PATTERNS IN DEEP-SEA CORALS: SEAWATER CHEMISTRY DATA REPORT

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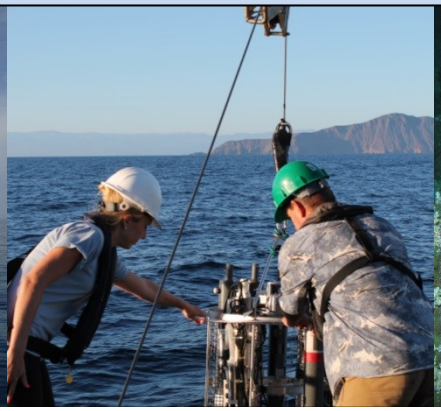
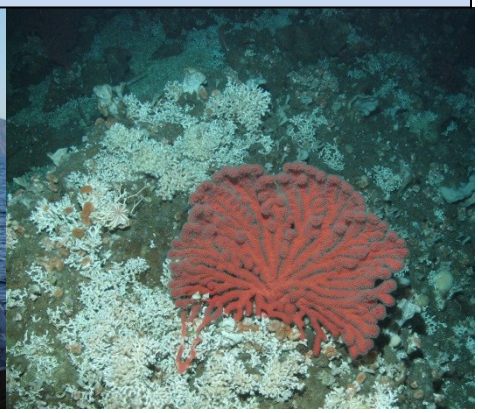

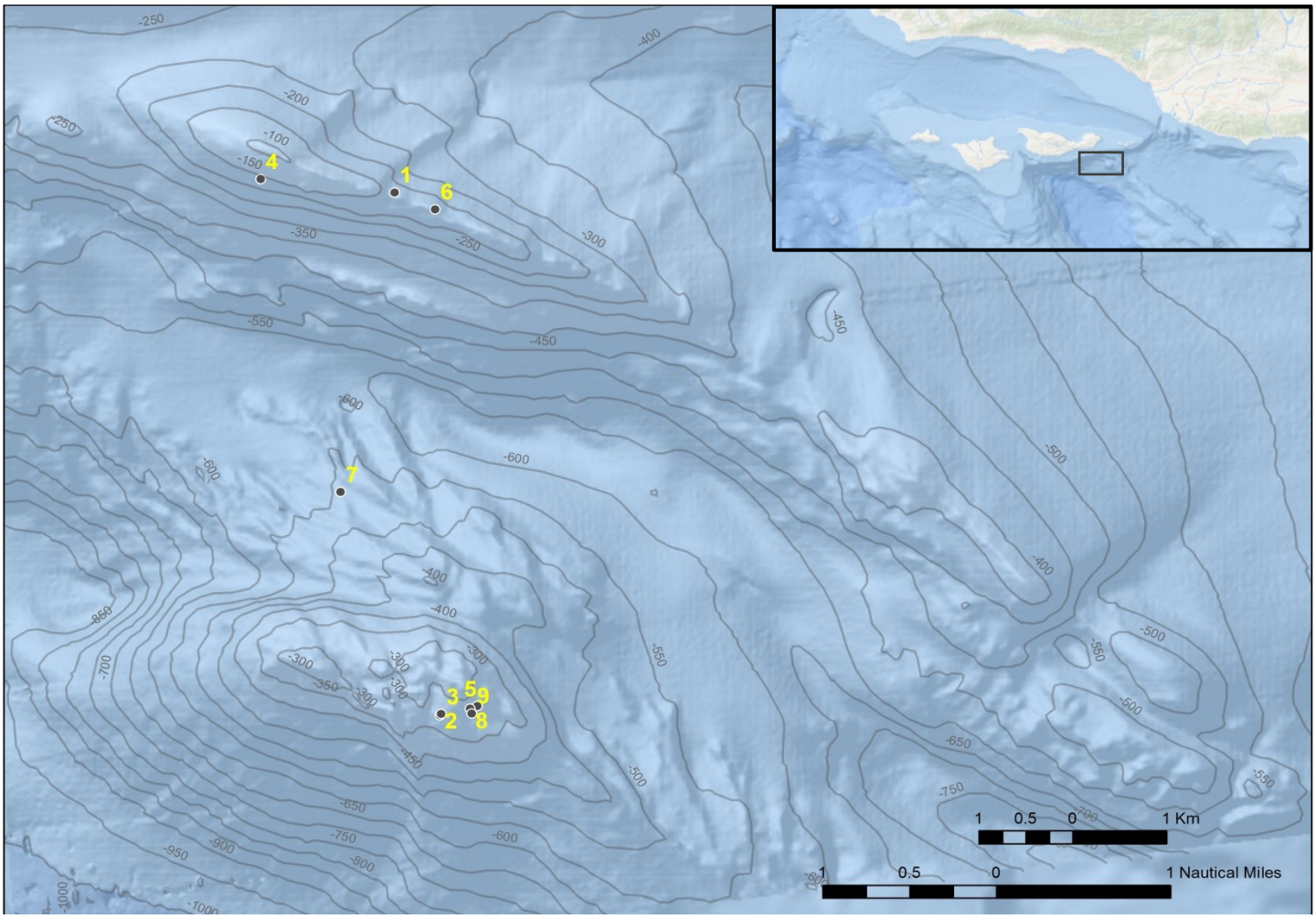

Fig 1. Map of CTD casts in the Channel Islands National Marine Sanctuary from 2014 and 2015

Table 1. Sampling Station Overview

No.	CastID	Date	Place	Start Time	Lat	Long
1	14-08-01.1	August 17 2014	Footprint	8:09 PDT	33.96094	-119.47934
2	14-08-02.1	August 17 2014	Piggy Bank	16:21 PDT	33.91678	-119.47501
3	14-08-02.2	August 17 2014	Piggy Bank	17:15 PDT	33.91691	-119.47487
4	14-08-01.2	August 17 2014	Footprint	18:13 PDT	33.96208	-119.49216
5	15-03-01	March 13 2015	Piggy Bank	21:15 PDT	33.91757	-119.47140
6	15-03-02	March 14 2015	Footprint	18:52 PDT	33.95951	-119.47544
7	15-03-03	March 18 2015	Deep cast	7:41 PDT	33.93566	-119.48450
8	15-08-01.1	August 1 2015	Piggy Bank	17:14 PDT	33.91736	-119.47209
9	15-08-01.2	August 1 2015	Piggy Bank	18:30 PDT	33.91695	-119.47194

Introduction

Between August 2014 and August 2015 three deep-sea coral research cruises were conducted within the Channel Islands National Marine Sanctuary. These surveys included four primary objectives:

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 (March 2015)

2) to make CTD-niskin casts to collect water samples between 50 and 600 meters depth to characterize the seawater chemistry (August 2014, March 2015, August 2015)

3) to characterize deep-water coral and fish assemblages using forward-looking oblique cameras mounted on an ROV (August 2014, March 2015, August 2015); 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 (August 2014, March 2015, August 2015).

This report includes a summary of water sampling data. The primary purpose of water sampling was to assess the aragonite saturation near *Lophelia pertusa* coral habitats in CINMS. Methods were consistent with previous studies (Lipski et al 2011, Yoklavich et al 2011) to support synoptic monitoring of essential fish habitat in deep waters around CINMS. Ship time and ROV operations were provided and/or funded by NOAA's Office of National Marine Sanctuaries and National Centers for Coastal Ocean Science and Marine Applied Research and Exploration (MARE). The CTD rosette in August 2014 was provided by NOAA Southwest Fisheries Science Center, Santa Cruz and in August 2015 by the Valentine laboratory at the University of California Santa Barbara.

Methods

The first of three research cruises took place August 15-18, 2014 aboard the R/V *Shearwater.* There were two casts at each site, one deep and one shallow, to collected seawater samples throughout the water column. The CTD rosette in 2014 included 4 niskin bottles and a Sea-Bird CTD (SBE 19*plus*) with salinity, dissolved oxygen and temperature sensors. The first cast took place the morning of August 17 but CTD operations were suspended due to Naval activity. The final three casts were all completed the evening of August 17. The second research cruise took place March 13-22, 2015. The first and second casts were within close proximity of casts on the 2014 cruise and adjacent to *Lophelia pertusa* aggregations. The third cast targeted deeper water between Footprint and Piggy Bank. The CTD rosette included 12 niskin bottles with a Sea-Bird CTD (SBE 9) with salinity, dissolved oxygen, temperature and fluorescence sensors. The third research cruise took place August 1-4, 2015. There were two casts, one deep and one shallow, taken at the same location as the previous casts on Piggy Bank. The CTD rosette included 6 niskin bottles with a Sea-Bird CTD (SBE 19*plus*) with salinity and temperature sensors.

Water samples were collected according to SOP 1 in Dickson et al. (2007). Samples for total alkalinity were poisoned with a saturated solution of mercuric chloride and stored in 125ml HDPE bottles (Huang et al. 2012). In 2015 most sampling included dissolved inorganic carbon (DIC); seawater was collected in 250ml borosilicate bottles and poisoned with saturated mercuric chloride. Samples for pH were brought to ambient temperature, calibrated against Tris/HCl buffers, and run in duplicate. Total alkalinity was determined by potentiometric titration at NOAA's Center for Coastal Environmental and Biomolecular Research in Charleston, SC. Samples for DIC were analyzed by coulometric titration at NOAA's Pacific Marine Environmental Laboratory. Additional carbonate parameters were calculated in CO2SYS (Pierrot et al. 2006).

