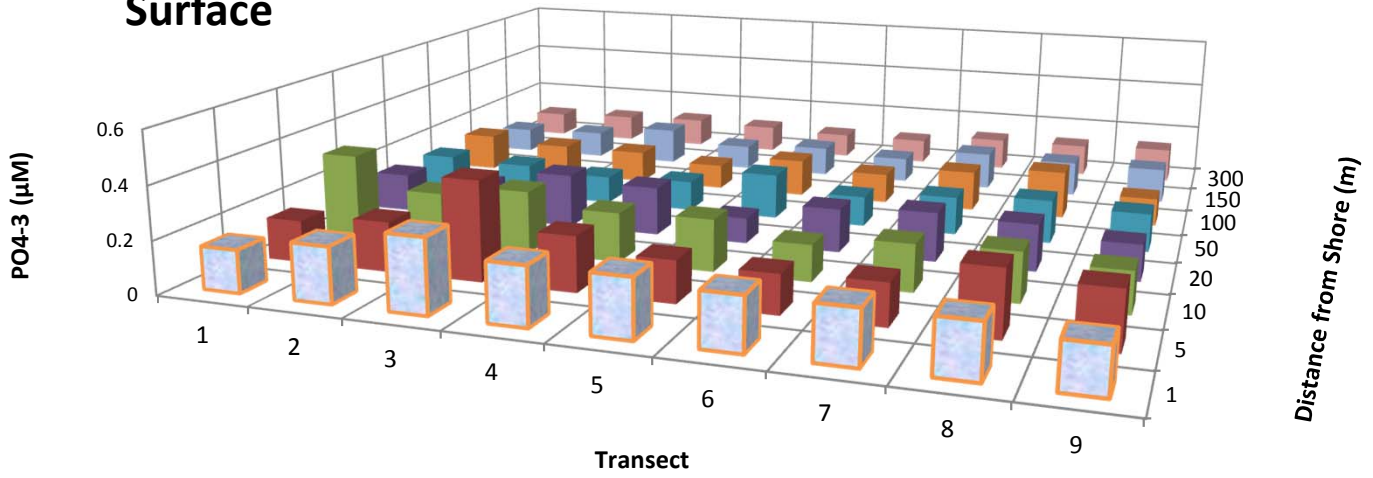
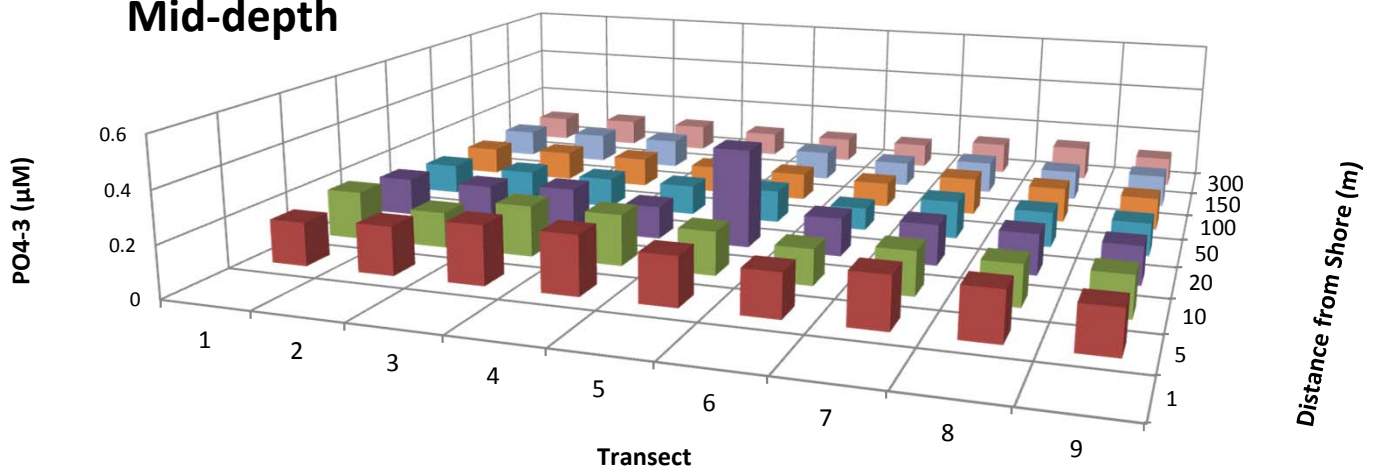


EXHIBIT 7. Three-dimensional histograms of concentrations of nitrate+nitrite nitrogen at the surface, mid-depth in the water column and just above the bottom at 72 sampling locations off of Kahekili Beach. Axis across front of plot shows sampling transect number; axis from front to back of page shows distance offshore from the shoreline. Plot of surface values includes sampling points at the shoreline shown as gray bars. For locations of sampling transects, see Exhibit 2.

Surface



Mid-depth



Bottom

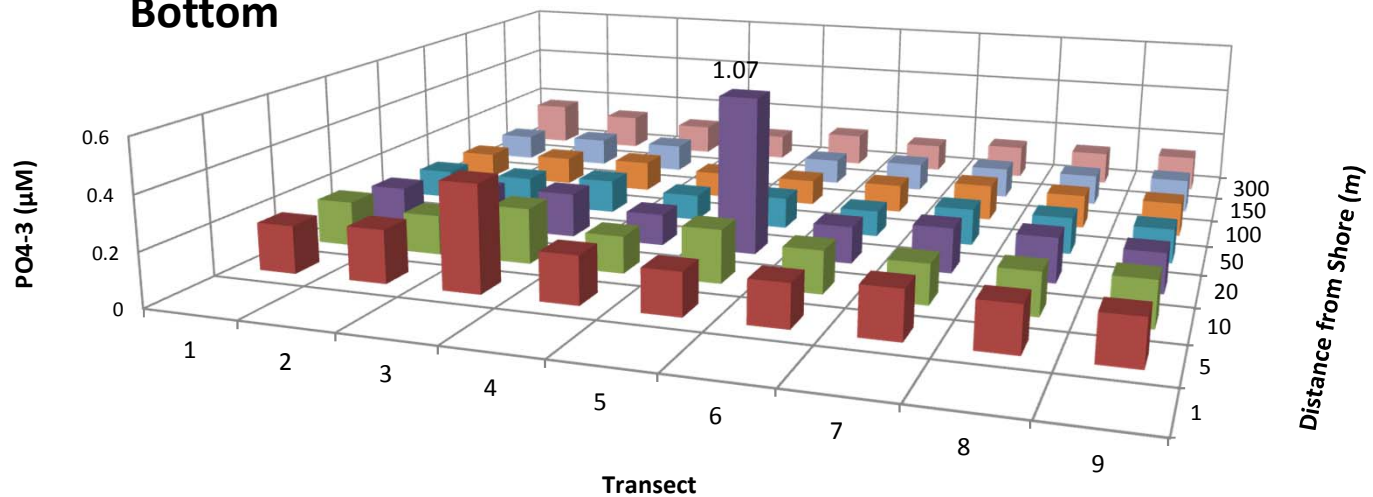


EXHIBIT 8. Three-dimensional histograms of concentrations of phosphate phosphorus (PO_4^{3-}) at the surface, mid-depth in the water column and just above the bottom at 72 sampling locations off of Kahekili Beach. Axis across front of plot shows sampling transect number; axis from front to back of page shows distance offshore from the shoreline. Plot of surface values includes sampling points at the shoreline shown as gray bars. For locations of sampling transects, see Exhibit 2.

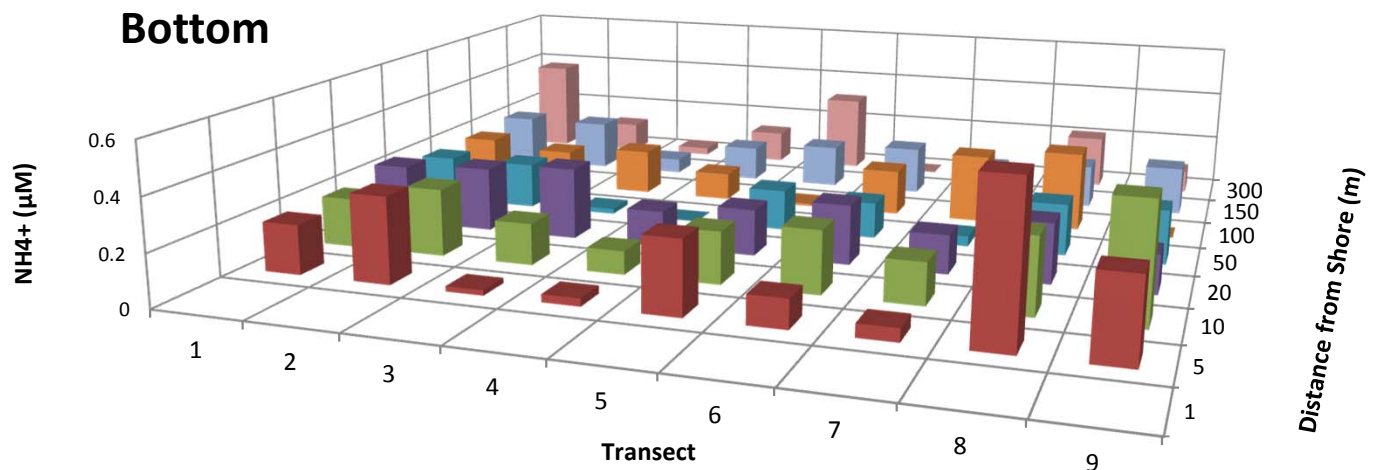
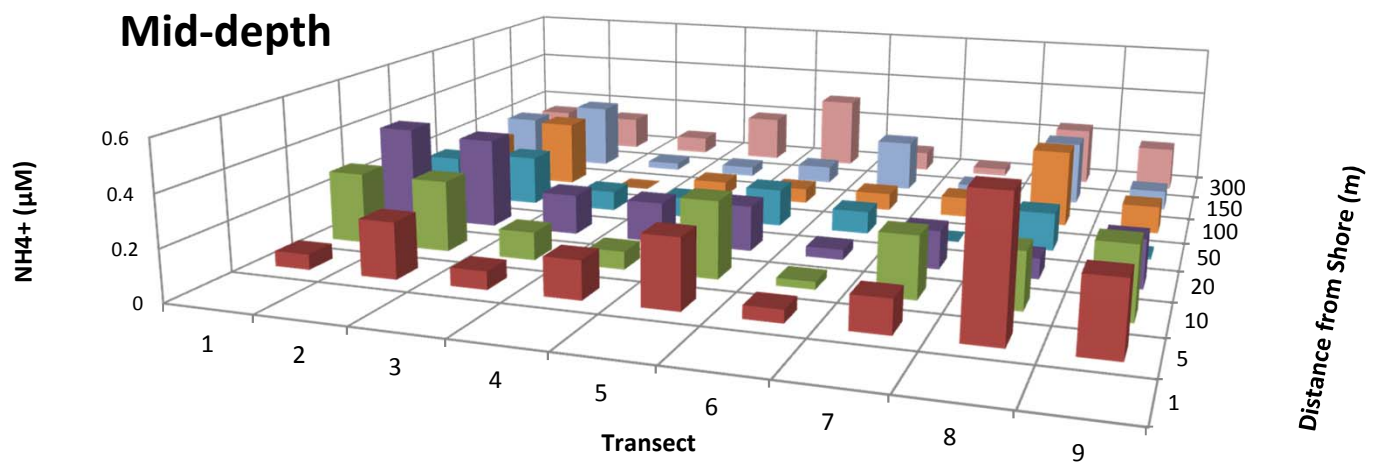
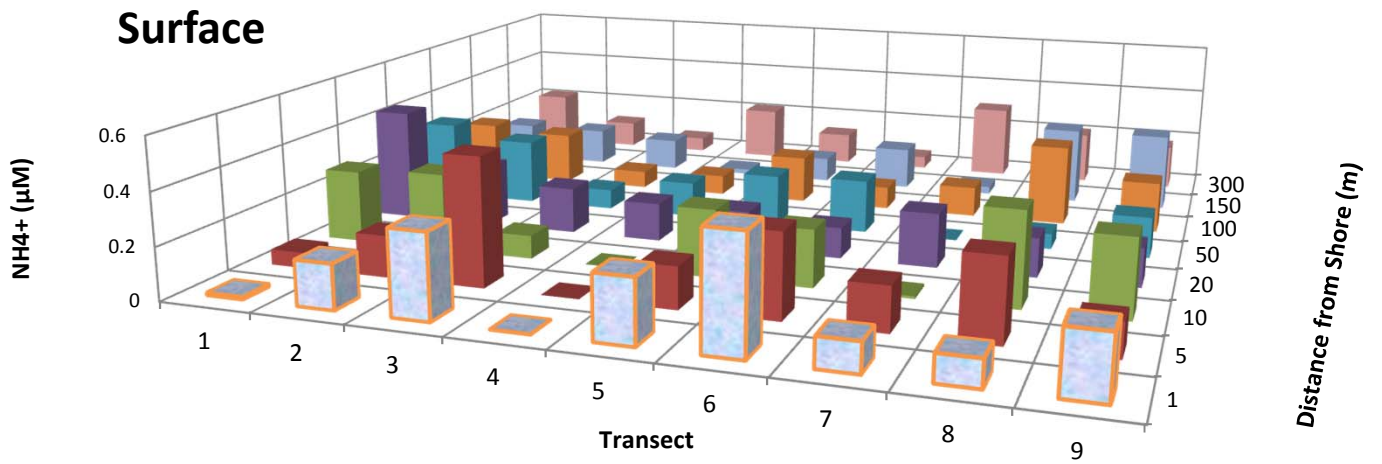


EXHIBIT 9. Three-dimensional histograms of concentrations of ammonium nitrogen (NH_4^+) at the surface, mid-depth in the water column and just above the bottom at 72 sampling locations off of Kahekili Beach. Axis across front of plot shows sampling transect number; axis from front to back of page shows distance offshore from the shoreline. Plot of surface values includes sampling points at the shoreline shown as gray bars. For locations of sampling transects, see Exhibit 2.

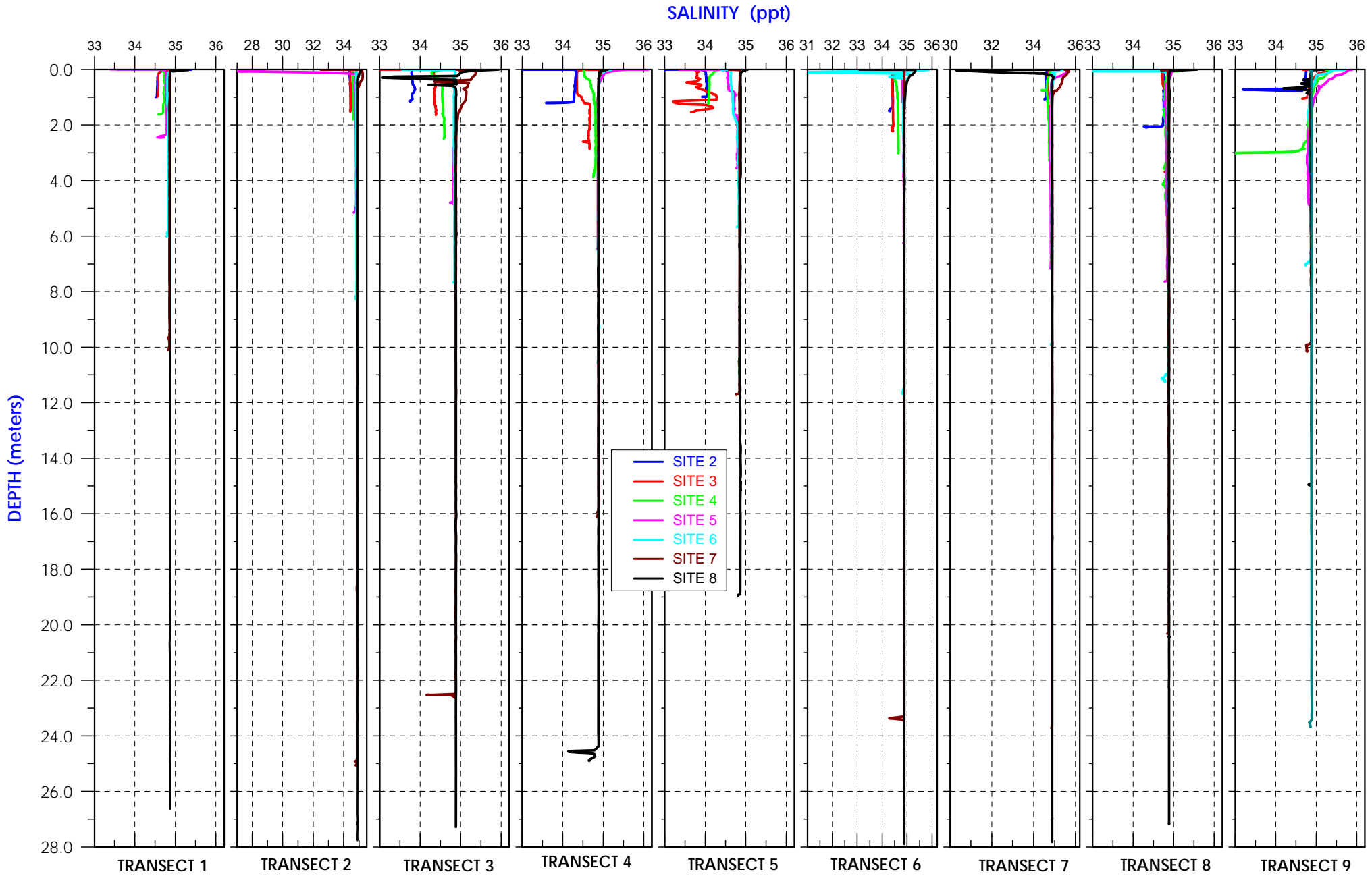


EXHIBIT 10. Vertical profiles of salinity from the ocean surface to reef surface along nine transects extending from the shoreline to open coastal waters at the Kahekili reef site. On each transect, sampling was conducted at seven locations. The North Seep Group is located at the inshore end of Transect 3, and the South Seep Group is located at the inshore end of Transect 5. For locations of Transects and sampling sites, see Exhibit 2.

