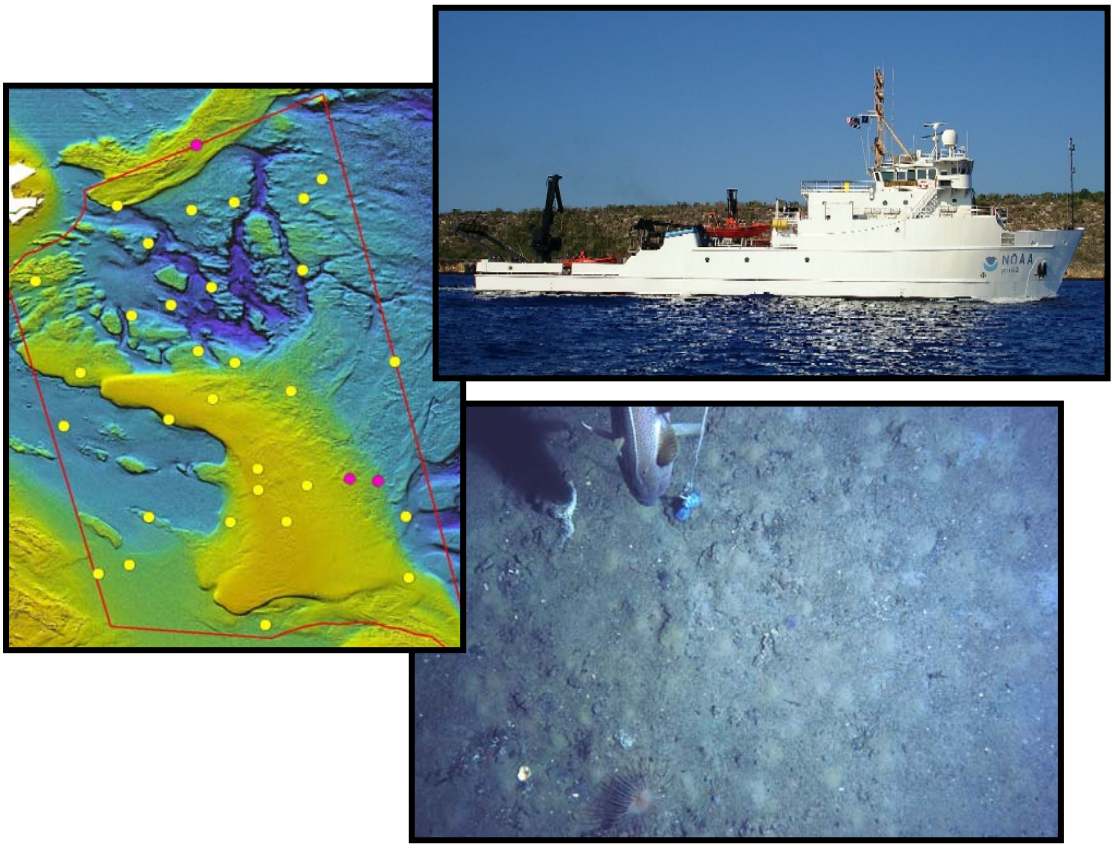
Cruise Report: Summer 2008 Ecological Assessment of Stellwagen Bank National Marine Sanctuary

NOAA Ship NANCY FOSTER NF-08-09-CCEHBR

(June 14 - June 21, 2008)



NOAA Technical Memorandum NOS NCCOS 87

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(June 14 - June 21, 2008)

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Summary

This cruise report is a summary of a field survey conducted within the Stellwagen Bank National Marine Sanctuary (SBNMS), located between Cape Cod and Cape Ann at the mouth of Massachusetts Bay. The survey was conducted June 14 – June 21, 2008 on NOAA Ship NANCY FOSTER Cruise NF-08-09-CCEHBR. Multiple indicators of ecological condition and human dimensions were sampled synoptically at each of 30 stations throughout SBNMS using a random probabilistic sampling design. Samples were collected for the analysis of benthic community structure and composition; concentrations of chemical contaminants (metals, pesticides, PAHs, PCBs, PBDEs) in sediments and target demersal biota; nutrient and chlorophyll levels in the water column; and other basic habitat characteristics such as depth, salinity, temperature, dissolved oxygen, turbidity, pH, sediment grain size, and organic carbon content. In addition to the fish samples that were collected for analysis of chemical contaminants relative to human-health consumption limits, other human-dimension indicators were sampled as well including presence or absence of fishing gear, vessels, surface trash, marine mammals, and noxious sediment odors. The overall purpose of the survey was to collect data to assess the status of ecosystem condition and potential stressor impacts throughout SBNMS, based on these various indicators and corresponding management thresholds, and to provide this information as a baseline for determining how such conditions may be changing with time. While sample analysis is still ongoing a few preliminary results and observations are reported here. A final report will be completed once all data have been processed. The results are anticipated to be of value in supporting goals of the SBNMS and National Marine Sanctuary Program aimed at the characterization, protection, and management of sanctuary resources (pursuant to the National Marine Sanctuary Reauthorization Act) as well as a new priority of NCCOS and NOAA to apply Ecosystem Based approaches to the Management of coastal resources (EBM) through Integrated Ecosystem Assessments (IEAs) conducted in various coastal regions of the U.S. including the Northeast Atlantic continental shelf.

This was a multi-disciplinary partnership effort made possible by scientists from the following organizations:

- NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Environmental Health and Biomolecular Research (CCEHBR), Charleston, SC.
- U.S. Environmental Protection Agency (EPA), National Health and Environmental Effects Research Laboratory (NHEERL), Atlantic Ecology Division (GED), Narragansett, RI.
- U.S. Environmental Protection Agency (EPA), National Health and Environmental Effects Research Laboratory (NHEERL), Gulf Ecology Division (GED), Gulf Breeze, FL.
- U.S. Geological Survey (USGS), National Wetlands Research Center, Gulf Breeze Project Office, Gulf Breeze, FL.
- NOAA, Office of Marine and Aviation Operations (OMAO), NOAA ship Nancy Foster.

Additional copies of this cruise report can be obtained by contacting:
NOAA, Center for Coastal Environmental Health and Biomolecular Research, 219 Fort Johnson Road, Charleston, South Carolina, 29412, Telephone: 843/762-8511. Attention: Cynthia Cooksey.

1.0 Introduction

This survey is part of a continuum of studies being conducted by the National Oceanic and Atmospheric Administration (NOAA), U.S. Environmental Protection Agency (EPA), and partnering states to assess condition of aquatic resources throughout coastal-ocean waters of the U.S., inclusive of several National Marine Sanctuaries, using multiple indicators of ecological condition. The scope and design of these studies are similar to those used in the coastal component of EPA's Environmental Monitoring and Assessment Program (EMAP) and more recent National Coastal Assessment Program, which have focused mostly on estuaries and inland waters. The present work extends these prior efforts to NOAA's Stellwagen Bank National Marine Sanctuary (SBNMS). Surveys of benthic fauna and other multiple indicators of ecological condition — including basic habitat characteristics such as depth, salinity, temperature, dissolved oxygen, pH, sediment grain size and organic content; nutrient and chlorophyll levels in the water column; chemical contaminants in sediments and biota — are conducted in these waters over a series of random stations using a probabilistic sampling design. Accordingly, the resulting data can be used to make estimates of the spatial extent of the sanctuary's health with respect to the various measured indicators, and to provide this information as a baseline for determining how environmental conditions may be changing with time.

The present survey was conducted within the Stellwagen Bank National Marine Sanctuary (SBNMS) encompassing 842 square miles of productive marine habitats, located between Cape Cod and Cape Ann at the mouth of Massachusetts Bay in the southwestern corner of the Gulf of Maine (Fig. 1). SBNMS is a marine protected area, including multiple submerged aquatic features such as Stellwagen Bank, Tillies Bank, and the southern portion of Jeffreys Ledge, which supports important regional ecological and economic resources. Synoptic sampling of multiple ecological and human-dimension indicators was conducted at each of 30 random stations throughout these waters. The consistent and synoptic sampling of the different biological and environmental variables across these stations will provide an opportunity for learning more about the spatial patterns of these resources and processes controlling their distributions. As mentioned above, by incorporating a random probabilistic station design, the resulting data also can used to make unbiased statistical estimates of the spatial extent of the sanctuary's health with respect to the various measured indicators and corresponding management thresholds and to provide this information as a baseline for determining how environmental conditions may be changing in the future. This is the first such baseline of data representative of the entire footprint of the sanctuary. The survey also builds upon a previous assessment of ecosystem conditions conducted by NCCOS scientists for the adjacent Stellwagen Bank region including stations in Boston Harbor, Massachusetts and Cape Cod Bays, and a portion of the sanctuary (six stations) on the southwestern side (NOAA 2006). The following report provides a brief summary of the scope and preliminary results of the supporting field work conducted June 14 – June 21, 2008 on NOAA Ship NANCY FOSTER Cruise NF-08-09-CCEHBR.

2.0 Scientific Approach

Samples were collected on NOAA Ship NANCY FOSTER Cruise NF-08-09-CCEHBR, 14 - 21 June 2008, at 30 random stations within the Stellwagen Bank National Marine Sanctuary (Figure 1, Table 1). At each station, samples were obtained for characterization of the following core indicators (Table 2): (1) community structure and composition of benthic macroinfauna (> 0.5 mm); (2) concentration of chemical contaminants in sediments (metals, pesticides, PCBs, PAHs, PBDEs); (3) sediment toxicity testing (Microtox assay); and (4) general habitat conditions (water depth, dissolved oxygen, conductivity, temperature, chlorophyll a, total suspended solids, water-column nutrients, turbidity, % silt-clay versus sand content of sediment, organic-carbon content of sediment). Where possible, samples of demersal fish species were collected by hook and line for analysis of chemical contaminant body burdens and visual evidence of pathological disorders. Once available, the fish contaminant data will be compared to human-health consumption limits as a measure of potential human-health risks. Additional human-dimension indicators were sampled as well including presence or absence of fishing gear, vessels, surface trash, marine mammals, and noxious sediment odors. The visual range used for observation of human-dimension indicators was highly variable – daytime observations were limited to a range of 2-5 nm while nighttime observations were limited to what was immediately adjacent to the vessel or the object being observed had lights that could be seen from a distance. Note that at three stations (27, 28, and 30) the bottom was too rocky to collect sediment samples, so they were replaced by three alternate stations (A02, A07, and A28 respectively). However, the water-column samples from the three original stations were processed and are included in this report.

Sediment sampling was conducted using a 0.04 m^2 Young-modified Van Veen grab. Samples for benthic macro-infaunal analysis were collected in duplicate, live-sieved onboard through a 0.5 mm screen, and preserved separately in 10% buffered formalin with Rose Bengal stain. Samples for the analysis of sediment toxicity, sediment contaminants, % silt-clay, % water, and % TOC were sub-sampled from composited surface sediment (upper 3-5 cm) taken from additional grabs (typically two) independent of the macro-infaunal grabs. The grab frame also was equipped with a digital camera, strobe, and bottom-triggered shutter release to capture pictures of the undisturbed ocean floor and any epifaunal species present at the sediment surface just prior to the grab's contact with the bottom.

A CTD was used to acquire continuous profiles of conductivity, temperature, pH, dissolved oxygen, and depth as it was lowered and raised through the water column. The unit also was equipped with 12 Nisken bottles to acquire discrete water samples at two designated water depths (near surface and near-bottom) for analysis of nutrients, total suspended solids, turbidity (NTU), and chlorophyll.

3.0 Preliminary Results

A total of 30 stations were sampled for all indicators throughout the study region, with an additional three stations sampled for water-column indicators (Figure 1, Table 1). Appendix A provides a complete log of sampling activities conducted during the cruise including fish

collections. Presented here are preliminary results and observations from the research cruise, a final report will be completed once all data have been processed.

Water depths at the 33 stations averaged 70.2 m and ranged from 31 – 137 m. Bottom-water salinity levels (PSU) were very uniform across the sanctuary with values falling within a narrow range of 32.1 to 32.5 and averaging 32.3. Other bottom-water physical characteristics were more variable, including DO which ranged from 5.98 mg/L to 7.01 mg/L and averaged 6.45 mg/L. These values are above the range (< 2 mg/L) typically associated with benthic impacts (USEPA 2004, Diaz and Rosenberg 1995), though lower than DO levels (~ 9.5-10.5 mg/L) previously reported at SBNMS by the Massachusetts Water Resources Authority (MWRA). The higher DO levels reported by MWRA represent mean water-column levels including surface water, which generally have higher DO values, from a more limited number of sites (Werme 2007). Bottom-water temperature had a moderate range of 4.36ºC to 6.23 ºC with warmer temperatures occurring at the shallower stations on Stellwagen Bank, Gloucester Bank, and Jeffrey's Ledge. Bottom water quality measurements for depth, temperature, salinity, pH and DO at each station are presented in Table 1.

Both turbidity (NTU), as a direct measure of water clarity, and total suspended solids (TSS) were measured at each of the 33 stations (Table 1). Generally as TSS increases, the water becomes murkier or more turbid, as a result of increasing suspended particulate matter. Thus TSS can serve as an indicator of water clarity as well. TSS in bottom water ranged from 3.4 mg/L to 15.1 mg/L and averaged 6.9 mg/L while turbidity ranged from 0.214 NTU to 2.850 NTU and averaged 0.832 across the sanctuary. These TSS values are dramatically higher, indicating more turbid water, than values previously reported for SBNMS during the summer stratification period by MWRA which ranged from 0.62 to 1.91 mg/L and averaged 1.00 mg/L (Libby 2005). The lower TSS levels reported by MWRA represent mean water-column values from a limited number of sites. These limited sites may not provide an accurate representation of condition within SBNMS.

Nutrient levels throughout the sanctuary were at relatively low levels in both surface and bottom water (Table 3). As is typical for the Gulf of Maine, all measured nutrients (DIN, DIP, Silicate, Total N, and Total P) were higher in bottom water than surface water (NOAA 2006). In contrast, chlorophyll a levels were higher in surface water compared to bottom water. Nutrient levels also were generally lower at shallow stations on top of Stellwagen Bank in comparison to the deeper stations in the remainder of the sanctuary.

Observations of several human-dimension indicators (e.g., presence or absence of fishing gear, vessels, surface trash, marine mammals, and noxious sediment odors) also were made at each station (Table 4). At two-thirds (67 %) of the stations at least one indicator of human use (precense of fishing gear, or vessels), was observed. Vessels were observed throughout the sanctuary, day and night (Figure 2). Fishing gear was also observed at many of the stations located on Stellwagen Bank (Figure3). The same areas where fishing gear were common were also where marine mammal sightings occurred (Figure 4). Caution is advised when interrupting these observations as sampling occurred day and night, and nighttime observations where limited.

Water-column profiles (Appendix B) highlight the strong stratification of the water column throughout SBNMS as is typical for this region in June – August (NOAA 2006). The pycnocline layer, the part of the water column experiencing a rapid change in temperature and salinity, is in the 10 – 25 m zone across all 33 stations. The pycnocline is also the area where the sub-surface chlorophyll *a* maximum (SCM) was reached across the entire sanctuary, based upon fluorescence measurements (Appendix B). This close agreement between the depth of the pycnocline layer and depth of the SCM is typical for the Gulf of Maine region during the summer months (Holligan et al. 1984). Surface waters across the sanctuary were warmer and fresher in comparison to bottom waters.

The addition of a digital camera to capture pictures of the undisturbed ocean floor and any epifaunal species present at the sediment surface just prior to the grab's contact with the bottom has added an exciting new component to our surveys. Appendix B shows the diverse range of bottom types across the sanctuary. Based on these images (actual grain-size samples are still being processed) it appears that coarse sandy sediments occur on top of Stellwagen Bank; muddy sands dominate in Stellwagen Basin; and a variety of mud, sand, gravel, and boulder substrates are found throughout the remainder of the sanctuary. One additional notable feature of the photos is the diverse array of marine life associated with the bottom habitat. Numerous fishes and invertebrates are present in the photos, as well as burrows, tracks, and mounds indicating large amounts of biological activity. Photos will be processed to determine species composition of visible biota and percent cover.

Data for other biological and abiotic environmental variables listed in Table 2 will be available once the processing of these samples has been completed.

4.0 Acknowledgements

Funding for this project has been provided through NOAA/NOS/NCCOS/CCEHBR (field sampling supplies and equipment; sample processing), EPA/NHEERL/GED (sample design and nutrient analysis), and EPA/NHEERL/AED (field sampling). All members of the field crew (Table 5) are commended for their high level of technical expertise, teamwork and dedication to getting the required sampling completed. Special appreciation also is extended to the officers and crew of the NOAA ship NANCY FOSTER for the superb job performed on NF-08-09-CCEHBR.

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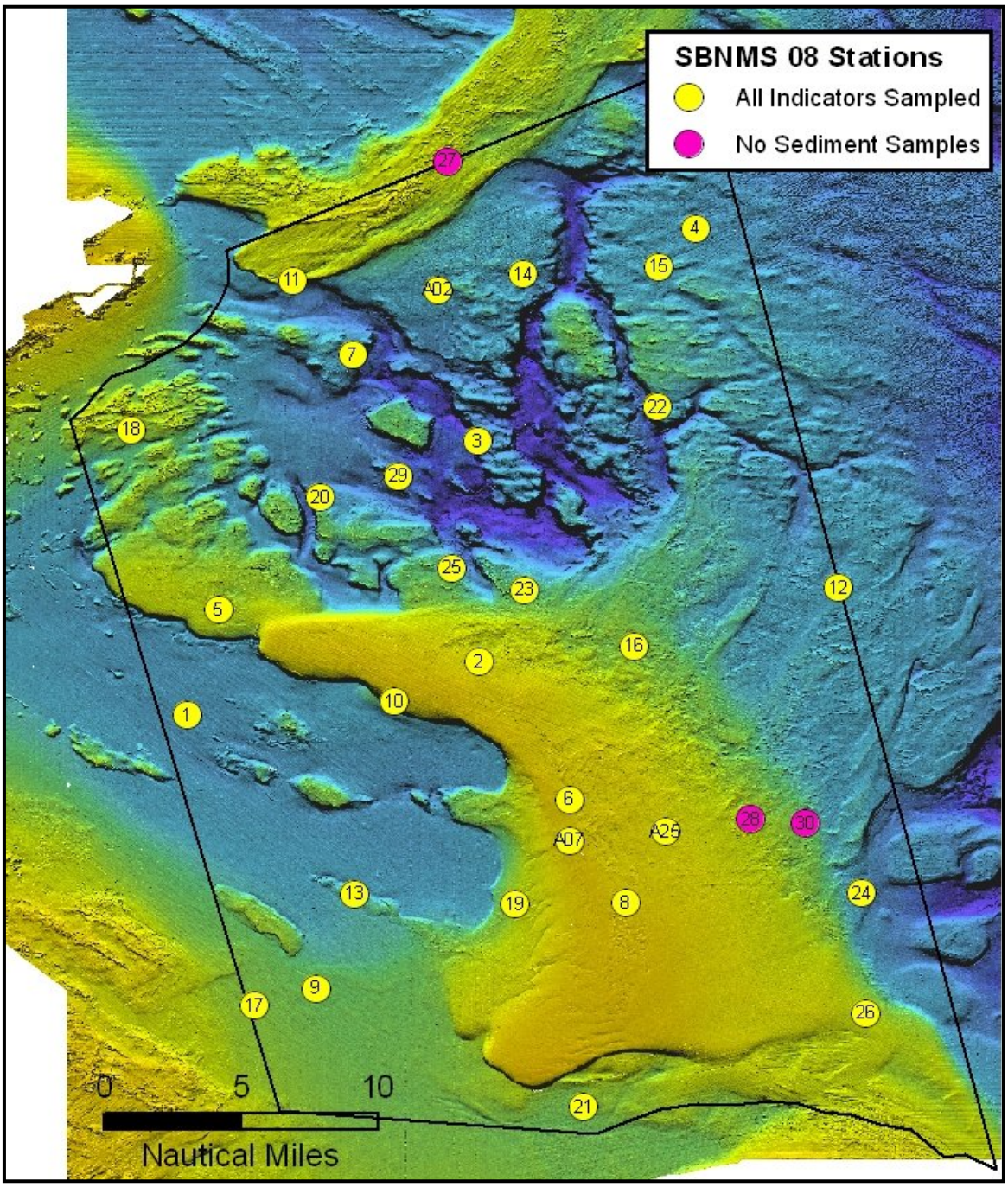


Figure 1. Overall study area and sampling sites for summer 2008 Integrative Assessment of Stellwagen Bank National Marine Sanctuary. Yellow circles indicate stations where all indicators were sampled. Pink circles indicate stations where no sediment samples were collected because of rocky bottom habitat.

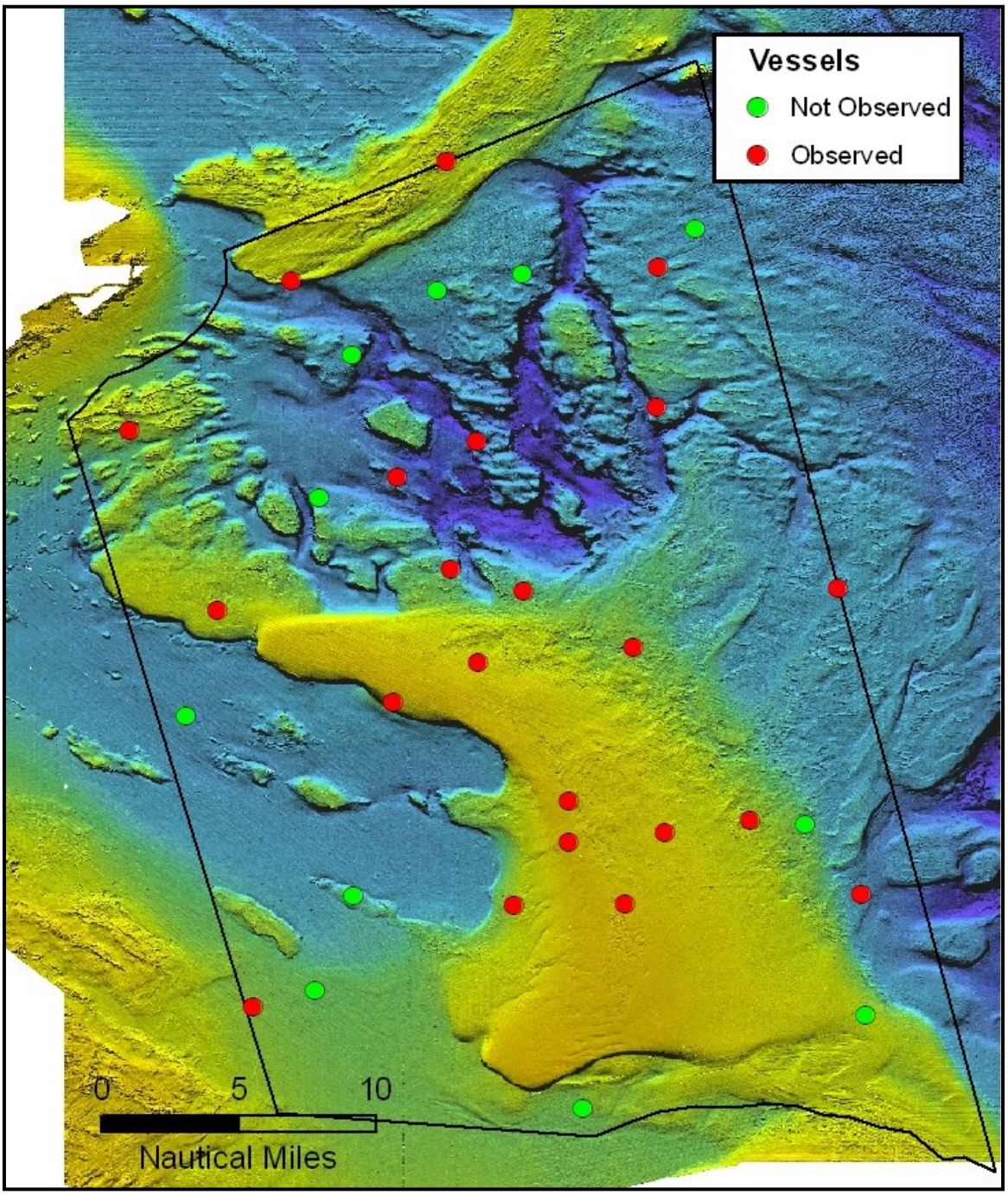


Figure 2. Station locations where vessels were observed (red circles) or not observed (green circles) during summer 2008 Integrative Assessment of Stellwagen Bank National Marine Sanctuary.