Sampling Overview

Project	CINMS Patterns in Deep Sea Corals
Chief Scientist	Peter Etnoyer, NOAA CCEHBR peter.etnoyer@noaa.gov
Purpose	Characterize deep-sea coral communities in the Channel Islands National Marine Sanctuary and conduct vulnerability assessments of these communities to climate change
Vessel	August 2014: NOAA CINMS R/V *Shearwater* March 2015: NOAA FSV *Bell M. Shimada* August 2015: NOAA CINMS R/V *Shearwater*
Water chemistry scientist	Leslie Wickes, JHT, Inc., NOAA CCEHBR leslie.wickes@noaa.gov
CTD Sensors	August 2014: temperature, salinity, dissolved oxygen March 2015: temperature, salinity, dissolved oxygen, fluorescence August 2015: temperature, salinity
Data Analysts	Leslie Wickes
Date Compiled	April 2016

CTD CAST 14 08 01.1 *STUDY AREA: FOOTPRINT*

Date	17 August 2014
Maximum Bottom Depth (m)	190
Start Cast Time (PDT)	8:09 PDT
Latitude (N)	33.96094
Longitude (W)	-119.47934

CTD Data

Cast Depth (m)	184
Temperature (°C) Min/Max:	9.39/20.95
Salinity Min/Max:	32.82/33.98
Oxygen (ml/l) Min/ Max	2.47/6.45

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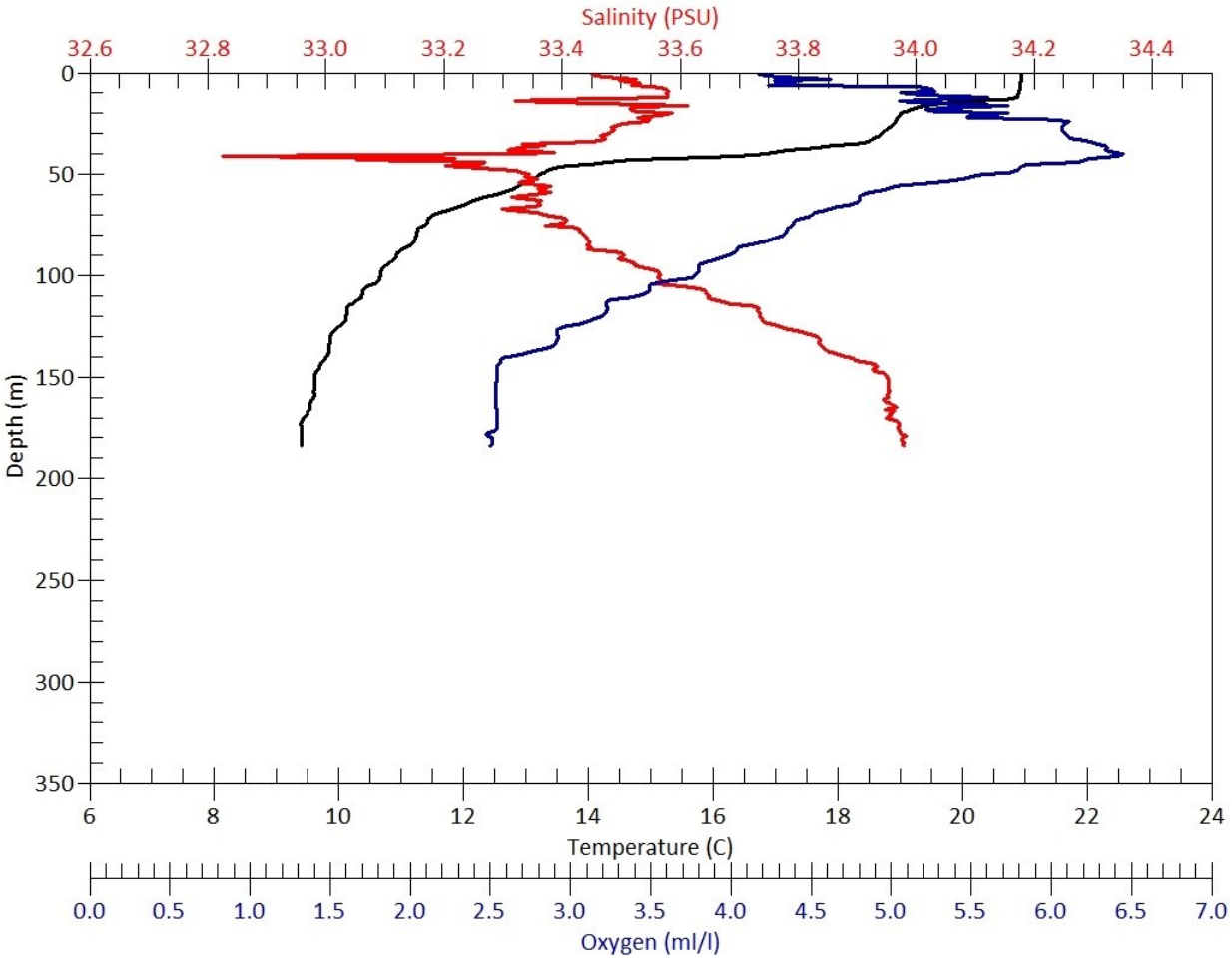

Fig 2. A plot of salinity, temperature, oxygen and depth from a CTD cast at The Footprint Essential Fish Habitat (EFH) area in August 2014

CTD CAST 14 08 01.2 *STUDY AREA: FOOTPRINT*

Date	17 August 2014
Maximum Bottom Depth (m)	160
Start Cast Time (PDT)	18:13 PDT
Latitude (N)	33.96208
Longitude (W)	-119.49216

CTD Data

Cast Depth (m)	155
Temperature (°C) Min/Max:	9.74/23.02
Salinity Min/Max:	32.96/33.92
Oxygen (ml/l) Min/ Max	2.59/6.55

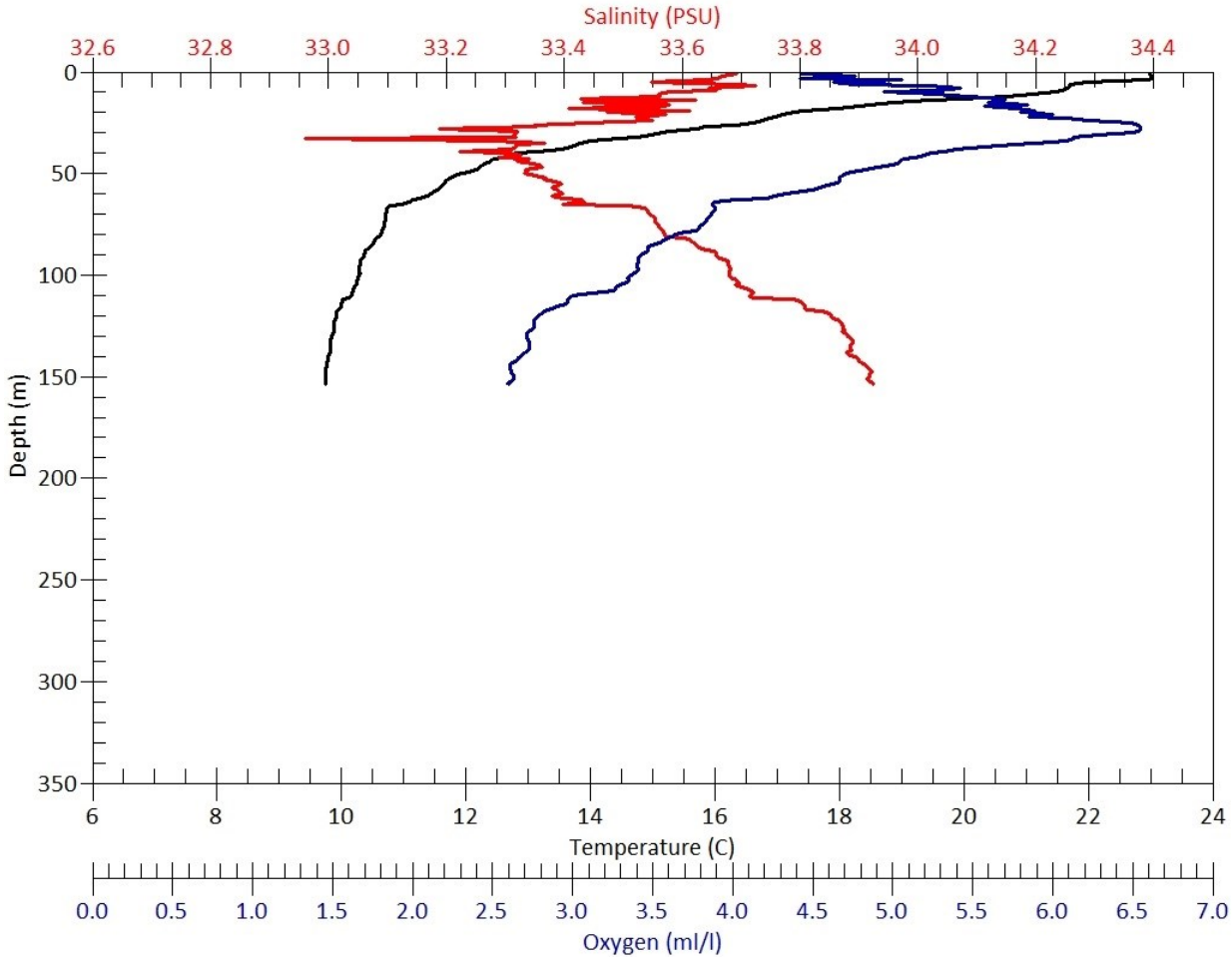

Fig 3. A plot of salinity, temperature, oxygen and depth from a CTD cast at The Footprint Essential Fish Habitat (EFH) area in August 2014