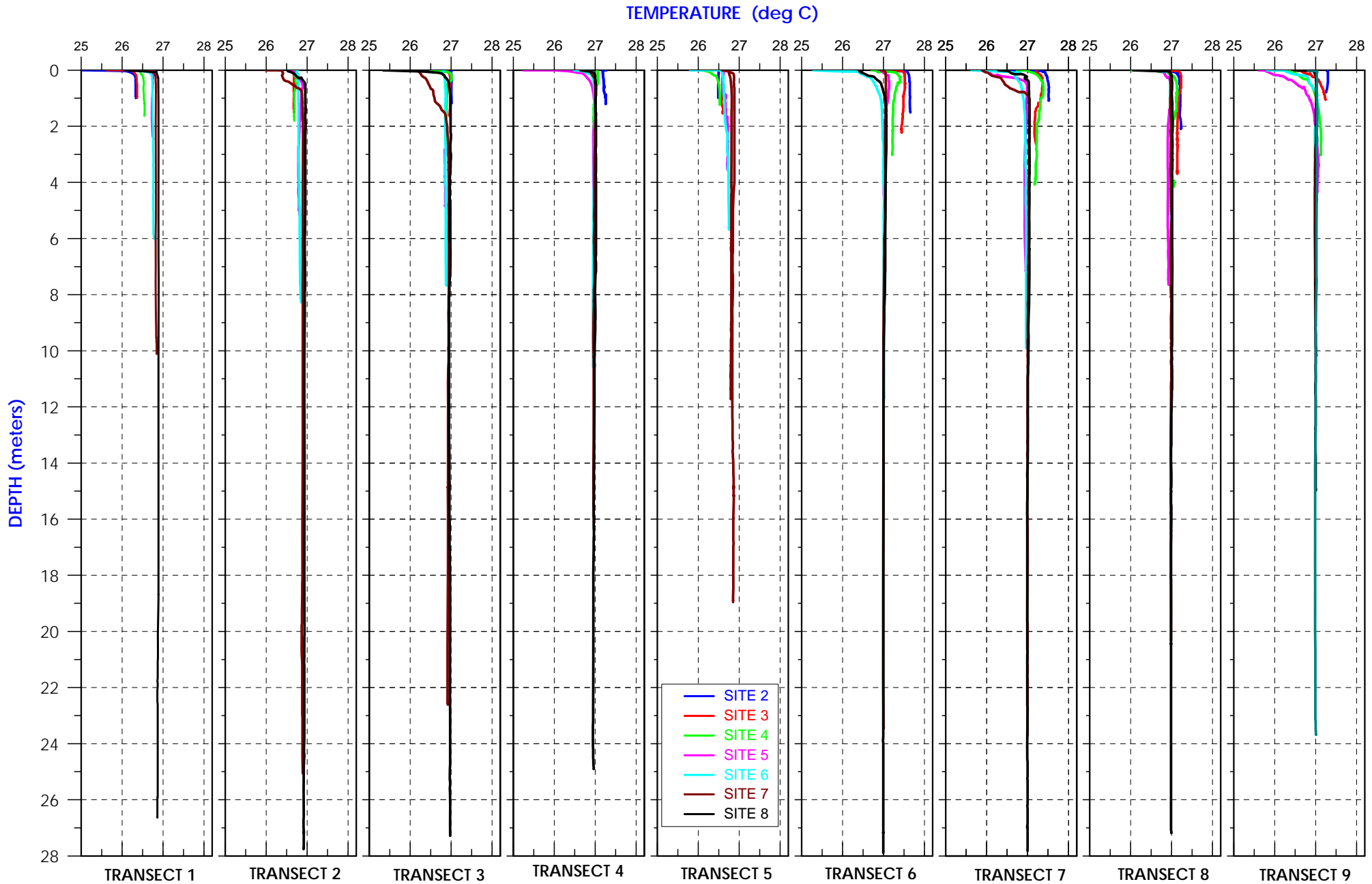


EXHIBIT 11. Vertical profiles of temperature from the ocean surface to a depth of 6 meters along nine transects extending from the shoreline to open coastal waters at the Kahekili reef site. On each transect, sampling was conducted at seven locations. The North Seep Group is located at the inshore end of Transect 3, and the South Seep Group is located at the inshore end of Transect 5. For locations of Transects and sampling sites, see Exhibit 2.

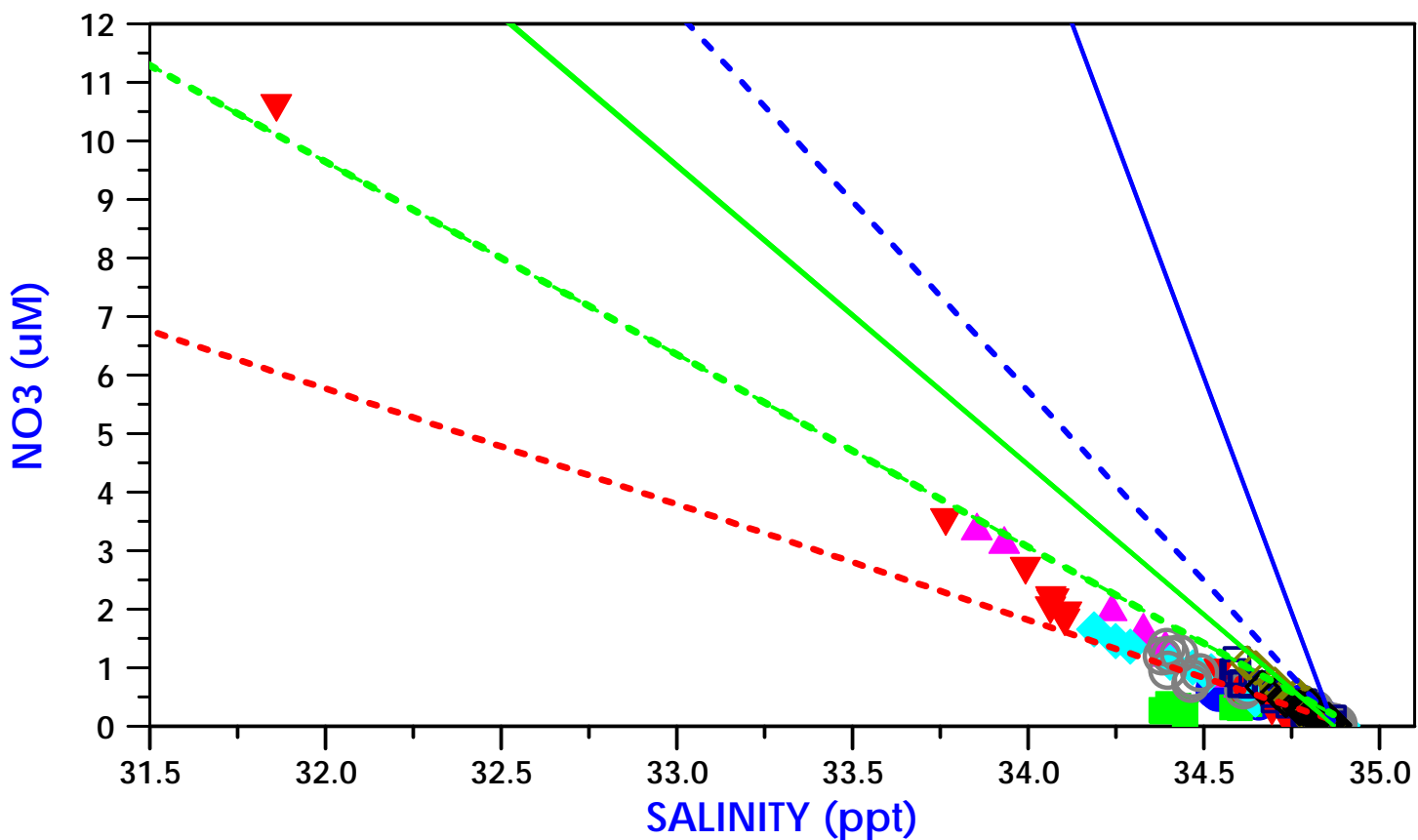
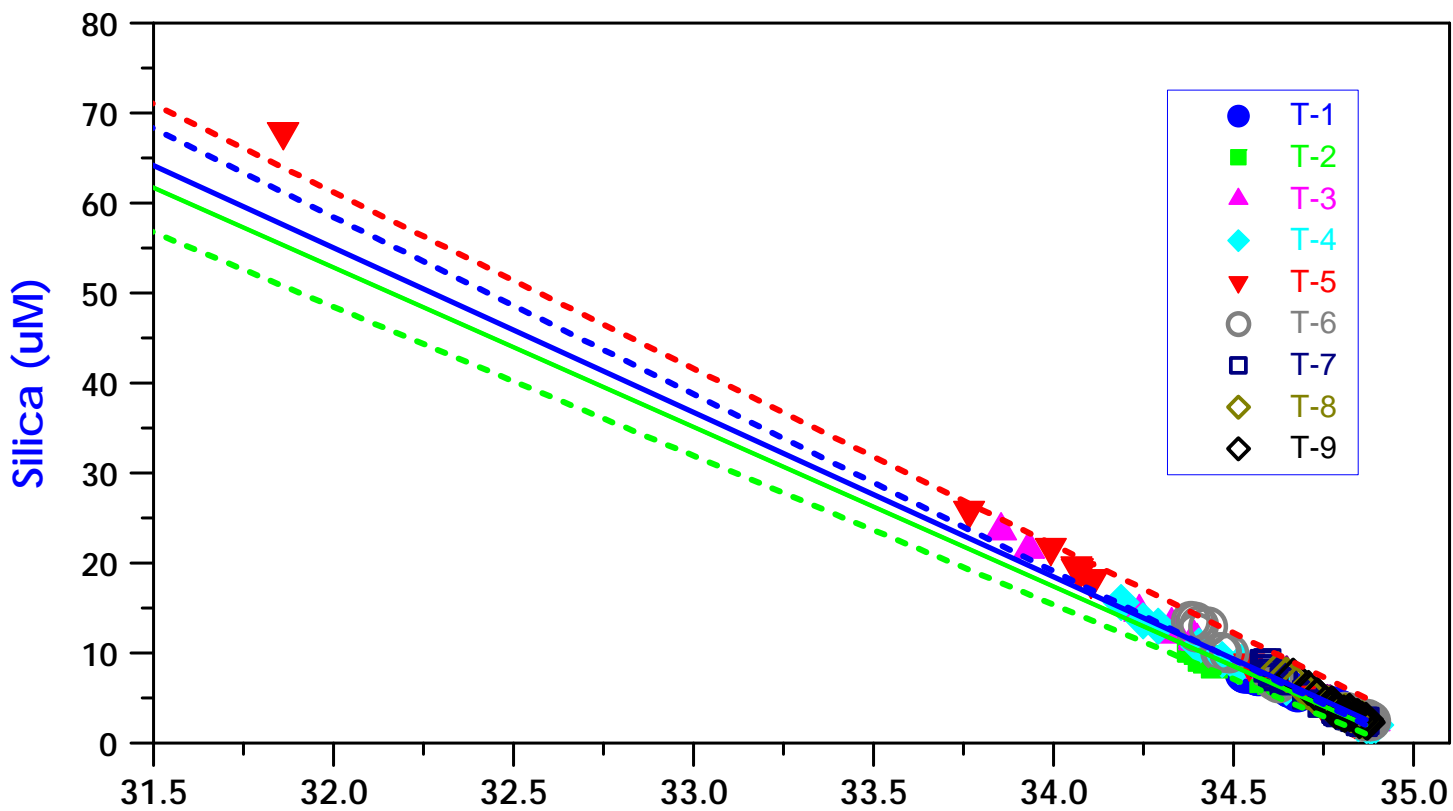


EXHIBIT 12. Mixing diagrams of silica (top) and nitrate nitrogen (bottom) plotted versus salinity from samples collected along nine transects off Kahekili Beach. Straight lines are conservative mixing lines constructed by connecting endpoint concentrations in sewage effluent from the Lahaina Wastewater Reclamation Facility and open coastal waters (blue); groundwater above former sugarcane fields (red); and groundwater from below former sugarcane fields (green). For locations of transects, see Exhibit 2. Dashed represent data from GTS. Solid lines represent data from Dollar and Andrews (1997) and Soicher and Peterson (1997).

EXHIBIT 13. Summary statistics of Dept. of Health water quality sampling at West Maui seep sites from January 2012 to December 2014. Means are shaded in yellow. "n" indicates number of days when any measurements were conducted per station. However, not all constituents were measured on all days.

STATION	STATISTIC	TEMP. °C	SALINITY ‰	DISS. O2 mg/L	DISS. O2 % sat.	pH	TURB. ntu	TSS mg/L	NH ₄ ⁺ µg N/L	NO ₃ ⁻ + NO ₂ ⁻ µg N/L	Total N µg N/L	Total P µg P/L	SiO ₂ µg Si/L	Chl. a µg/L
NORTH CONTROL SURFACE n=32	MEAN	25.34	35.16	5.95	89.53	8.20	1.21	11.00	3.78	7.68	61.96	15.20	575	0.14
	MIN	23.14	34.45	5.33	82.10	8.12	0.31	2.00	1.00	1.00	25.00	8.00	500	0.03
	MAX	27.86	35.73	6.47	96.50	8.34	3.51	22.00	26.00	30.00	108.00	36.00	1244	0.45
	STD	1.27	0.29	0.31	3.92	0.05	0.79	5.51	4.68	8.61	20.42	5.54	154	0.10
NORTH CONTROL MID n=32	MEAN	25.36	35.22	6.02	90.64	8.20	0.99	10.31	3.69	6.02	63.50	14.56	555	0.13
	MIN	23.07	34.55	5.32	81.90	8.14	0.26	1.00	1.00	1.00	29.00	8.00	500	0.05
	MAX	27.89	35.73	7.30	107.50	8.32	3.40	25.00	19.00	28.00	120.00	36.00	1074	0.34
	STD	1.25	0.31	0.43	5.58	0.04	0.74	6.38	3.38	7.09	21.93	5.34	142	0.08
NORTH SEEP A n=32	MEAN	27.40	6.09	5.21	68.25	7.72	3.53	5.70	6.83	964.77	1396.83	343.08	40865	0.12
	MIN	24.16	3.81	2.84	38.50	7.33	0.19	0.50	2.00	1.00	40.00	90.00	15400	0.01
	MAX	30.2	25.39	7.55	95.90	8.17	65.40	25.00	101.00	5660.00	6297.00	765.00	48000	0.87
	STD	1.50	4.60	1.18	16.51	0.23	11.37	5.52	17.89	1238.03	1609.99	115.28	6705	0.19
NORTH SEEP B n=24	MEAN	28.63	5.47	5.11	69.34	7.78	3.31	5.15	2.86	1281.73	2007.08	353.17	41903	0.05
	MIN	26.26	3.80	2.75	35.90	7.36	0.20	0.50	2.00	1.00	45.00	280.00	28700	0.01
	MAX	30.73	13.34	7.11	93.20	8.03	23.90	20.00	7.00	4110.00	4971.00	645.00	50570	0.18
	STD	1.36	2.01	1.21	16.37	0.19	5.60	5.74	1.46	1162.03	1719.18	80.83	5027	0.03
NORTH SEEP C n=8	MEAN	29.80	6.63	4.66	64.23	7.80	4.25	4.75	3.00	1164.38	1651.69	304.86	41466	0.04
	MIN	27.83	3.82	2.78	38.30	7.42	0.07	1.00	2.00	42.00	66.00	190.00	23200	0.02
	MAX	32.24	20.25	6.52	89.40	8.02	21.10	16.00	4.00	2088.00	3532.50	396.00	46100	0.05
	STD	1.68	5.59	1.20	17.77	0.21	7.03	4.83	1.07	771.59	1203.99	65.50	7592	0.01
NORTH SEEP SURFACE n=32	MEAN	25.46	34.73	5.92	89.21	8.22	0.94	11.34	4.06	18.43	74.04	21.36	1236	0.14
	MIN	23.31	33.80	5.30	80.30	8.16	0.24	1.00	1.00	1.00	31.00	13.00	500	0.03
	MAX	27.9	35.39	6.42	97.70	8.37	3.76	24.00	20.00	63.00	123.00	79.00	4180	0.51
	STD	1.21	0.39	0.31	3.83	0.05	0.71	6.54	3.86	16.20	25.57	12.85	674	0.11
NORTH SEEP MID n=32	MEAN	25.48	34.82	5.89	88.59	8.23	0.92	13.09	3.81	17.67	69.69	19.96	948	0.15
	MIN	23.28	33.88	5.26	74.80	8.16	0.17	1.00	1.00	1.00	25.00	10.00	500	0.04
	MAX	27.91	35.49	6.52	96.80	8.40	2.43	39.00	21.00	65.00	134.80	78.00	1680	0.51
	STD	1.23	0.44	0.32	4.46	0.05	0.58	8.36	3.75	16.91	29.32	12.87	366	0.10
SOUTH CONTROL SURFACE n=33	MEAN	25.84	35.09	6.85	104.07	8.26	0.74	12.82	4.87	6.79	57.80	13.92	611	0.13
	MIN	23.9	34.50	6.12	95.50	8.17	0.29	2.00	1.00	1.00	25.00	8.00	500	0.03
	MAX	28.12	35.48	7.82	117.00	8.36	1.84	32.00	18.00	30.00	91.00	34.00	900	0.36
	STD	1.19	0.25	0.36	5.27	0.05	0.38	8.34	4.13	6.22	18.38	5.44	118	0.09
SOUTH CONTROL MID n=41	MEAN	25.77	35.19	6.85	104.20	8.27	0.63	13.03	3.94	7.00	56.35	13.31	553	0.12
	MIN	23.85	34.58	6.13	96.80	8.19	0.26	1.00	1.00	1.00	28.00	5.00	500	0.04
	MAX	28.11	35.53	7.94	118.40	8.34	2.13	34.00	18.00	25.00	128.70	35.00	1040	0.44
	STD	1.18	0.23	0.37	5.29	0.04	0.38	8.17	3.58	5.77	20.37	5.72	117	0.08
SOUTH SEEP A n=35	MEAN	28.92	5.00	4.79	65.16	7.66	4.01	6.54	3.90	891.00	1592.47	398.96	43485	0.36
	MIN	25.45	2.83	2.73	36.10	7.48	0.34	0.50	2.00	1.00	47.00	285.00	21200	0.02
	MAX	32.24	22.76	7.14	92.70	7.90	14.10	15.00	11.00	3540.00	5877.50	750.00	53400	6.14
	STD	1.81	4.49	1.23	16.73	0.11	4.04	4.79	2.31	1036.87	1874.26	83.48	5431	1.06
SOUTH SEEP B n=34	MEAN	29.52	7.00	5.04	69.39	7.66	4.99	9.62	3.87	854.22	1326.72	400.12	41708	1.24
	MIN	25.52	3.28	3.00	40.80	7.44	0.57	1.00	2.00	1.00	53.00	225.00	19900	0.01
	MAX	33.16	22.73	7.05	94.00	7.84	47.30	36.00	12.00	3204.00	4820.00	735.00	52805	34.17
	STD	1.83	5.38	1.04	14.27	0.10	8.92	8.91	2.43	1008.39	1488.01	87.82	6567	5.93
SOUTH SEEP C n=30	MEAN	29.53	7.47	4.92	67.86	10.07	4.20	9.50	3.66	815.28	1244.69	362.87	38932	0.45
	MIN	25.99	3.22	1.79	23.70	7.44	0.65	1.00	2.00	1.00	50.00	66.00	10500	0.03
	MAX	34.39	28.43	7.01	97.30	76.60	18.30	49.00	10.00	2430.00	3712.00	645.00	50300	5.39
	STD	2.17	6.34	1.20	17.92	12.80	4.83	9.54	2.21	943.45	1375.83	101.80	9755	1.08
SOUTH SEEP SURFACE n=33	MEAN	25.78	34.91	6.78	102.87	8.25	0.94	13.06	3.87	16.15	69.93	19.88	905	0.13
	MIN	23.85	34.20	5.61	86.30	8.13	0.15	2.00	1.00	1.00	24.00	10.00	500	0.03
	MAX	28.13	35.71	7.93	118.50	8.35	4.13	34.00	18.00	63.15	153.00	59.00	2397	0.41
	STD	1.18	0.37	0.42	6.12	0.06	0.77	8.62	3.62	18.72	31.26	10.86	418	0.08
SOUTH SEEP MID n=33	MEAN	25.74	34.94	6.79	102.86	8.26	0.78	13.33	4.06	15.93	95.52	17.42	815	0.13
	MIN	23.87	33.23	5.57	85.70	8.17	0.07	2.00	1.00	1.00	30.00	6.00	500	0.03
	MAX	28.14	35.71	7.93	118.20	8.34	2.43	37.00	18.00	105.30	803.00	46.00	2171	0.43
	STD	1.22	0.49	0.43	6.13	0.05	0.55	8.88	3.77	21.95	142.04	7.93	449	0.09
WAHI-KULI n=21	MEAN	25.39	33.25	6.28	93.10	8.22	1.23	13.21	8.29	68.74	140.21	21.69	2805	0.68
	MIN	22.96	30.76	5.46	84.40	8.06	0.37	2.00	1.00	1.00	75.00	10.00	500	0.32
	MAX	28.2	35.57	7.63	113.00	8.34	3.10	37.00	24.00	123.00	196.00	33.00	6120	1.40
	STD	1.20	1.49	0.57	8.56	0.08	0.69	11.00	7.81	35.72	38.52	6.63	1630	0.32
BLACK ROCK n=7	MEAN	25.19	1.34	4.50	55.04	7.82	0.61	5.50	6.25	3043.00	3800.00	235.25	55734	0.07
	MIN	24.33	1.19	3.86	47.50	7.65	0.28	1.00	2.00	1990.00	2530.00	186.00	53700	0.05
	MAX	25.99	1.46	5.16	65.00	8.06	1.07	10.00	11.00	3680.00	4500.00	279.00	57390	0.13
	STD	0.68	0.11	0.50	6.51	0.16	0.28	3.87	3.77	763.32	903.95	39.34	1605	0.04