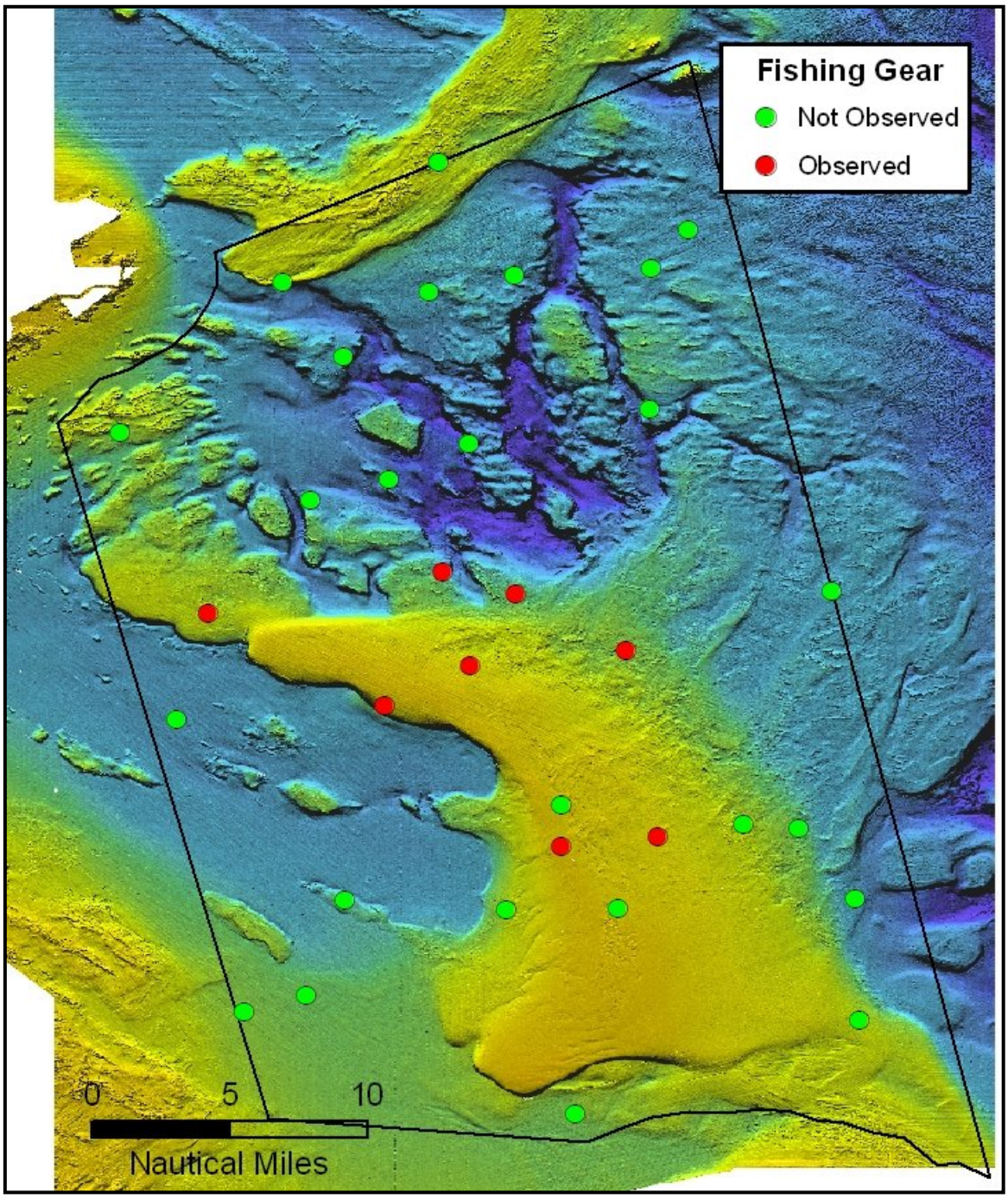


Figure 3. Station locations where fishing gear was observed (red circles) or not observed (green circles) during summer 2008 Integrative Assessment of Stellwagen Bank National Marine Sanctuary.

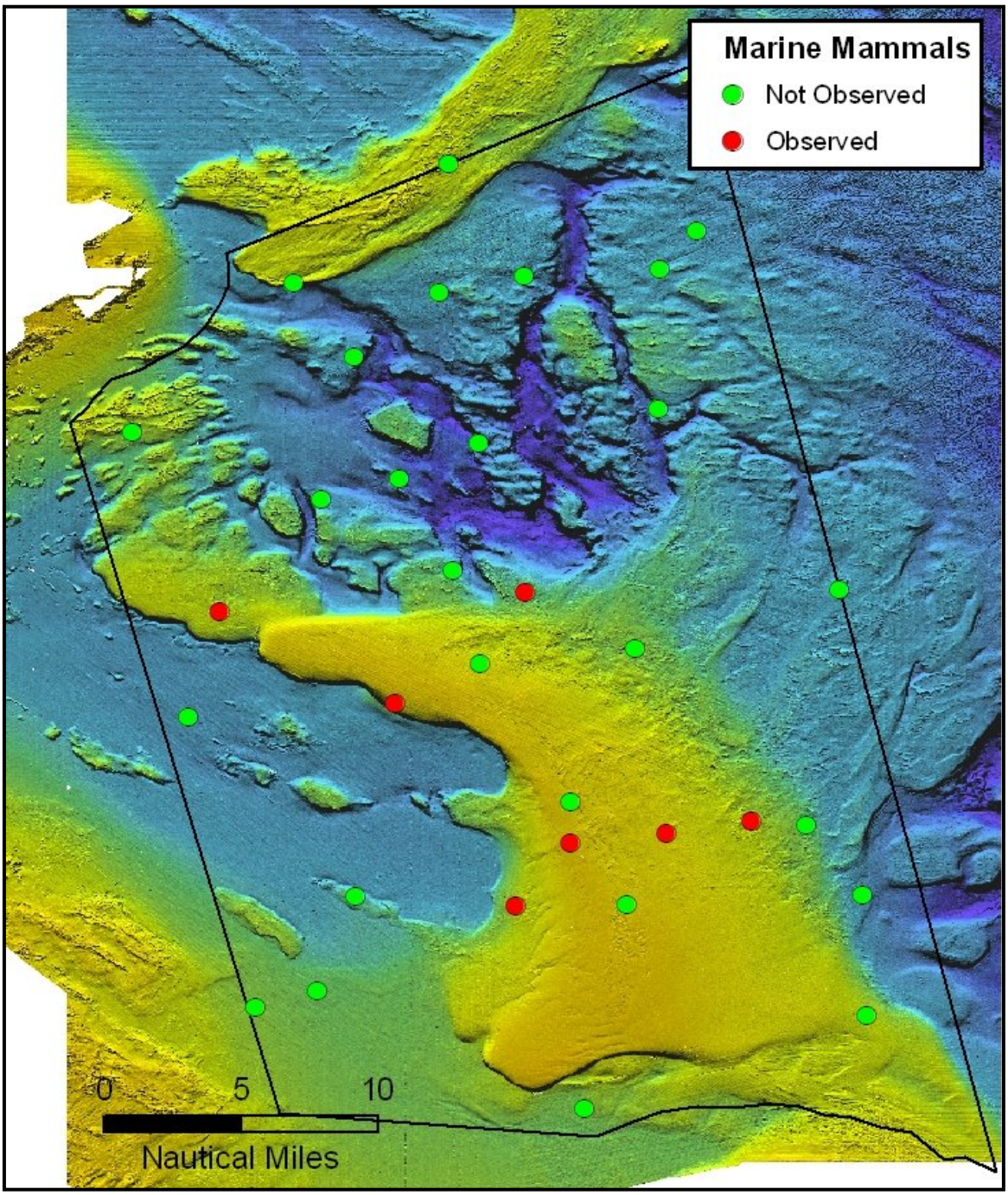


Figure 4. Station locations where marine mammals were observed (red circles) or not observed (green circles) during summer 2008 Integrative Assessment of Stellwagen Bank National Marine Sanctuary.

Table 1. Locations, depths, and bottom water characteristics for 33 stations sampled within SBNMS, June 2008.

Station	Date Sampled	Latitude (DD)	Longitude (DD)	Depth (m)	Near-Bottom Water					
					Temp. (C)	DO (mg/L)	pH	Salinty (ppt)	Turbidity (NTU)	TSS (mg/L)
1	6/19/2008	42.36902	-70.52692	93	4.36	5.98	7.65	32.40	1.361	6.9
2	6/19/2008	42.40162	-70.34907	42	5.58	6.66	7.74	32.20	0.687	15.1
3	6/20/2008	42.53540	-70.35034	137	4.62	6.33	7.70	32.52	0.352	5.8
4	6/20/2008	42.66465	-70.21794	90	4.94	6.30	7.71	32.46	0.357	8.7
5	6/19/2008	42.43304	-70.50733	55	5.49	6.47	7.74	32.20	0.712	6.2
6	6/19/2008	42.31778	-70.29494	34	6.02	6.82	7.80	32.40	0.433	8.7
7	6/20/2008	42.58792	-70.42620	85	5.04	6.41	7.74	32.37	0.594	5.2
8	6/18/2008	42.25497	-70.26070	33	5.92	6.69	7.80	32.16	1.609	7.0
9	6/18/2008	42.20325	-70.44878	65	4.64	6.16	7.71	32.35	1.514	6.3
10	6/19/2008	42.37727	-70.40142	42	6.13	6.65	7.77	32.22	0.846	5.9
11	6/20/2008	42.63309	-70.46301	50	5.75	6.66	7.78	32.15	0.432	5.2
12	6/19/2008	42.44634	-70.13119	84	4.82	6.42	7.67	32.48	0.214	6.0
13	6/18/2008	42.26046	-70.42533	75	4.39	5.98	7.61	32.40	1.612	7.4
14	6/20/2008	42.63698	-70.32280	89	5.03	6.38	7.69	32.45	0.396	5.2
15	6/20/2008	42.64134	-70.24021	83	4.96	6.35	7.73	32.47	0.392	9.1
16	6/19/2008	42.41108	-70.25529	59	5.15	6.66	7.72	32.26	0.254	8.6
17	6/18/2008	42.19279	-70.48567	61	4.79	6.28	7.69	32.33	1.878	6.7
18	6/21/2008	42.54229	-70.56082	65	5.92	6.57	7.76	32.10	0.439	8.0
19	6/18/2008	42.25418	-70.32759	54	4.69	6.09	7.68	32.35	1.397	7.3
20	6/19/2008	42.50134	-70.44600	82	5.08	6.40	7.72	32.34	0.810	6.0
21	6/17/2008	42.13129	-70.28621	65	4.98	6.34	7.76	32.22	2.850	5.0
22	6/20/2008	42.55612	-70.24165	95	4.69	6.37	7.71	32.50	0.339	9.3
23	6/19/2008	42.44507	-70.32237	68	5.35	6.55	7.73	32.30	0.363	6.7
24	6/18/2008	42.26105	-70.11768	93	4.98	6.46	7.68	32.39	0.616	5.8
25	6/19/2008	42.45865	-70.36629	83	5.34	6.54	7.70	32.29	0.743	7.0
26	6/17/2008	42.18791	-70.11456	55	5.19	6.46	7.66	32.35	2.116	6.3
29	6/20/2008	42.51436	-70.39874	130	4.62	6.30	7.68	32.49	0.403	9.7
A02	6/20/2008	42.62745	-70.37403	85	5.18	6.40	7.73	32.41	0.513	4.8
A07	6/18/2008	42.29310	-70.29426	31	6.23	7.01	7.77	32.19	0.290	3.4
A25	6/18/2008	42.29822	-70.23617	40	5.78	6.56	7.75	32.25	0.247	6.9
27*	6/20/2008	42.70567	-70.36828	52	5.55	6.50	7.73	32.23	0.569	4.8
28*	6/18/2008	42.30580	-70.18511	45	5.54	6.56	7.76	32.26	0.476	4.4
30*	6/18/2007	42.30322	-70.15112	68	5.25	6.53	7.73	32.34	0.258	4.7
			Mean	*70.2*	*5.22*	*6.45*	*7.72*	*32.33*	*0.832*	*6.9*

* - no sediment samples collected, too rocky.

Table 2. Summary of field samples to be collected at each 2008 SBNMS station.

Parameters	# of Replicates	Container	Sample Size	Preservation
Infauna	2	1000 ml Polypropylene jar	All material retained on 0.5mm sieve	10% Buffered Formalin in the field
Metal Contaminants	1 (composited sediment)	250 ml (8 oz) polypropylene jar	2/3 full	frozen
Organic Contaminants	1 (composited sediment)	250 ml (8 oz) glass jar	2/3 full	frozen
TOC	1 (composited sediment)	125 ml (4 oz) Polypropylene jar	2/3 full	frozen
% Silt/Clay & % Moisture	1 (composited sediment)	500 ml (16 oz) HDPE jar	2/3 full	frozen
Microtox	1 (surficial sediment scoped from surface)	125 ml (4 oz) Glass jar	2/3 Full	Refrigerate
Water Column (Temp., D.O., pH, Sal.)	1	N/A	Profile	N/A
Turbidity (NTU)	2 (water column - surface, bottom)	N/A	Hach Turbidimeter	N/A
Total Suspended Solids	2 (water column - surface, bottom)	47 mm preweighed filter pads	TSS retained on filter pad	frozen
Nutrients	2 (water column - surface, bottom)	60 ml HDPE containers	2/3 full	frozen
Chlorophyll a	2 (water column - surface, bottom)	25 mm filter pads	cells retained on pad	frozen
Fish Tissue	--	ziplock bag	Multiple specimens	frozen

Table 3. Summary by station of nutrients and chlorophyll at 33 stations sampled within SBNMS, June 2008. All data are reported in µg/L.

	Surface Water						Bottom Water					
Station	DIP	DIN	Silicate	Total N	Total P	CHL*a*	DIP	DIN	Silicate	Total N	Total P	CHL*a*
1	0.03	0.03	0.16	0.21	0.02	0.77	0.14	0.68	0.95	0.28	0.04	0.21
2	0.03	0.06	0.39	0.16	0.02	0.56	0.09	0.36	0.58	0.30	0.04	0.56
3	0.03	0.05	0.07	0.12	0.02	0.54	0.13	0.74	0.79	0.27	0.04	0.09
4	0.03	0.05	0.22	0.11	0.02	0.63	0.13	0.68	0.77	0.27	0.04	0.08
5	0.03	0.06	0.20	0.18	0.02	0.54	0.09	0.33	0.39	0.30	0.04	1.10
6	0.03	0.05	0.07	0.11	0.02	0.58	0.09	0.34	0.30	0.20	0.03	1.07
7	0.03	0.06	0.18	0.14	0.02	0.38	0.12	0.59	0.77	0.30	0.04	0.26
8	0.04	0.07	0.04	0.19	0.02	0.56	0.10	0.32	0.37	0.35	0.03	0.87
9	0.03	0.06	0.02	0.14	0.02	0.31	0.13	0.63	0.69	0.31	0.04	0.23
10	0.03	0.06	0.22	0.22	0.02	0.37	0.09	0.28	0.36	0.29	0.03	1.12
11	0.03	0.06	0.28	0.16	0.01	0.40	0.11	0.44	0.42	0.32	0.03	0.42
12	0.04	0.05	0.04	0.11	0.01	0.37	0.13	0.68	0.66	0.25	0.04	0.07
13	0.02	0.06	0.07	0.16	0.02	0.47	0.13	0.67	0.89	0.33	0.04	0.25
14	0.03	0.08	0.30	0.16	0.01	0.34	0.12	0.65	0.88	0.36	0.04	0.11
15	0.03	0.05	0.00	0.11	0.01	0.38	0.12	0.66	0.69	0.26	0.04	0.07
16	0.03	0.05	0.05	0.12	0.02	0.59	0.10	0.46	0.50	0.21	0.03	0.29
17	0.02	0.05	0.19	0.16	0.02	0.71	0.11	0.57	0.82	0.28	0.04	0.26
18	0.05	0.06	0.27	0.14	0.02	1.65	0.10	0.35	0.61	0.26	0.04	0.35
19	0.02	0.05	0.00	0.17	0.02	0.32	0.13	0.62	0.70	0.43	0.04	0.24
20	0.10	0.55	0.66	0.20	0.02	0.45	0.02	0.06	0.11	0.33	0.04	0.25
21	0.02	0.05	0.08	0.22	0.02	1.26	0.12	0.46	0.60	0.38	0.04	0.33
22	0.03	0.05	0.01	0.11	0.02	0.39	0.12	0.70	0.70	0.26	0.04	0.07
23	0.03	0.05	0.09	0.12	0.02	0.75	0.10	0.50	0.49	0.25	0.04	0.21
24	0.03	0.05	0.04	0.17	0.02	0.48	0.12	0.59	0.56	0.27	0.04	0.15
25	0.03	0.05	0.19	0.14	0.02	0.61	0.12	0.51	0.60	0.34	0.04	0.34
26	0.03	0.06	0.02	0.24	0.02	0.64	0.12	0.55	0.52	0.31	0.04	0.22
29	0.03	0.05	0.04	0.14	0.02	0.36	0.13	0.73	0.73	0.29	0.04	0.09
A02	0.12	0.56	0.72	0.30	0.04	0.40	0.12	0.55	0.71	0.13	0.02	0.16
A07	0.03	0.05	0.06	0.14	0.02	0.78	0.10	0.32	0.32	0.21	0.03	1.00
A25	0.03	0.05	0.03	0.13	0.02	0.59	0.10	0.39	0.33	0.23	0.04	0.47
27	0.03	0.05	0.32	0.13	0.02	0.31	0.11	0.50	0.64	0.32	0.04	0.18
28	0.03	0.05	0.05	0.12	0.02	0.60	0.11	0.45	0.37	0.25	0.04	0.31
30	0.11	0.52	0.50	0.18	0.02	0.42	0.11	0.53	0.48	0.26	0.04	0.15
Mean	*0.04*	*0.10*	*0.17*	*0.16*	*0.02*	*0.56*	*0.11*	*0.51*	*0.58*	*0.29*	*0.04*	*0.35*

Table 4. Summary by station of human-dimension indicators at 33 stations sampled within SBNMS, June 2008. Cautionary Note: The visual range was highly variable – daytime observations were limited to a range of 2-5 nm while nighttime observations were limited to what was immediately adjacent to the vessel or the object being observed had lights that could be seen from a distance..

Station	Surface Trash Present (Y/N)	Trash Description	Surface Oil Present (Y/N)	Other Vessels Present (Y/N)	Fishing Gear Present (Y/N)	Marine Mammals Present (Y/N)
1	N		N	N	N	N
2	N		N	Y	Y	N
3	Y	Plastic jug	N	Y	N	N
4	N		N	N	N	N
5	N		N	Y	Y	Y
6	N		N	Y	N	N
7	N		N	N	N	N
8	N		N	Y	N	N
9	N		N	N	N	N
10	N		N	Y	Y	Y
11	N		N	Y	N	N
12	N		N	Y	N	N
13	N		N	N	N	N
14	N		N	N	N	N
15	Y	Mylar balloon, Plastic bag	N	Y	N	N
16	N		N	Y	Y	N
17	N		N	Y	N	N
18	N		N	Y	N	N
19	N		N	Y	N	Y
20	N		N	N	N	N
21	N		N	N	N	N
22	N		N	Y	N	N
23	N		N	Y	Y	Y
24	N		N	Y	N	N
25	Y	Mylar balloon	N	Y	Y	N
26	N		N	N	N	N
29	N		N	Y	N	N
A02	N		N	N	N	N
A07	Y	Plastic pail, Balloons	N	Y	Y	Y
A25	N		N	Y	Y	Y
27	N		N	Y	N	N
28	N		N	Y	N	Y
30	N		N	N	N	N

Table 5. NF-08-09-CCEHBR cruise participants.

Name	Affliation
Cynthia Cooksey*	NOAA/NOS/CCEHBR
Len Balthis	NOAA/NOS/CCEHBR
Don Cobb	US EPA/Atlantic Ecology Div
JD Dubick	NOAA/NOS/CCEHBR
Anna Greene	NOAA/NOS/CCEHBR
Julie Higgins	NOAA/NOS/CCEHBR
Jeff Hyland	NOAA/NOS/CCEHBR
Laura Kracker	NOAA/NOS/CCEHBR
Steve Roth	NOAA/NOS/CCEHBR
Blaine West	NOAA/NOS/CCEHBR

* - Chief Scientist

Affiliation Addresses:
NOAA/NOS/CCEHBR: 219 Fort Johnson Rd, Charleston, SC 29412
US EPA/Atlantic Ecology Div.: 27 Tarzwell Drive, Narragansett, RI 02882

Appendix A. Activity log for research cruise NF-08-09-CCEHBR.

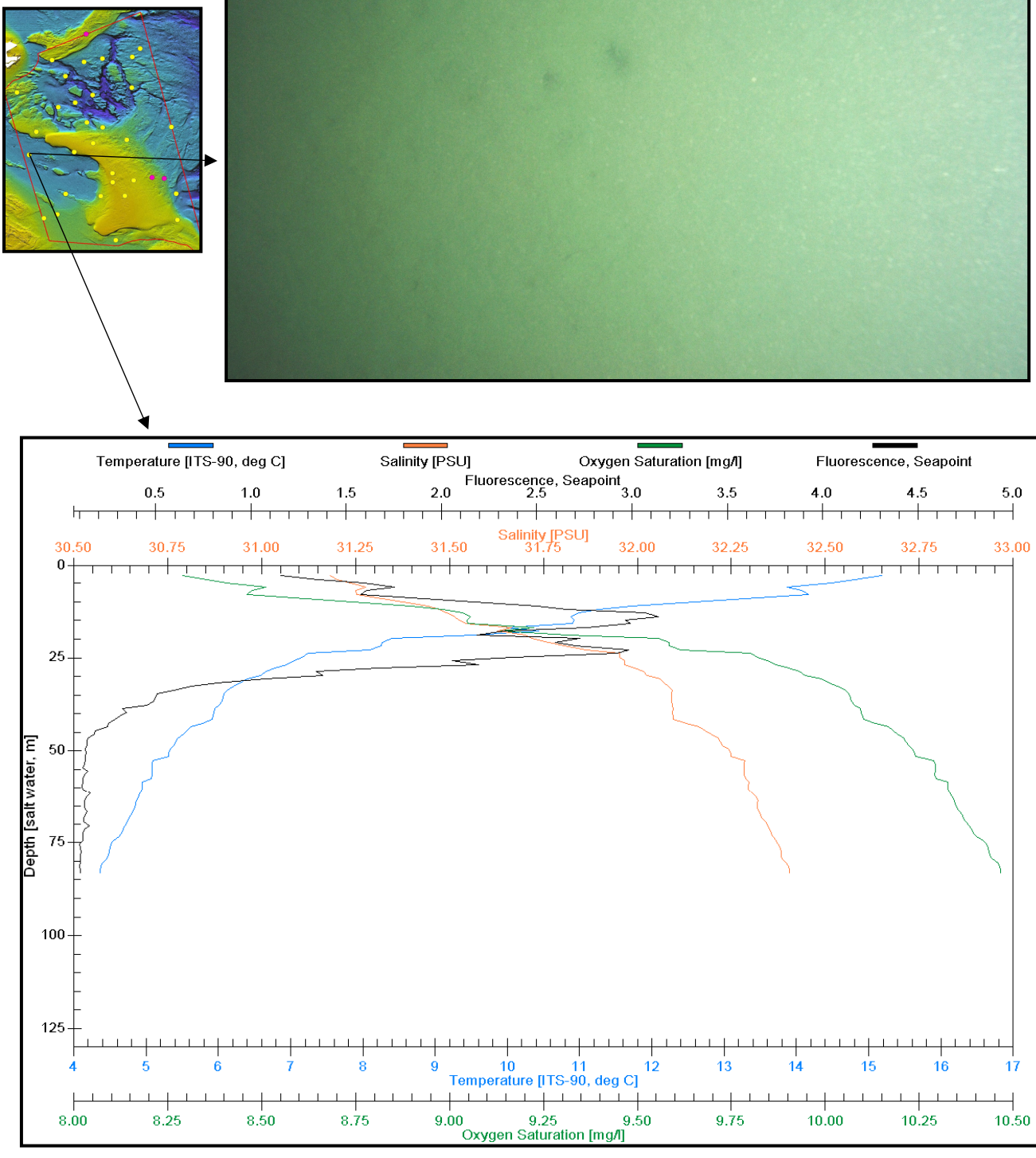
Day	Stations Sampled	CTD Profile	Discrete Water (Surface, Bottom)	Infauna Grab (2 reps)	Bottom Photos	Sediment Chemistry	Fishing (fish caught*)	Comments
1 6/14/08	none; transiting from Charleston							
2 6/15/08	none; transiting from Charleston; 34 08.004N 75 53.735W							CTD cast and Multibeam line for Steve Ross
3 6/16/08	none; transiting from Charleston							
4 6/17/08	21	1	1 (S,B)	2	Yes	1	1 (Hake)	
	26	1	1 (S,B)	2	Yes	1	1 (Hake)	
5 6/18/08	24	1	1 (S,B)	2	Yes	1	1 (Hake)	
	30	1	1 (S,B)		Yes		no fishing	Too rocky, moved to ALT07
	28	1	1 (S,B)		Yes		no fishing	Too rocky, moved to ALT26
	Alt25	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	Alt07	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	8	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	19	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	9	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	17	1	1 (S,B)	2	Yes	1	1 Silver Hake; 1 Red Hake	CTD Cast Last; One dogfish with parasites
	13	1	1 (S,B)	2	Yes	1	6 Red Hake	CTD Cast Last
6 6/19/08	6	1	1 (S,B)	2	Yes	1	2 Red Hake	CTD Cast Last
	12	1	1 (S,B)	2	Yes	1	2 Haddock	CTD Cast Last
	16	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	23	1	1 (S,B)	2	Yes	1	no fish	CTD Cast Last
	25	1	1 (S,B)	2	Yes	1	1 Haddock; 3 Red Hake	CTD Cast Last
	2	1	1 (S,B)	2	Yes	1	no fish	
	10	1	1 (S,B)	2	Yes	1	no fish	
	7	1	1 (S,B)	2	Yes	1	1 American plaice	
	5	1	1 (S,B)	2	Yes	1	no fish	
	20	1	1 (S,B)	2	Yes	1	1 Red Hake	
7 6/20/08	29	1	1 (S,B)	2	Yes	1	1 Acadian Redfish	