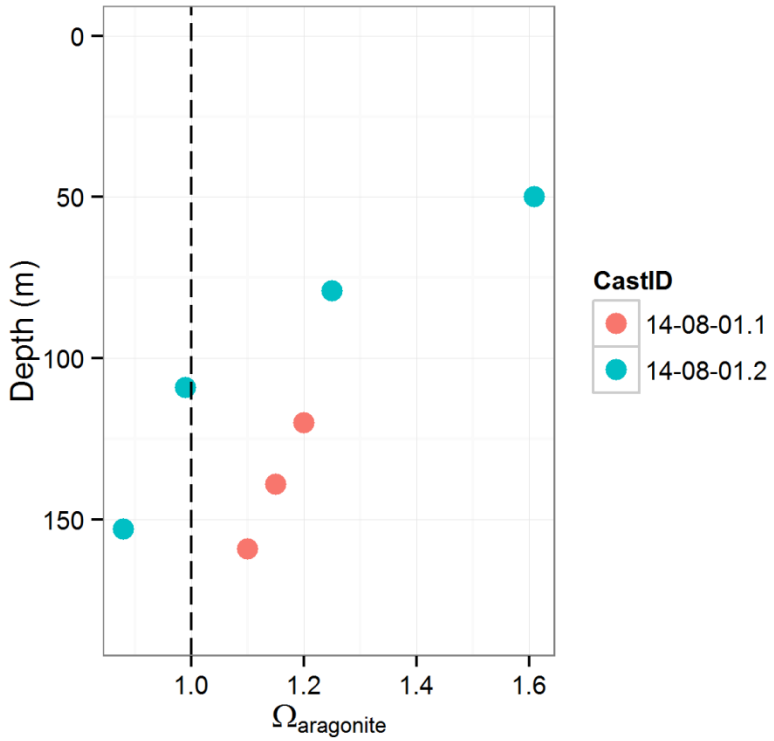

Fig 4. Depth profile of aragonite from CTD Casts 14-08-01.1 and 14-08-01.2 at The Footprint Essential Fish Habitat (EFH) area in August 2014

SampleID	Depth	Temperature	Oxygen	Salinity	pH	Alkalinity	DIC*	pCO2*	Calcite*	Aragonite*
14-08-01-001	183	9.40	2.52	33.98	NA	2257.7	NA	NA	NA	NA
14-08-01-002	159	9.59	2.51	33.96	7.782	2249.7	2171.1	752	1.74	1.1
14-08-01-003	139	9.83	2.82	33.86	7.797	2249.7	2165.9	728.1	1.81	1.15
14-08-01-004	120	10.08	3.17	33.75	7.813	2243.6	2154.2	700.6	1.88	1.2
14-08-01-013	153	9.74	2.60	33.92	7.673	2261.1	2215.6	991.8	1.39	0.88
14-08-01-014	109	10.02	3.02	33.79	7.722	2253.4	2192.7	881.7	1.56	0.99
14-08-01-015	79	10.65	3.77	33.57	7.825	2239.5	2144.4	682.8	1.97	1.25
14-08-01-016	50	11.79	4.72	33.42	7.927	2227.8	2091.9	528.4	2.52	1.61

Table 2. Bottle sample data for CTD casts 14-01-01.1 and 14-01-01.2. Temperature, oxygen and salinity are from the CTD. pH values were measured on the total scale and converted to *in situ* temperature and pressure. Variables with asterisks are derived from CO2SYS (Pierrot et al. 2006).

CTD CAST 14 08 02.1 *STUDY AREA: PIGGY BANK*

Date	17 August 2014
Maximum Bottom Depth (m)	316
Start Cast Time (PDT)	16:21 PDT
Latitude (N)	33.91678
Longitude (W)	-119.47501

CTD Data

Cast Depth (m)	301
Temperature (°C) Min/Max:	8.64/22.77
Salinity Min/Max:	33.13/34.26
Oxygen (ml/l) Min/ Max	0.99/6.56

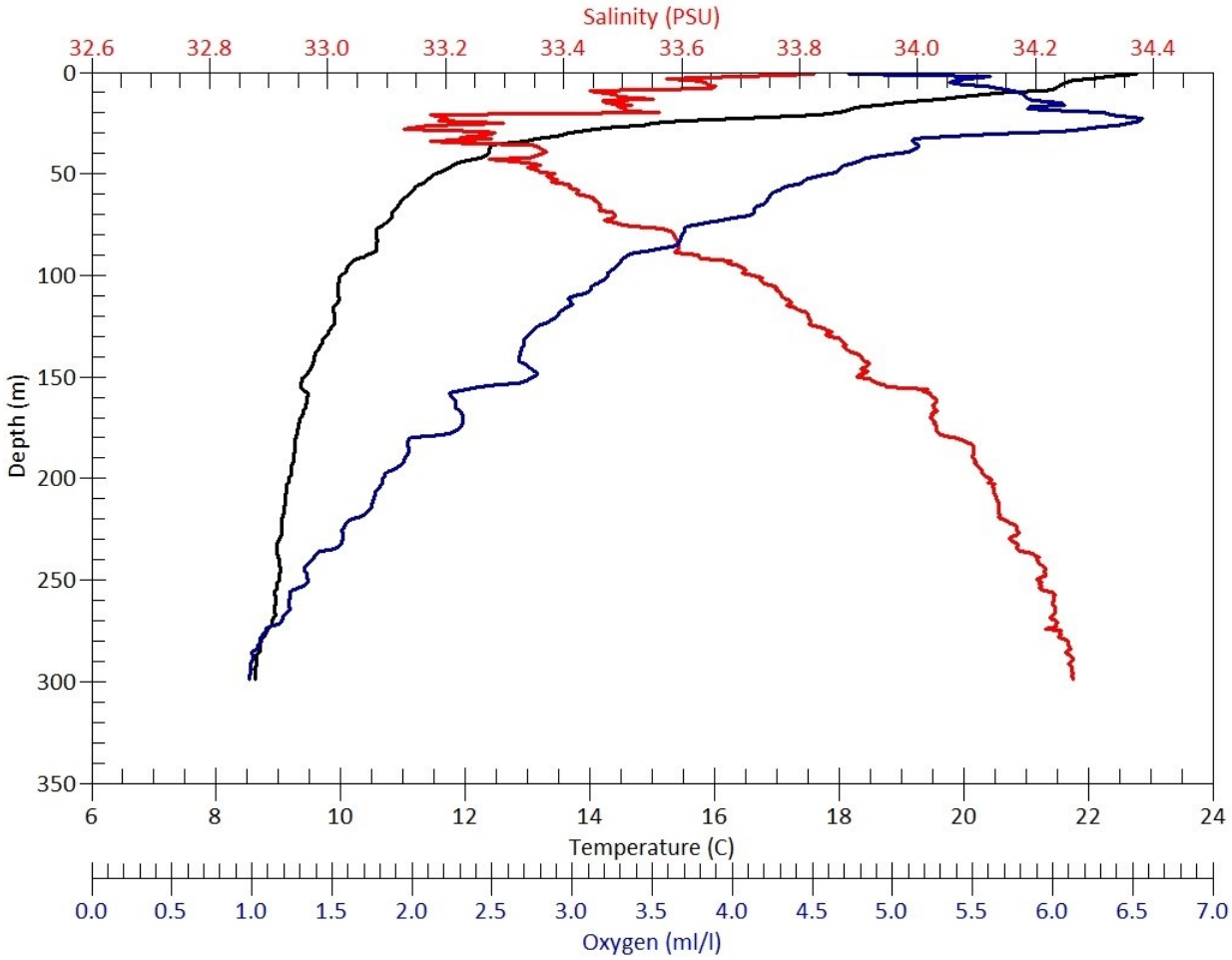

Fig 5. A plot of salinity, temperature, oxygen and depth from a CTD cast at Piggy Bank in August 2014

CTD CAST 14 08 02.2 *STUDY AREA: PIGGY BANK*

Date	17 August 2014
Maximum Bottom Depth (m)	320
Start Cast Time (PDT)	17:15 PDT
Latitude (N)	33.91691
Longitude (W)	-119.47487

CTD Data

Cast Depth (m)	174
Temperature (°C) Min/Max:	9.3/23.1
Salinity Min/Max:	33.1/34.0
Oxygen (ml/l) Min/ Max	2.27/6.57

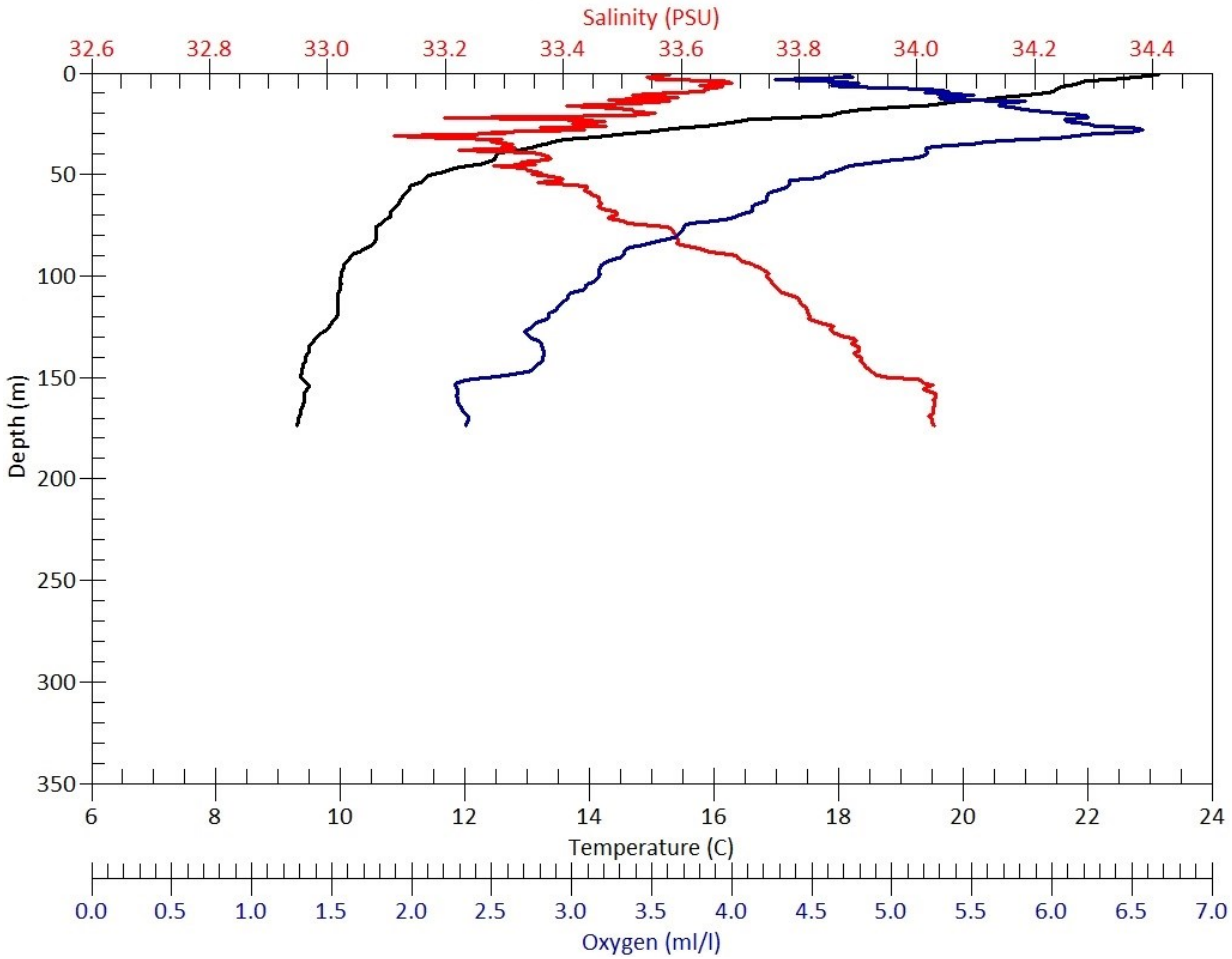

Fig 6. A plot of salinity, temperature, oxygen and depth from a CTD cast at Piggy Bank in August 2014