DOH STANDARDS - OPEN COASTAL WATERS

NTE 10%							1.25			14.00	250.00	40.00		0.90
NTE 2%							2.00			25.00	350.00	60.00		1.75
GEOMEAN							0.50			5.00	250.00	20.00		0.30

MAUI Marine Waters													
Water Body Type	Scope of Assessment	Geocode ID	Wet/Dry Criteria	Enterococci	TN	NO ₃ +NO ₂	NH ₄	TP	Turbidity	Chl <i>a</i>	Other Pollutants	Category	TMDL Priority
C	Ahihi-Kinau Natural Area Reserve	HIW00084	Dry	?	?	?	?	?	?	?		3	
C	Alaeloa Beach	HI616569	Dry	?	?	?	?	?	?	?		3	
C	Awalua Beach	HI839739	Dry	?	?	?	?	?	?	?		3	
C	Father Jules Papa	HI525524	Dry	?	?	?	?	?	?	?		3	
C	Fleming Beach North	HI253548	Dry	A	?	?	?	?	N	N		2,3,5	M
C	H.A. Baldwin Beach Co. Park	HI846900	Dry	A	?	?	?	?	N	?		2,3,5	L
C	Hamoia	HI287670	Dry	?	?	?	?	?	?	?		3	
C	Hana Bay	HI996835	Dry	?	?	?	?	?	?	?		3	
C	Hanaka'o'o Beach Co. Park	HI797917	Dry	A	A	N	N	N	N	N		2,5	M
C	Hanaka'o'o Station*	HIW00165	Dry	?	?	N	?	?	N	?		3,5	M
C	Hata's	HI553820	Dry	A	?	?	?	?	?	?		2,3	
C	Honokeana Bay	HI229021	Dry	?	?	?	?	?	?	?		3	
C	Honokohau Bay	HI432902	Dry	?	?	?	?	?	?	?		3	
C	Honokowai Beach Co. Park	HI412391	Dry	A	A	N	N	A	N	N		2,5	M
C	Honokowai Point to Kaanapali	HIW00139	Dry	?	N	A	N	A	A	A		2,3,5	M
C	Honolua Bay	HI280286	Dry	A	N	N	N	N	?	N		2,3,5	L
C	Honomanu Bay	HI985873	Wet	N	?	?	?	?	?	?		3,5	L
C	Ho'okipa Beach Co. Park	HIW00024	Dry	A	?	?	?	?	N	?		2,3,5	L
C	H-Poko Papa	HI901232	Dry	?	?	?	?	?	?	?		3	
C	Huakini Bay	HI385800	Dry	?	?	?	?	?	?	?		3	
C	Kaanapali (Kahekili Beach)	HI643627	Wet	A	A	A	A	A	N	A		2,5	M
C	Kaanapali (Sheraton Kaanapali Shoreline)	HIW00022	Dry	A	?	?	?	?	N	N		2,3,5	M
C	Kahana (Mahinahina Condo Shoreline)	HI160433	Dry	A	N	N	N	N	N	N		2,5	M

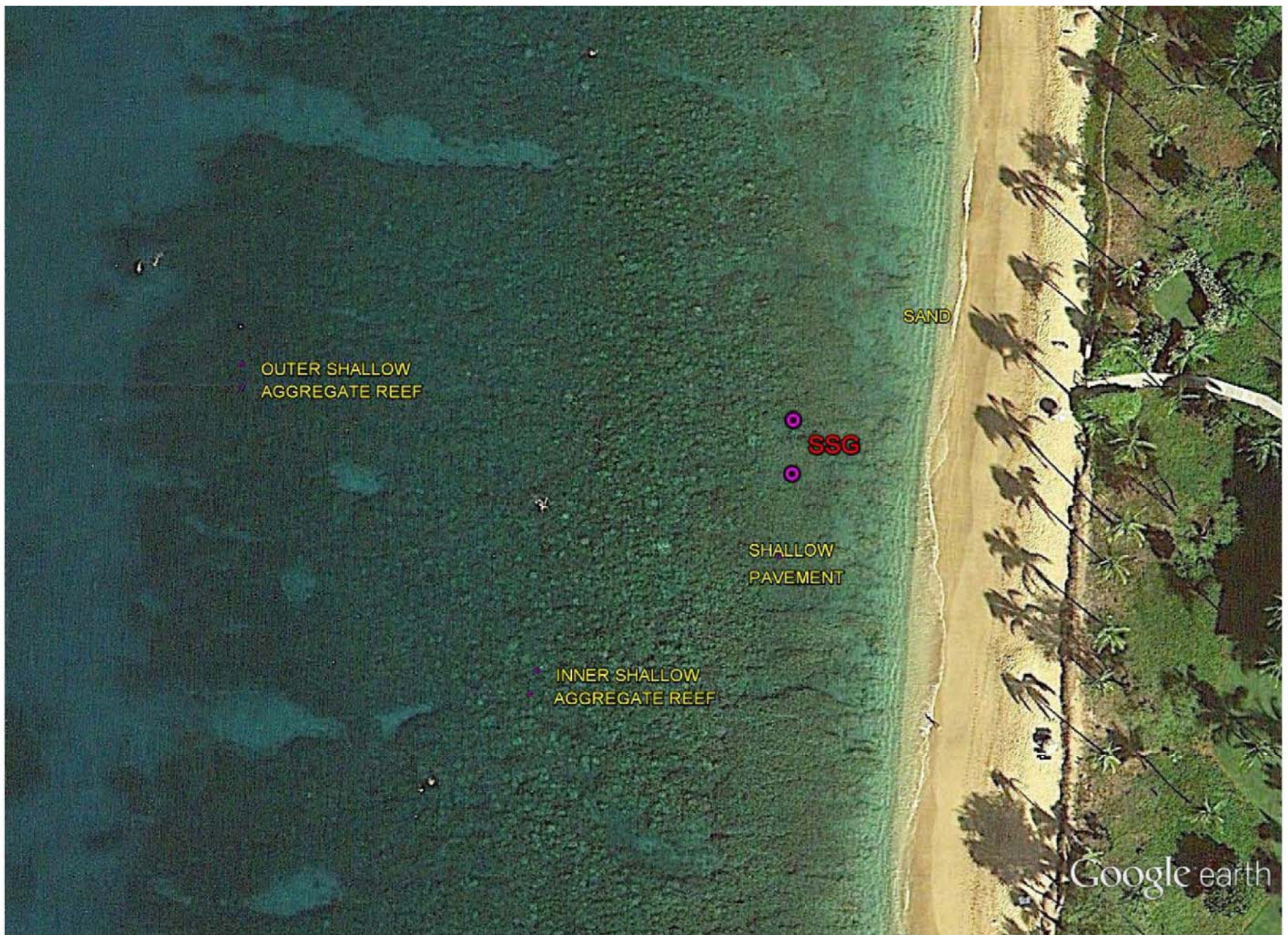
Decision Codes: ? = insufficient data, A = attained, A_T = attained (TMDL approved for parameter), N = not attained, N_T = not attained (TMDL approved for parameter), V = visual listing from 2001-2004, Y = previous listing from 1998 or earlier.; **Category:** 1 = all uses attained, 2 = some uses attained, 3 = not enough data to evaluate, 4 = at least one use not attained, but no TMDL needed, 4a = TMDL approved, 5 = at least one use not attained, TMDL needed; **TMDL Priority Codes:** High (H), Medium (M), & Low (L) priority for initiating TMDL development within the current monitoring and assessment cycle (through October 31, 2013); **IP** = TMDL development in progress; prior assessments confirmed with new data are shaded; *category changes are bolded, italicized, underlined & shaded.*



Google earth



EXHIBIT 15. Google earth image (taken 1/12/13) showing location of North Seep Group (NSG) at Kahekili Beach, West Maui. Also shown are locations of shallow pavement, inner shallow aggregate reef, and outer shallow aggregate reef zones. Note distinctly different visible bottom structure in each zone.



Google earth

feet
meters



EXHIBIT 16. Google earth image (taken 1/12/13) showing location of South Seep Group (SSG) at Kahekili Beach, West Maui. Also shown are locations of shallow pavement, inner shallow aggregate reef, and outer shallow aggregate reef zones. Note distinctly different visible bottom structure in each zone.

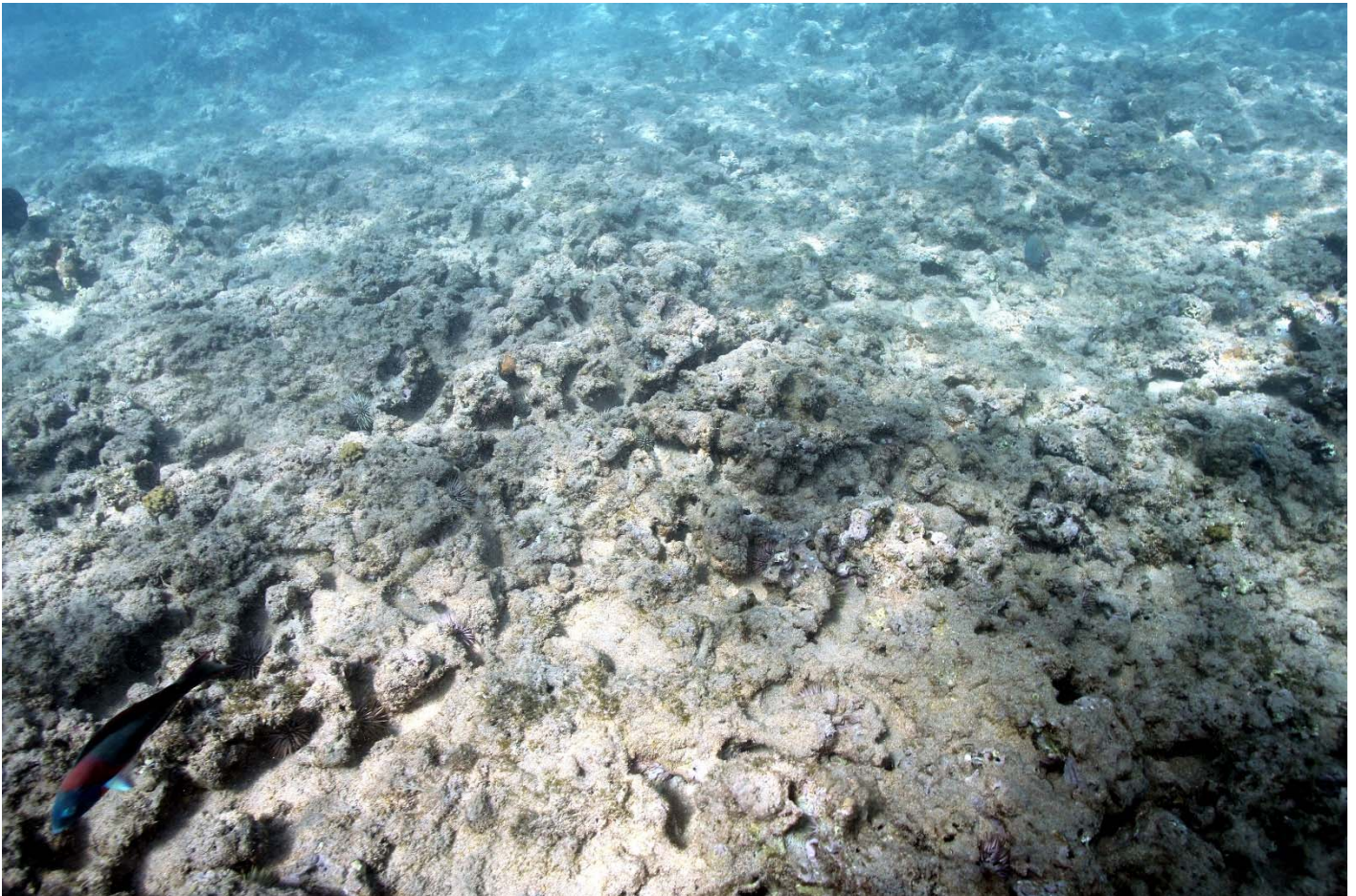


EXHIBIT 17. Typical views of pitted limestone surface comprising the Shallow Pavement zone adjacent to the shoreline off Kahekili Beach adjacent to South Seep Group. Water depth is approximately 1 meter.

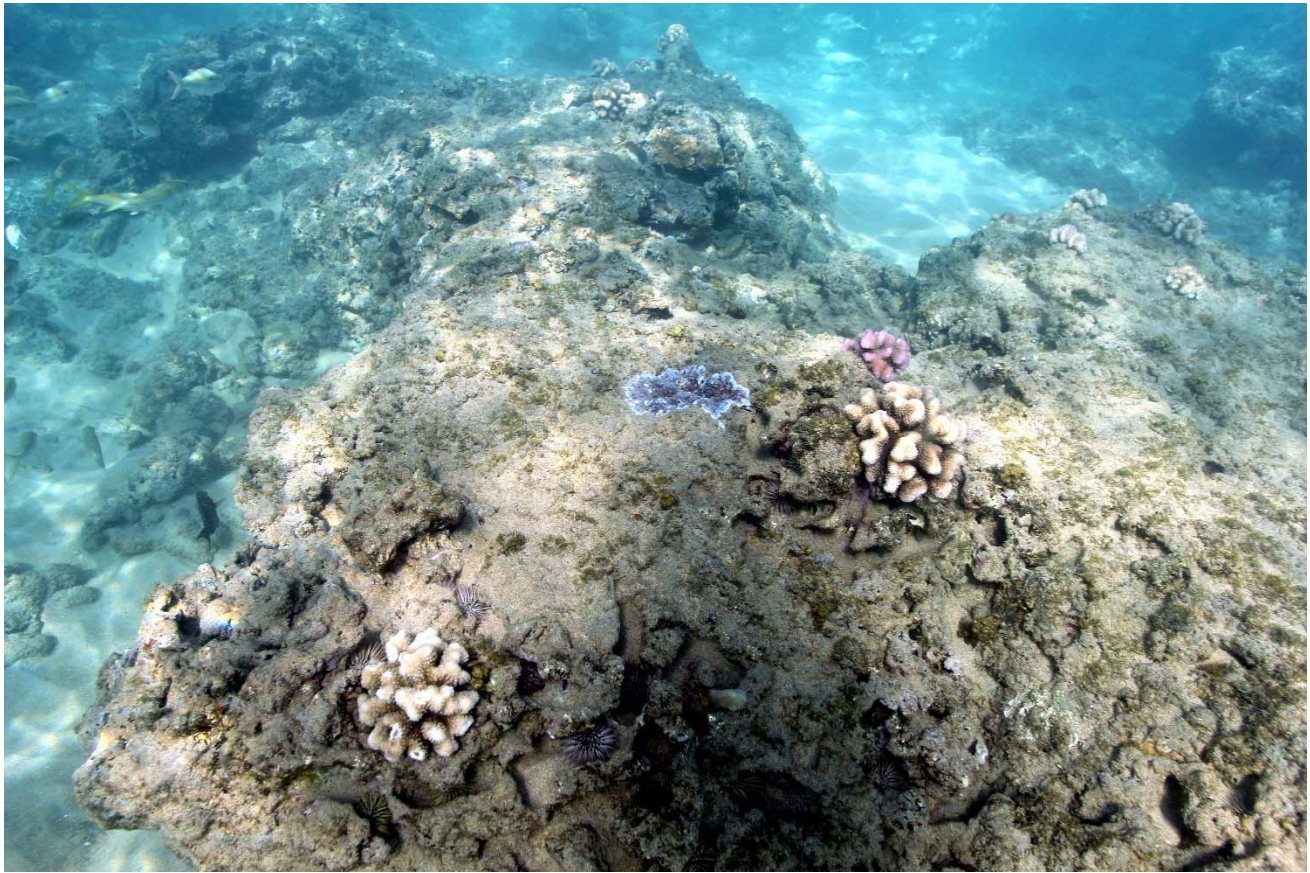


EXHIBIT 18. Photos of area of North Seep Group. Upper photo shows bubble streams emanating from sand bed covering seeps. Note large ripples in sand indicating significant wave action. Bottom photo shows section of raised pavement above sand bed adjacent to South Seep Group. Round branching corals growing on pavement are *Pocillopora meandrina*, which is a species that commonly occurs in the nearshore reefs of Hawaii in areas too harsh for other species. The size of the colonies indicates that they are no greater than five years old, indicating that they would have recruited and settled in the area during the period when the LWRF was in operation. Water depth is approximately 1 meter.