Day	Stations Sampled		CTD Profile	Discrete Water (Surface, Bottom)	Infauna Grab (2 reps)	Bottom Photos	Sediment Chemistry	Fishing (fish caught*)	Comments
								1 Acadian Redfish; 1	
		3	1	1 (S,B)	2	Yes	1	Haddock	
		22	1	1 (S,B)	2	Yes	1	4 Haddock	
								1 Haddock, 1	
		15	1	1 (S,B)	2	Yes	1	Atlantic Cod	
								1 Haddock, 1	
		4	1	1 (S,B)	2	Yes	1	Atlantic Cod	
		14	1	1 (S,B)	2	Yes	1	no fish	
									Too rocky, moved to
		27	1	1 (S,B)		Yes		no fishing	ALT11
	Alt02		1	1 (S,B)	2	Yes	1	no fish	
		11	1	1 (S,B)	2	Yes	1	1 Silver Hake	
		7	1	1 (S,B)	2	Yes	1	1 Red Hake	
									Benthic Camera
8 6/21/08		18	1	1 (S,B)	2	No	1	1 Hake (juv.)	Failure
6/21/2008	return to port								

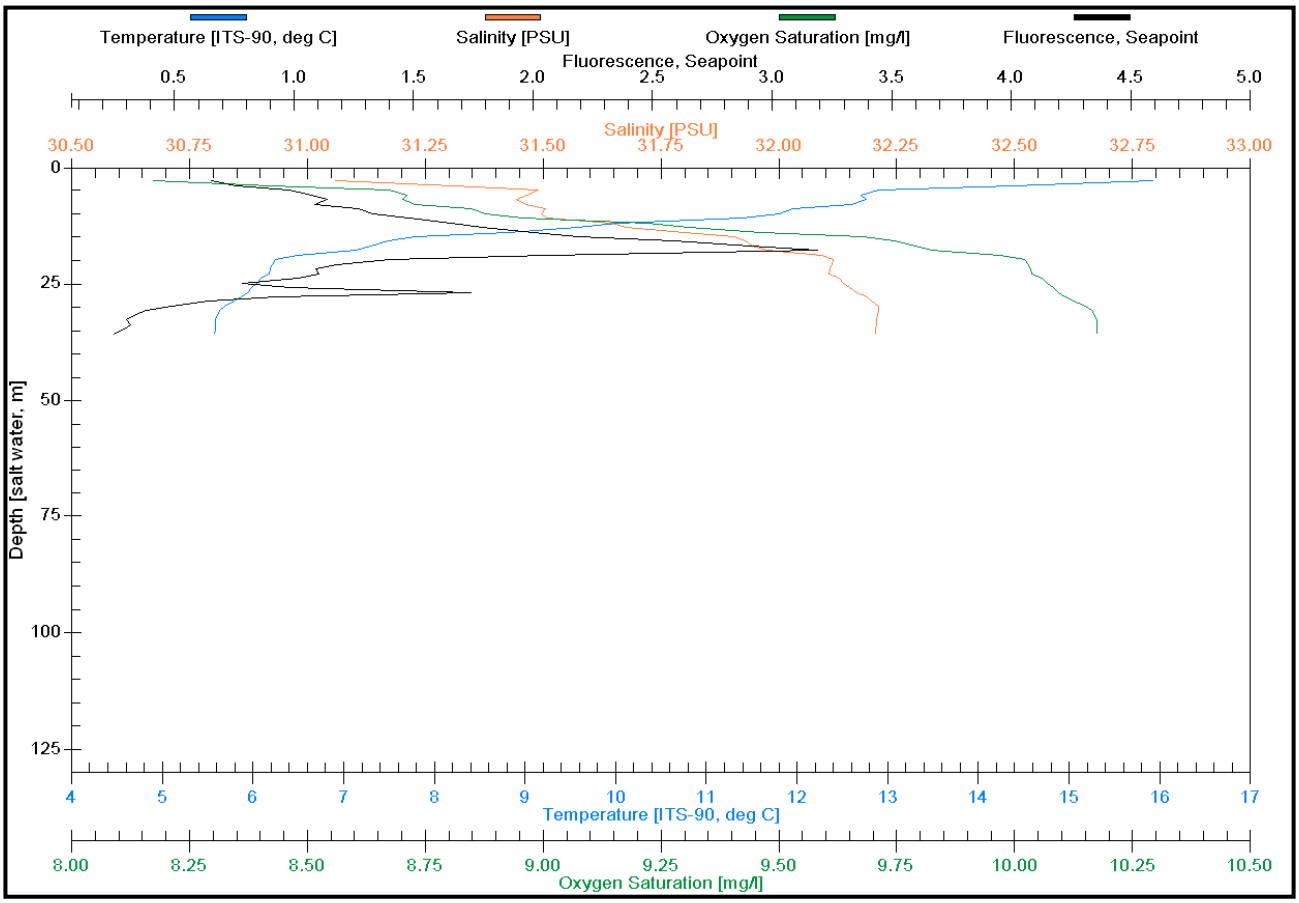
*-excludes dogfish

Appendix B

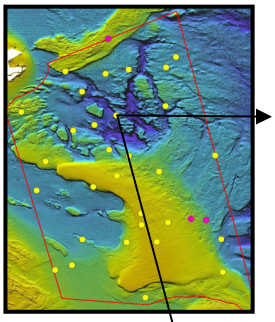
Station 001

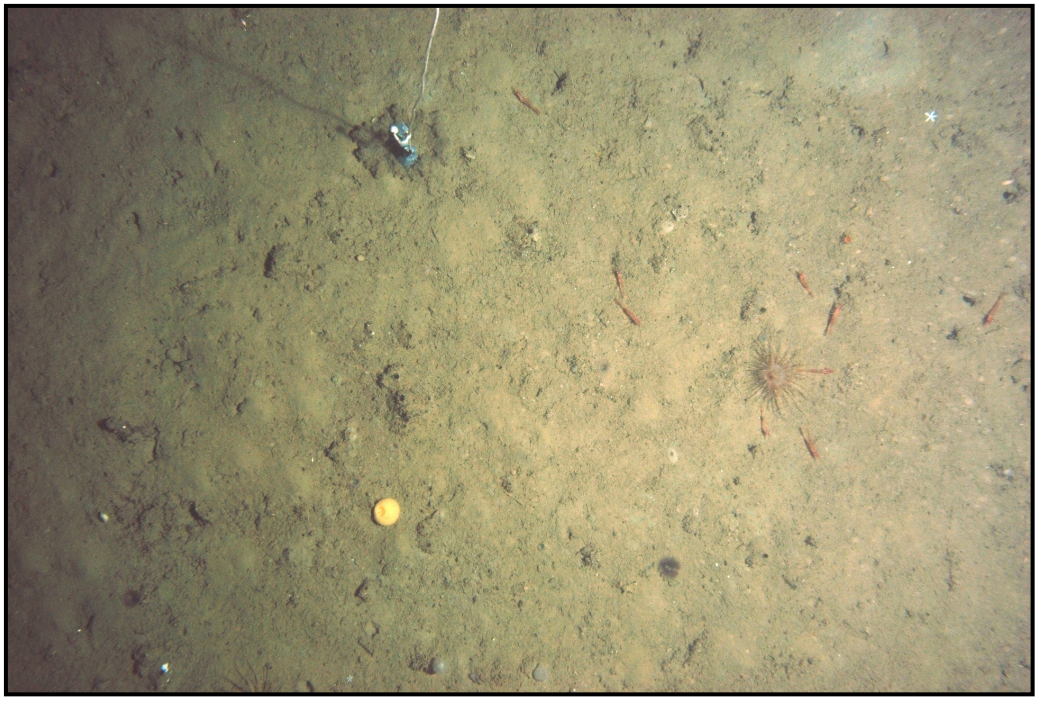

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0
25
50
75
100
125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

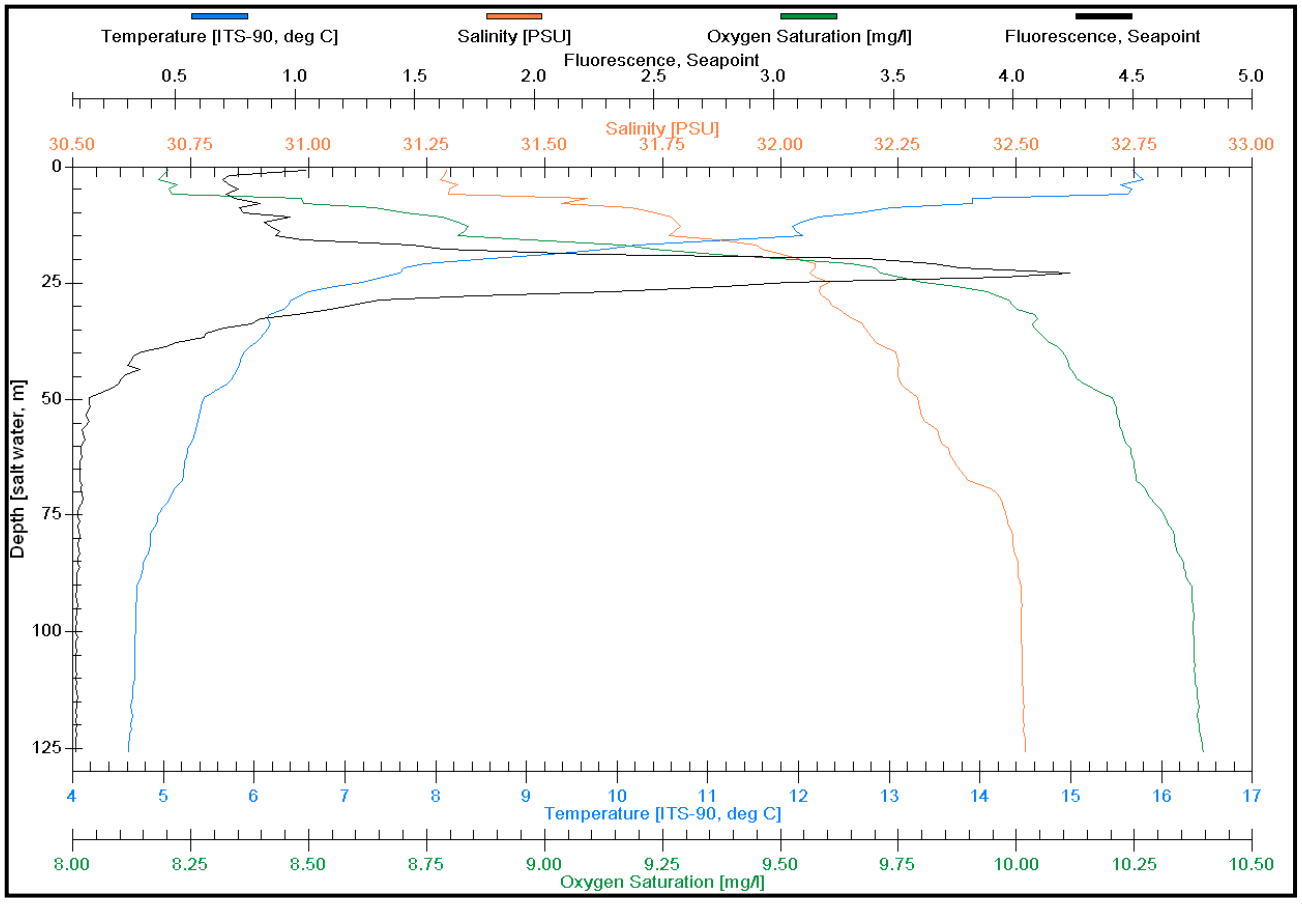
Station 002


Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
Temperature [ITS-90, deg C]
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Oxygen Saturation [mg/l]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50