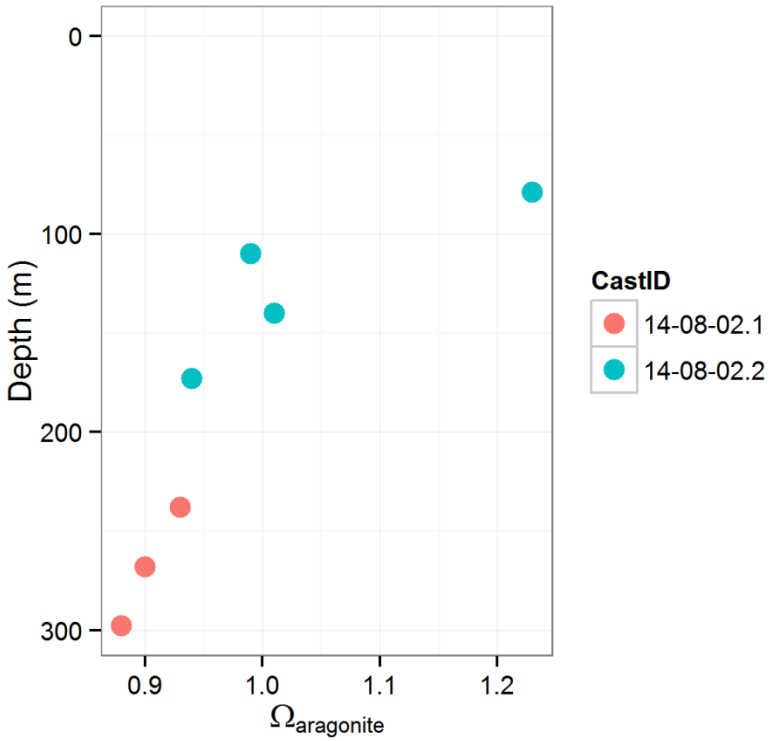

Fig 7. Depth profile of aragonite from CTD Casts 14-08-02.1 and 14-08-02.2 at Piggy Bank in August 2014

SampleID	Depth	Temperature	Oxygen	Salinity	pH	Alkalinity	DIC*	pCO2*	Calcite*	Aragonite*
14-08-02-005	298	8.62	0.98	34.26	7.692	2282.8	2233.7	934.8	1.38	0.88
14-08-02-006	268	8.91	1.19	34.24	7.693	2286.8	2236.4	937.9	1.41	0.9
14-08-02-007	238	8.99	1.41	34.20	7.710	2279.8	2224.4	900.4	1.47	0.93
14-08-02-008	198	9.15	1.81	34.13	7.736	2272.0	2208.6	845.2	1.56	0.99
14-08-02-009	173	9.31	2.34	34.03	7.706	2280.9	2226.5	917.9	1.48	0.94
14-08-02-010	140	9.41	2.80	33.91	7.737	2271.8	2208.4	851.6	1.58	1.01
14-08-02-011	110	9.94	2.96	33.80	7.721	2251.7	2191.6	882.6	1.55	0.99
14-08-02-012	79	10.55	3.60	33.60	7.818	2243.2	2150.6	695.7	1.94	1.23

Table 3. Bottle sample data for CTD casts 14-01-02.1 and 14-01-02.2. Temperature, oxygen and salinity are from the CTD. pH values were measured on the total scale and converted to *in situ* temperature and pressure. Variables with asterisks were derived in CO2SYS (Pierrot et al. 2006).

Date	13 March 2015
Maximum Bottom Depth (m)	318
Start Cast Time (PDT)	21:15 PDT
Latitude (N)	33.91757
Longitude (W)	-119.47140

CTD Data

Cast Depth (m)	314
Temperature (°C) Min/Max:	8.16/16.88
Salinity Min/Max:	33.27/34.24
Oxygen (ml/l) Min/ Max	0.9/ 5.82
Fluorescence Min/Max	0.034/1.138

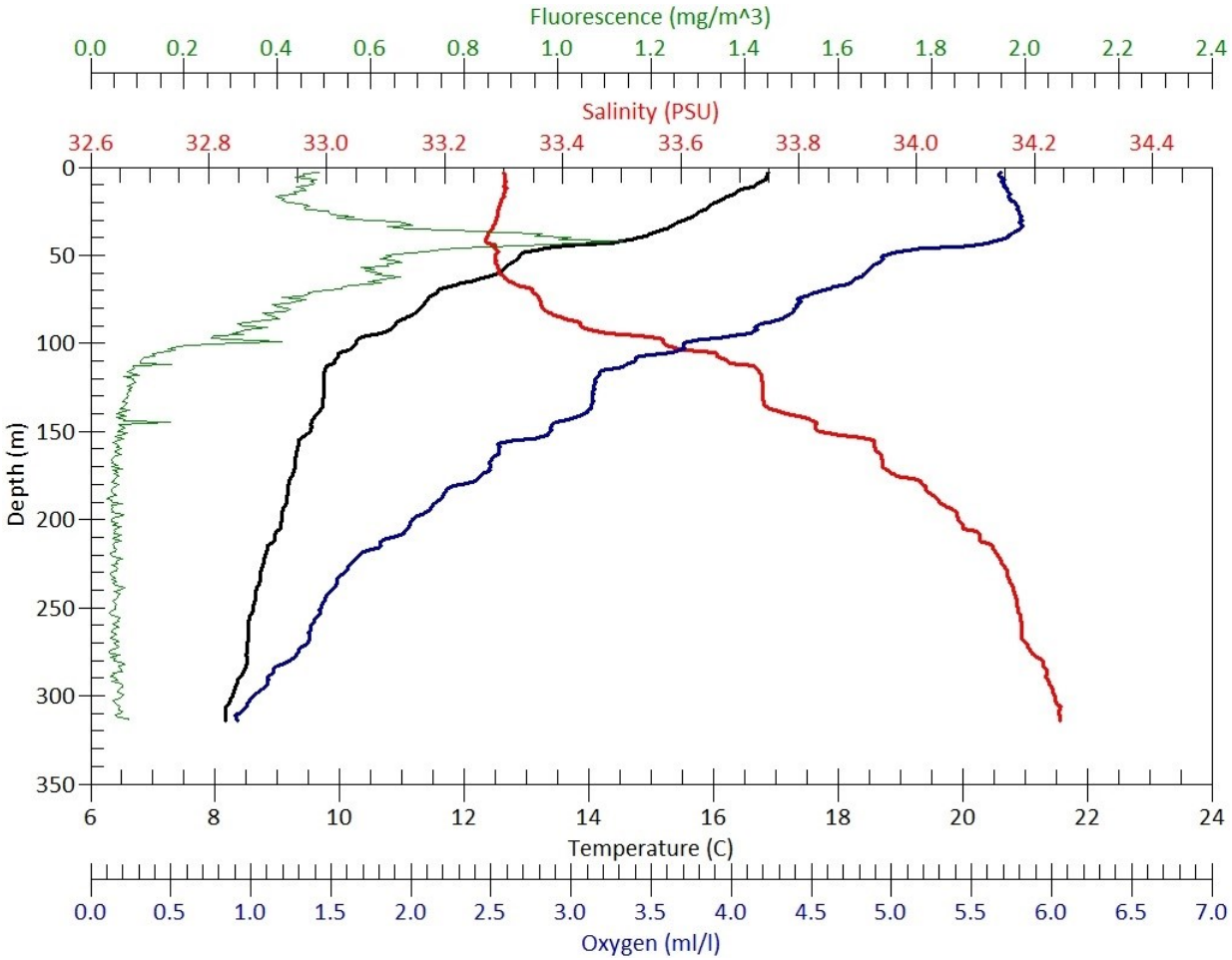

Fig 8. A plot of salinity, temperature, oxygen, fluorescence and depth from a CTD cast at Piggy Bank in March 2015

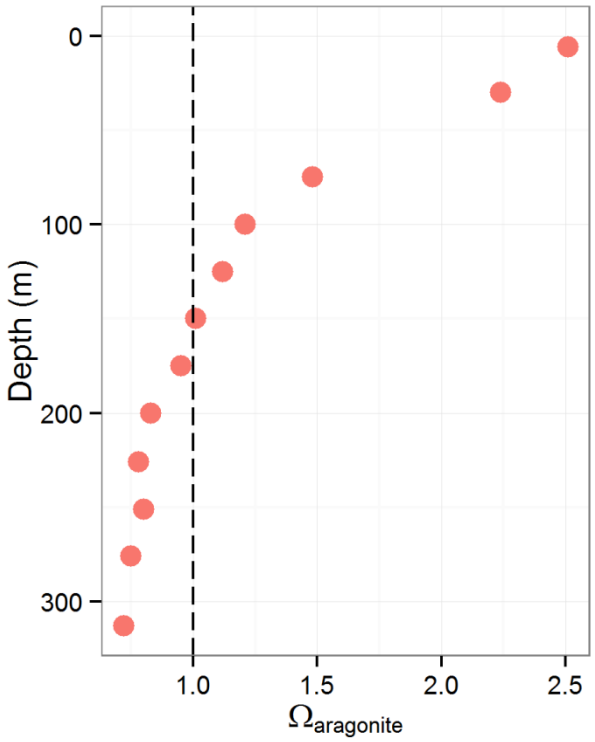

Fig 9. Depth profile of aragonite from CTD Casts 15-03-01 at Piggy Bank in March 2015