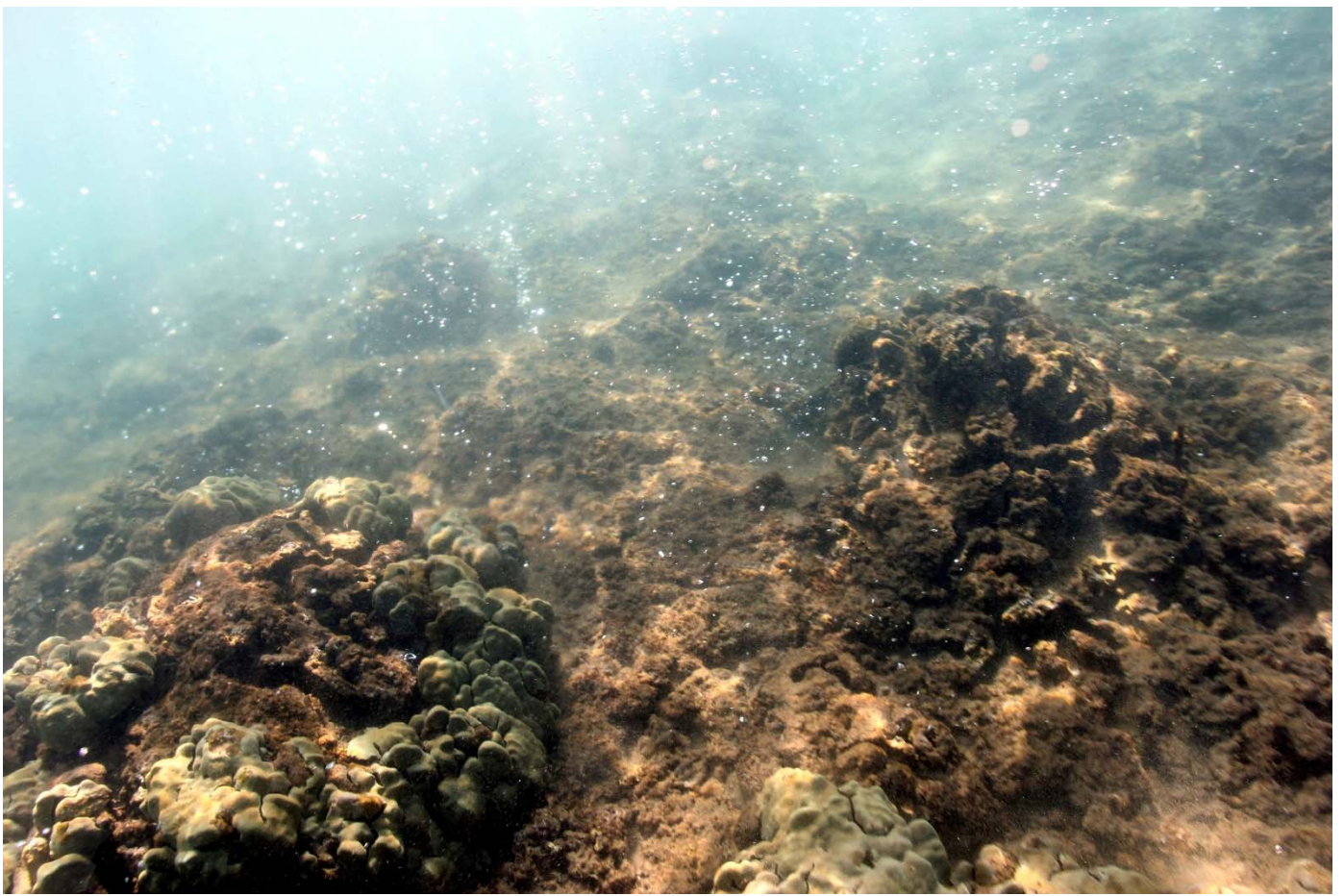


EXHIBIT 19. Photos of area of South Seep Group. Upper photo shows bubble streams emanating from seeps in reef pavement (note presence of living corals adjacent to bubble streams). Bottom photo shows upper surface of metal piezometer tube pounded into seep aperture in reef pavement. Plastic tube attached to meter piezometer is used to sample water from interior of reef. Water depth is approximately 1.5 meters.

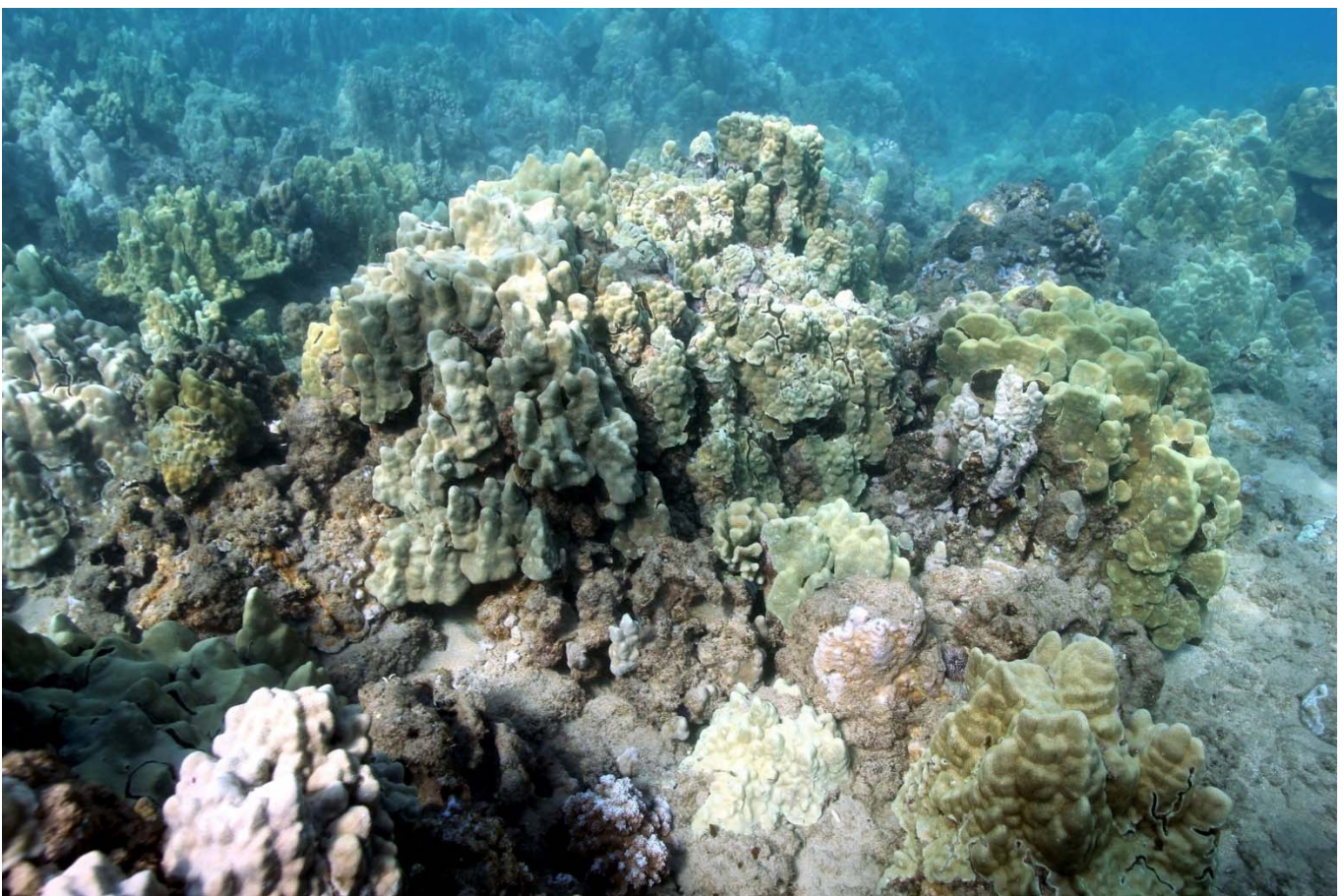


EXHIBIT 20. Typical coral community structure in Inner Shallow Aggregate reef zone off Kahekili Beach adjacent to South Seep Group. Both photos shows large colonies of lobe coral (*Porites lobata*) growing in approximately 3-4 meters of water. Coral in bottom photo is approximately 1.5 meters in diameter, making it at least 50 years old, and is located approximately 10 meters from South Seep Group. Top of coral colony in lower photo appears to be flat owing to close proximity to the sea surface.

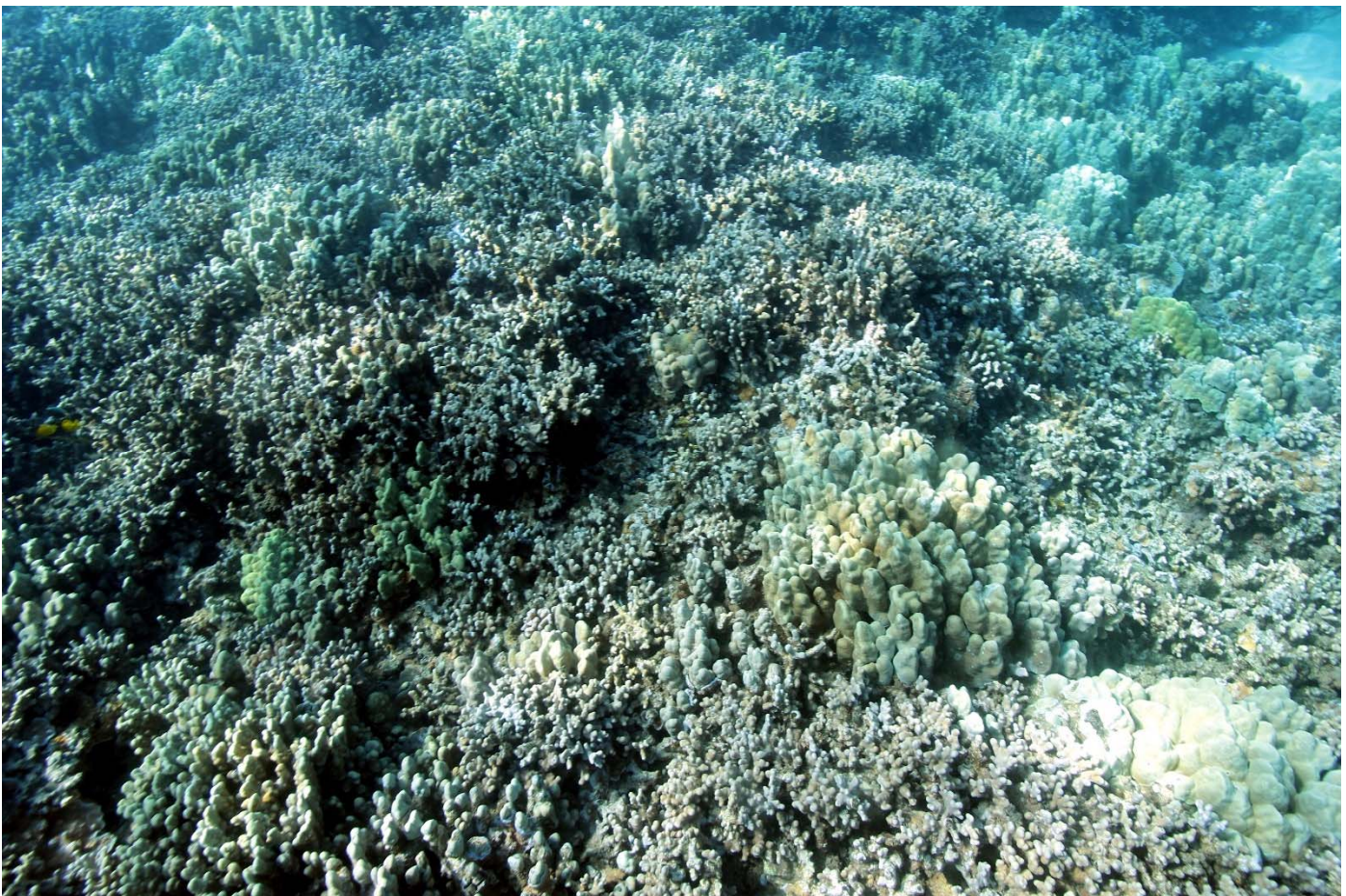
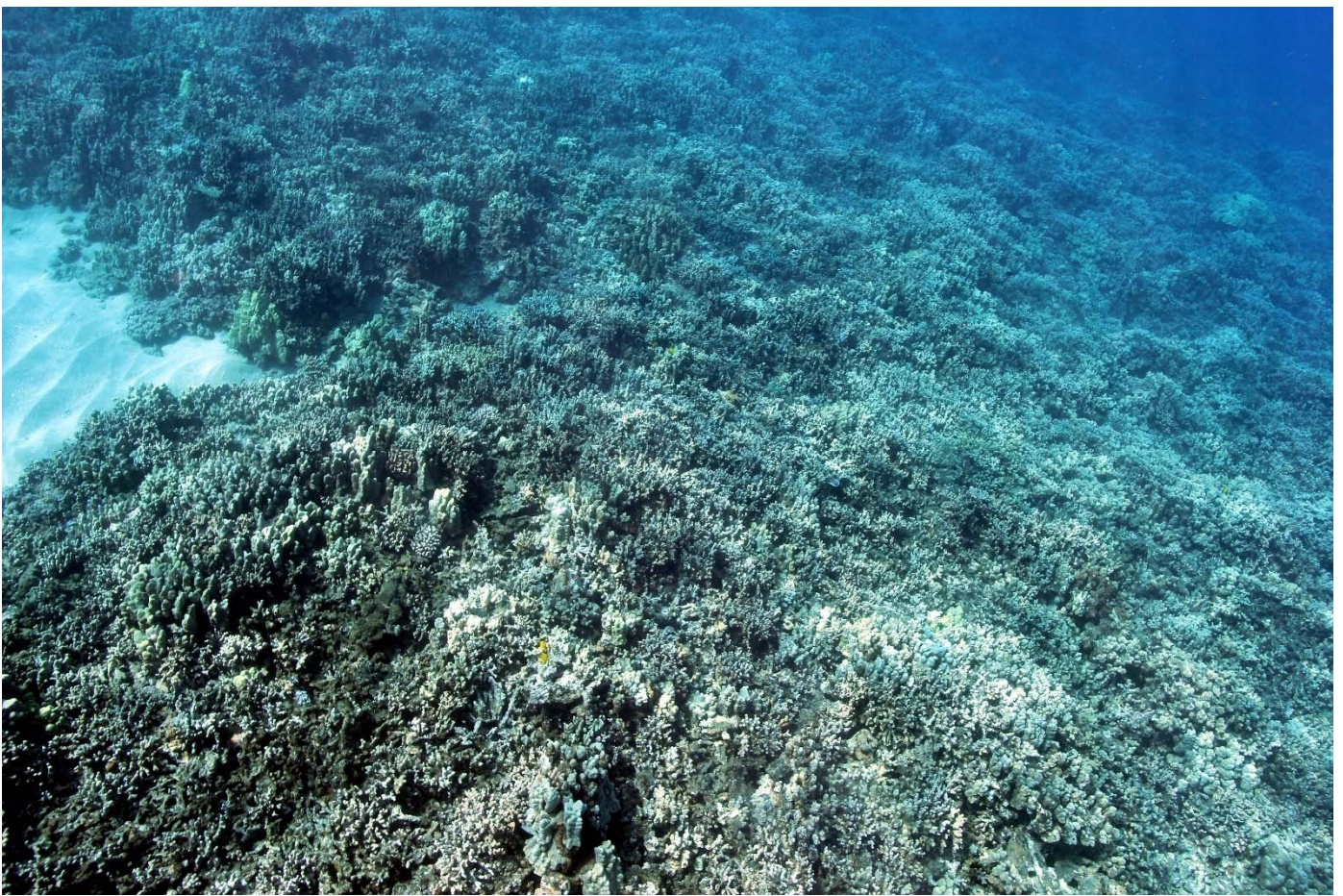


EXHIBIT 21. Typical coral community structure in Outer Shallow Aggregate reef slope zone off Kahekilli Beach. Both photos shows large expanses of interconnected mats of finger coral (*Porites compressa*) growing in approximately 5-8 meters of water directly seaward of the South Seep Group. Note lack of "dead zones" in both photos.

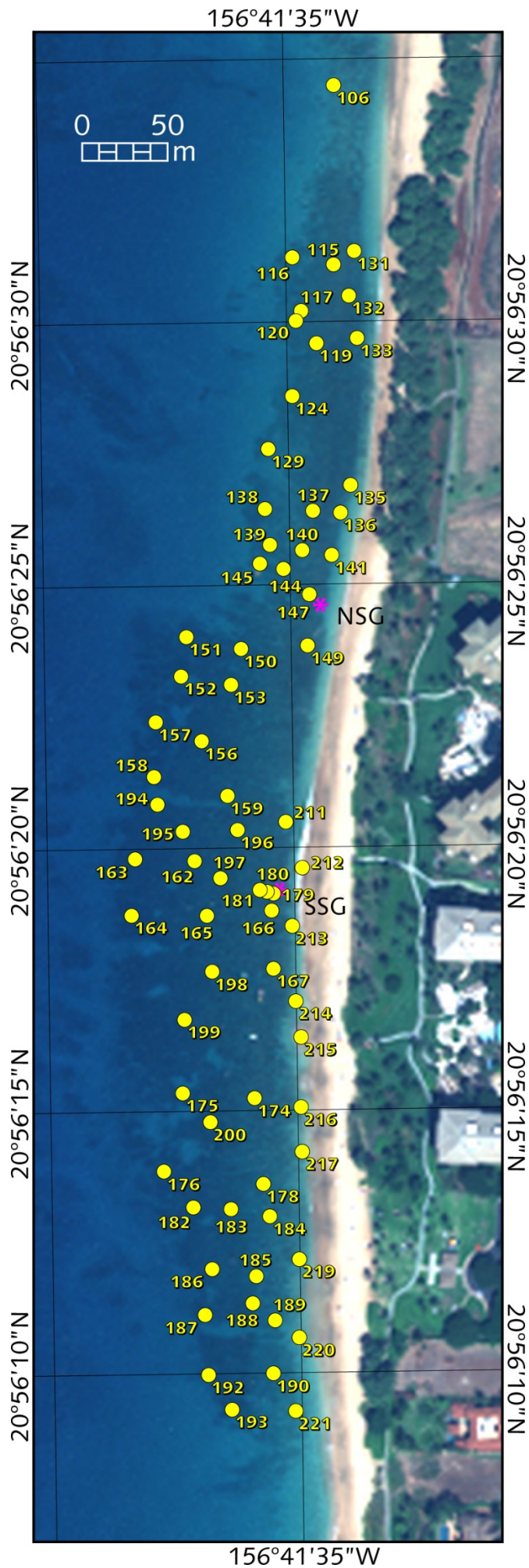


EXHIBIT 22. Numbered photomosaic sites on Kahekili reef.