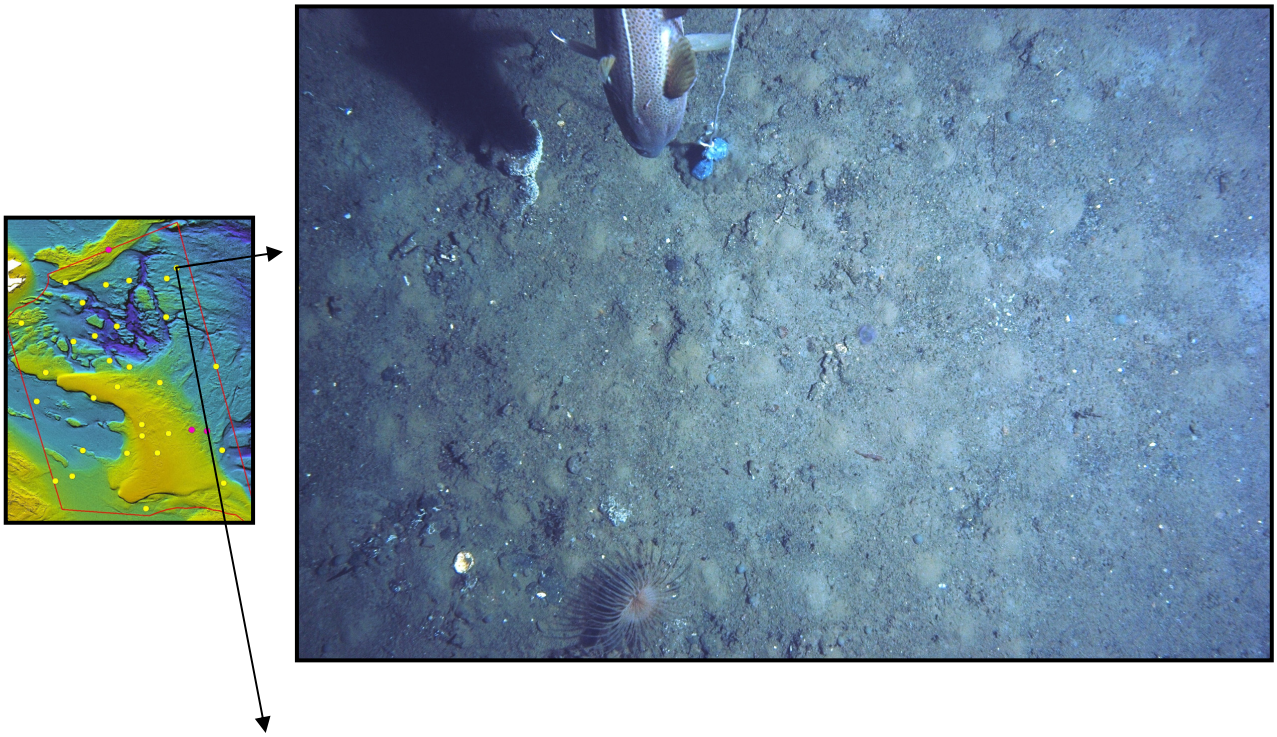
Station 003

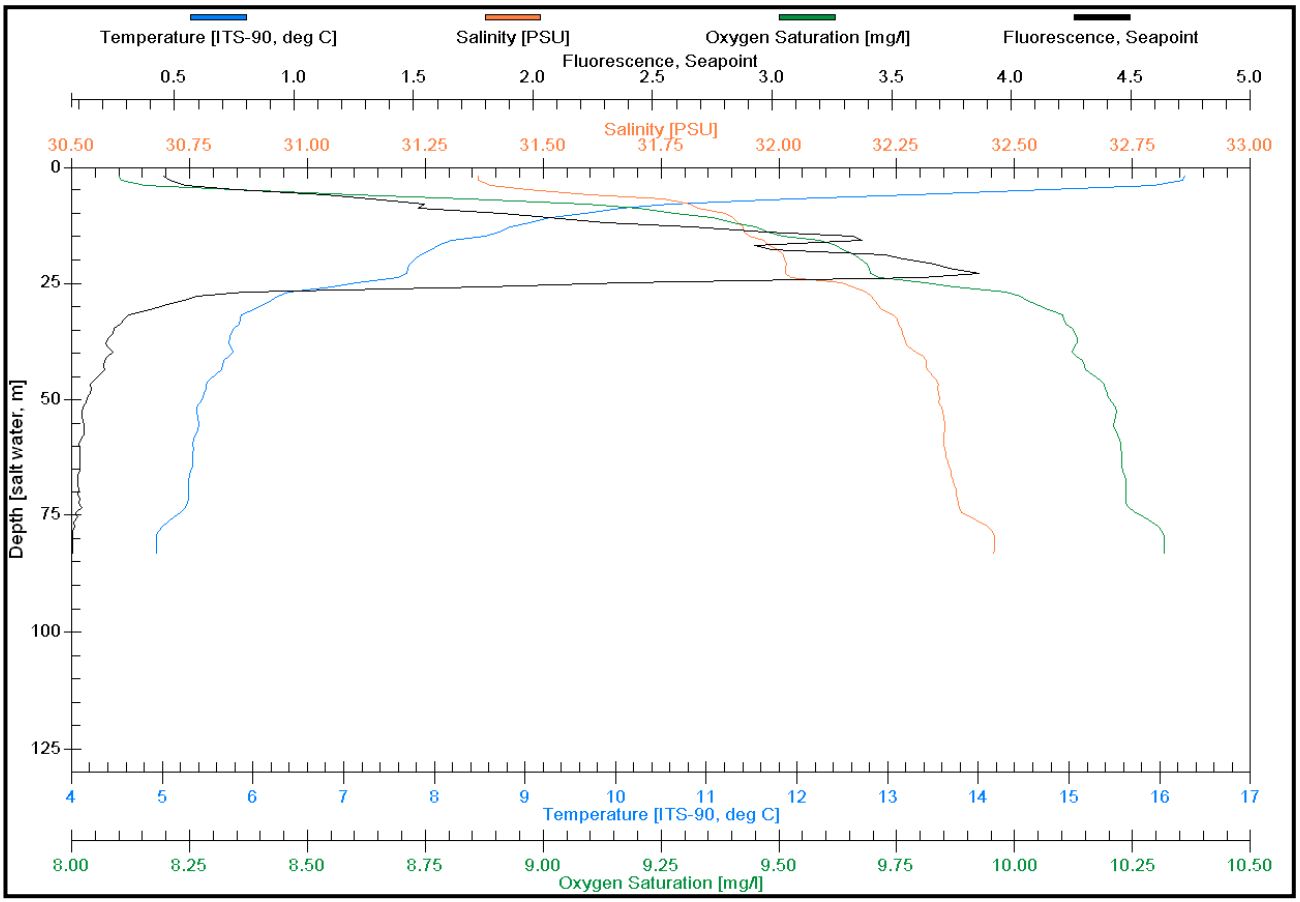




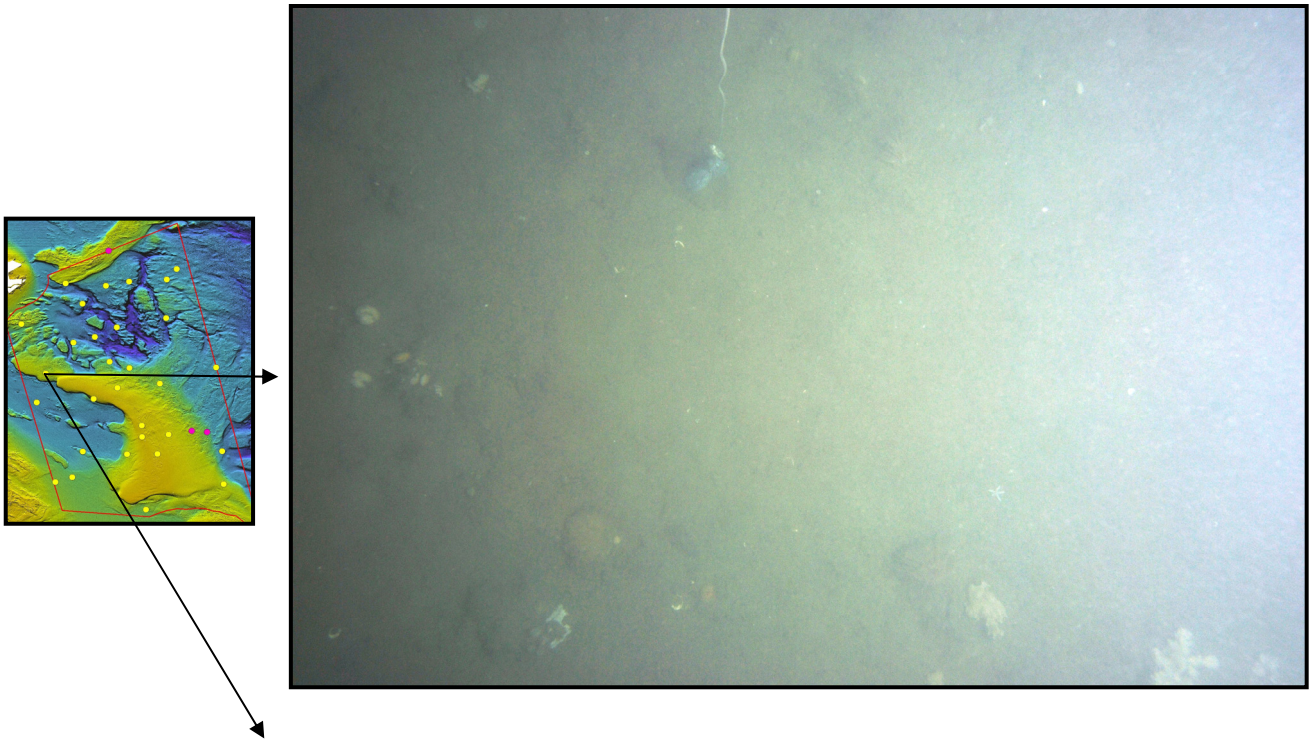

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

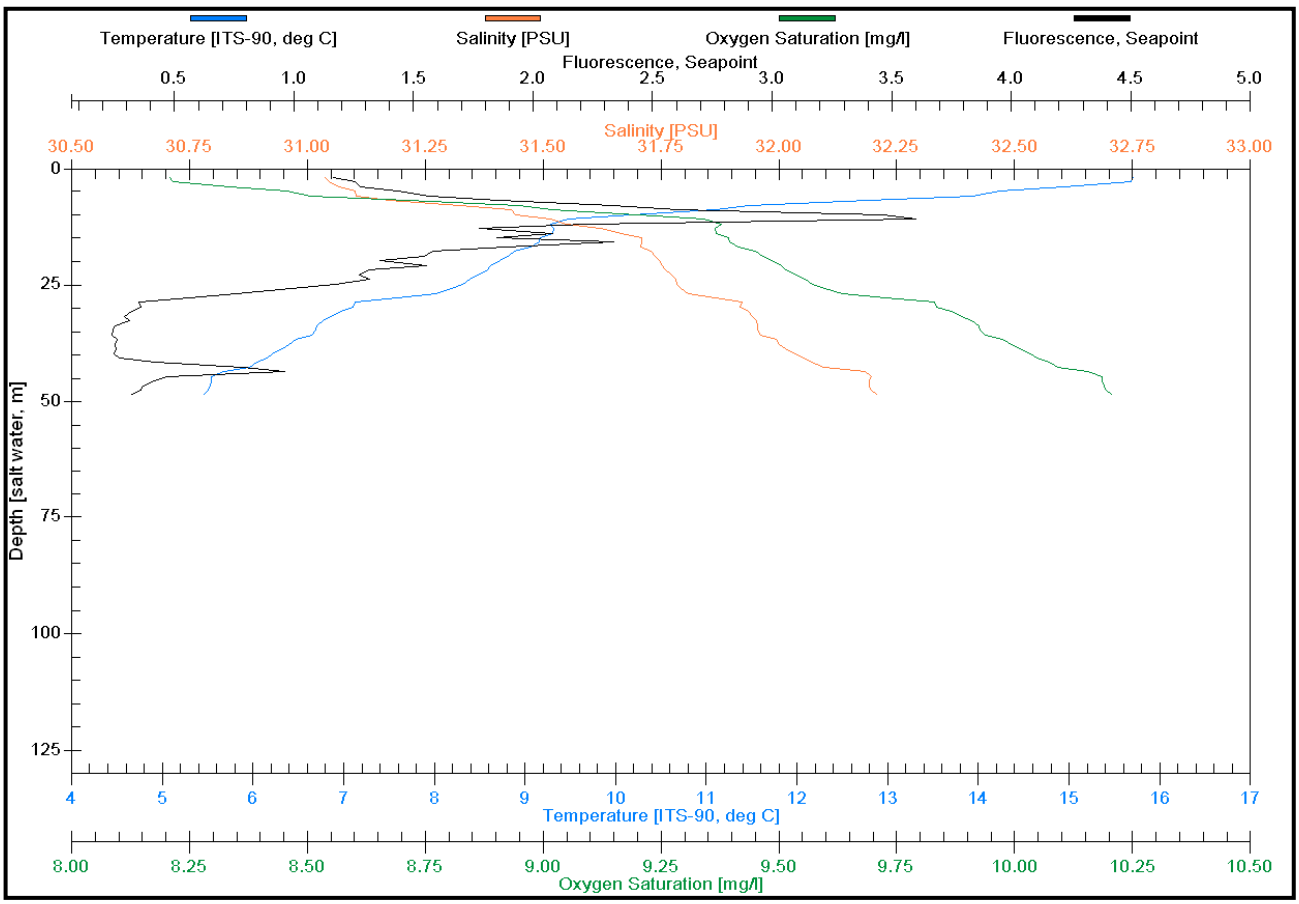
Station 004



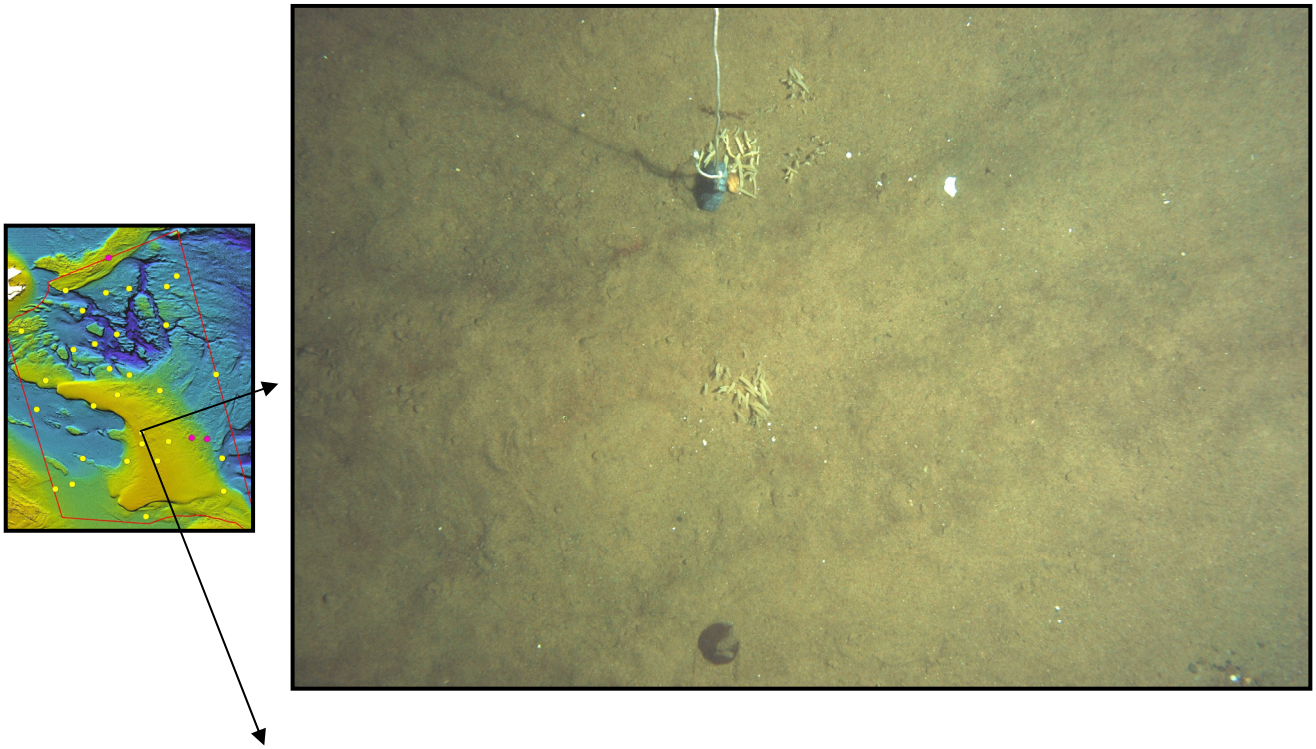

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

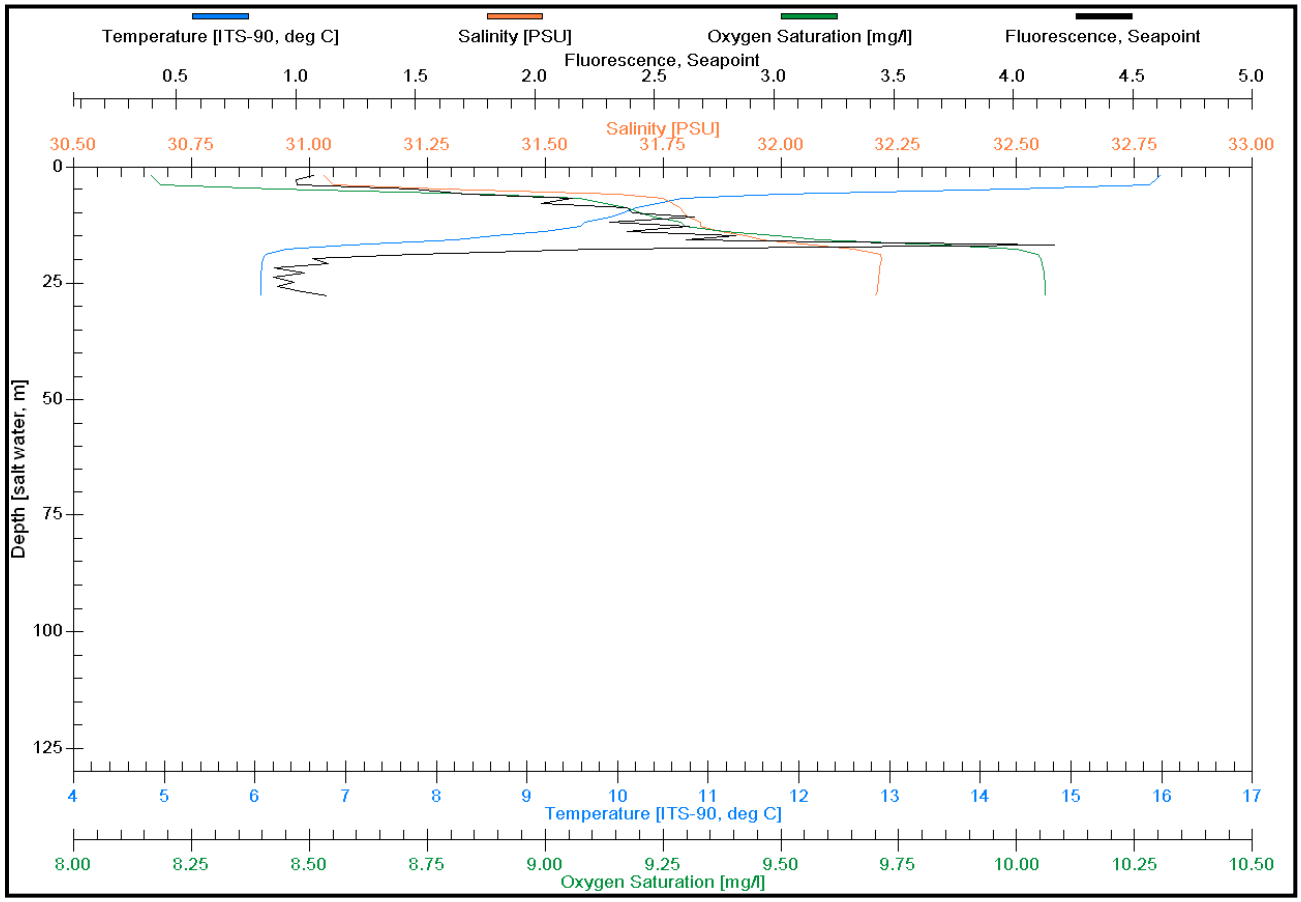
Station 005



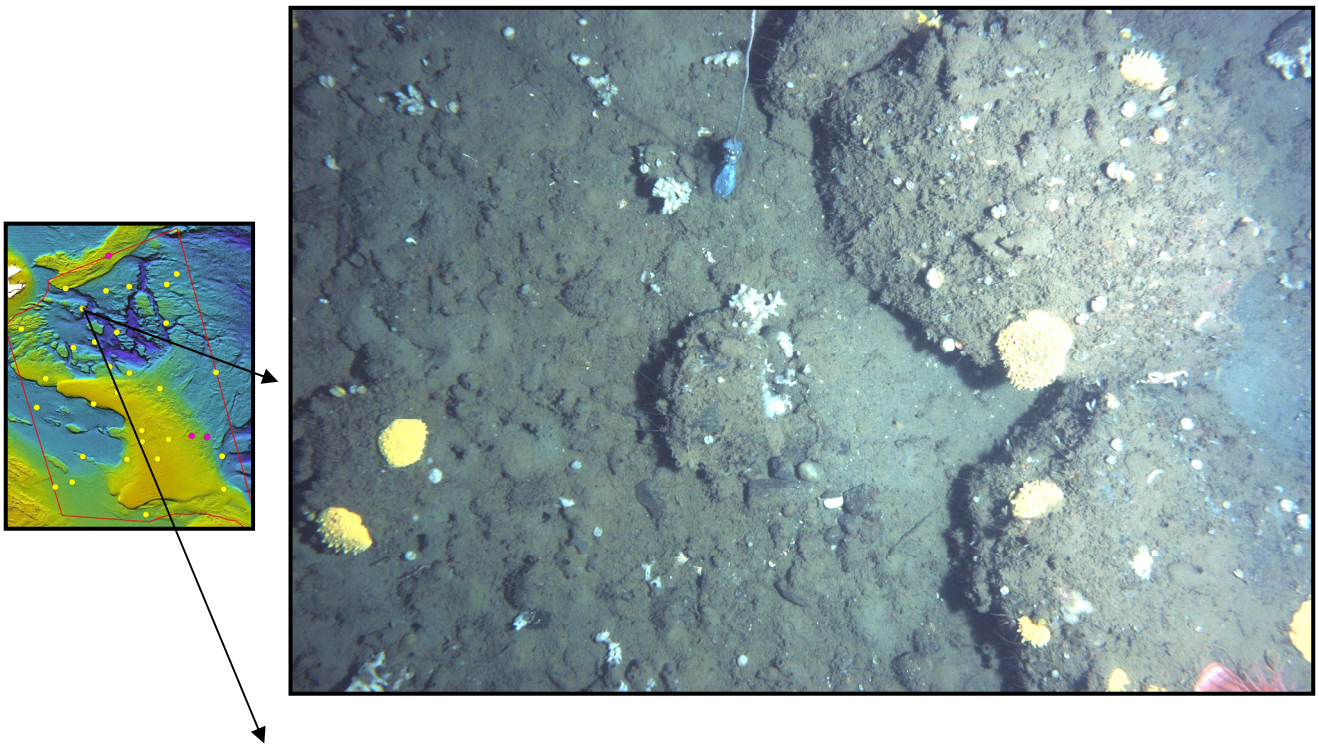

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

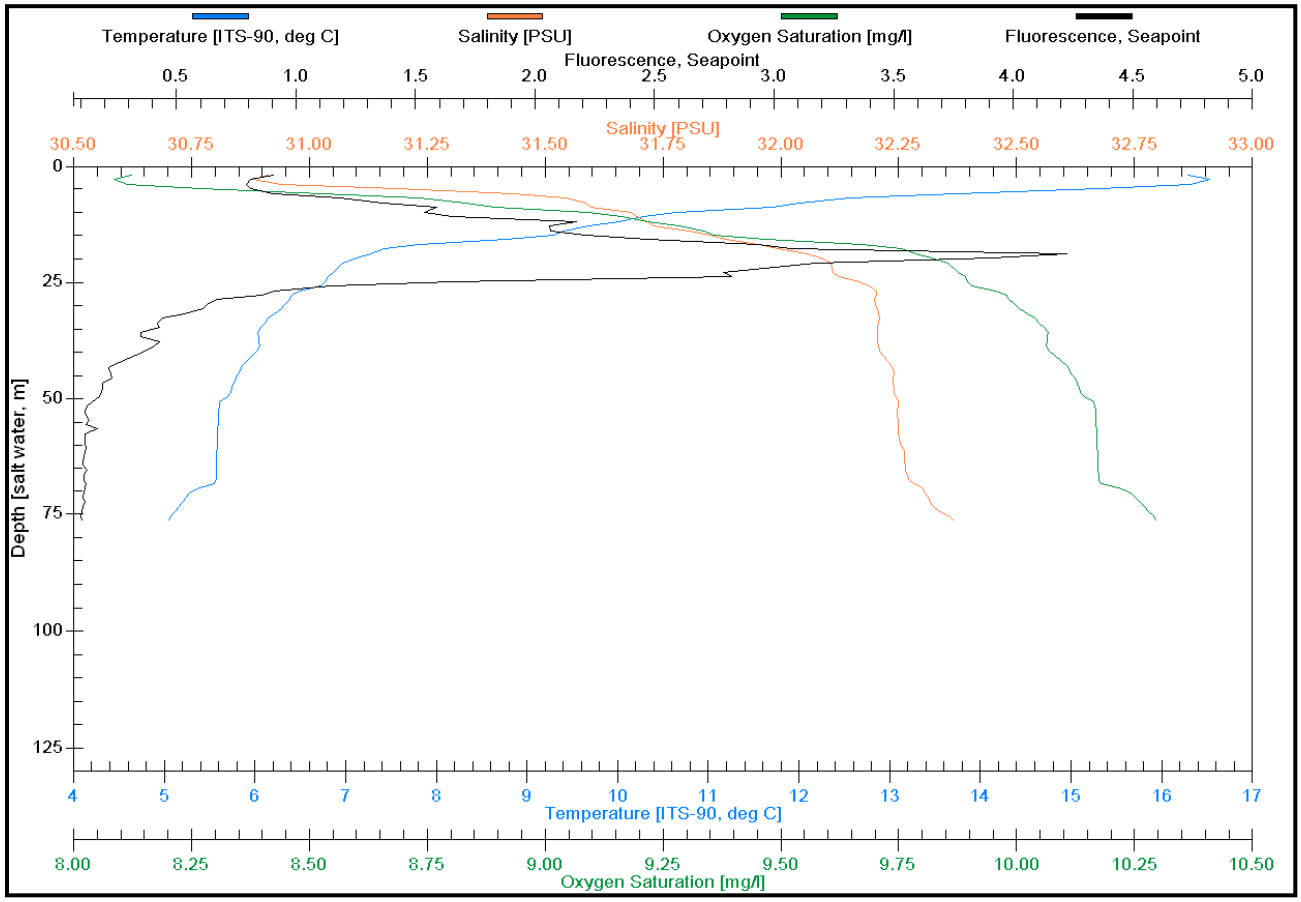
Station 006



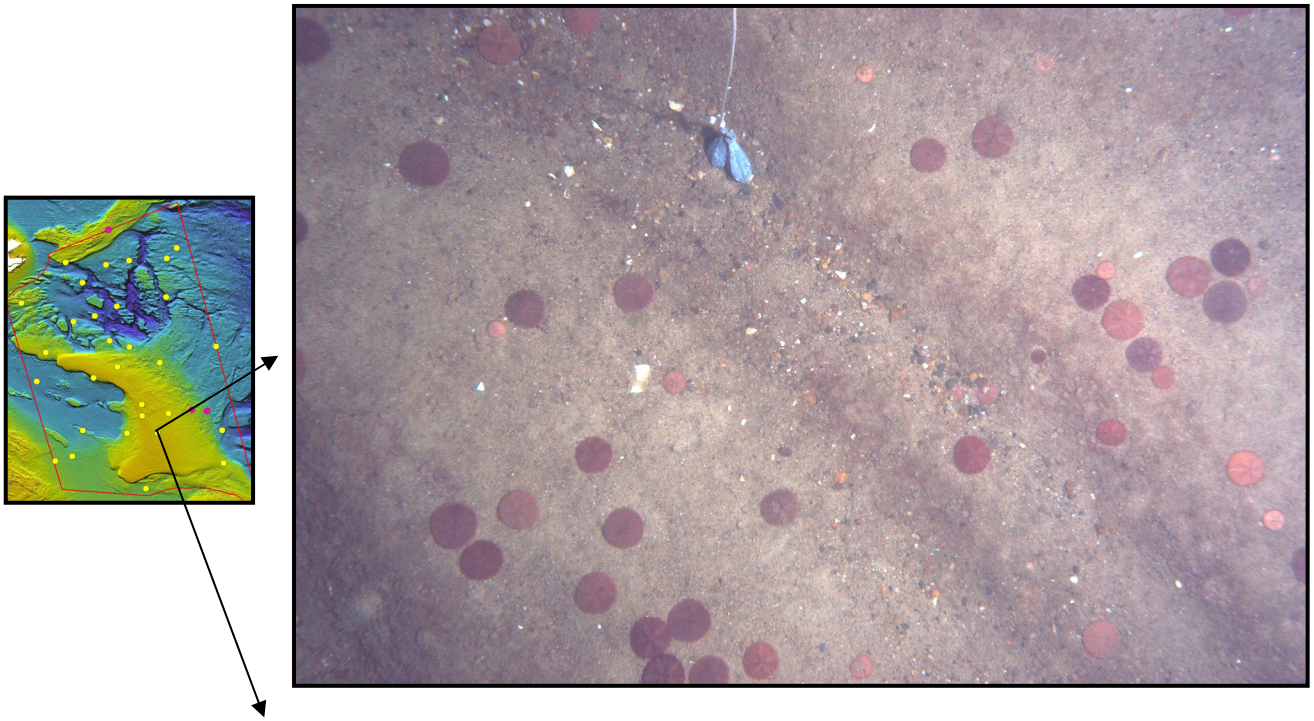

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