SampleID	Depth	Temp	Oxygen	Salinity	DIC	Alkalinity	pH*	pCO2*	Calcite*	Aragonite*
15-03-1-001	313	8.19	0.91	34.24	2264.5	2286.8	7.608	1146.7	1.13	0.72
15-03-1-002	276	8.50	1.23	34.20	2252.7	2278.9	7.619	1120	1.17	0.75
15-03-1-003	251	8.62	1.4	34.17	NA	2274.5	NA	1100	1.26	0.8
15-03-1-004	226	8.78	1.57	34.14	2237.7	2268.8	7.634	1082.2	1.23	0.78
15-03-1-005	200	9.08	1.97	34.06	2224.4	2262.6	7.656	1028	1.3	0.83
15-03-1-006	175	9.21	2.27	33.99	2204.4	2261.0	7.717	888.2	1.49	0.95
15-03-1-007	150	9.46	2.61	33.86	2195.2	2260.1	7.743	836.8	1.59	1.01
15-03-1-008	125	9.74	3.09	33.74	2166.4	2246.5	7.79	743	1.77	1.12
15-03-1-009	100	10.31	3.64	33.55	2149.1	2239.4	7.817	697.5	1.9	1.21
15-03-1-010	75	11.42	4.36	33.35	2104.8	2226.9	7.897	570.8	2.32	1.48
15-03-1-011	30	15.48	5.76	33.27	2026.7	2226.6	8.029	409	3.49	2.24
15-03-1-012	6	16.87	5.68	33.30	2000.5	2225.4	8.062	375.6	3.9	2.51

Table 3. Bottle sample data for CTD casts 15-03-01. Temperature, oxygen and salinity are from the CTD. Variables with asterisks were derived in CO2SYS (Pierrot et al. 2006).

Date	14 March 2015
Maximum Bottom Depth (m)	174
Start Cast Time (PDT)	18:52 PDT
Latitude (N)	33.95951
Longitude (W)	-119.47544

CTD Data

Cast Depth (m)	171
Temperature (°C) Min/Max:	8.98/16.71
Salinity Min/Max:	33.25/34.10
Oxygen (ml/l) Min/ Max	1.88/5.88
Fluorescence Min/Max	0.041/2.053

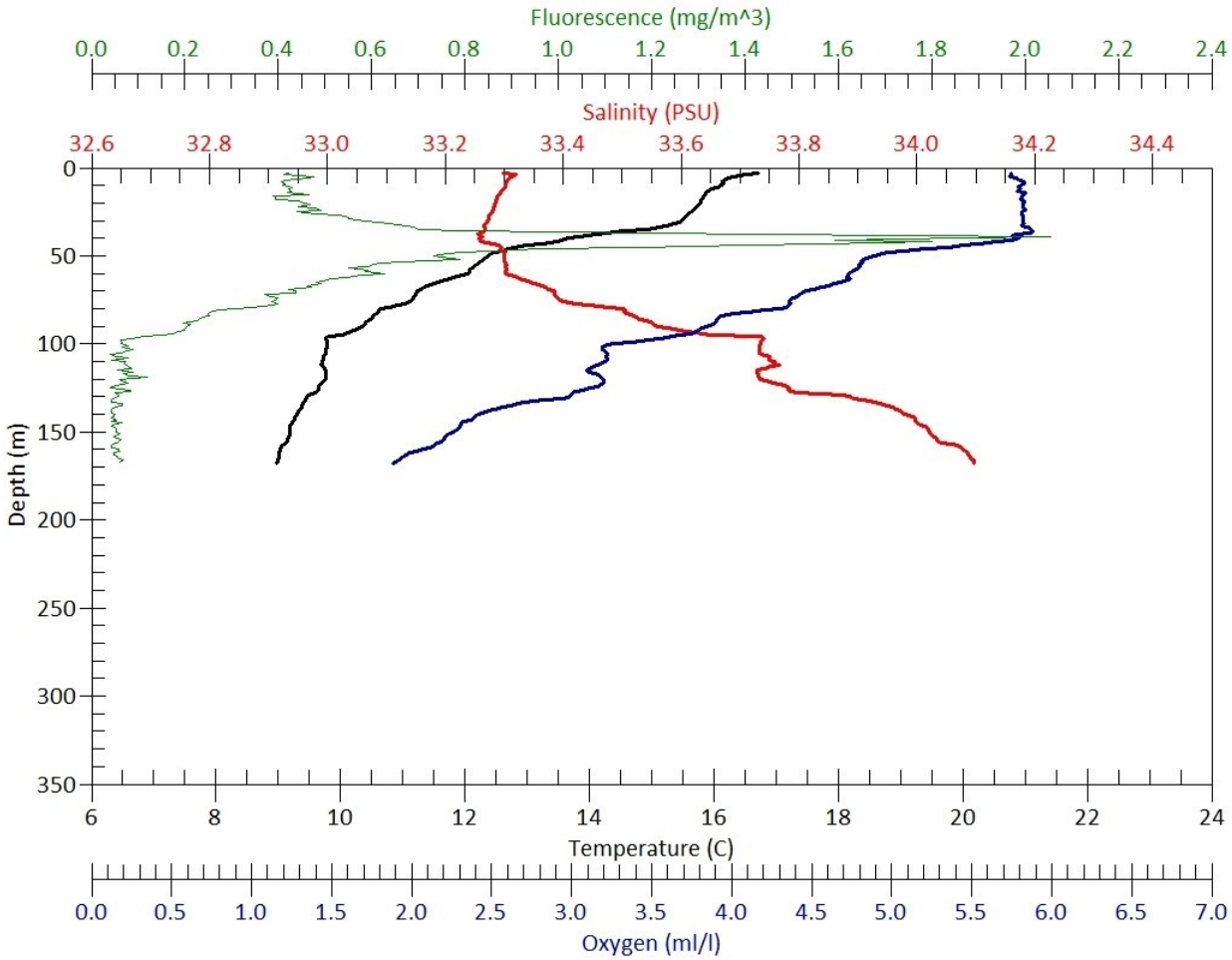

Fig 10. A plot of salinity, temperature, oxygen, fluorescence and depth from a CTD cast at The Footprint Essential Fish Habitat (EFH) March 2015

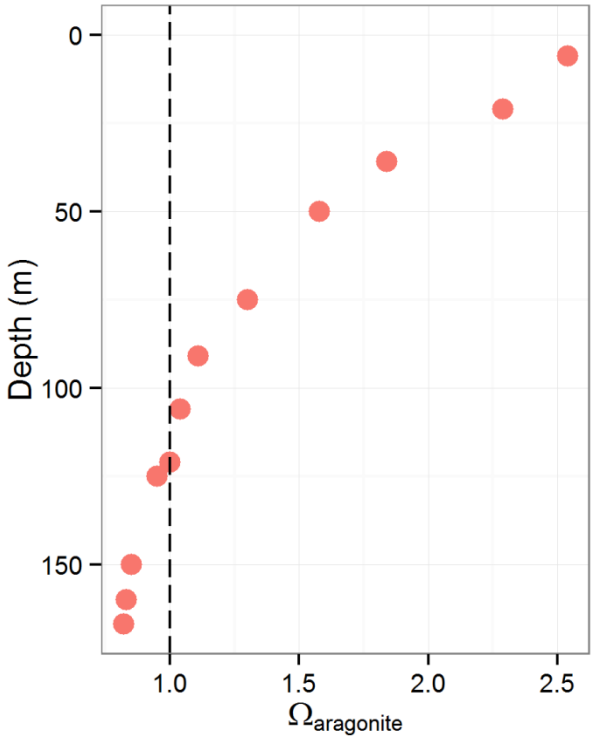

Fig 11. Depth profile of aragonite from CTD Casts 15-03-02 at The Footprint Essential Fish Habitat (EFH) in March 2015

SampleID	Depth	Temperature	Oxygen	Salinity	pH	DIC	Alkalinity	pCO2*	Calcite*	Aragonite*
15-03-2-013	167	8.98	1.88	34.10	7.655*	2221.0	2258.2	1031.7	1.29	0.82
15-03-2-014	160	9.05	1.95	34.07	7.677	2221.1*	2264.9	NA	1.32	0.83
15-03-2-015	150	9.19	2.16	34.02	7.750	2216.9	2257.7	1008.0	1.34	0.85
15-03-2-016	125	9.73	2.96	33.74	7.759	2175.3*	2245.4	NA	1.55	0.95
15-03-2-017	121	9.73	3.08	33.74	7.806	2174.7	2237.6	847.5	1.57	1
15-03-2-018	106	9.71	3.06	33.75	7.802	2154.1*	2237.6	NA	1.7	1.04
15-03-2-019	91	10.20	3.65	33.59	7.846	2157.0	2234.4	765.6	1.75	1.11
15-03-2-020	75	11.00	4.02	33.40	7.852	2121.6*	2226.2	NA	2.09	1.3
15-03-2-021	50	12.48	4.8	33.26	7.917	2085.8	2218.5	549.8	2.48	1.58
15-03-2-022	36	15.15	5.72	33.23	7.952	2060.4	2218.8	517.1	2.88	1.84
15-03-2-023	21	15.98	5.77	33.28	8.033	2018.1	2223.0	404.5	3.57	2.29
15-03-2-024	6	16.39	5.79	33.29	8.067	2003.1	2231.5	363.1	3.95	2.54

Table 3. Bottle sample data for CTD casts 15-03-02. Temperature, oxygen and salinity are from the CTD. Variables with asterisks were derived in CO2SYS (Pierrot et al. 2006).