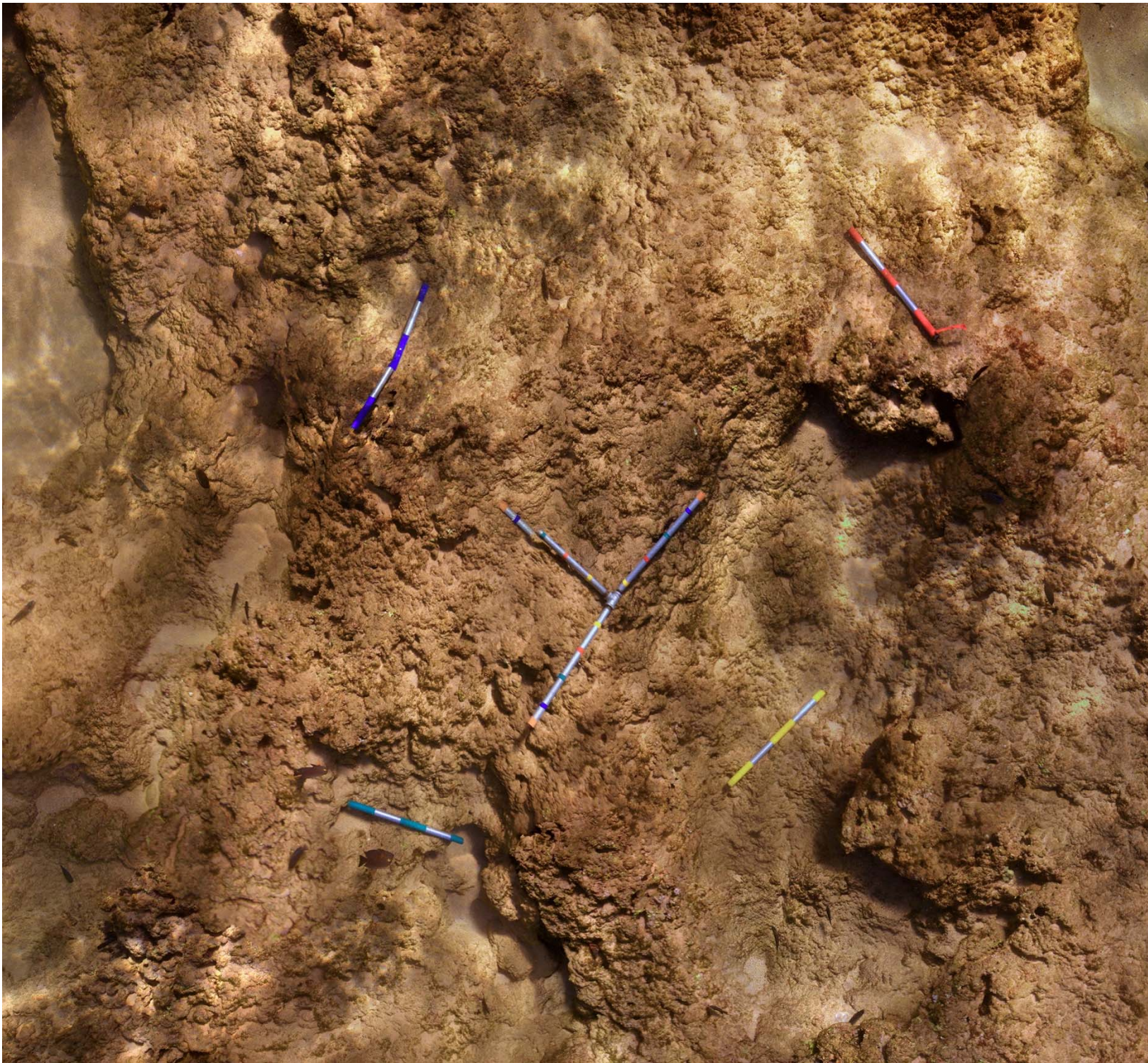


EXHIBIT 23. Photomosaic 217 taken in Shallow Pavement Zone.



EXHIBIT 24. Photomosaic 138 taken in Inner Shallow Aggregate Reef Zone.

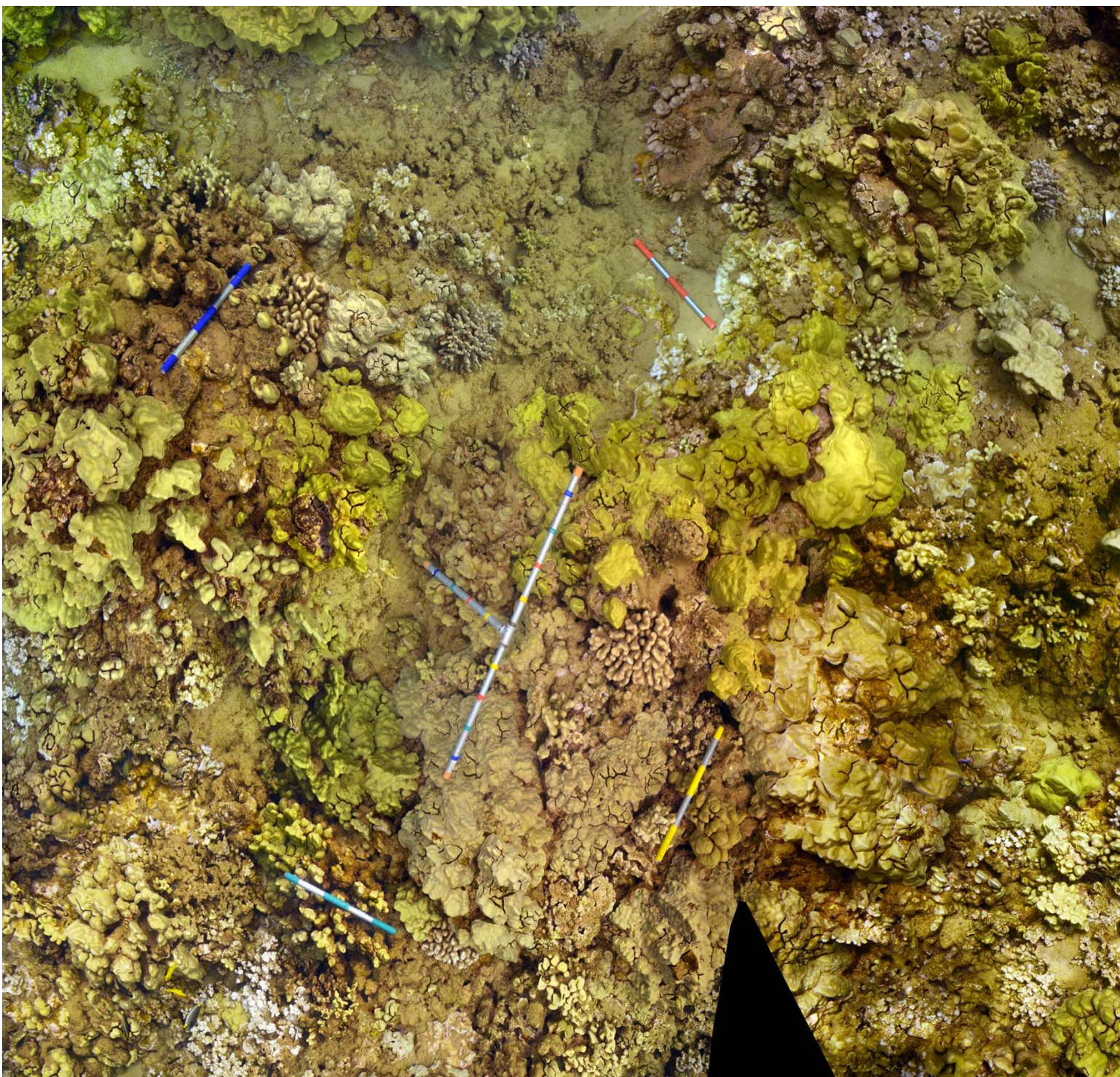


EXHIBIT 25. Photomosaic 196 taken in Inner Shallow Aggregate Reef Zone.

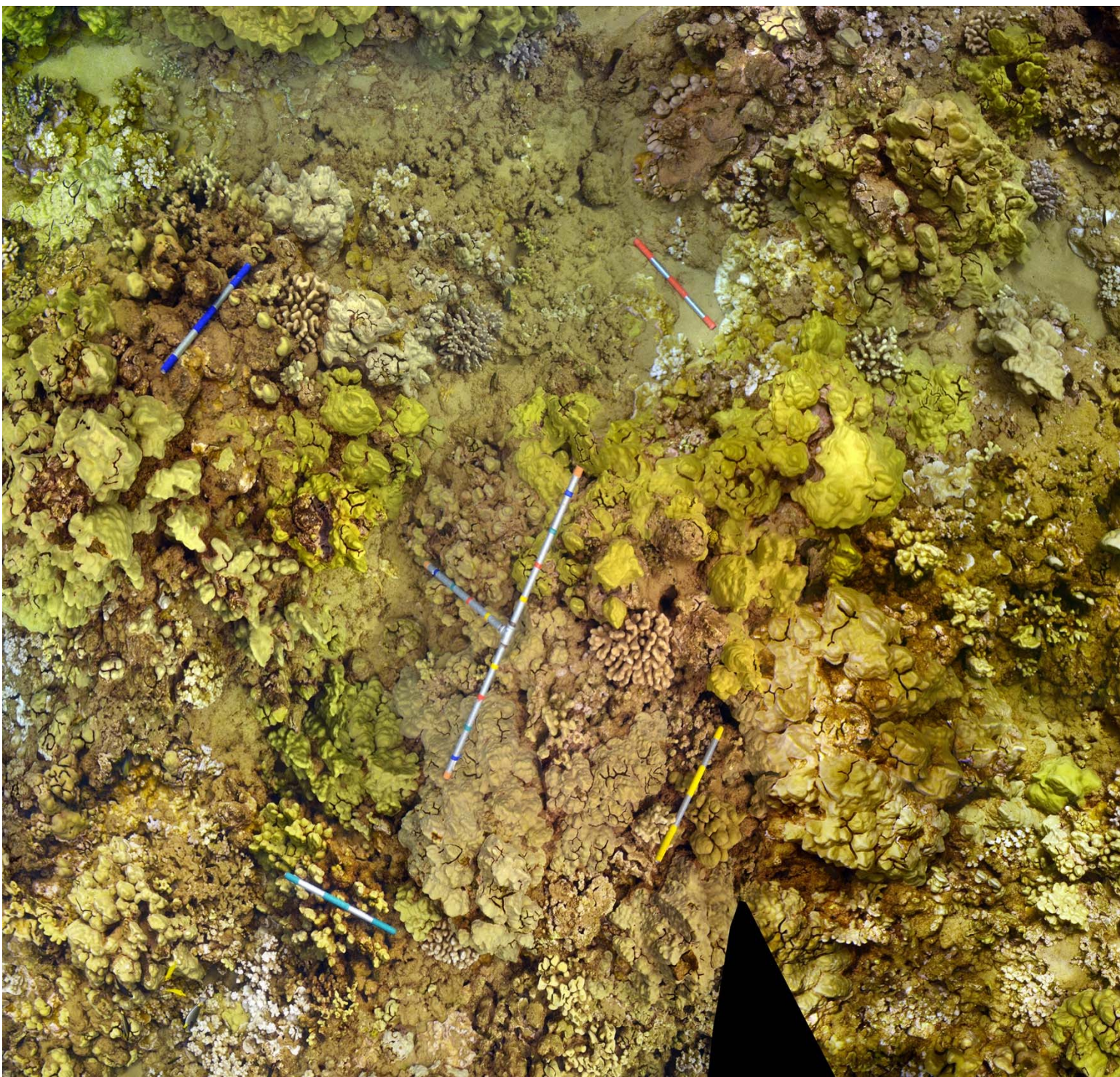


EXHIBIT 26. Photomosaic 196 taken in Inner Shallow Aggregate Reef Zone.



EXHIBIT 27. Photomosaic 192 taken in Outer Shallow Aggregate Reef Zone.



EXHIBIT 28. Photomosaic 157 taken in Inner Outer Aggregate Reef Zone.

EXHIBIT 30. Error analysis rates (%) for coral, turf, and crustose coralline algae (CCA) in benthic habitat maps of Kahekili reef. To read a matrix, the intersection value for an actual class (columns) and a predicted class (rows) represents the percentage accuracy of that class. For example, pixels that are actually "20 < coral ≤ 30" are incorrectly predicted to be "10 < coral ≤ 20" 2.4% of the time. Pixels that are actually "20 < coral ≤ 30" are correctly predicted to be "20 < coral ≤ 30" 95.2% of the time. Shaded values indicate correct analysis rates of each category. The overall accuracy of the classification is 95.7% indicating that the remote sensing maps are a good representation of the reef. At the least, the maps clearly demonstrate the zonation in benthic community structure.

		ACTUAL CORAL COVER									
		coral = 0	0 < coral ≤ 10	10 < coral ≤ 20	20 < coral ≤ 30	30 < coral ≤ 40	40 < coral ≤ 50	50 < coral ≤ 60	60 < coral ≤ 70	70 < coral ≤ 80	80 < coral ≤ 90
PREDICTED CORAL COVER	coral = 0	98.1	1.4	0	0	0	0	0	0	0	0
	0 < coral ≤ 10	1.2	97.6	0.7	0.6	0	0.4	0	0	0	0
	10 < coral ≤ 20	0	0.3	96.6	2.4	0	1.1	0	0	0	0
	20 < coral ≤ 30	0.8	0.7	2.1	95.2	1.4	1.1	0	0	0	0
	30 < coral ≤ 40	0	0	0	0.6	95.7	0	1	0	0	0
	40 < coral ≤ 50	0	0	0.7	1.2	2.9	95	2.4	5	0	0
	50 < coral ≤ 60	0	0	0	0	0	0.7	94.7	0	3.8	0
	60 < coral ≤ 70	0	0	0	0	0	1.1	1	95.0	0	0
	70 < coral ≤ 80	0	0	0	0	0	0	1	0	96.2	0
80 < coral ≤ 90	0	0	0	0	0	0.7	0	0	0	100	

		ACTUAL TURF COVER								
		10 < turf ≤ 20	20 < turf ≤ 30	30 < turf ≤ 40	40 < turf ≤ 50	50 < turf ≤ 60	60 < turf ≤ 70	70 < turf ≤ 80	80 < turf ≤ 90	90 < turf ≤ 100
PREDICTED TURF COVER	10 < turf ≤ 20	100	0	0	0.7	0	0	0	0	0
	20 < turf ≤ 30	0	94.8	2.6	0.7	0	0	0	0	0
	30 < turf ≤ 40	0	1.6	94.8	0.4	2.2	0	0	0	0
	40 < turf ≤ 50	0	3.6	2.2	95.7	0	0	0.5	0	0
	50 < turf ≤ 60	0	0	0.4	0.7	88.9	0.6	0.5	0	0
	60 < turf ≤ 70	0	0	0	0.7	4.4	97.1	1.5	0.7	0.9
	70 < turf ≤ 80	0	0	0	0.7	4.4	1.8	96.9	0	0.3
	80 < turf ≤ 90	0	0	0	0.4	0	0	0.5	98.6	0.6
	90 < turf ≤ 100	0	0	0	0	0	0.6	0	0.7	98.2

		ACTUAL CCA COVER			
		CCA = 0	0 < CCA ≤ 10	10 < CCA ≤ 20	20 < CCA ≤ 30
PREDICTED CCA COVER	CCA = 0	96.7	0.6	0	0
	0 < CCA ≤ 10	3.3	98.8	8.2	0
	10 < CCA ≤ 20	0	0.6	91.8	4.3
	20 < CCA ≤ 30	0	0.1	0	95.7

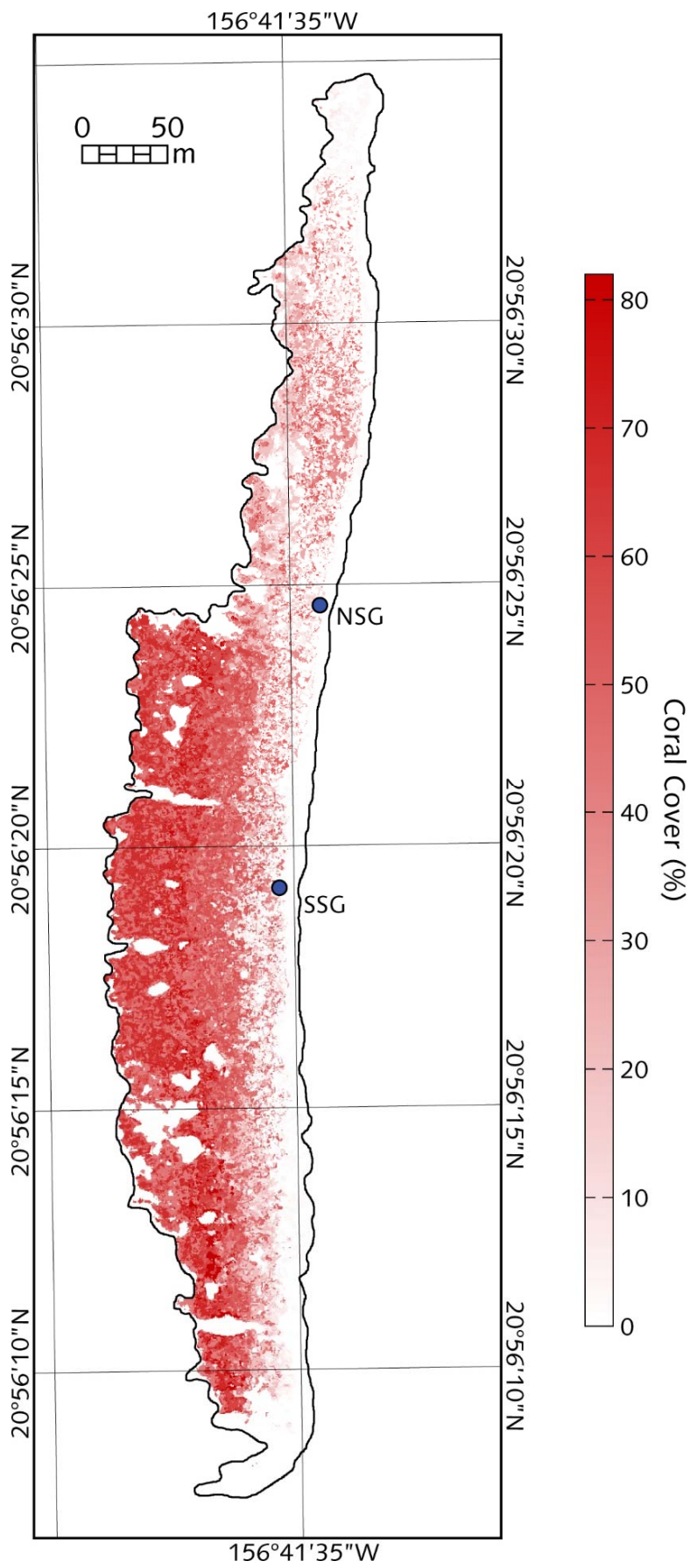


EXHIBIT 31. Remote sensing map created from photomosaic data showing percentage cover of living corals on Kahekili reef. Locations of North Seep Group (NSG) and South Seep Group (SSG) are also shown. Note that coral cover is uniformly low in the nearshore pavement zone where the seeps occur along the entire length of the reef.