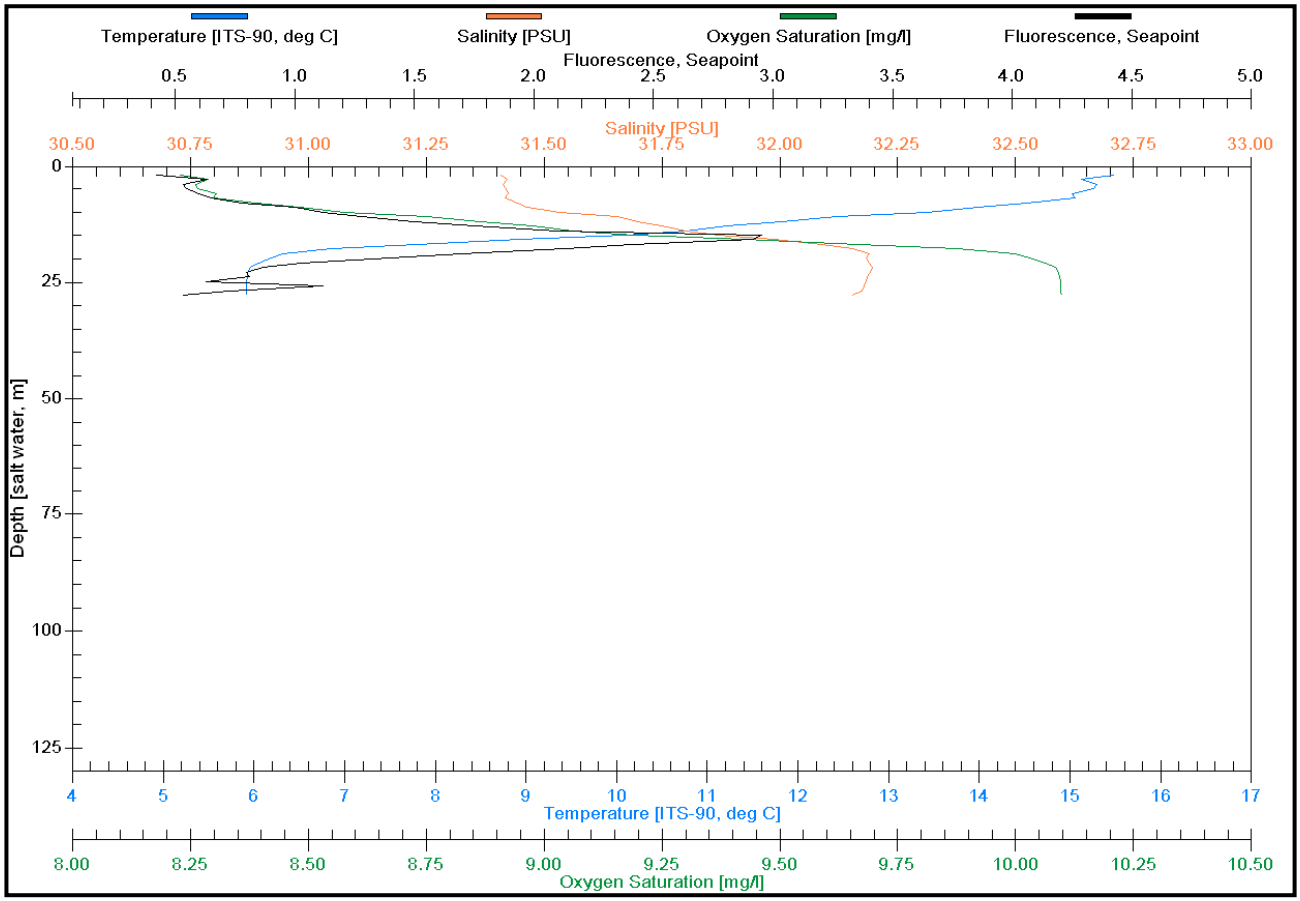
Station 007



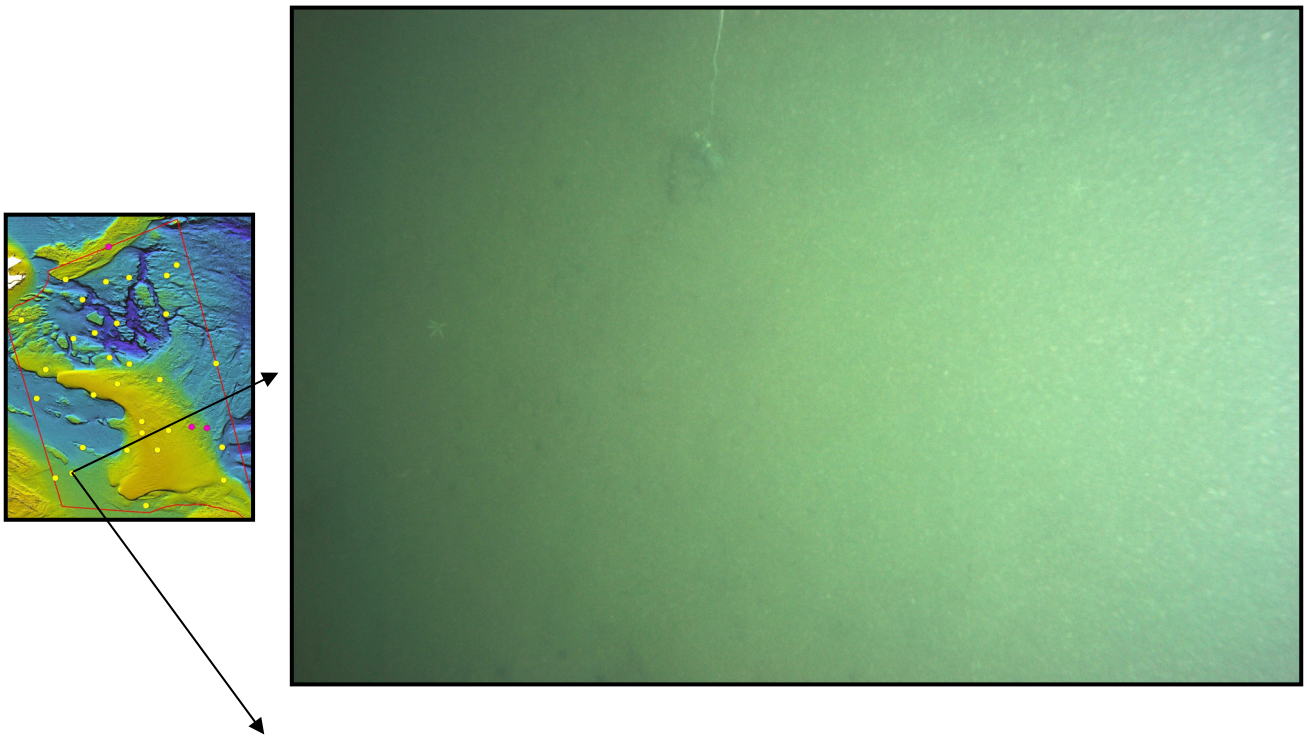

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

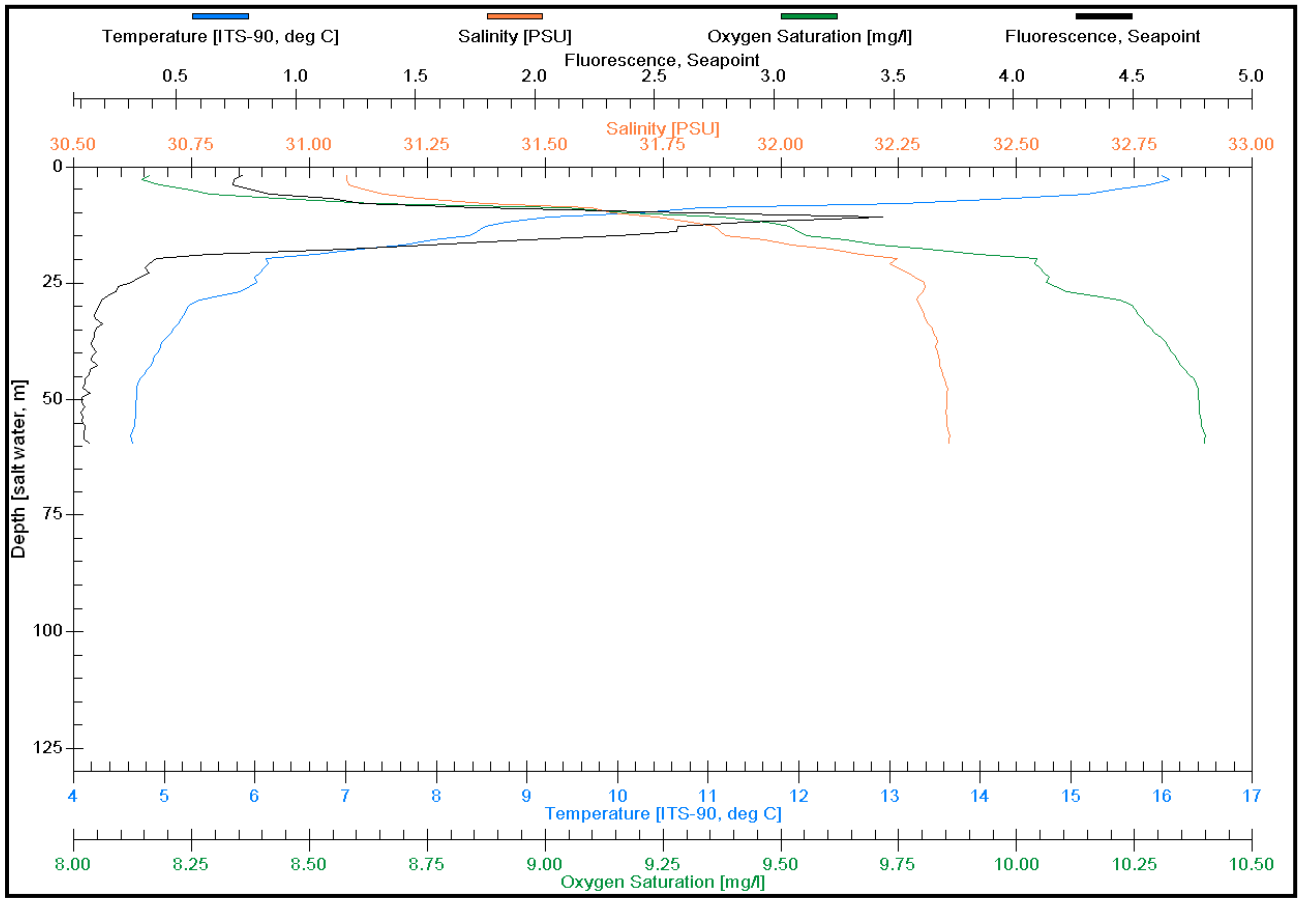
Station 008



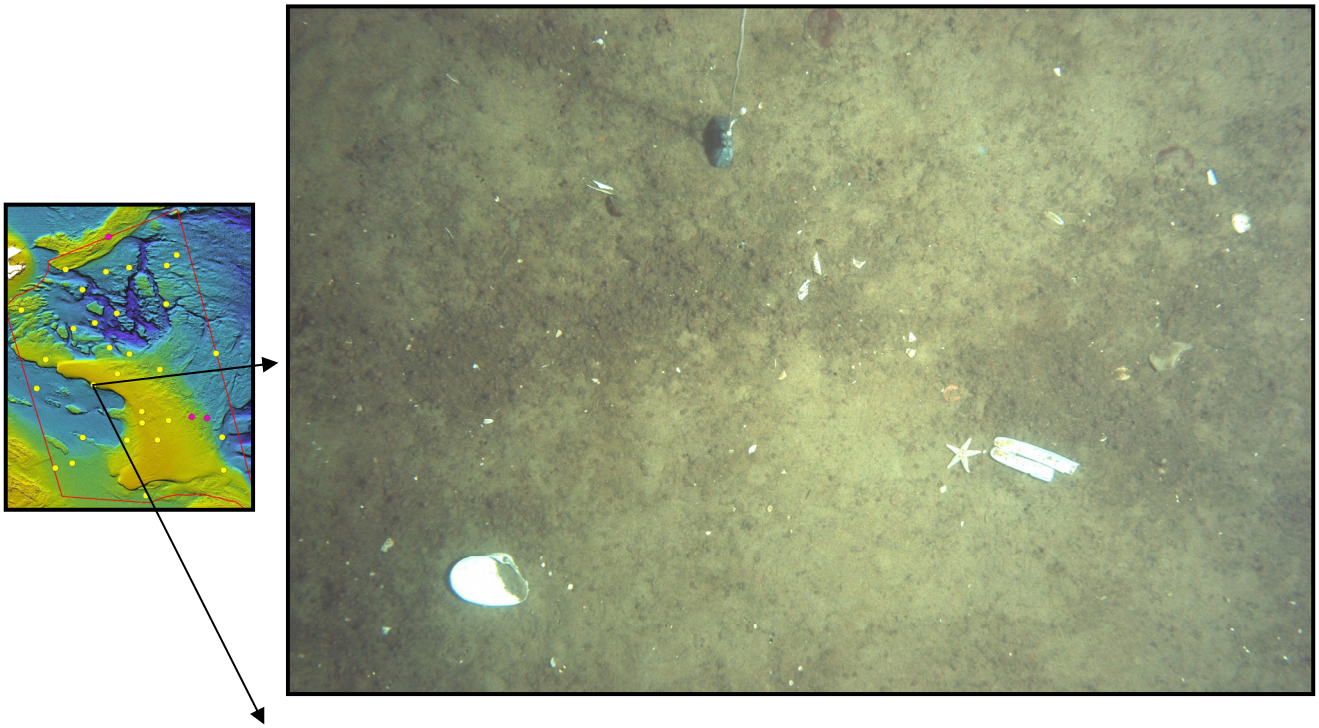

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

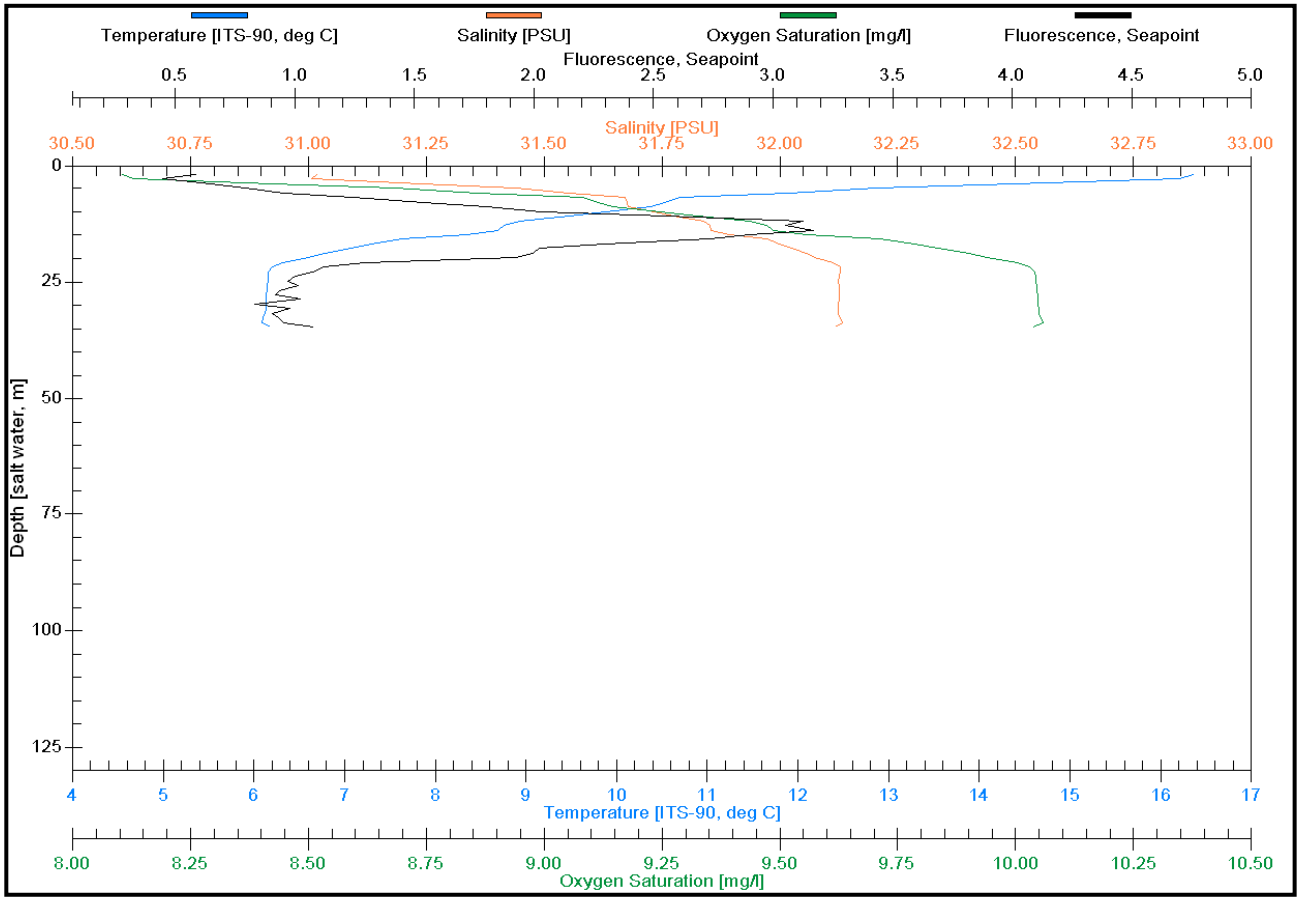
Station 009



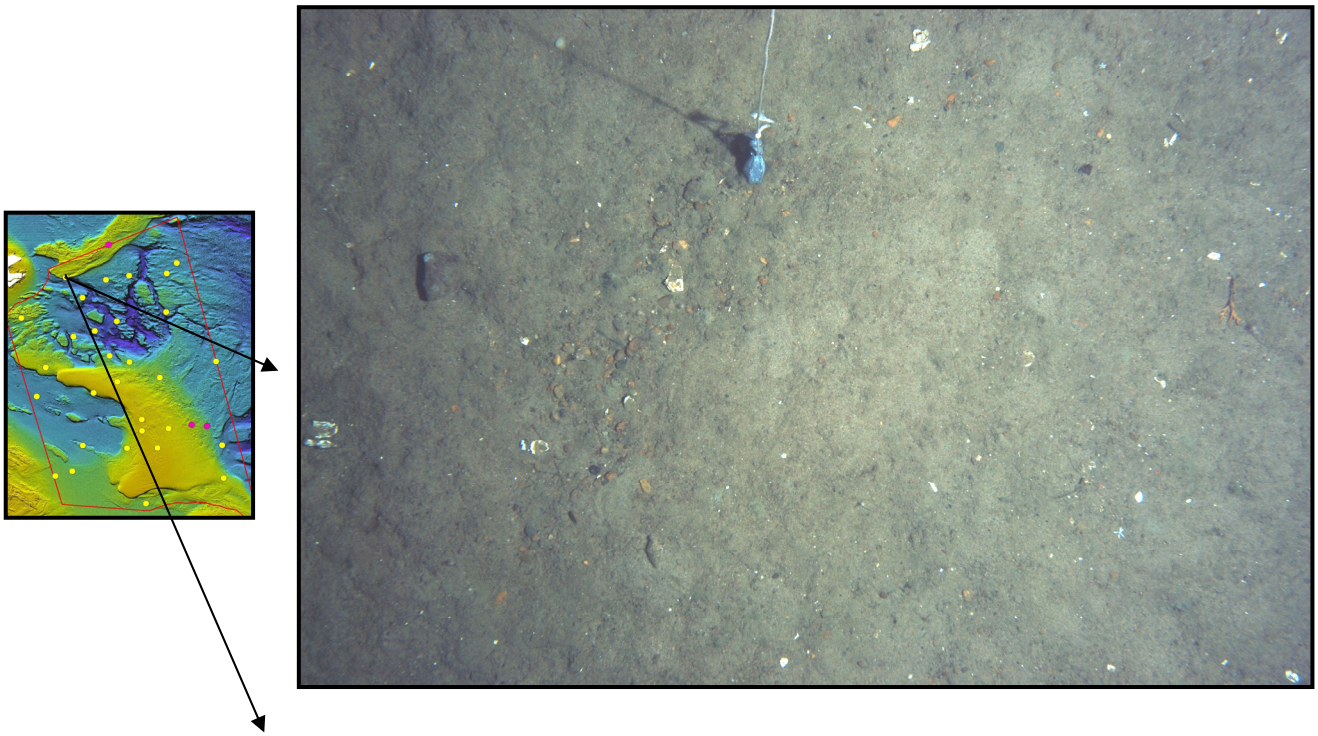

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

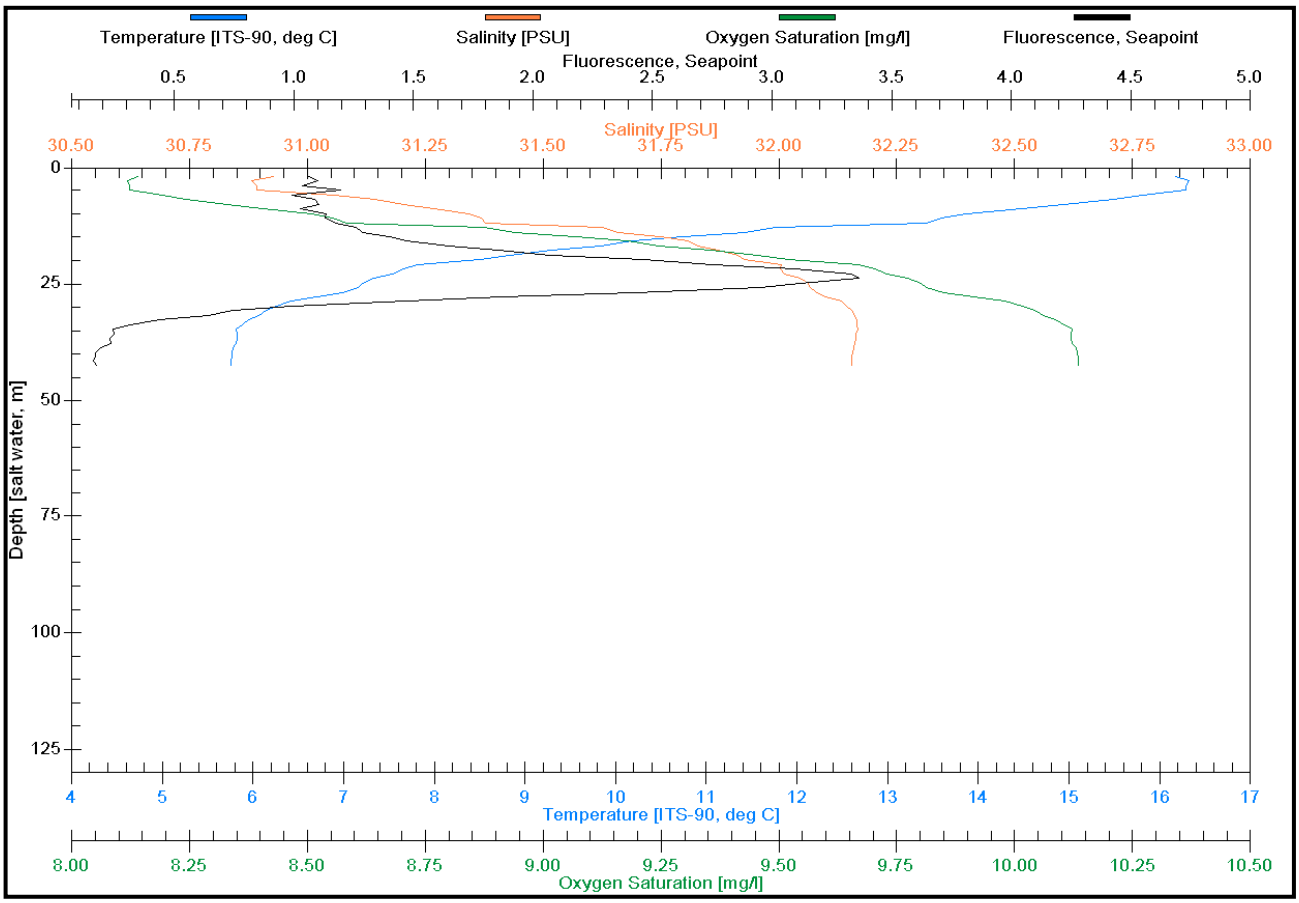
Station 010



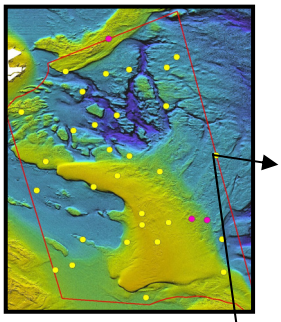

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