Date	18 March 2015
Maximum Bottom Depth (m)	567
Start Cast Time (PDT)	7:41 PDT
Latitude (N)	33.93566
Longitude (W)	-119.4845

CTD Data

Cast Depth (m)	556
Temperature (°C) Min/Max:	6.49/17.10
Salinity Min/Max:	33.24/ 34.32
Oxygen (ml/l) Min/ Max	0.29/5.89
Fluorescence Min/Max	0.033/ 0.94

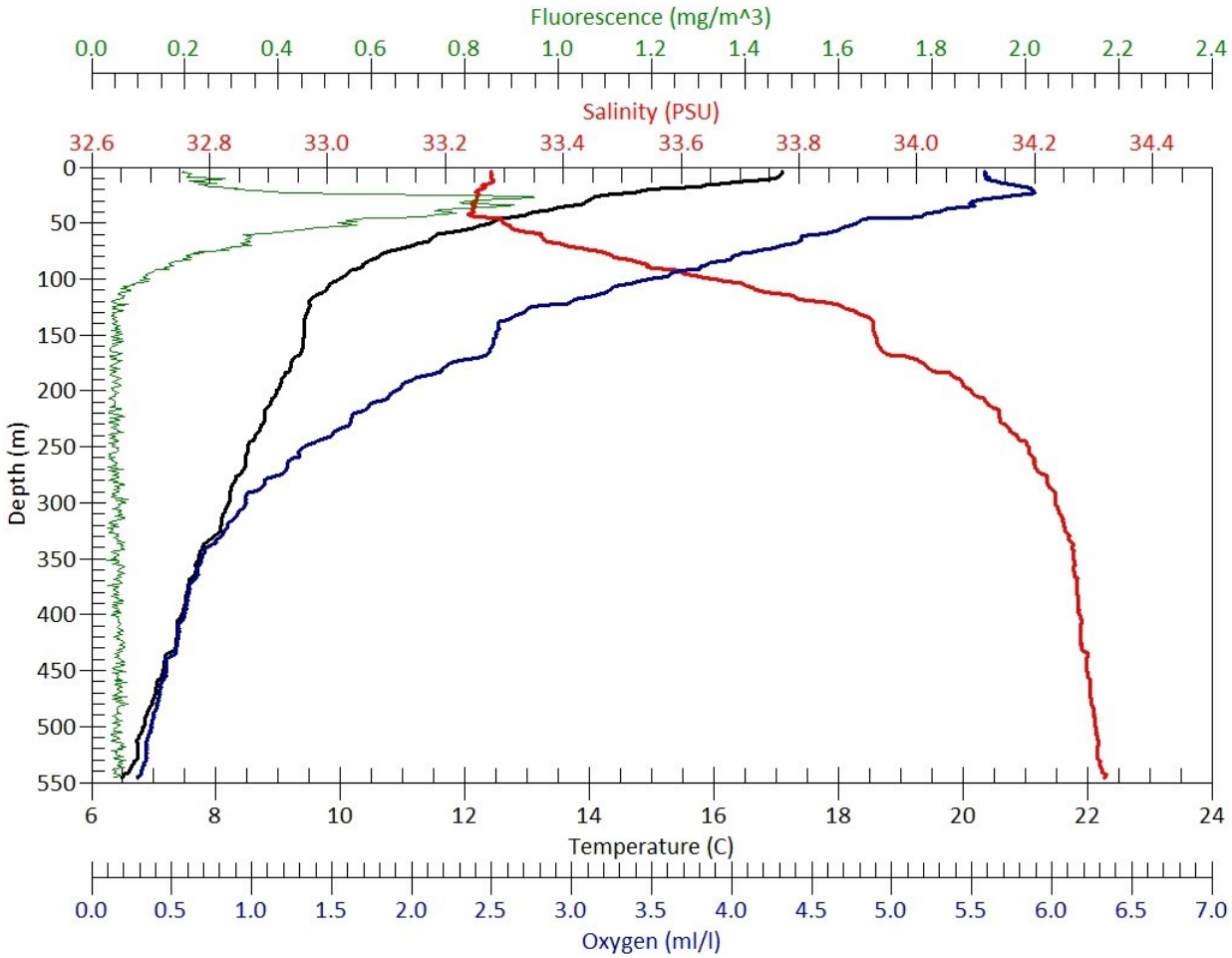

Fig 12. A plot of salinity, temperature, oxygen, fluorescence and depth from a CTD cast between The Footprint and Piggy Bank March 2014

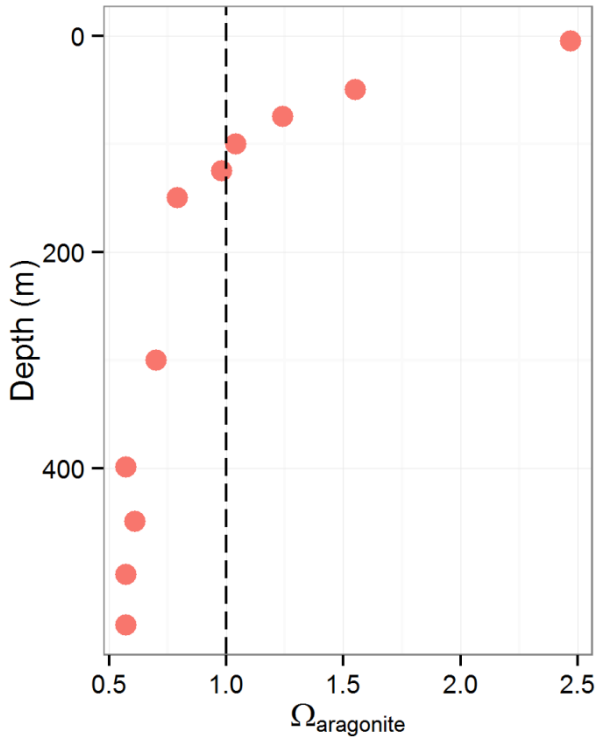

Fig 13. Depth profile of aragonite from CTD Casts 15-03-02 between The Footprint and Piggy Bank in March 2015

SampleID	Depth	Temperature	Oxygen	Salinity	DIC	Alkalinity	pH*	pCO2*	Calcite*	Aragonite*
15-03-3-025	545	6.62	0.3	34.31	2312.2	2309.6	7.536	1332.5	0.89	0.57
15-03-3-026	498	6.78	0.34	34.3	2307.6	2304.5	7.534	1343.5	0.90	0.57
15-03-3-027	449	7.14	0.44	34.29	2298.2	2302.6	7.557	1281.4	0.96	0.61
15-03-3-028	399	7.36	0.51	34.28	2303.7	2297.8	7.521	1404.1	0.90	0.57
15-03-3-029	300	8.21	0.93	34.23	2268.4	2286.7	7.595	1185.9	1.10	0.7
15-03-3-030	200	9.02	1.86	34.08	NA	NA	NA	NA	NA	NA
15-03-3-031	150	9.39	2.44	33.93	2241.4	2271.9	7.629	1112.4	1.25	0.79
15-03-3-032	125	9.52	2.74	33.85	2189.4	2249.4	7.728	867.5	1.54	0.98
15-03-3-033	100	9.97	3.37	33.65	2169.9	2238.8	7.753	814.5	1.64	1.04
15-03-3-034	75	10.69	3.99	33.46	2133.1	2226.5	7.823	685.5	1.94	1.24
15-03-3-035	50	12.42	4.71	33.28	2087.2	2216.9	7.905	559.7	2.44	1.55
15-03-3-036	5	17.06	5.56	33.26	2004.3	2225.4	8.052	386.4	3.84	2.47

Table 4. Bottle sample data for CTD casts 15-03-03. Temperature, oxygen and salinity are from the CTD. Variables with asterisks were derived in CO2SYS (Pierrot et al. 2006).

Date	1 August 2015
Maximum Bottom Depth (m)	322
Start Cast Time (PDT)	17:14 PDT
Latitude (N)	33.91736
Longitude (W)	-119.47209

CTD Data

Cast Depth (m)	313
Temperature (°C) Min/Max:	9.50/22.82
Salinity Min/Max:	33.09/34.30