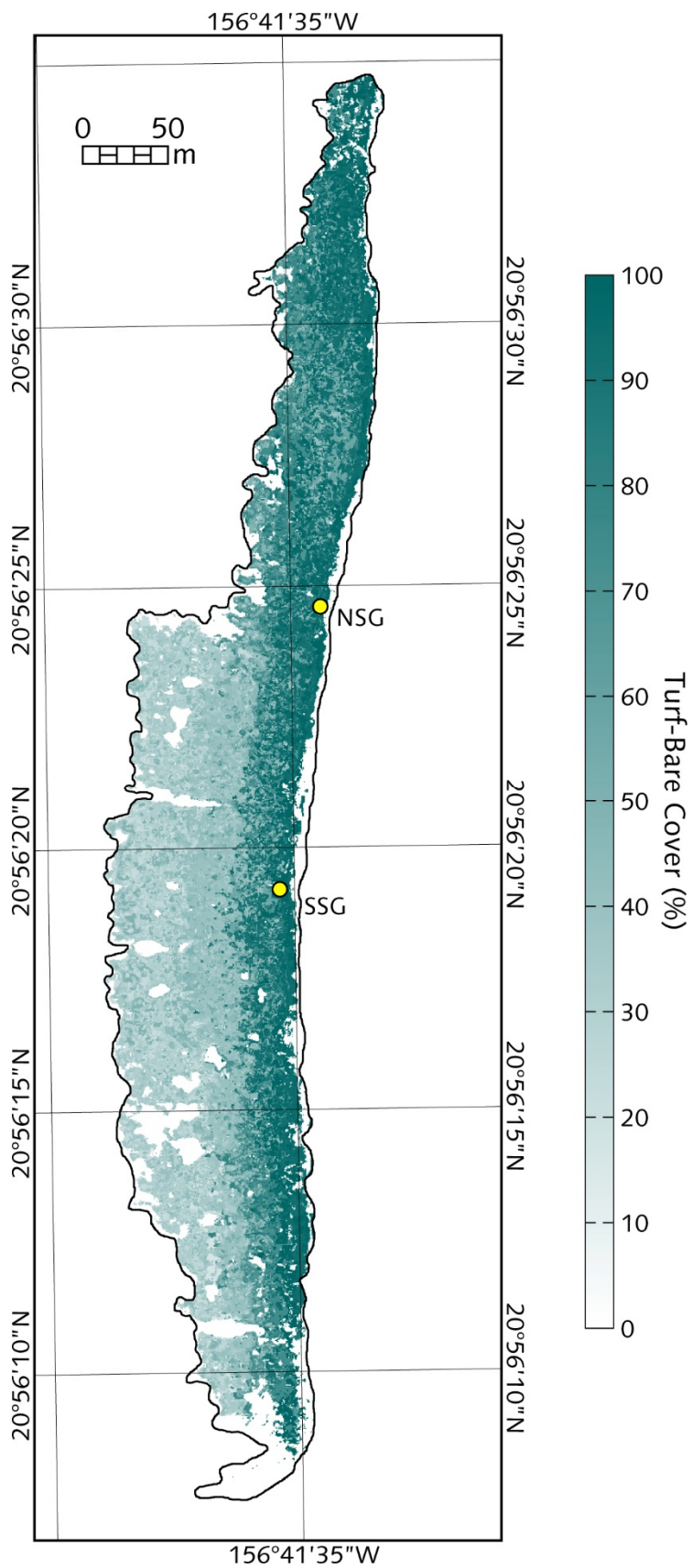


EXHIBIT 32. Remote sensing map created from photomosaic data showing percentage cover of turf algae and bare bottom on Kahekili reef. Locations of North Seep Group (NSG) and South Seep Group (SSG) are also shown. Note that turf-bare cover is uniformly high in the nearshore pavement zone where the seeps occur along the entire length of the reef.

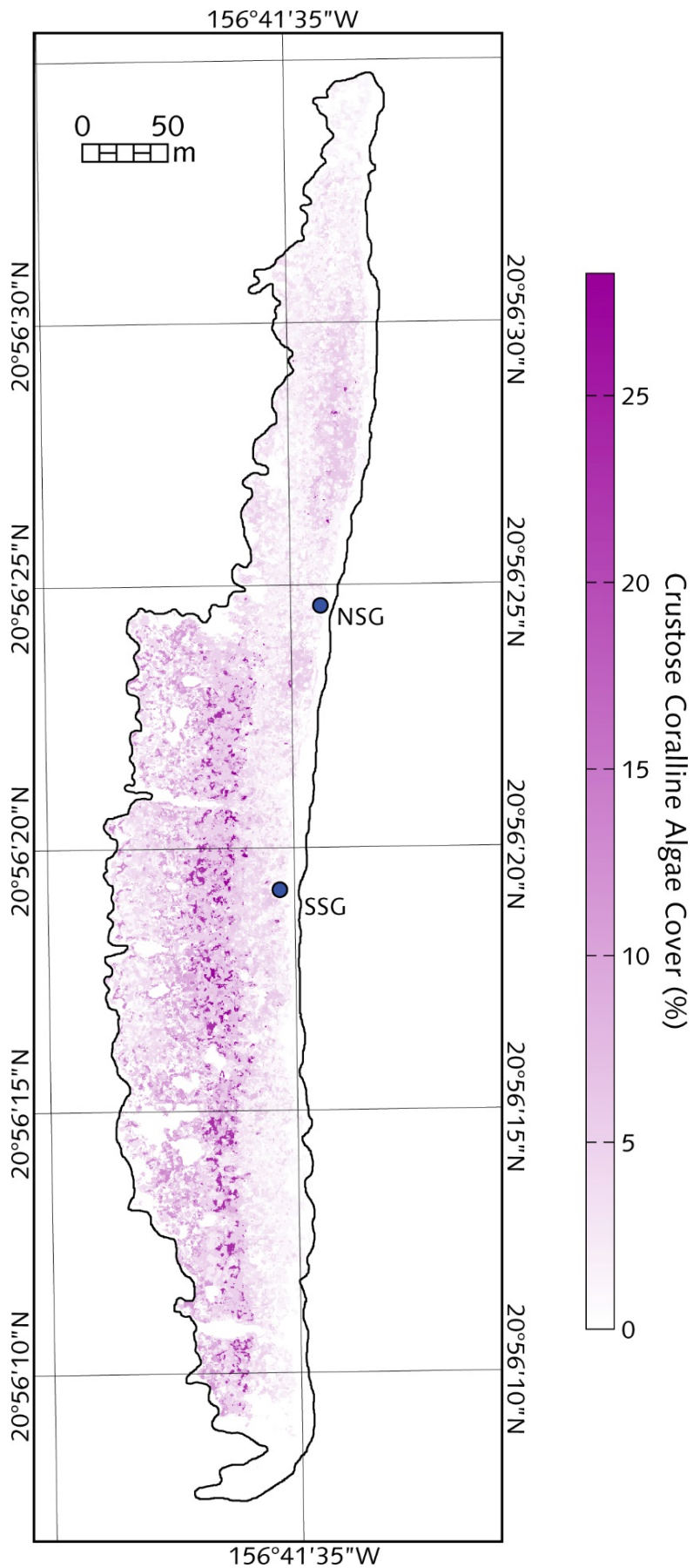


EXHIBIT 33. Remote sensing map created from photomosaic data showing percentage cover of crustose coralline algae (CCA) on Kahekili reef. Locations of North Seep Group (NSG) and South Seep Group (SSG) are also shown. Note that the pattern of CCA cover shows no gradients of abundance with respect to location of seeps along the entire length of the reef.

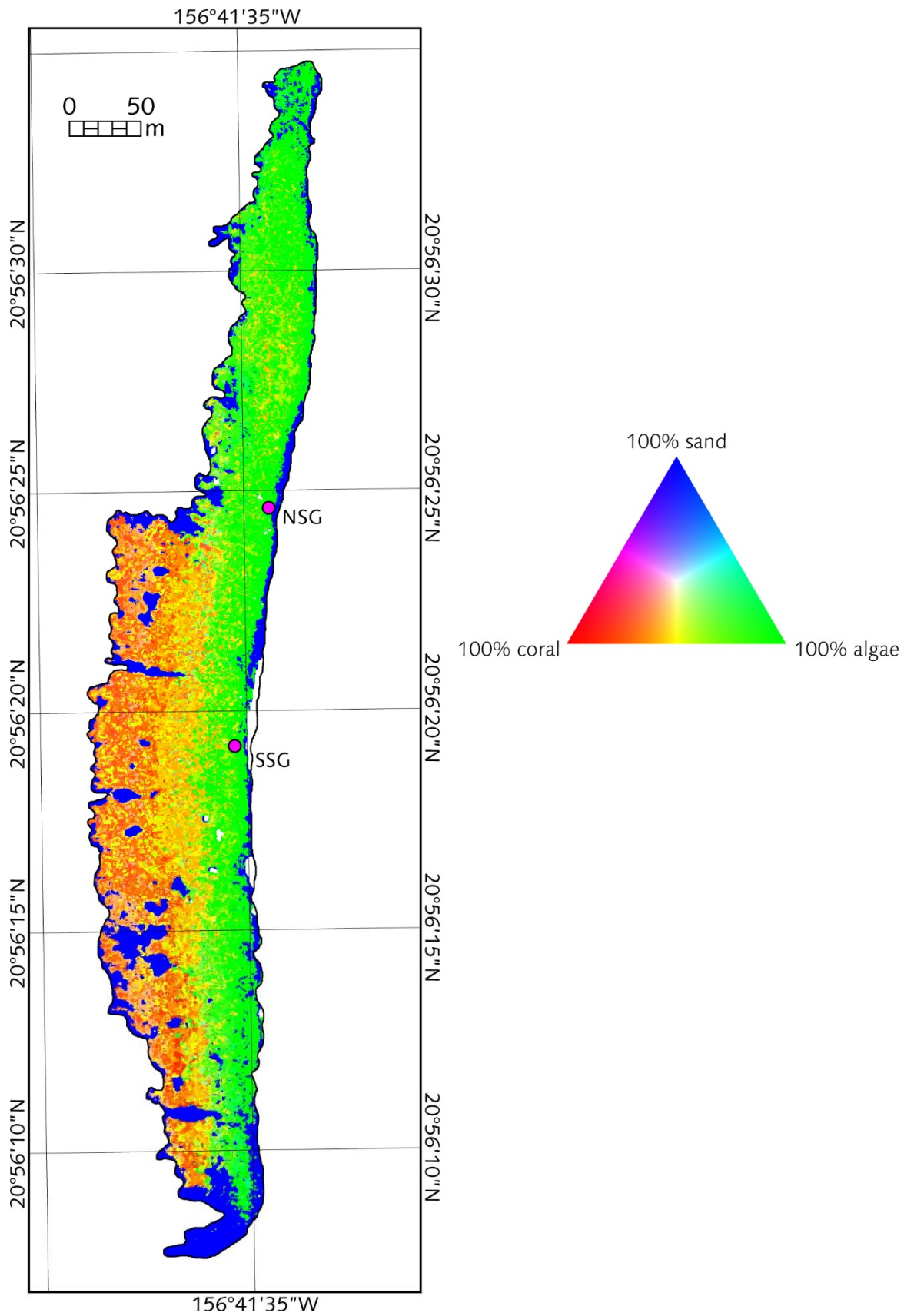


EXHIBIT 34. Tri-modal benthic cover map showing relationships between coral, algae and sand benthic cover created from photomosaic data. The map shows distinct zonation of bottom cover as a function of distance from shore, with high algae cover dominating the nearshore zone along the sandy shoreline. Locations of North Seep Group (NSG) and South Seep Group (SSG) are also shown. Note that the pattern of benthic cover shows no gradients of abundance with respect to location of seeps along the entire length of the reef.

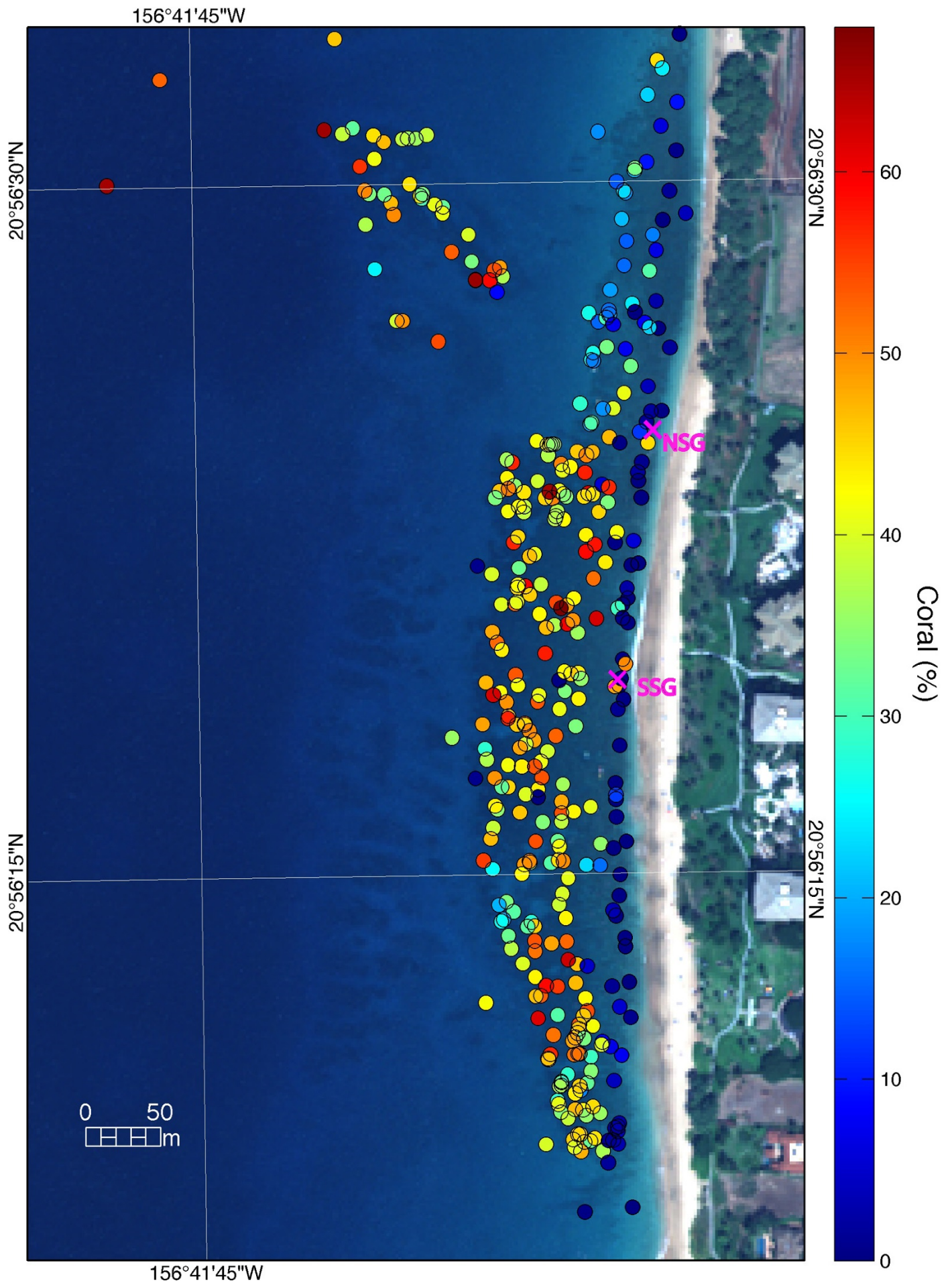


EXHIBIT 35. Satellite image of Kahekili reef showing locations of CRED survey transects color coded by abundance of coral cover. Locations of North Seep Group (NSG) and South Seep Group (NSG) are shown as magenta "X's.

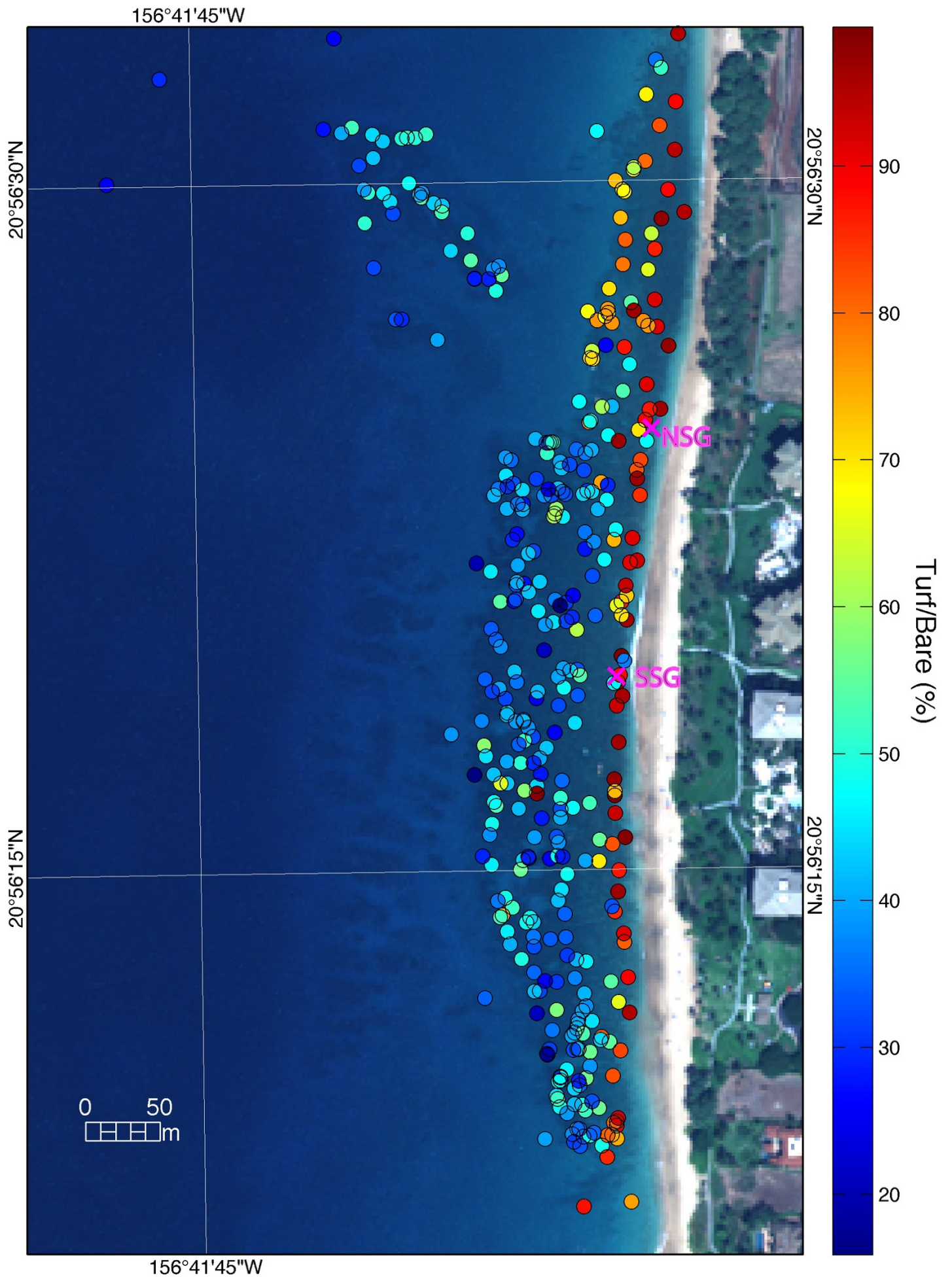
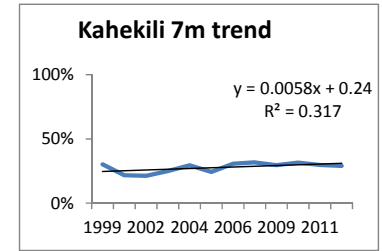
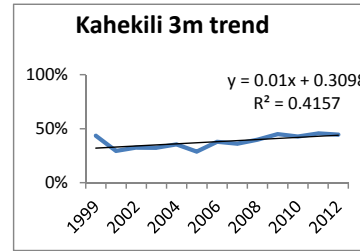
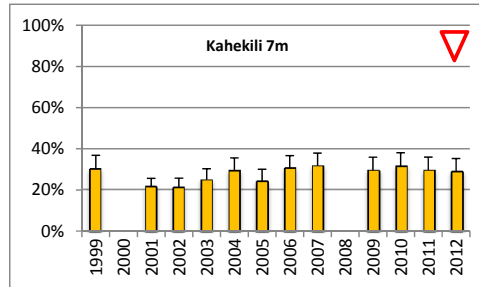
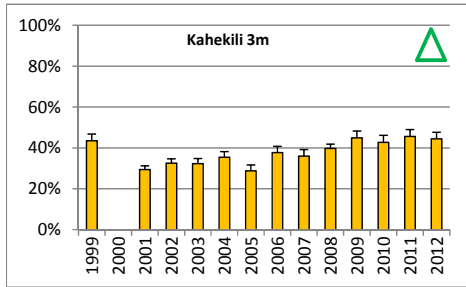


EXHIBIT 36. Satellite image of Kahekili reef showing locations of CRED survey transects color coded by abundance of turf-bare benthic cover. Locations of North Seep Group (NSG) and South Seep Group (SSG) are shown as magenta "X's".