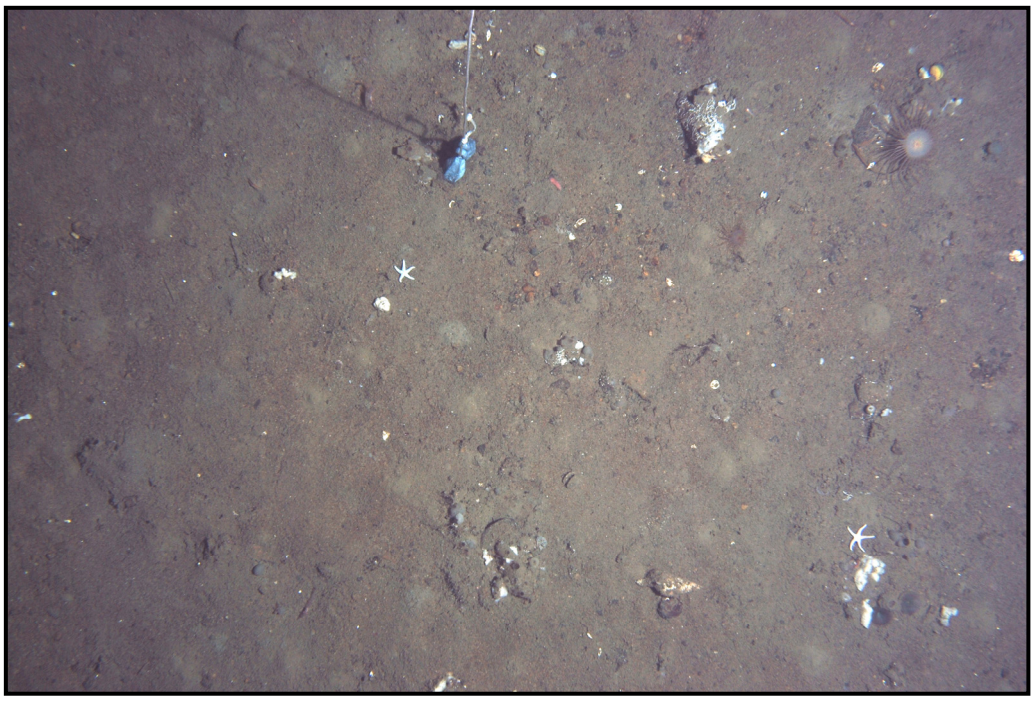
Station 011

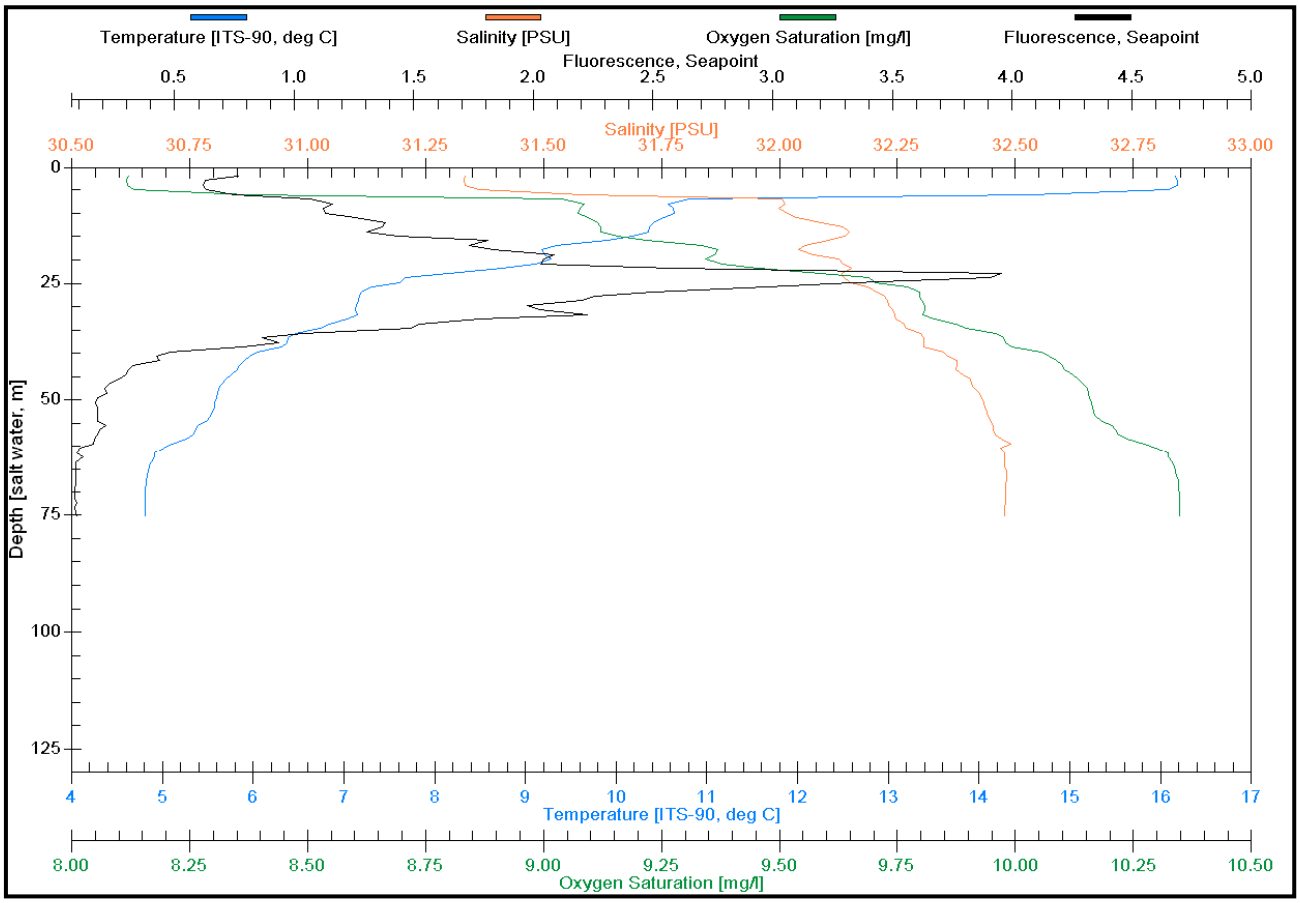



Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

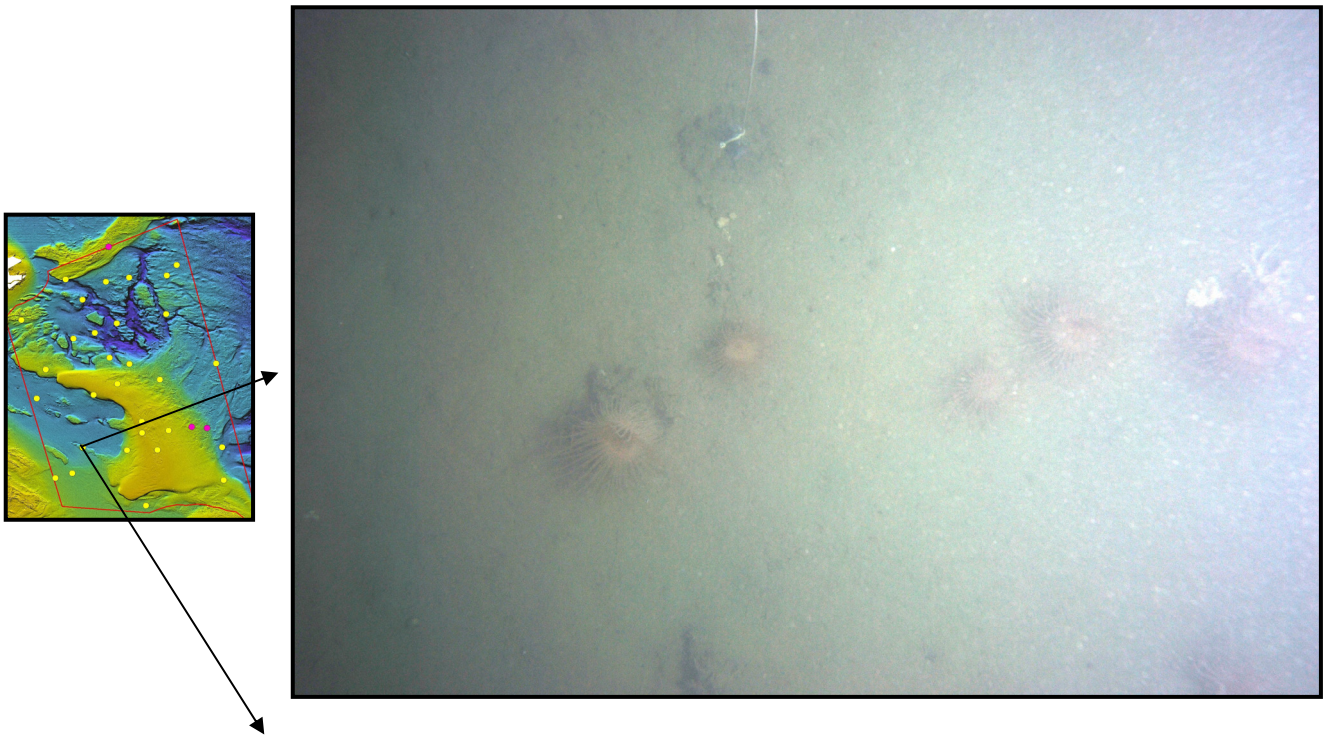
Station 012

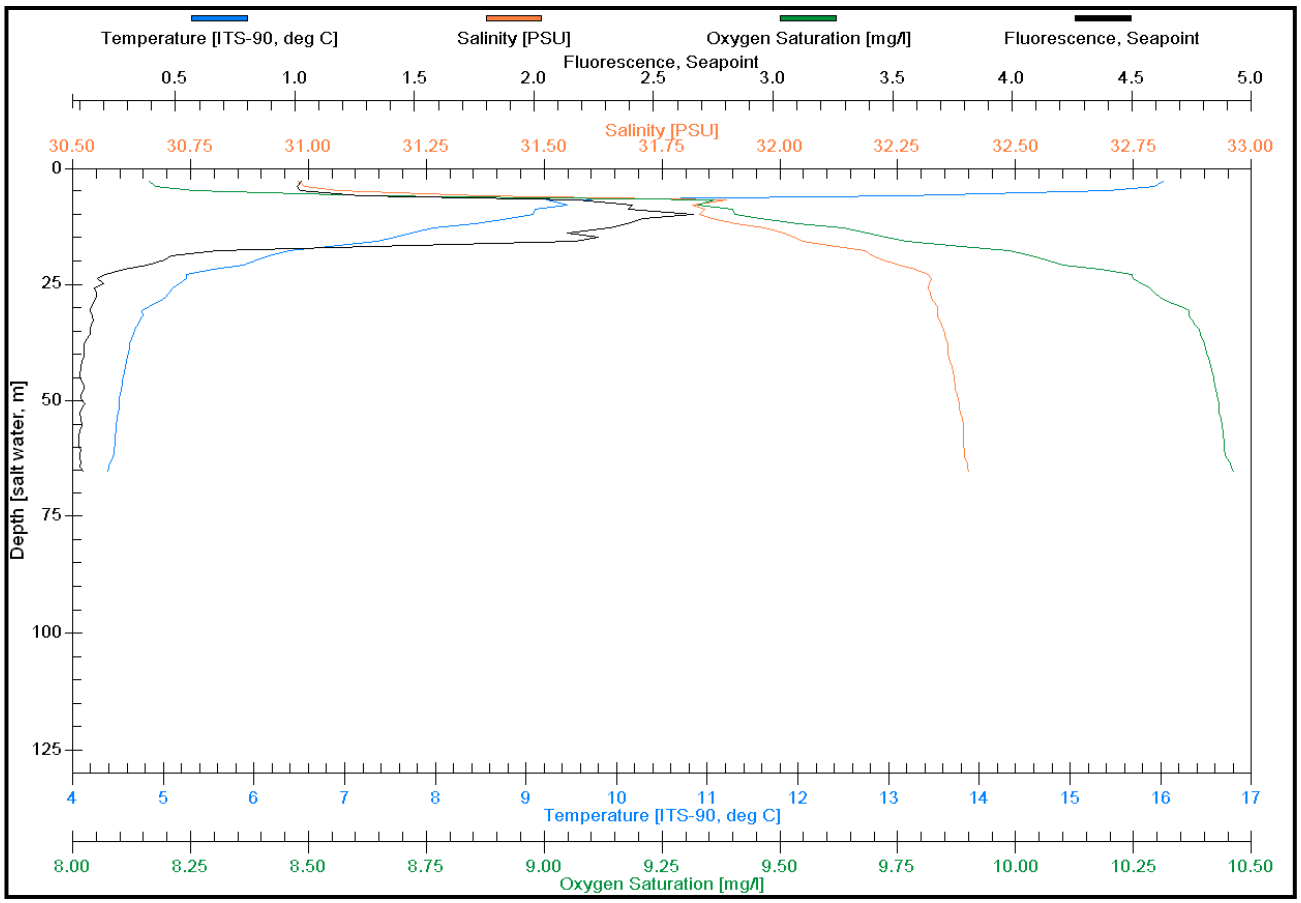




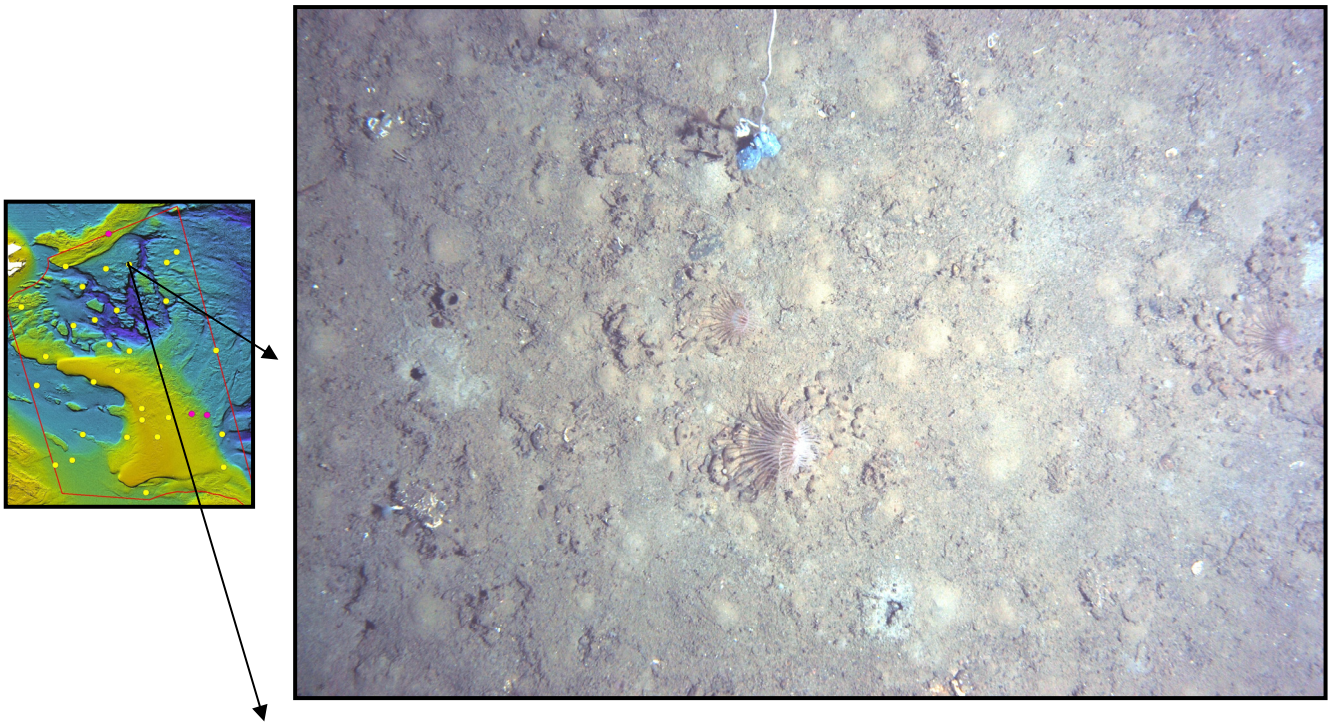

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

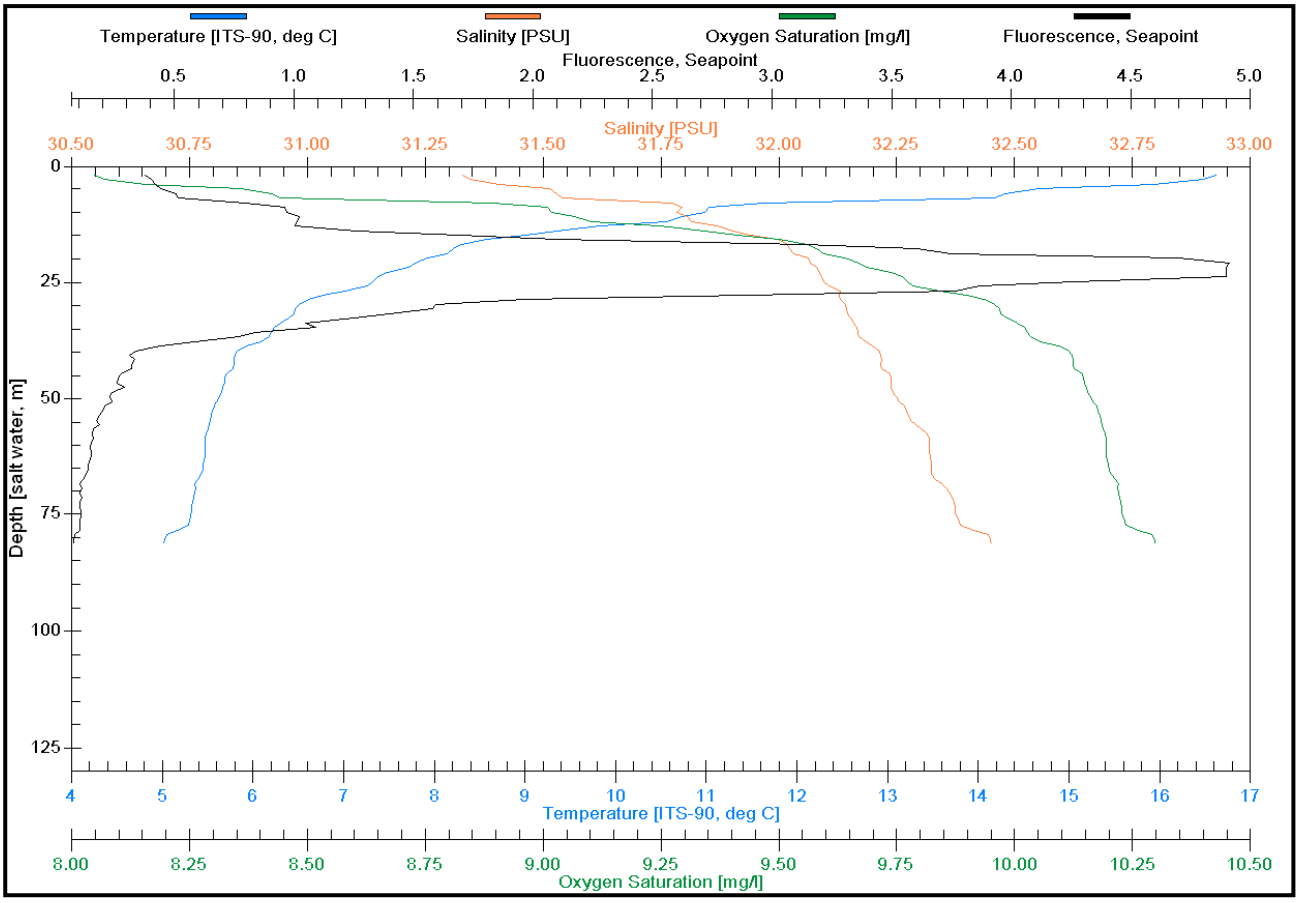
Station 013



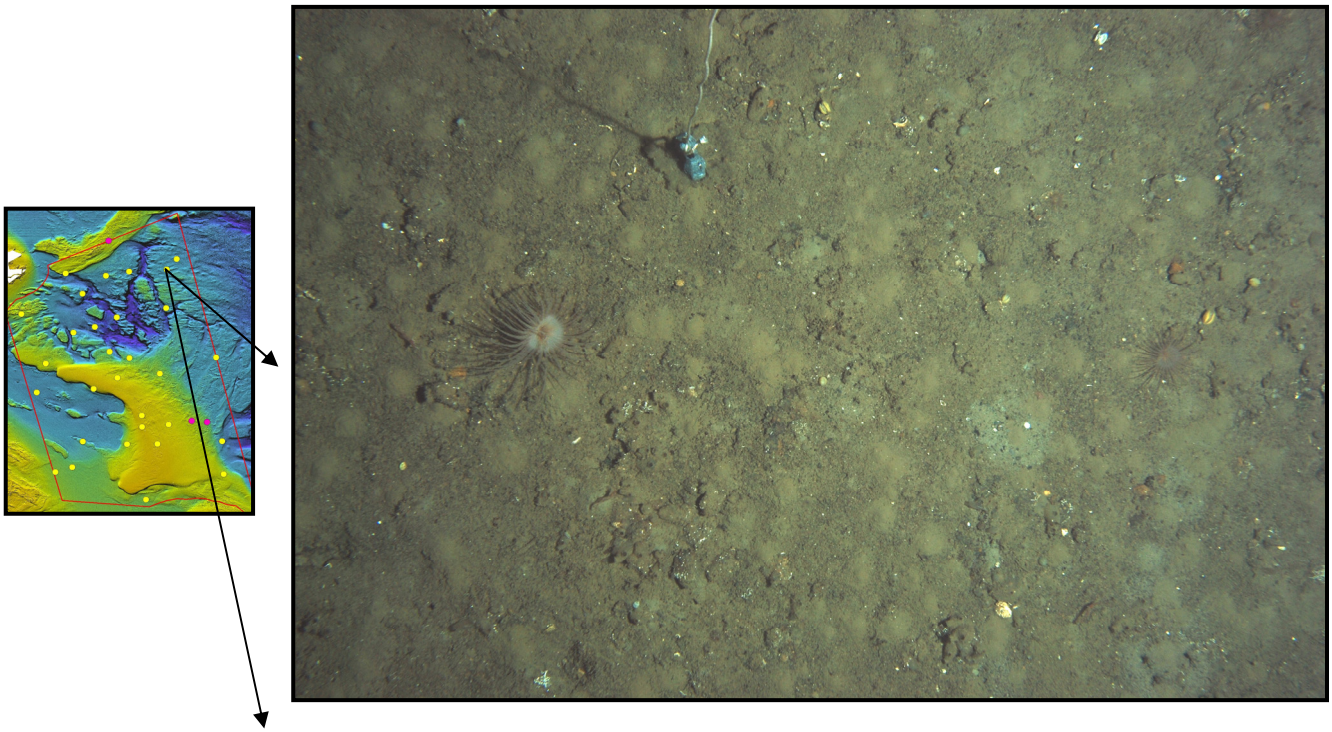

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

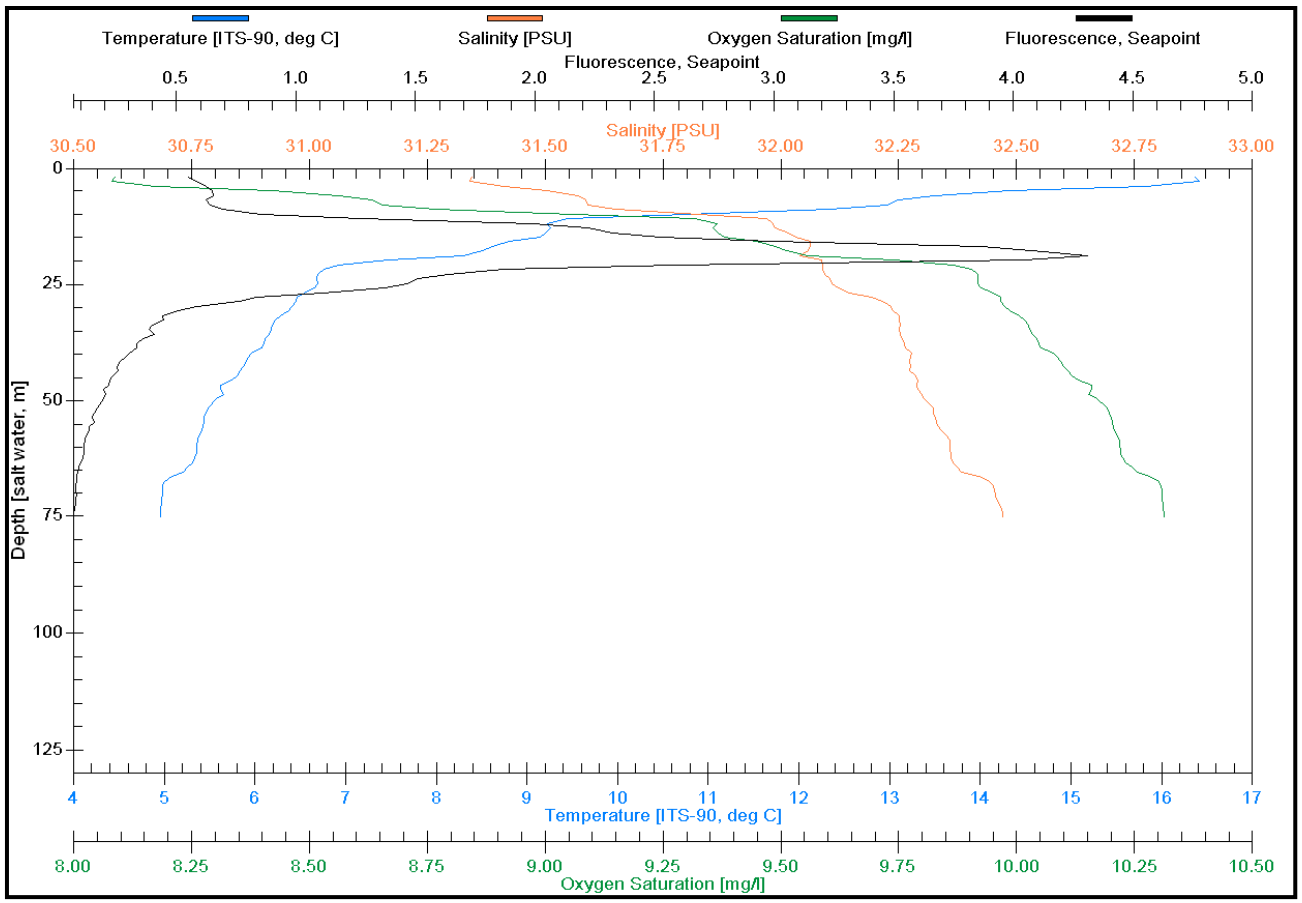
Station 014



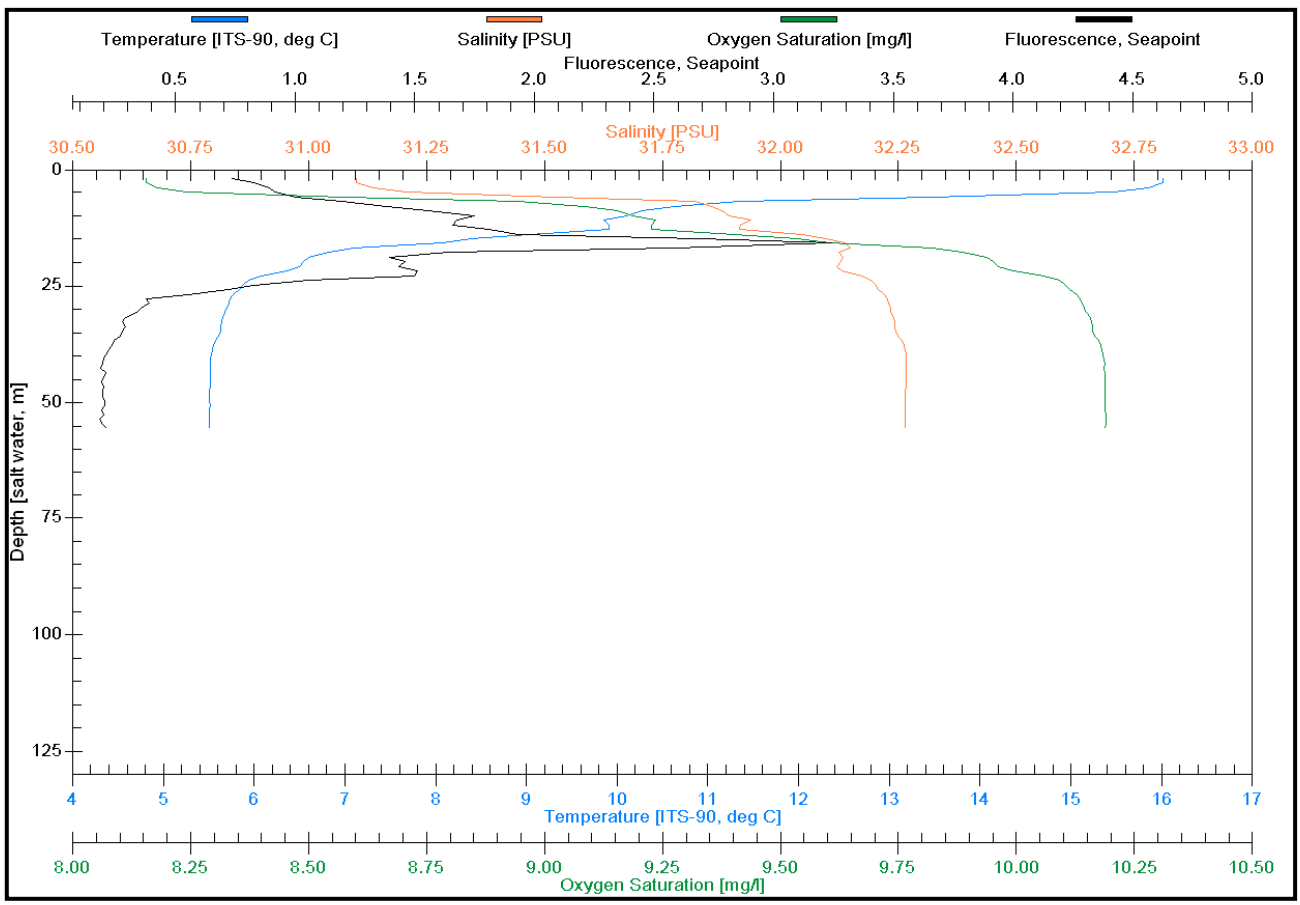