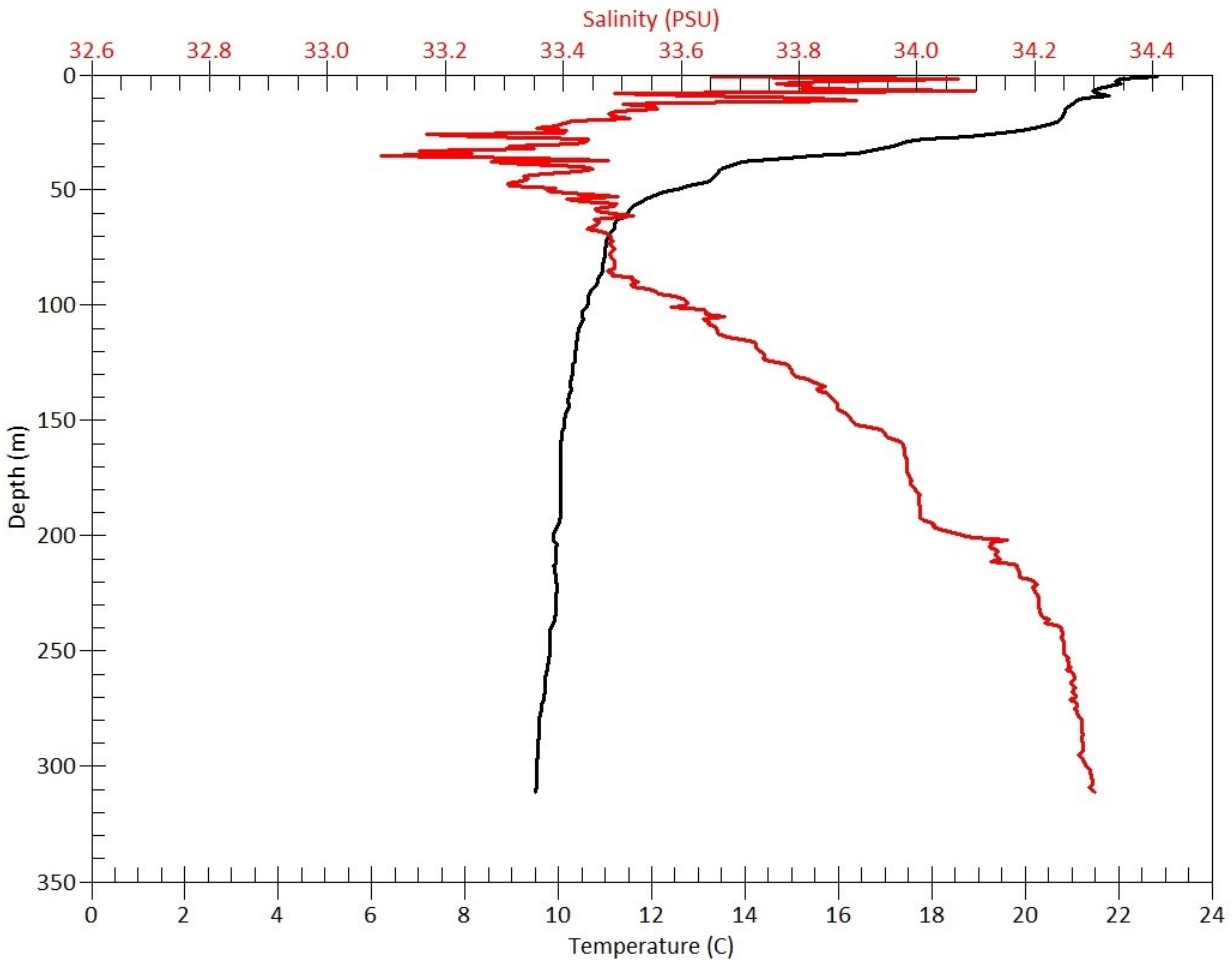

Fig 14. A plot of salinity and temperature from a CTD cast at Piggy Bank August 2015

CTD CAST 15 08 01.2 *STUDY AREA: PIGGY BANK*

Date	1 August 2015
Maximum Bottom Depth (m)	328
Start Cast Time (PDT)	18:30 PDT
Latitude (N)	33.91695
Longitude (W)	119.47194

CTD Data

Cast Depth (m)	162
Temperature (°C) Min/Max:	10.07/21.77
Salinity Min/Max:	33.06/33.95

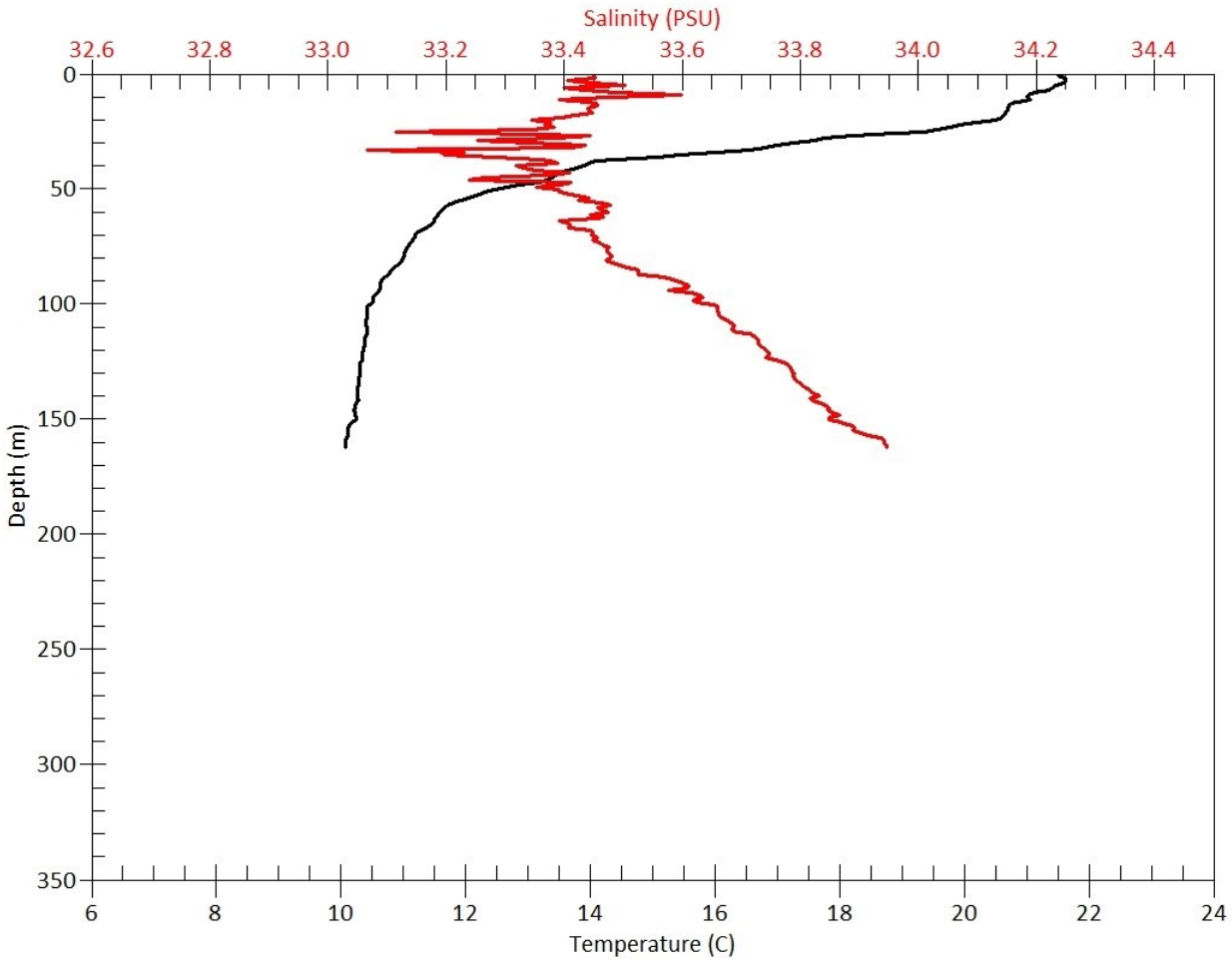

Fig 15. A plot of salinity and temperature from a CTD cast at Piggy Bank August 2015

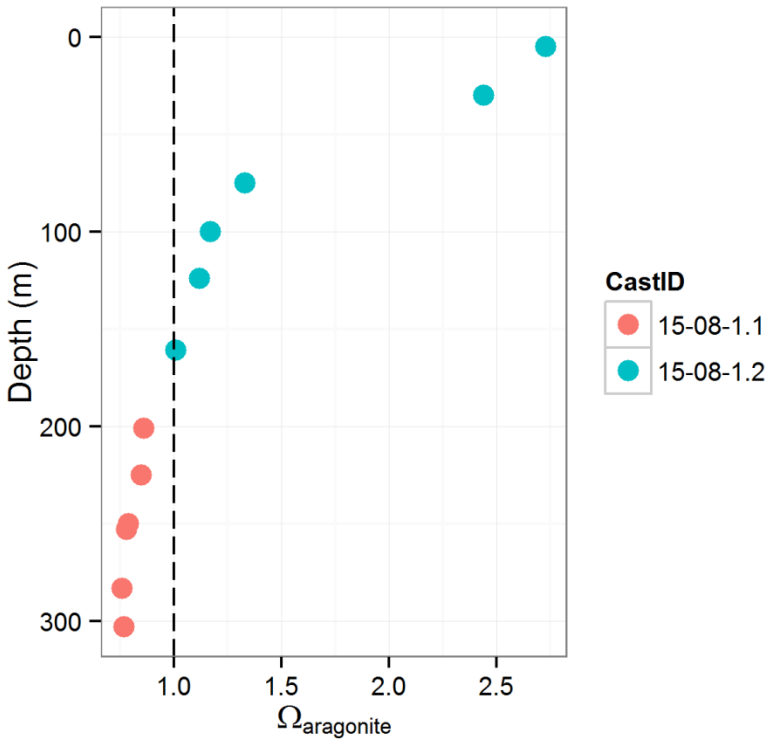

Fig 16. Depth profile of aragonite from CTD casts 15-08-01.1 and 15-08-01.2 at Piggy Bank in August 2015

SampleID	Depth	Temperature	Oxygen	Salinity	DIC	Alkalinity	pH*	pCO2*	Calcite*	Aragonite*
15-08-1-001	303	9.53	NA	34.3	2248.5	2278.3	7.615	1134.3	1.20	0.77
15-08-1-002	283	9.58	NA	34.28	2247.1	2274.6	7.607	1156.2	1.19	0.76
15-08-1-003	253	9.82	NA	34.25	2238.6	2269.8	7.618	1129.1	1.23	0.78
15-08-1-004	250	9.83	NA	34.25	2227.1	2260.6	7.626	1103.8	1.25	0.79
15-08-1-005	225	9.94	NA	34.18	2210	2252.7	7.657	1022.5	1.34	0.85
15-08-1-006	201	9.91	NA	34.09	2203.1	2247.5	7.665	1003.4	1.36	0.86
15-08-1-007	161	10.08	NA	33.94	2181.4	2246.9	7.735	848.9	1.59	1.01
15-08-1-008	124	10.33	NA	33.74	2168.2	2248.0	7.780	764.2	1.77	1.12
15-08-1-009	100	10.52	NA	33.63	2149.5	2234.7	7.797	731.0	1.84	1.17
15-08-1-010	75	11.00	NA	33.47	2120.7	2225.1	7.851	638.9	2.08	1.33
15-08-1-011	30	15.23	NA	33.46	2001.4	2223.8	8.079	356.8	3.81	2.44
15-08-1-012	5	21.50	NA	33.45	1992.7	2232.8	8.019	422.4	4.19	2.73

Table 5. Bottle sample data for CTD casts 15-08-01. Temperature, oxygen and salinity are from the CTD. Variables with asterisks were derived in CO2SYS (Pierrot et al. 2006).