Site	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
MaKah03	43.52%	0.00%	29.40%	32.53%	32.33%	35.49%	28.80%	37.76%	36.02%	39.79%	44.93%	42.77%	45.62%	44.48%
MaKah03st	0.03	0.00	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
MaKah07	30.16%	0.00%	21.65%	21.21%	24.96%	29.34%	24.28%	30.62%	31.69%	0.00%	29.50%	31.50%	29.60%	29.02%
MaKah07st	0.07	0.00	0.04	0.05	0.05	0.06	0.06	0.06	0.06	0.00	0.06	0.07	0.06	0.06

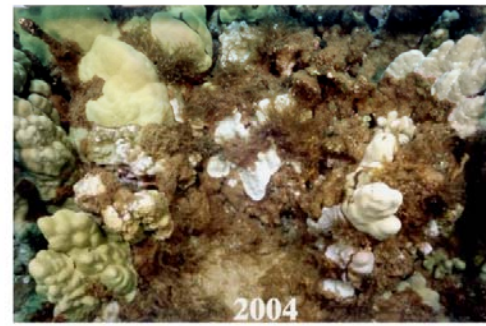
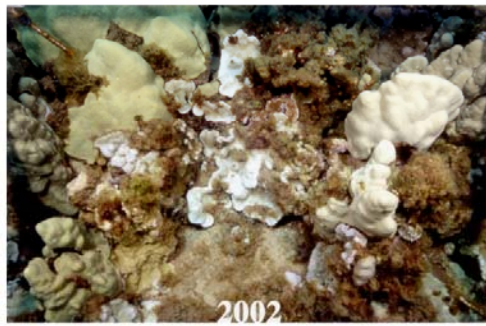
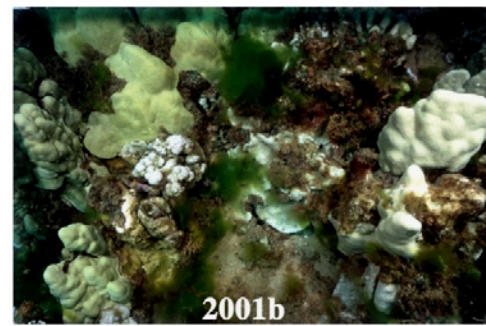
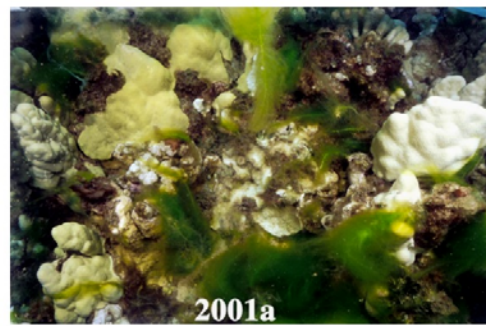
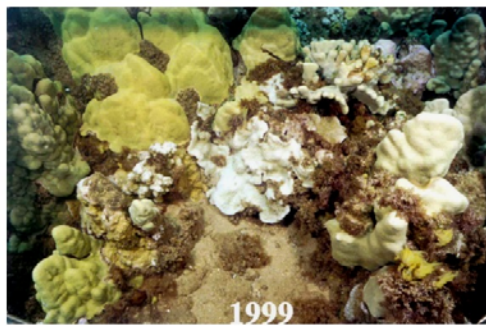
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
MaKah03	1	58.29%	0.00%	39.73%	42.35%	43.20%	46.33%	42.00%	52.40%	56.40%	31.67%	52.00%	44.40%	50.40%	57.09%
MaKah03	2	40.89%	0.00%	25.07%	29.18%	25.60%	32.31%	18.40%	26.00%	26.91%	30.18%	32.36%	33.82%	40.73%	37.20%
MaKah03	3	48.31%	0.00%	31.47%	40.75%	40.93%	46.00%	37.60%	48.80%	37.09%	46.91%	48.40%	47.67%	57.20%	50.55%
MaKah03	4	46.80%	0.00%	22.13%	32.47%	31.47%	30.00%	23.60%	31.20%	29.09%	43.27%	40.33%	28.73%	28.73%	28.73%
MaKah03	5	21.22%	0.00%	28.27%	20.82%	22.93%	20.92%	15.20%	29.60%	21.33%	34.67%	33.50%	36.00%	32.36%	35.64%
MaKah03	6	49.18%	0.00%	33.87%	36.12%	32.00%	38.91%	30.40%	41.20%	34.50%	47.20%	58.18%	54.55%	42.80%	49.09%
MaKah03	7	40.11%	0.00%	21.60%	26.82%	26.00%	27.67%	33.60%	32.00%	33.09%	37.60%	41.33%	45.82%	49.09%	39.60%
MaKah03	8	43.42%	0.00%	26.53%	29.38%	23.87%	36.67%	20.80%	34.00%	35.64%	47.64%	45.82%	41.45%	48.36%	48.00%
MaKah03	9	34.74%	0.00%	30.93%	29.60%	35.20%	31.33%	29.60%	32.80%	40.00%	41.09%	34.55%	32.00%	42.55%	38.91%
MaKah03	10	52.21%	0.00%	34.40%	37.76%	42.13%	44.73%	36.80%	49.60%	46.18%	37.67%	62.80%	63.27%	64.00%	60.00%
MaKah07	1	43.05%	0.00%	19.20%	21.60%	28.67%	26.00%	19.20%	31.20%	30.91%	0.00%	30.80%	21.82%	18.91%	25.09%
MaKah07	2	37.30%	0.00%	36.27%	35.47%	44.27%	53.60%	41.20%	53.60%	56.80%	0.00%	50.80%	54.91%	64.00%	56.00%
MaKah07	3	6.32%	0.00%	9.33%	3.87%	7.60%	8.36%	8.00%	8.40%	10.40%	0.00%	2.80%	5.82%	5.45%	4.73%
MaKah07	4	26.11%	0.00%	18.00%	18.67%	20.40%	26.91%	21.60%	23.20%	30.40%	0.00%	37.00%	31.00%	24.73%	25.20%
MaKah07	5	35.75%	0.00%	19.73%	20.40%	23.87%	25.33%	24.40%	38.15%	34.40%	0.00%	23.20%	28.00%	33.09%	26.18%
MaKah07	6	3.00%	0.00%	6.67%	3.88%	6.40%	10.55%	5.60%	11.60%	8.40%	0.00%	10.80%	10.91%	12.40%	11.64%
MaKah07	7	63.82%	0.00%	34.13%	38.27%	34.53%	49.45%	39.20%	51.60%	46.40%	0.00%	48.40%	46.55%	46.55%	46.55%
MaKah07	8	58.00%	0.00%	44.53%	45.07%	57.87%	62.91%	62.00%	58.80%	64.80%	0.00%	64.40%	72.73%	57.82%	62.80%
MaKah07	9	17.06%	0.00%	13.47%	15.20%	16.00%	22.00%	14.40%	18.00%	24.40%	0.00%	14.80%	22.55%	15.20%	20.73%
MaKah07	10	11.16%	0.00%	15.20%	9.73%	10.00%	8.33%	7.20%	11.60%	10.00%	0.00%	12.00%	20.73%	17.82%	11.27%

EXHIBIT 37. CRAMP data for Kahekili 3m and 7m sites (1999-2012).

EXHIBIT 38. Maui CRAMP sites showing depth, legal status (O=open, PP=partially protected, NT=no take), number of years surveyed, coral cover regression slope over the years surveyed (negative slope indicates decline). Bold p indicates statistically significant trend over the study period. Surveys were conducted from 1999-2012. Yellow highlights indicate results from two transects at Kahekili Beach, which showed increases at both depths, and a statistically significant increase at the 3 m station.

From: Unpublished manuscript: "Temporal Change in Hawaiian Coral Reefs; Hawai'i Coral Reef Assessment and Monitoring Program: Over a Decade of Change in Spatial and Temporal Dynamics in Coral Reef Communities (undated)." Ku'ulei S. Rodgers, Paul L. Jokiel, Eric K. Brown, Skippy Hau, and Russell Sparks.

MAUI SITE	Depth (m)	Legal Status	# Yrs Surveyed	Slope	p
Honolua North	3	NT	14	-0.48	0.035
Honolua South	3	NT	14	-1.64	<0.001
Kanahena Bay	1	NT	12	1.06	0.001
Kanahena Bay	3	NT	12	1.06	0.001
Kahekili	3	O	13	0.90	0.006
Kahekili	7	O	12	0.47	0.114
Kanahena Point	3	NT	13	-0.37	0.011
Kanahena Point	10	NT	13	-1.79	<0.001
Ma'alaea	3	O	12	-0.84	<0.001
Ma'alaea	6	O	12	-0.56	<0.001
Mahinahina	3	O	6	-0.27	0.807
Mahinahina	10	O	7	-0.25	0.656
Molokini	8	NT	13	0.15	0.600
Molokini	13	NT	13	-0.05	0.721
Olowalu	3	O	14	-0.37	0.212
Olowalu	7	O	14	-0.04	0.997
Papaula	4	O	13	-1.08	<0.001
Papaula	10	O	13	-4.28	<0.001
Puamana	3	O	12	-0.02	0.99
Puamana	13	O	14	0.09	0.282



Sparks 000199

EXHIBIT 39. Time-course photographs of same quadrat from CRAMP surveys at Kahekili, West Maui. Photographs provided by Russell Sparks. No information is provided as to the transect location of the photo-quadrats.

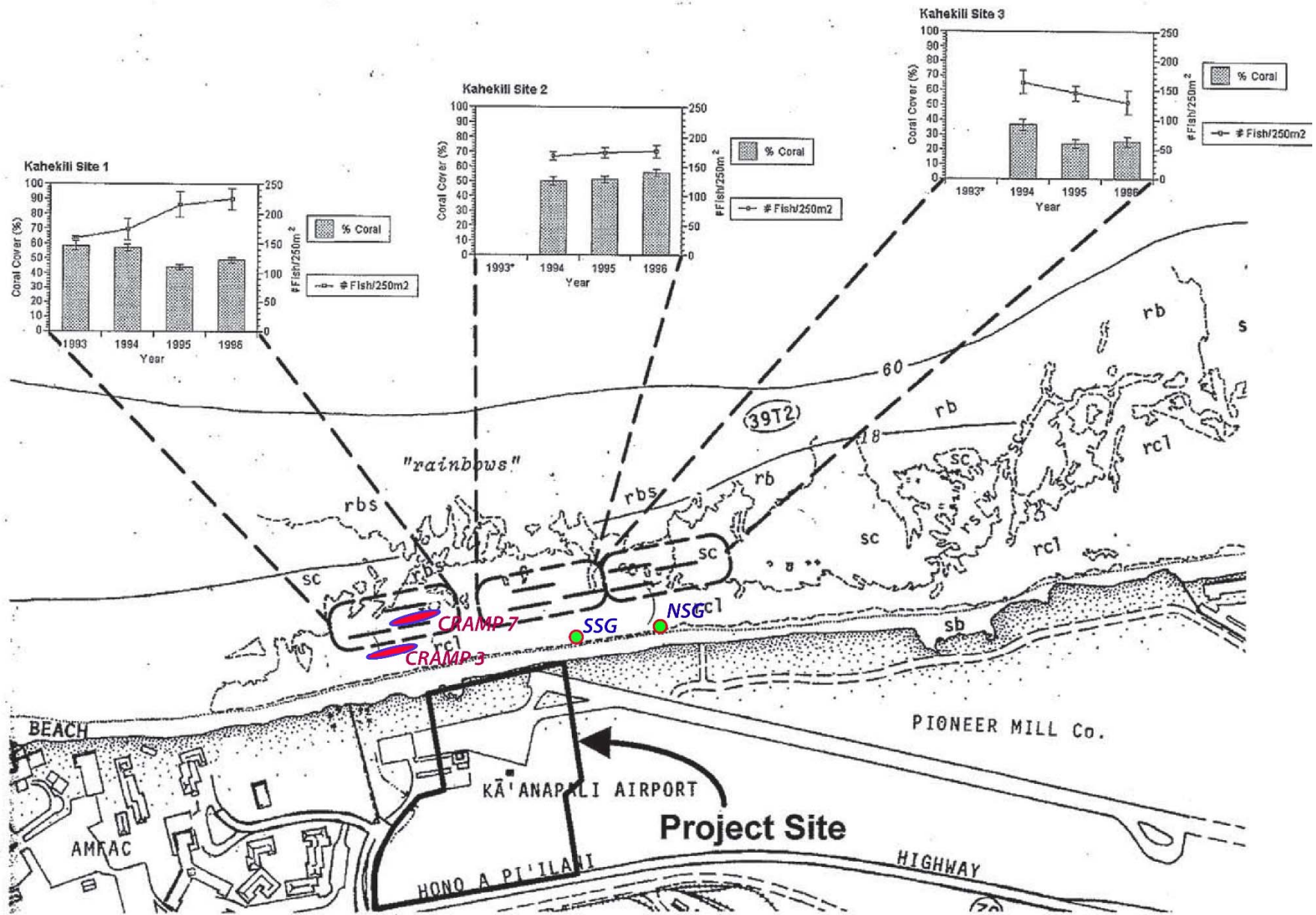


Figure 1: Temporal changes in percent coral coverage and fish density (#/250m²) at selected sites along North beach (Error bars are \pm 1SE). * = Not surveyed in 1993.

EXHIBIT 40. Figure 1 from Pacific Whale Foundation Coral Reef Monitoring Report showing locations of three survey sites at Kahekili Park. Also shown are plots of mean coral cover from 3 transects at each site. Superimposed on map are locations of CRAMP 3m and 7m survey sites, and locations of North and South Seep Groups (NSG, SSG).

EXHIBIT 41. Summary table of coral cover data from Pacific Whale Foundation benthic monitoring program showing results from surveys at three Kahekili stations (from "Saving Maui's Reefs" E. K. Brown. Pacific Whale Foundation, undated). Lower table shows average values of % coral cover at each Kahekili site and average of all sites during each year.

Table 2: Coral coverage (%) at our long term monitoring sites from 1989 to 1998 using identical transect locations (N=number of quadrat samples).

Survey Site	1989†	1991†	1992†	1993†	1994	1995	1996	1997	1998
Honolua Bay - South	38.4	38.8	35.0	24.4	42.0	43.5	36.9	33.5	27.9
N	14	9	16	71	77	72	119	68	89
Honolua Bay - North	63.5	53.9	56.0	46.8	43.9	34.9	26.9	28.7	23.5
N	15	11	12	72	69	111	128	85	99
Puamana - Offshore	*	11.7	12.6	0.9	1.25	0.8	0.3	0.3	1.2
N		11	16	63	77	93	68	37	73
Puamana - Nearshore	*	*	*	*	4.2	7.2	6.3	10.4	12.5
N					24	72	56	44	100
Olowalu - Offshore	*	34.5	34.9	27.6	33.1	28.7	30.4	29.2	20.8
N		32	30	53	62	58	92	81	59
Olowalu - Nearshore	*	*	*	*	30.8	29.6	23.3	28.4	30.1
N					68	91	74	60	68
Kahekili-Park Front Site 1	*	*	*	58.6	57.1	44.1	50.6	51.7	49.6
N				20	69	94	83	63	67
Kahekili-Treatment Site 2	*	*	*	*	50.0	51.3	56.2	57.4	56.4
N					61	72	84	61	49
Kahekili-Treatment Site 3	*	*	*	*	36.7	23.8	25.1	31.5	32.7
N					52	67	68	28	34

* These sites were not sampled for coral cover during the year indicated.

† Only transects 1 and 4 were sampled during this year.