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station 015

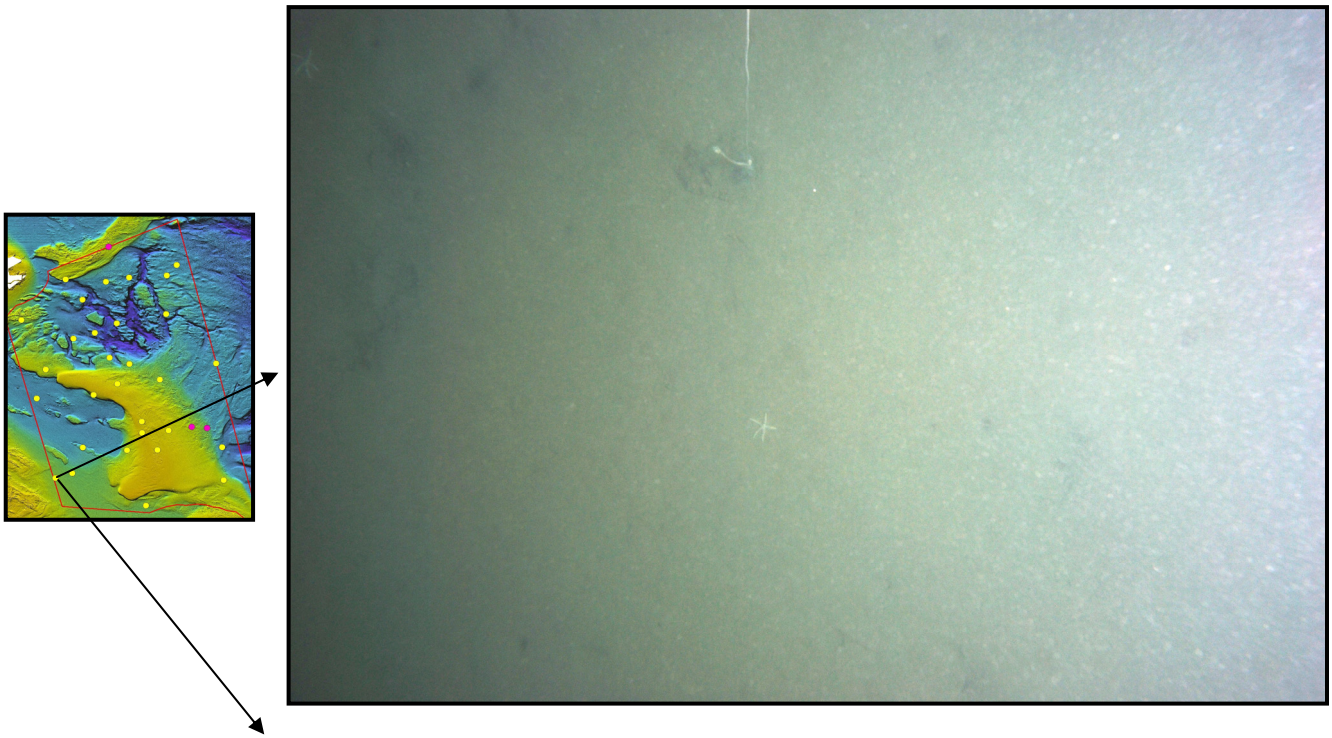


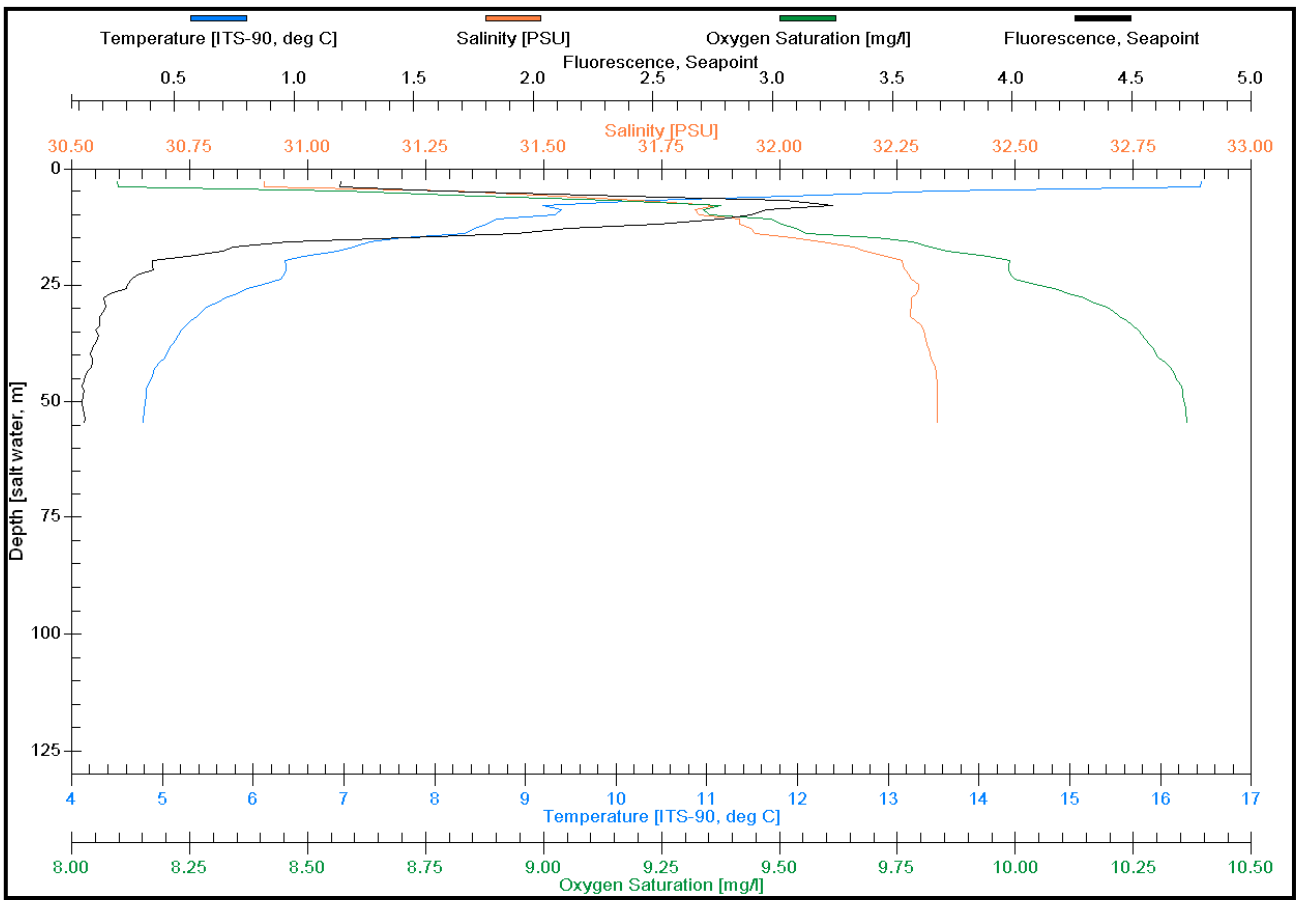

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station 016

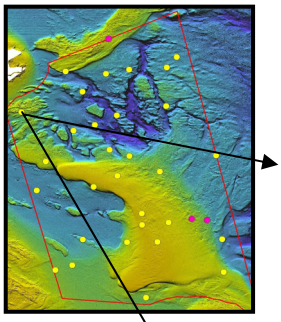

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station 017

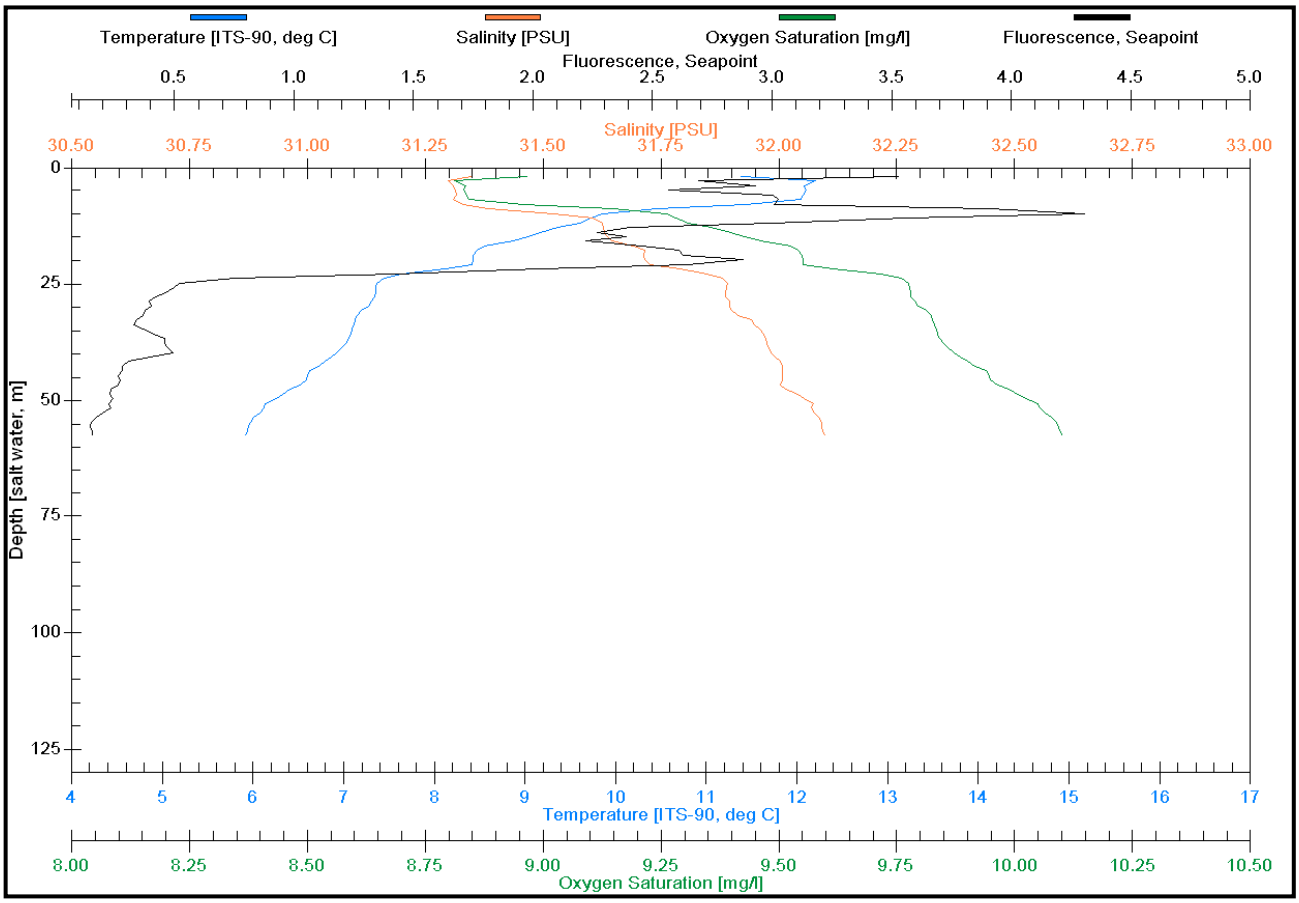



Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

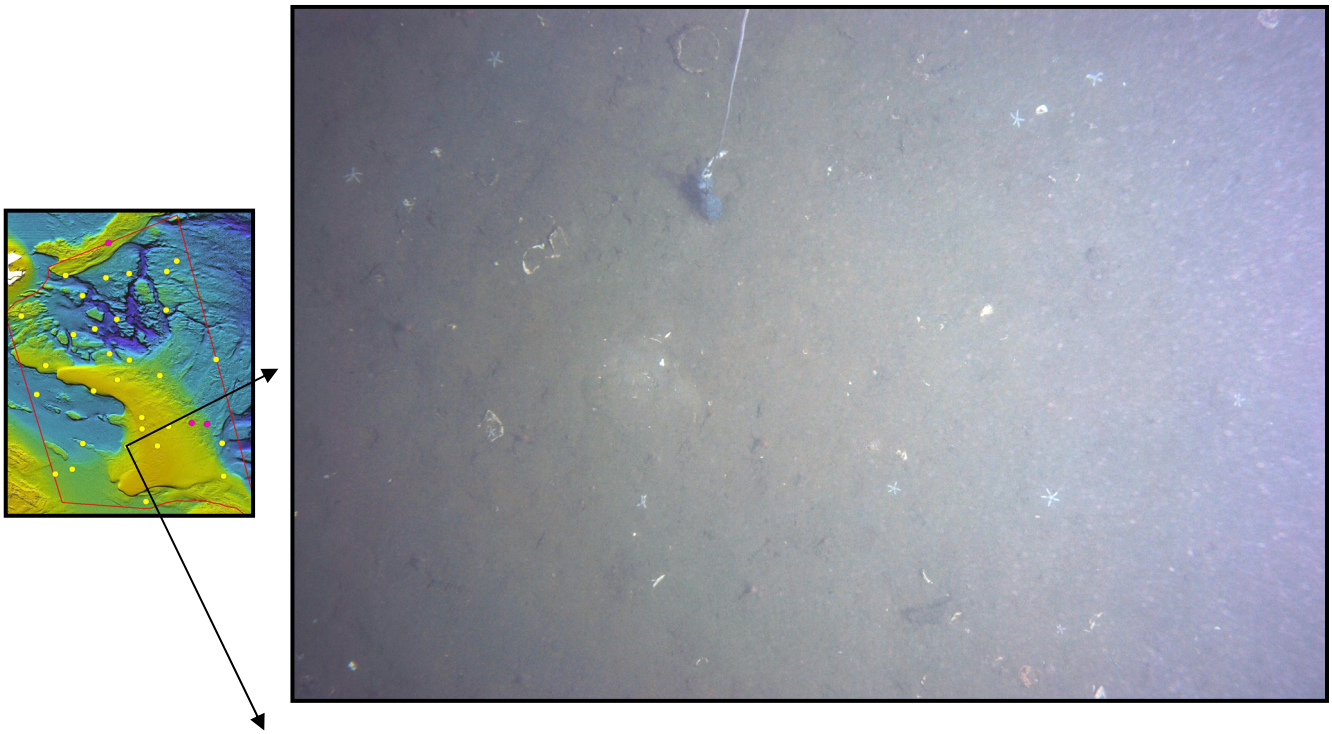
Station 018

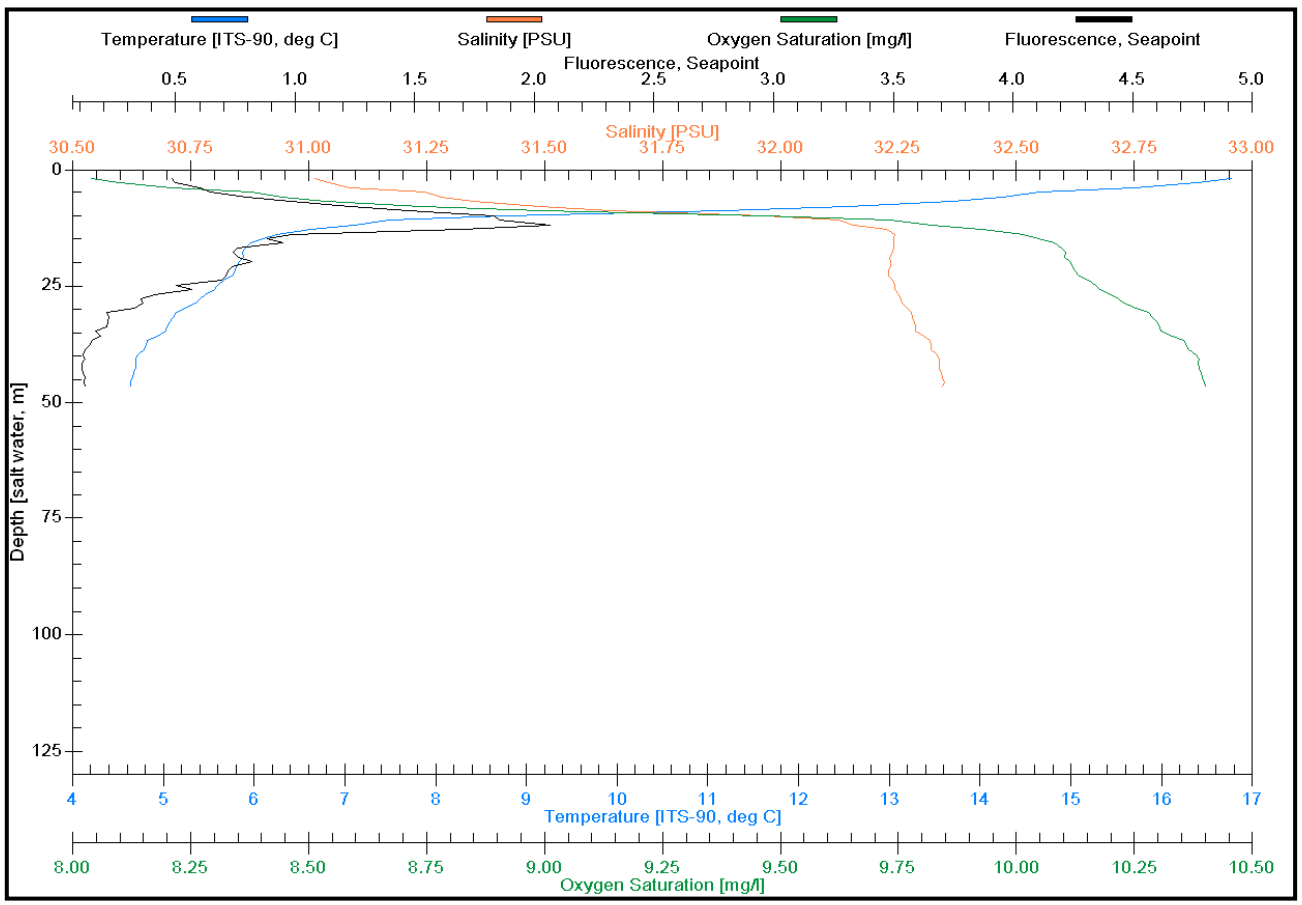


No Picture

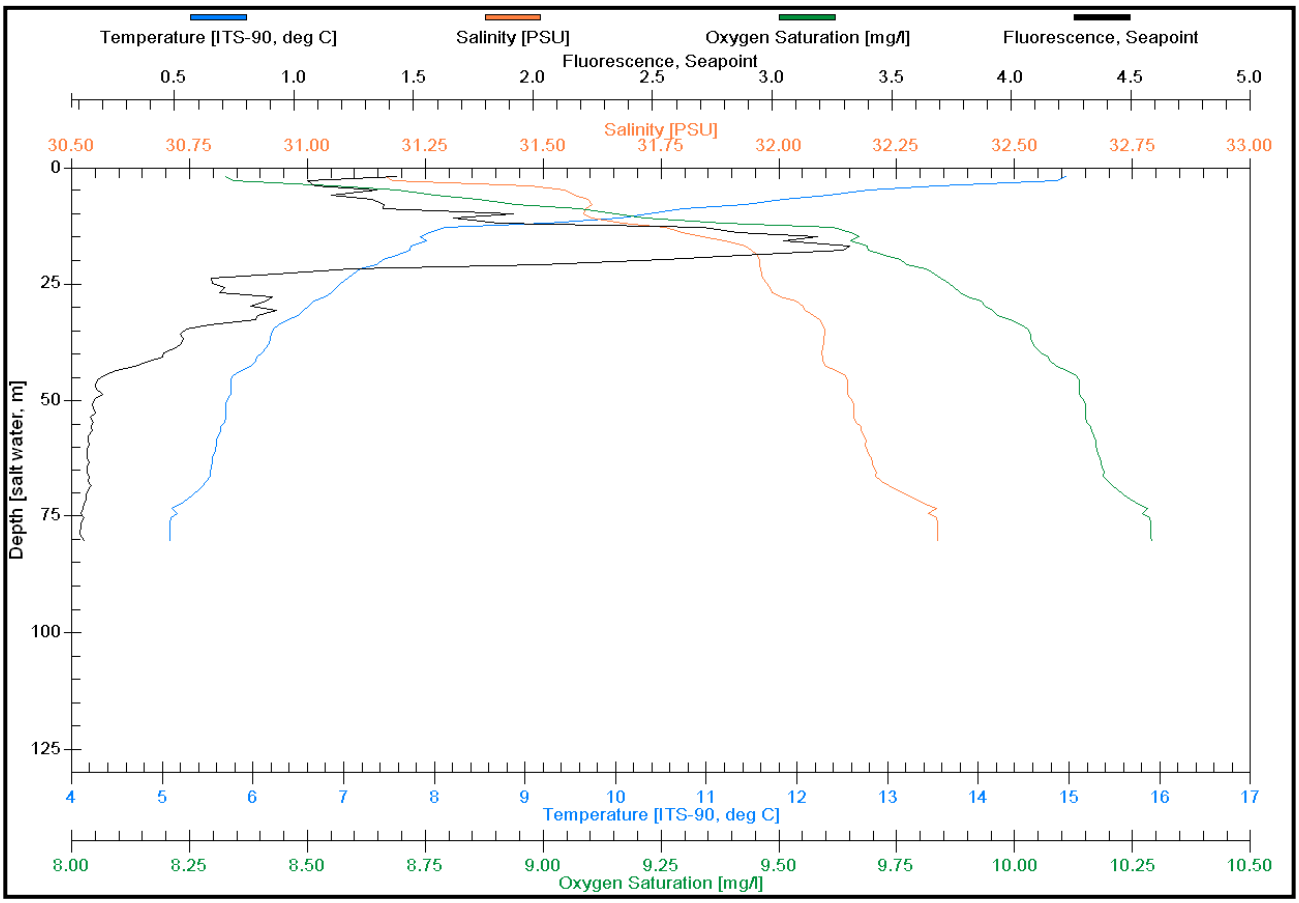


Station 019

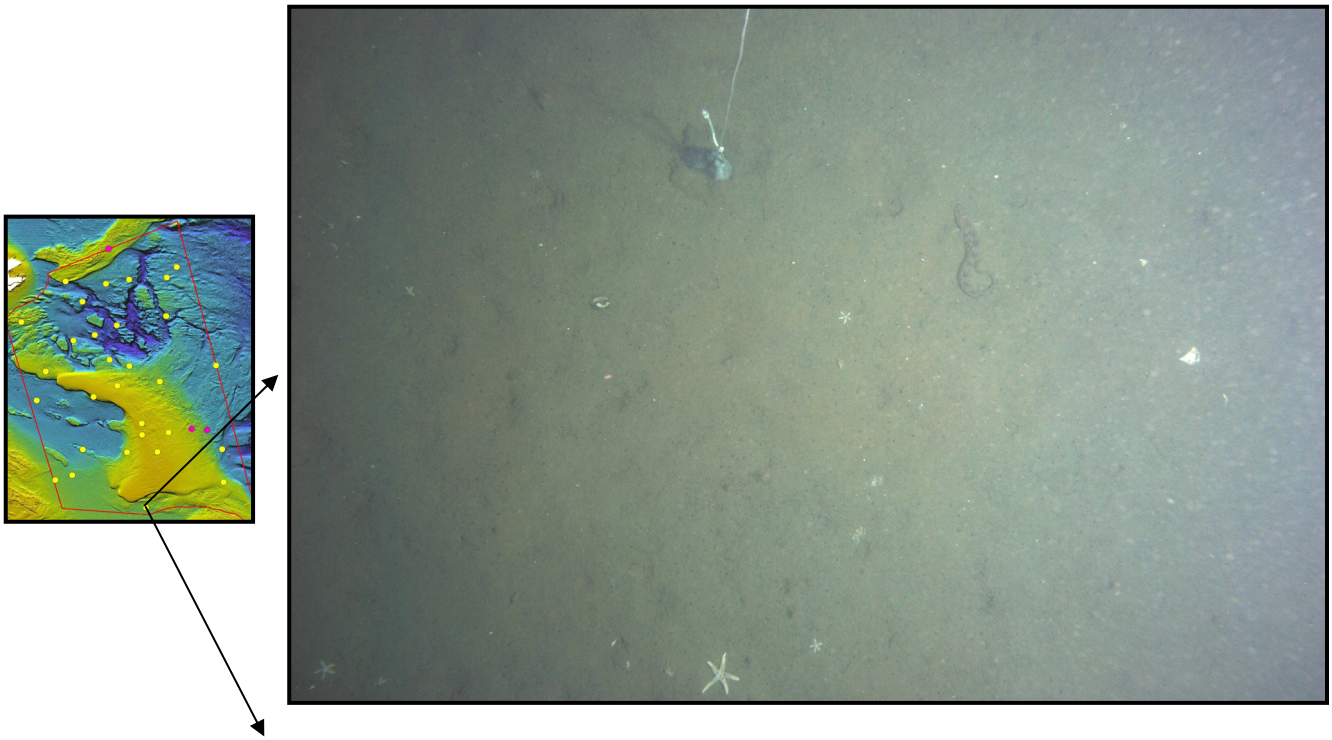


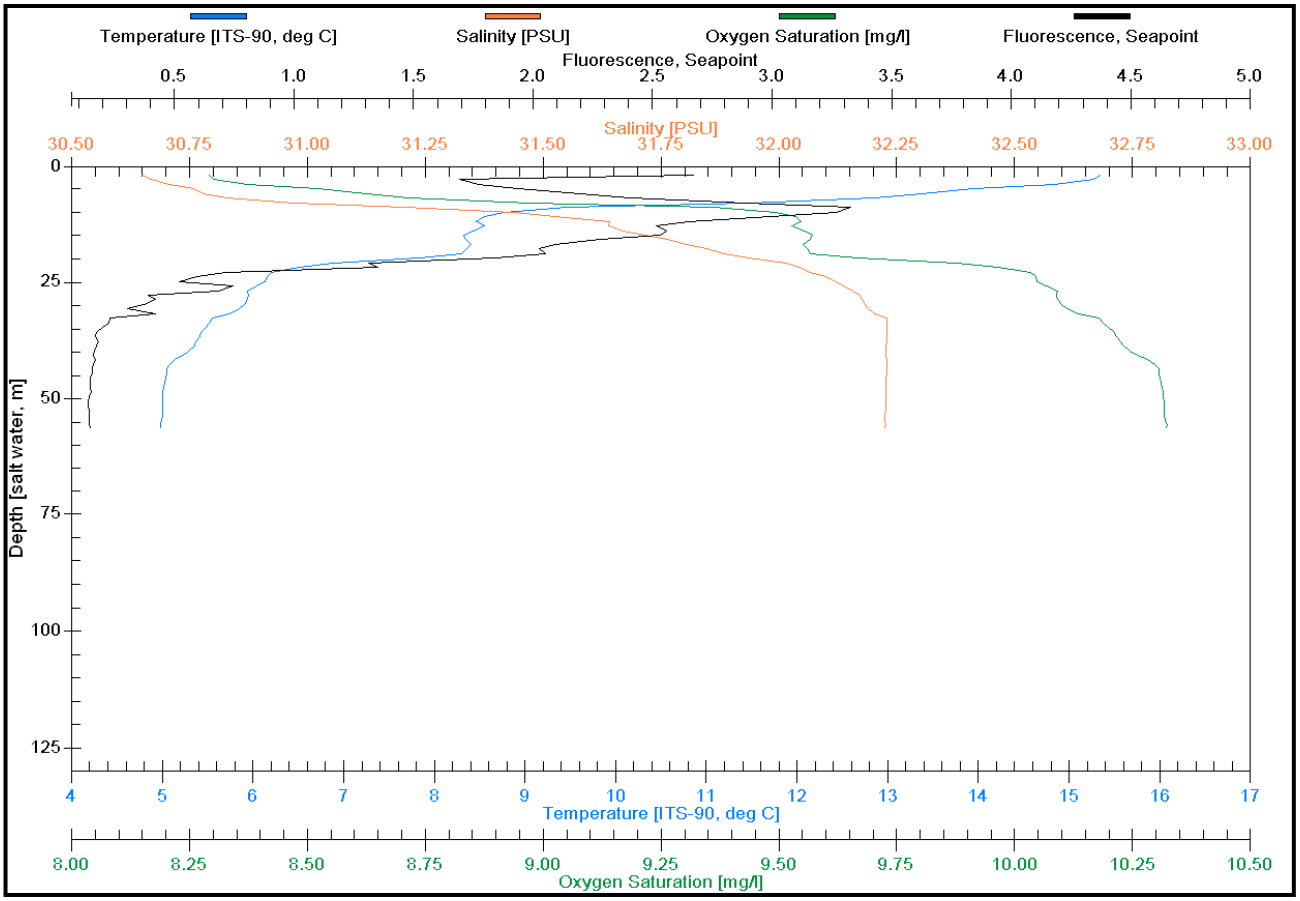