COMBINED PLOTS

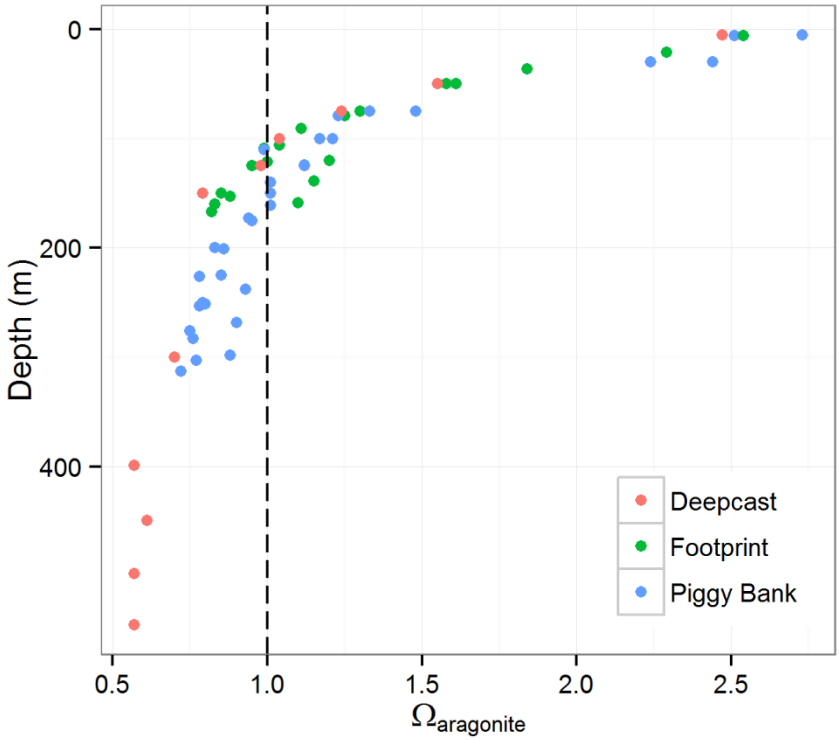

Fig 17. Depth profile of aragonite from all 9 CTD casts between 2014 and 2015 labeled by site

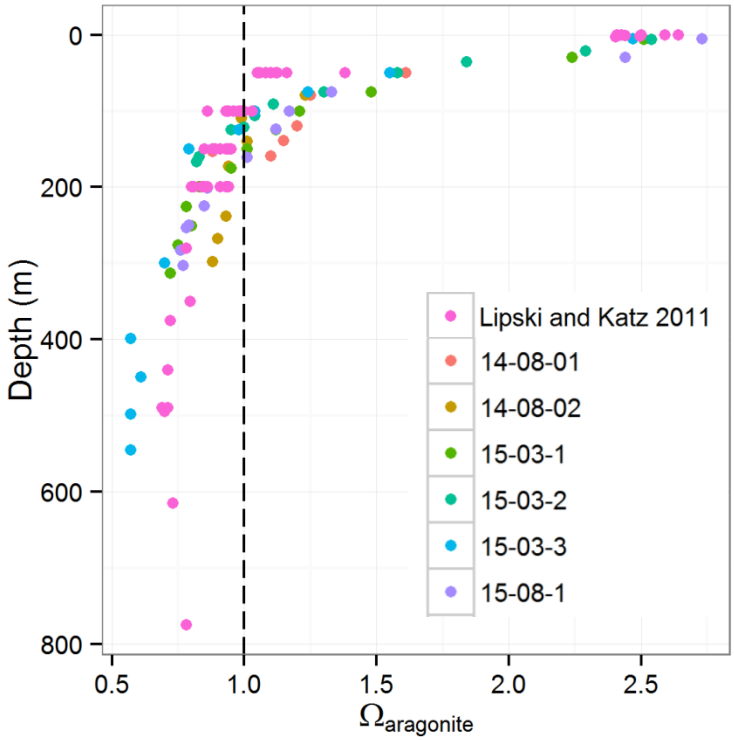

Fig 18. Depth profile of aragonite from all 9 CTD casts between 2014 and 2015 labeled by cast

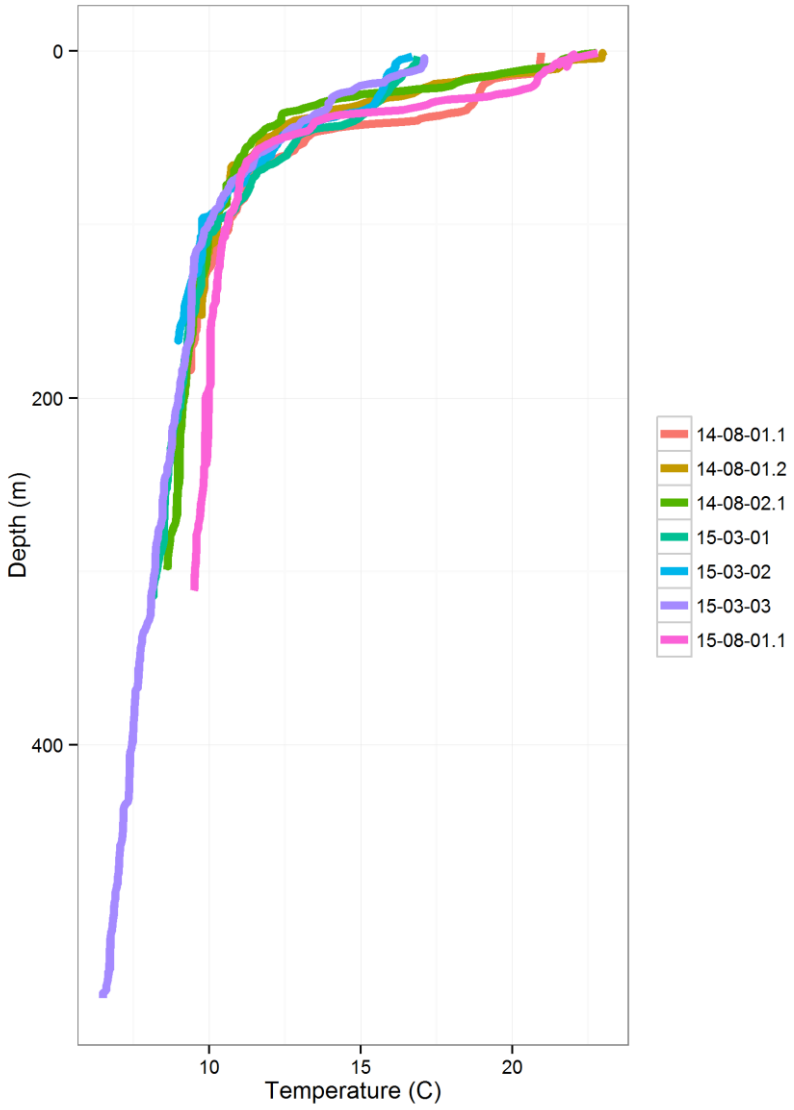

Fig 19. Depth profile of temperature from 7 CTD casts (shallow 14-08-02.2 and shallow 15-08-01.2 duplicate casts excluded) between 2014 and 2015 labeled by cast

Results and Discussion

Nine CTD casts across three locations were completed with 62 water samples analyzed for carbonate chemistry. Temperature, dissolved oxygen, pH and aragonite saturation decreased with increasing depth, while salinity and total alkalinity increased with depth. The warmest temperatures near the surface (3m) were documented in August 2014 (Max 23.0°C, Avg 19.81±2.79). The warmest temperatures at depth (~170 m) were documented in August 2015 (Fig. 18; Max 10.0°C, Avg 9.42±0.35). Oxygen ranged between 0.28 ml/l at 545 m and 6.56 ml/l at 23 m. pH ranged between 7.521 (total scale) at 400 m depth and 8.076 near the surface. Chlorophyll-a fluorescence measurements in March 2015 showed peak values near The Footprint and closest to shore (Fig. 10: 39 m, 2.053 ug/L). Fluorescence peaked at Piggy Bank at 42 m (Fig. 8: 1.138 ug/L) and between the two features at 27 m (Fig. 12: 0.947 ug/L)

The aragonite saturation horizon (ASH, Ω_{arag}=1) was observed between 109 and 161 m. Lipski et al. (2011) observed the ASH near 100 m at Piggy Bank in June/July of 2010. The deepest ASH was observed in August 2015, which corresponded to the warmest temperatures observed at depth (>100 m) over the three studies (Fig. 18). Aragonite saturation states at depth (30-160 m) appeared to be consistently higher throughout the water column above Piggy Bank. This pattern was most pronounced in March 2015 where at 150 m depth Ω_{arag} was 1.01 at Piggy Bank and Ω_{arag} 0.85 at Footprint. It is important to note that 150 m on Footprint is near the interface of the ridge feature, while it is nearly 170 m above the peak of Piggy Bank seamount. Nutrients were not included in analyses, but would not be expected to change aragonite saturation by more than -0.02 units (based on the largest values of phosphate and silicate measured in the Southern California Bight region, CalCOFI data 2007-2014). pH values in 2014 were likely affected by drift in instrumentation. Subsequent analyses for carbonate chemistry were generally restricted to calculations from DIC and TA measurements.

Aragonite saturation states (Ω_{arag}) at the peak of Piggy Bank (measured at 300-320 m) and proximal to coral aggregations were between 0.72 and 0.88 over the three studies. Along Footprint ridge and proximal to coral aggregations (91-183 m) Ω_{arag} ranged between 0.82 and 1.2. Other parameters at the peak of Piggy Bank (300-320 m) were within the following ranges over the three studies: pH 7.608-7.692, total alkalinity 2278-2286 umol/kg, DIC 2233-2264 umol/kg, temperature 8.19-9.53°C, dissolved oxygen 0.91-0.983 ml/l, and salinity 34.24-34.30. Other parameters along Footprint ridge (91-183 m) were within the following ranges over the three studies: pH 7.655-7.846, total alkalinity 2234-2263 umol/kg, DIC 2134 umol/kg, Ω_{arag} 0.82-1.2, temperature 8.98-10.20°C, dissolved oxygen 1.88-3.65 ml/l, and salinity 33.59-34.1.

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