	YEAR						
	93	94	95	96	97	98	AVE.
SITE 1	58.6	57.1	44.1	50.6	51.7	40.6	50.5
SITE 2	-	50.0	51.3	56.2	57.4	56.4	54.3
SITE 3	-	36.7	23.8	25.1	31.5	32.7	30.0
AVE.	58.6	47.9	39.7	44.0	46.9	43.2	44.9

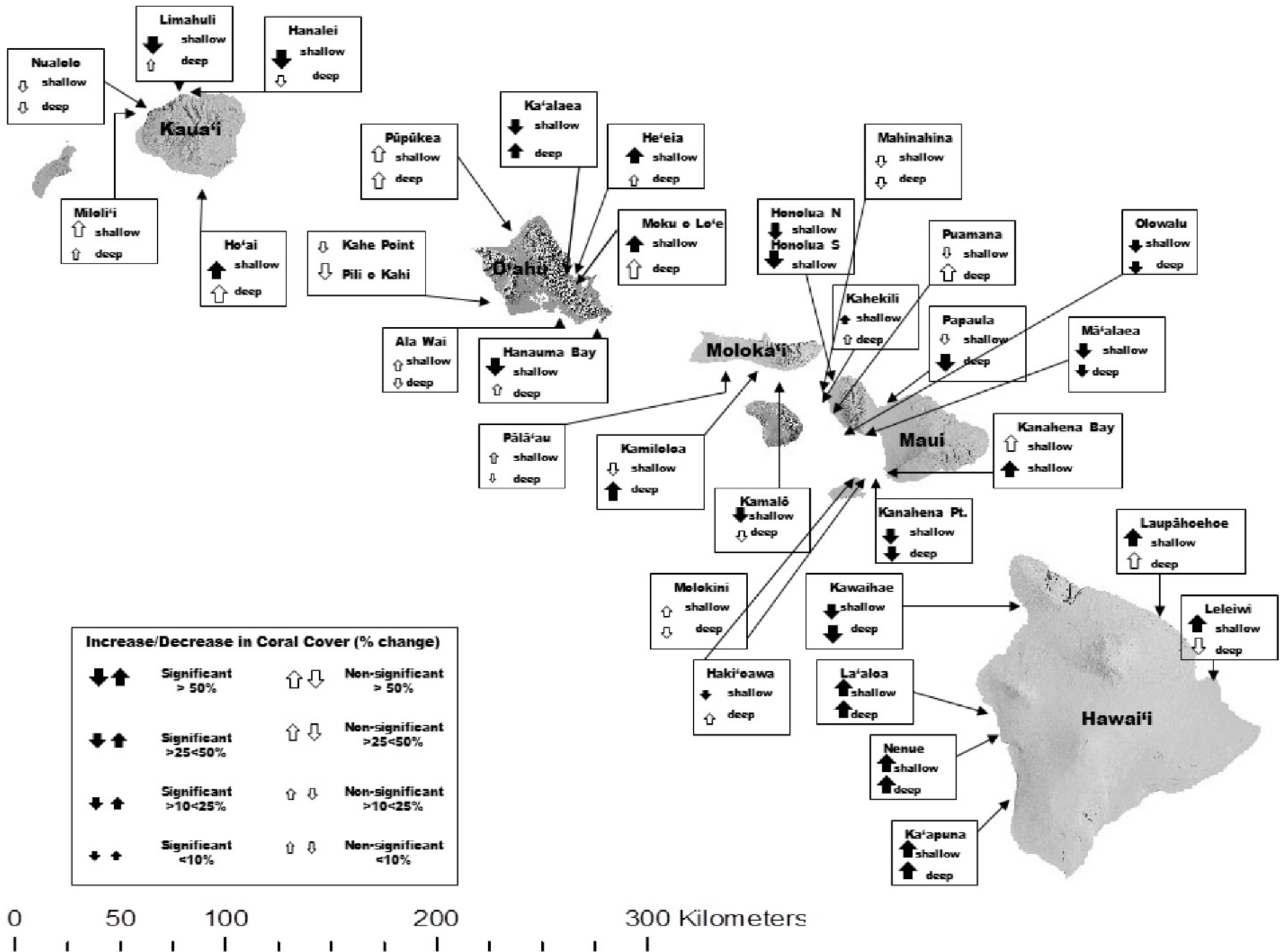


EXHIBIT 42. Statewide Coral Reef Assessment and Monitoring (CRAMP) stations showing change in coral cover and statistical significance from 1999/2000 to 2012. From "Temporal Change in Hawaiian Coral Reefs, Hawaii Coral Reef Assessment and Monitoring Program: Over a Decade of Change in Spatial and Temporal Dynamics in Coral Reef Communities." Rogers, K.S., P.L. Jokiel, E.K. Brown, S. Hau and R. Sparks. Undated manuscript.

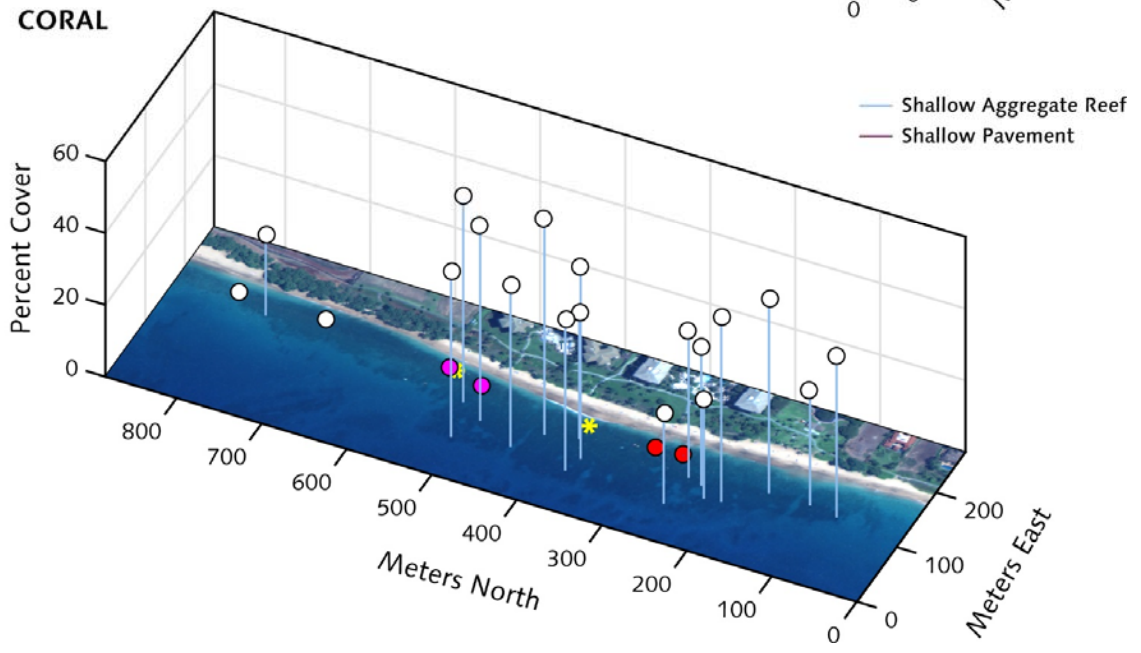
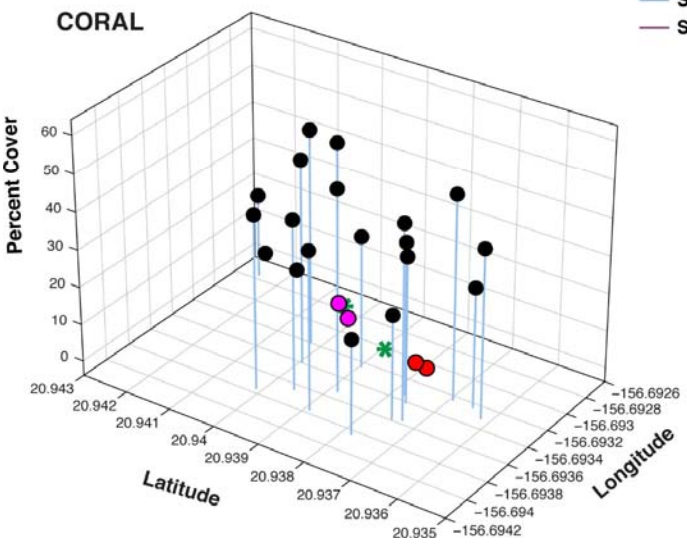
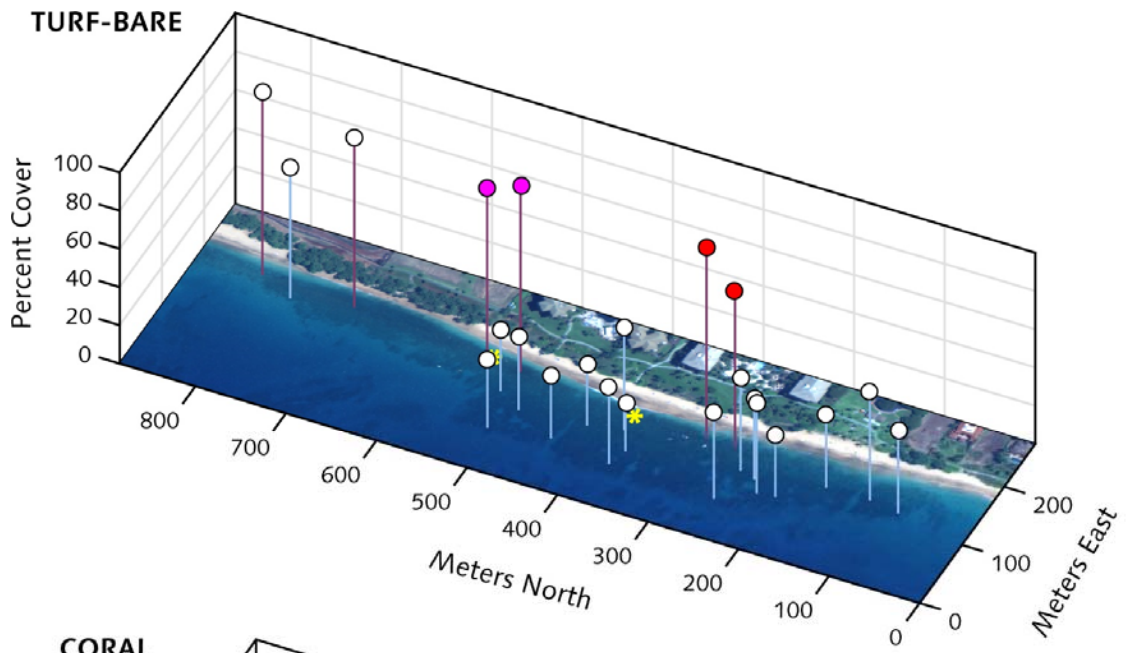
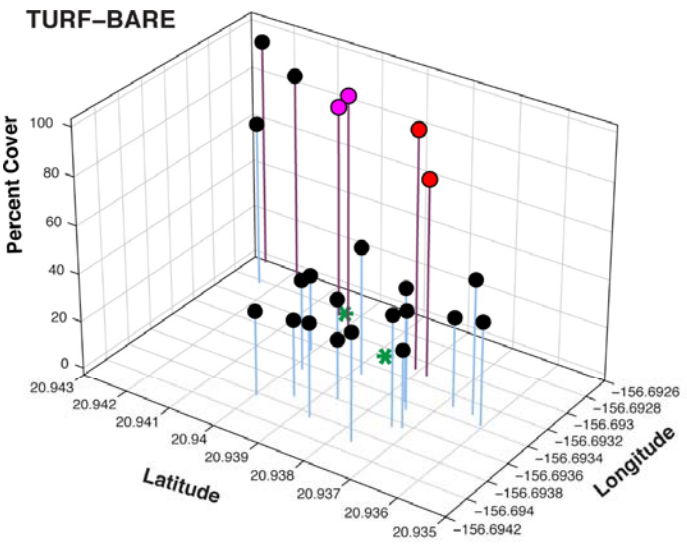
EXHIBIT 43. Tables showing correlation coefficients of CRED benthic cover and distance to nearest seep (top) and distance to shore (bottom). Asterisks (*) indicate significance of correlation ($p < 0.05$). From Hochberg (2014).

Table 4. Correlation coefficient (r) for benthic cover and distance to nearest seep for each bottom-type in each survey round. Asterisks (*) indicate statistical significance of the correlation ($p < 0.05$).

	KA0801	KA0808	KA0909	KA1009	KA1103	KA1109	KA1204	KA1209	KA1304	KA1309	KA1404
Cyanobacteria	0.19	0.13	0.30	0.03	-0.02	-0.13	-0.25	0.46*	0.48*	0.00	-0.12
CCA	-0.32*	-0.04	-0.11	0.11	-0.19	-0.19	0.06	-0.03	-0.03	-0.08	0.33
Encr. Macro.	0.32*	-0.21	-0.16	0.36	-0.15	-0.14	-0.21	-0.10	-0.12	-0.26	0.30
Coral	0.04	-0.01	0.11	-0.21	-0.35*	0.00	0.17	0.23	0.13	0.14	-0.06
Macroalgae	0.37*	0.10	0.15	0.08	0.05	-0.25	-0.28	0.01	-0.09	-0.19	0.18
Sand	0.06	0.22	-0.07	0.22	0.41*	-0.08	-0.12	-0.06	0.01	-0.17	-0.17
Sessile Invert.	0.02	-0.05	0.13	-0.18	-0.20	0.55*	0.28	-0.19	-0.28	0.34	-0.08
Turf-Bare	-0.06	-0.14	-0.07	0.00	0.04	0.16	-0.06	-0.22	-0.13	0.05	0.05

Table 5. Correlation coefficient (r) for benthic cover and distance to shore for each bottom-type in each survey round. Asterisks (*) indicate statistical significance of the correlation ($p < 0.05$).

	KA0801	KA0808	KA0909	KA1009	KA1103	KA1109	KA1204	KA1209	KA1304	KA1309	KA1404
Cyanobacteria	0.14	0.31	0.04	0.06	0.25	0.27	0.12	-0.19	0.39	0.15	-0.21
CCA	-0.12	0.08	0.08	0.11	0.29	0.22	0.16	0.42*	0.29	0.34	0.17
Encr. Macro.	-0.15	0.15	0.39*	0.22	0.28	0.31	0.63*	0.44*	0.41	0.41*	0.37
Coral	0.27	0.59*	0.63*	0.43*	0.49*	0.71*	0.74*	0.72*	0.64*	0.69*	0.64*
Macroalgae	-0.09	0.34	0.39*	0.42*	0.29	0.14	0.33	0.20	-0.32	0.21	-0.16
Sand	0.18	-0.10	0.23	-0.05	-0.12	0.01	0.04	-0.05	0.49*	0.23	0.01
Sessile Invert.	-0.20	-	0.20	-0.15	0.04	0.10	0.04	-0.09	-	-	-0.29
Turf-Bare	-0.42*	-0.58*	-0.69*	-0.43*	-0.49*	-0.70*	-0.79*	-0.68*	-0.79*	-0.76*	-0.64*



— Shallow Aggregate Reef
— Shallow Pavement

— Shallow Aggregate Reef
— Shallow Pavement

EXHIBIT 44. Two redrawn versions of Exhibit 8 of Dr. J. Smith’s expert disclosure report (provided by E. Hochberg). Plots on left have added stems to each data point to provide an indication of the location of sampling points. It can be seen that points near the seeps in red and fuschia with high turf-bare cover and low coral cover are located at the lowest longitude, or closest to shore. Overlay of data points on satellite image of Kahekili reef (right) show locations of seeps are closest to the shoreline in the shallow pavement zone. All other sample points are farther offshore.

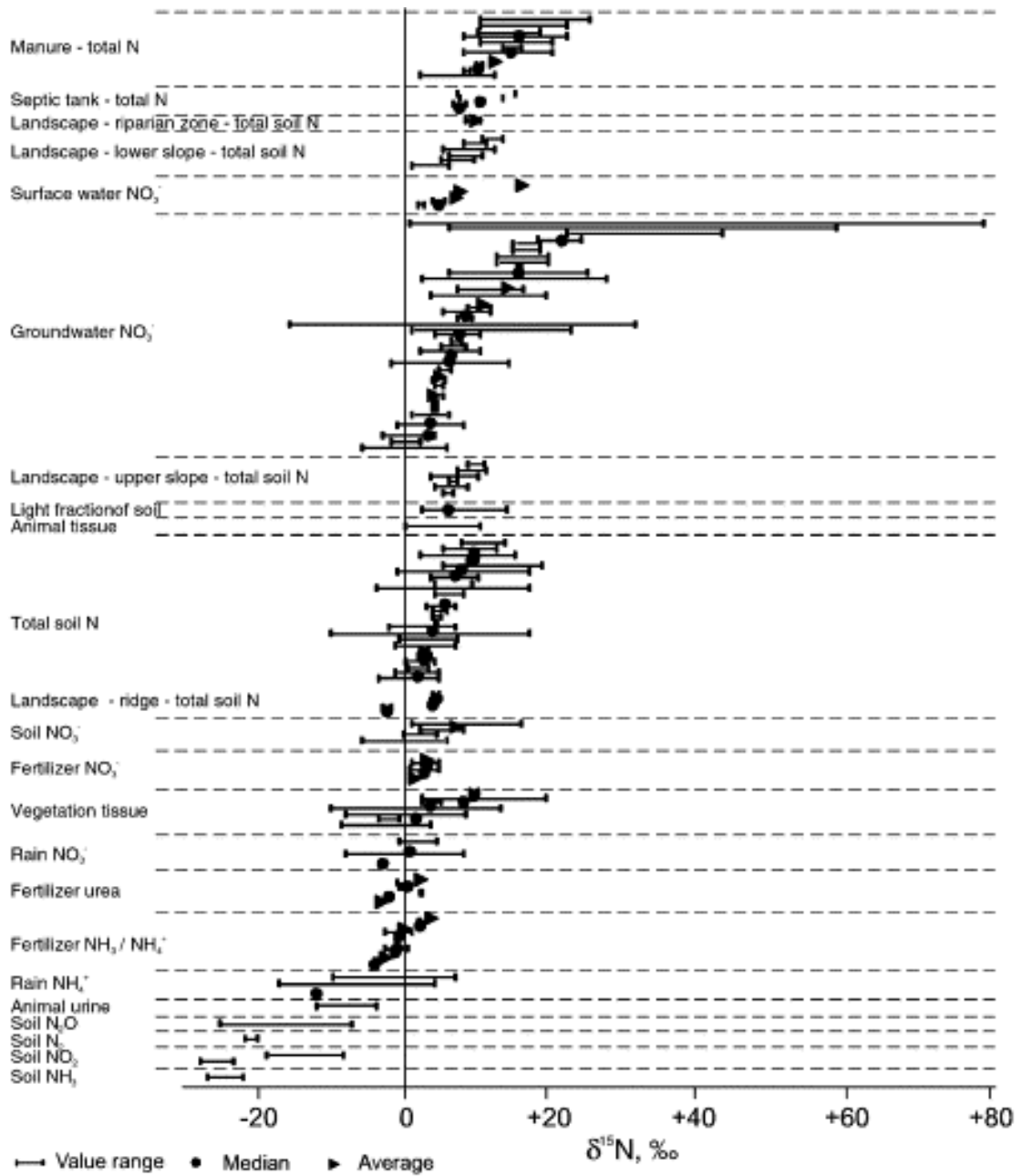


EXHIBIT 45. Range of values of $\delta^{15}\text{N}$ from various sources. From : Bedard-Haughn et. al. 2003. Journal of Hydrology. Tracing ^{15}N through landscapes: potential uses and precautions.



EXHIBIT 46. Area covered across Kahekili Reef during submarine spring survey during Groundwater Tracer Study. The area surveyed is shown in the yellow box of the map insert. Blue dots with white numbers represent the start and end of the transects; the transect widths (in yellow) are directly proportional to the visibility of the scuba divers at the time of the survey. Green dots with numbers represent samples collected from submarine springs, with the exception of 096 and 175, which were from diffuse discharge (Appendix Table A-6 of the Groundwater Tracer Study).