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station 020

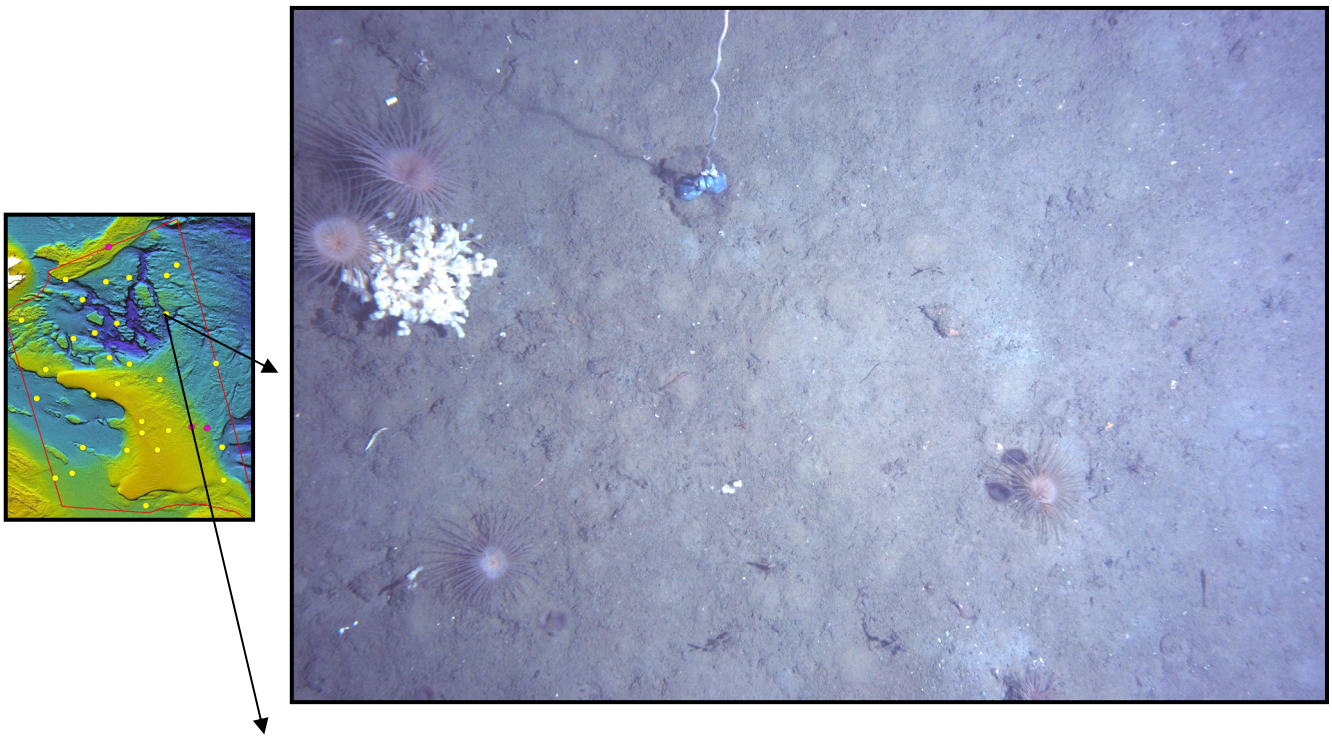

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

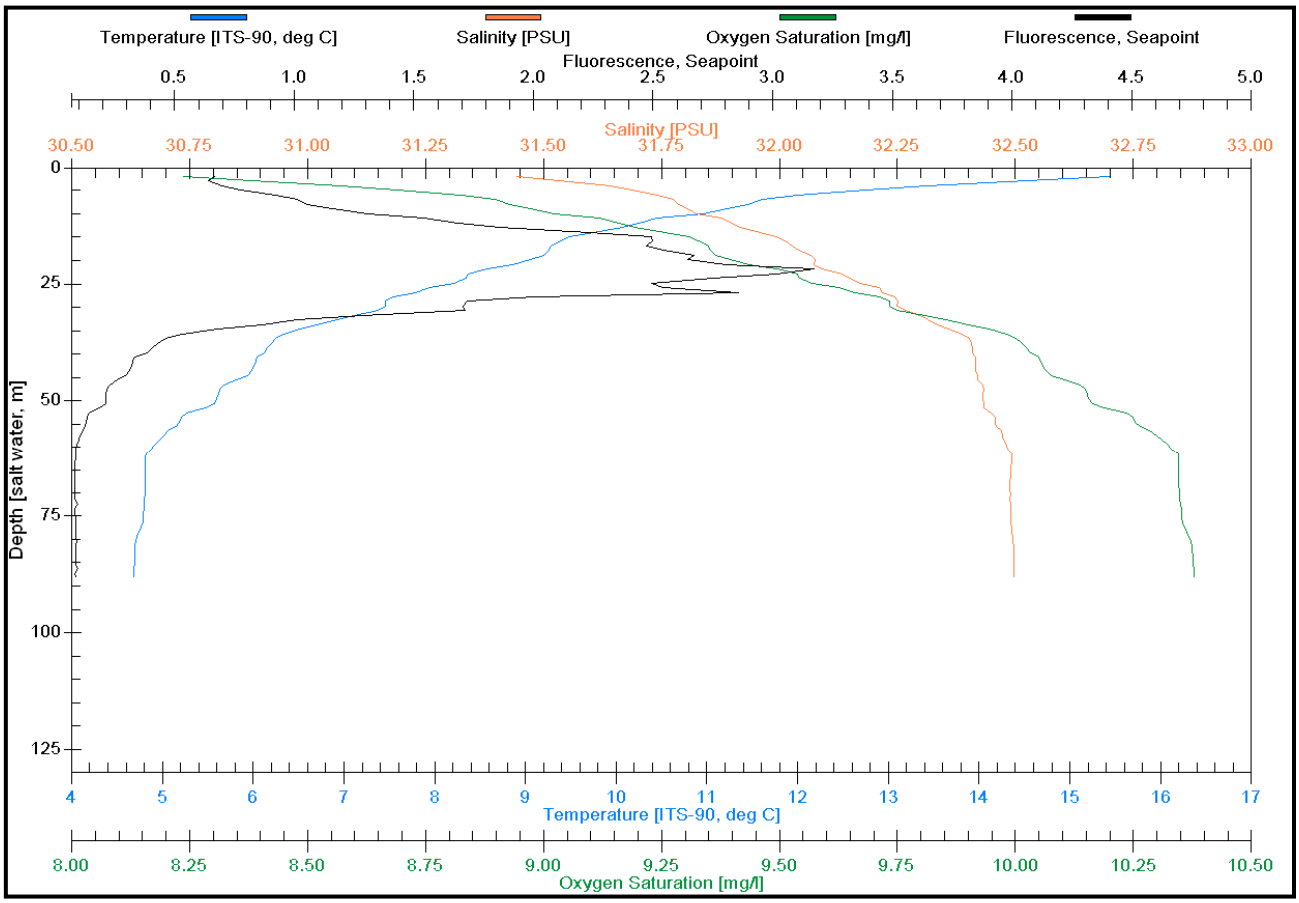
Station 021



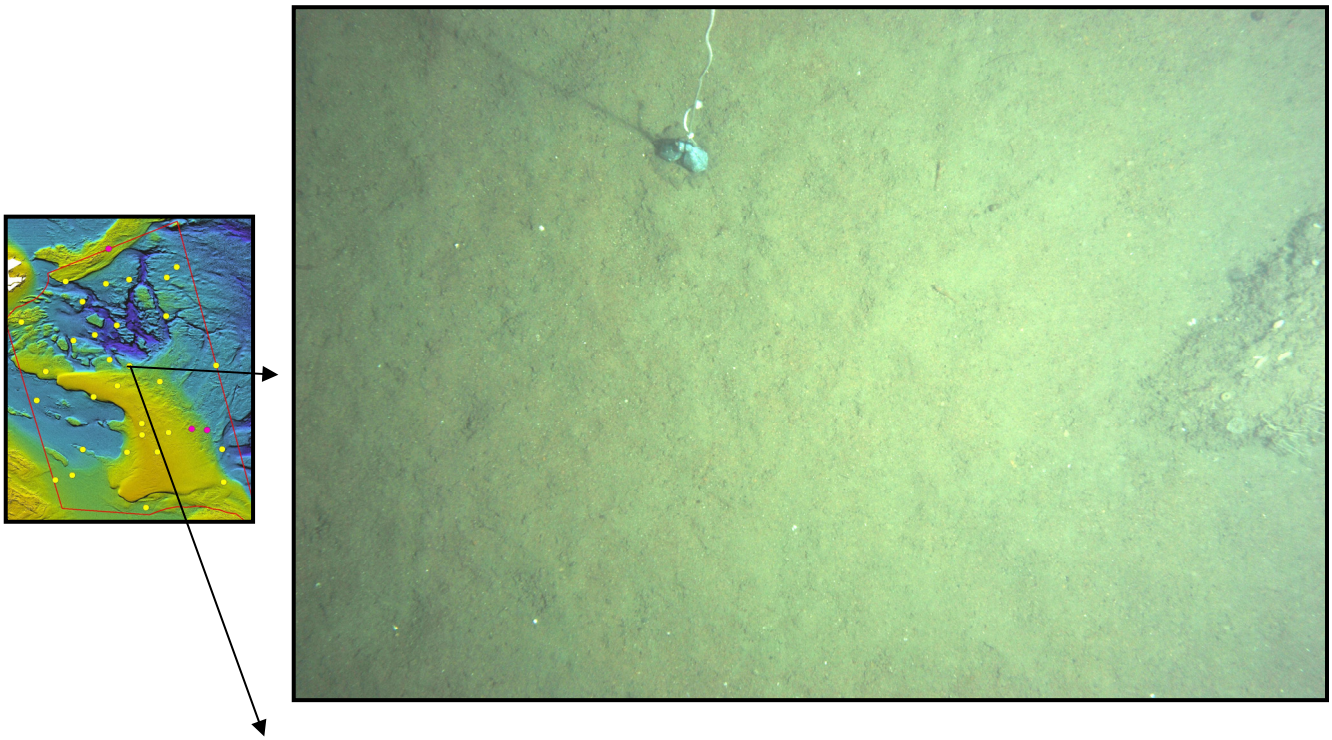

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

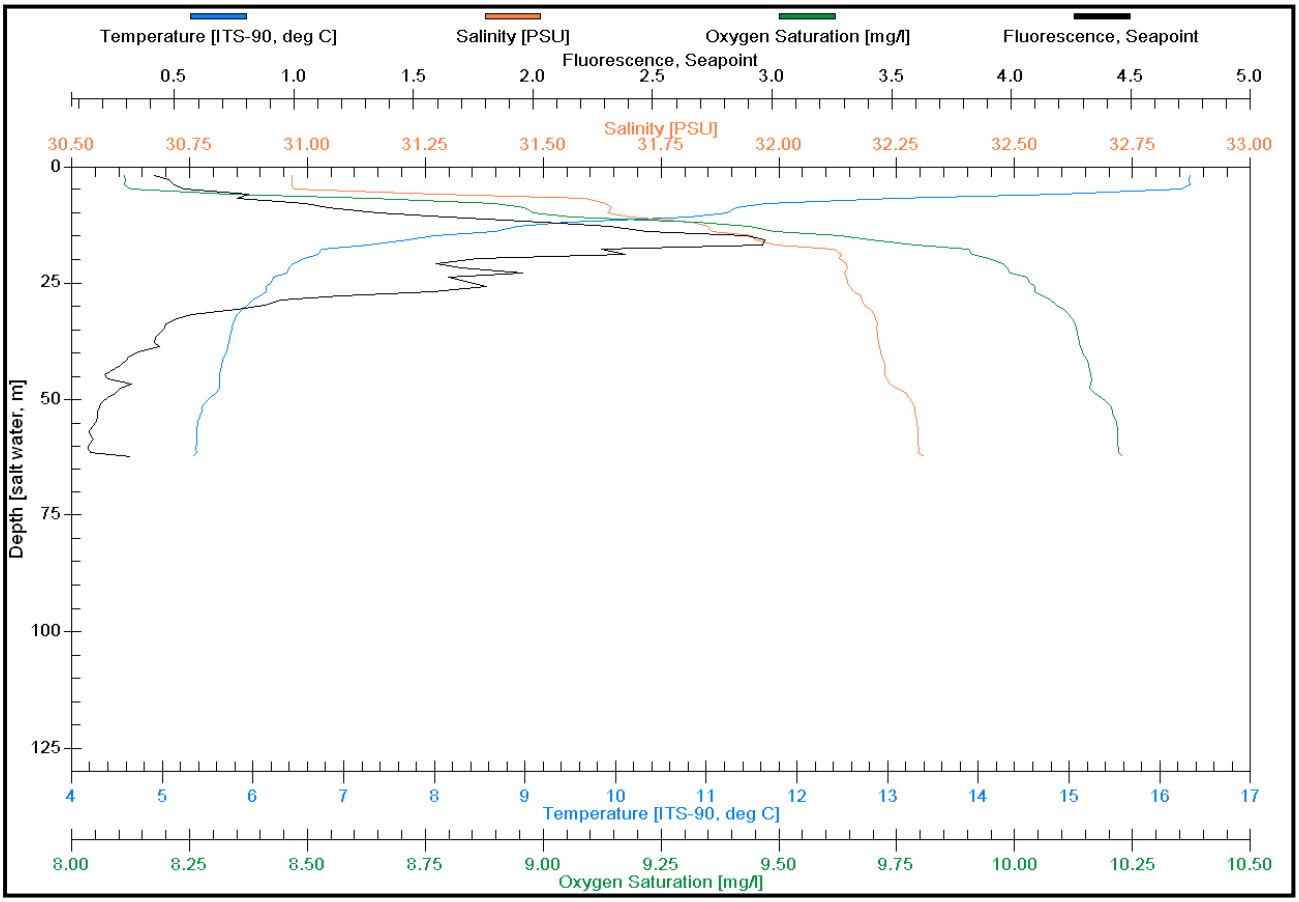
Station 022



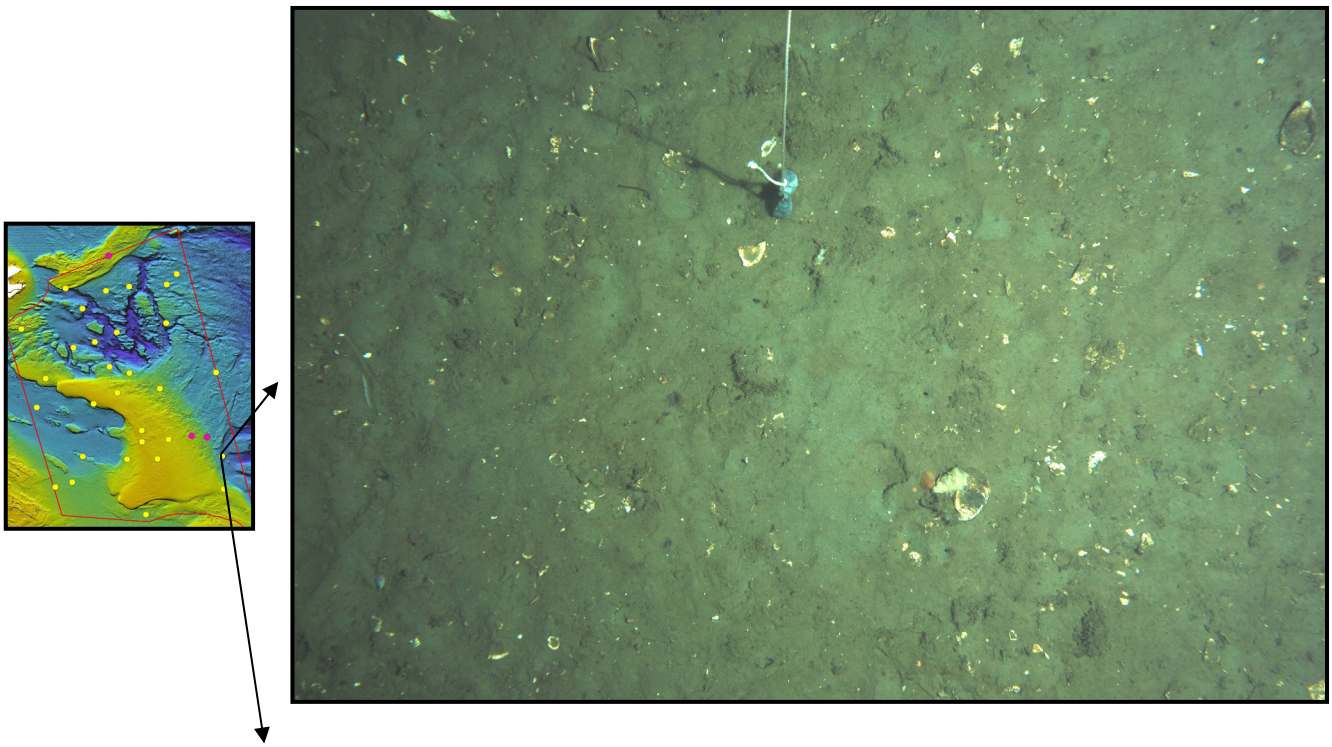

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

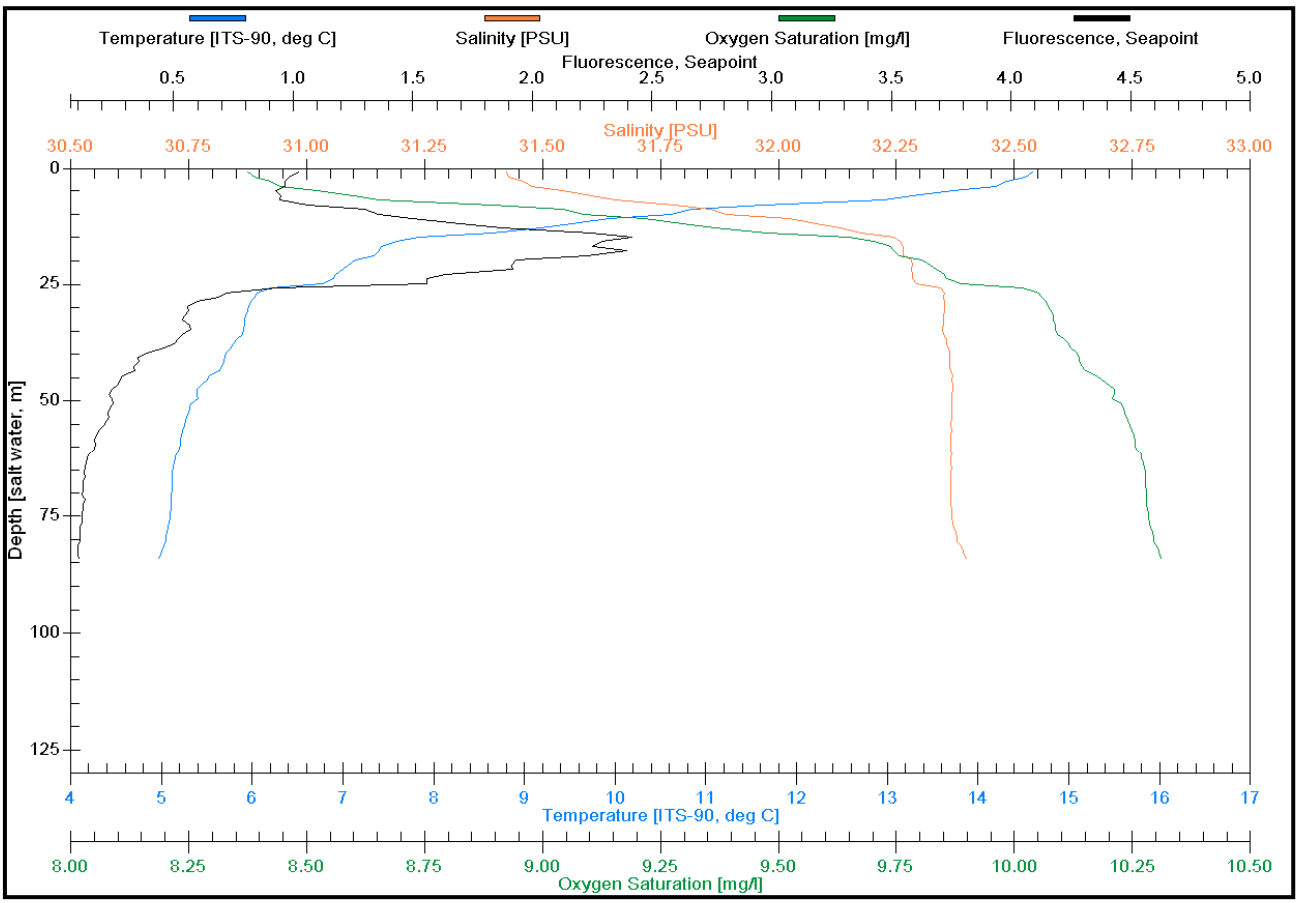
Station 023



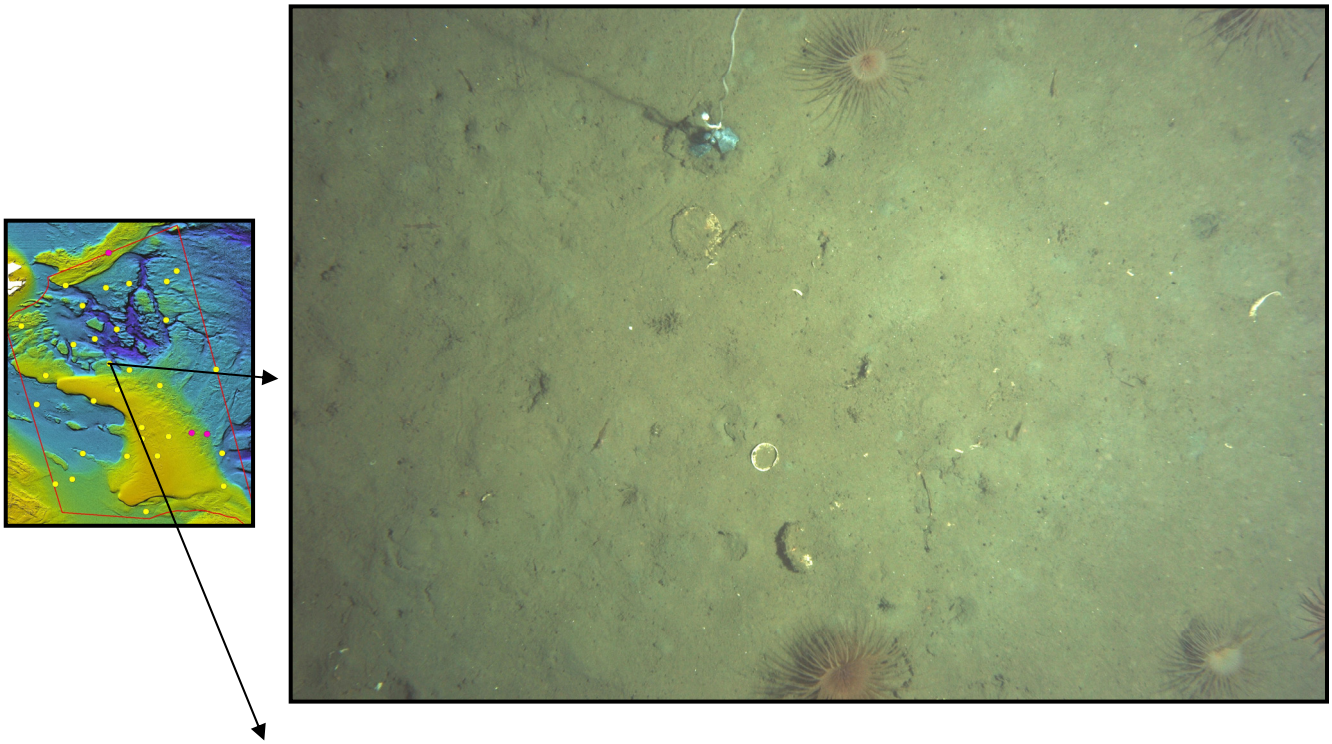

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

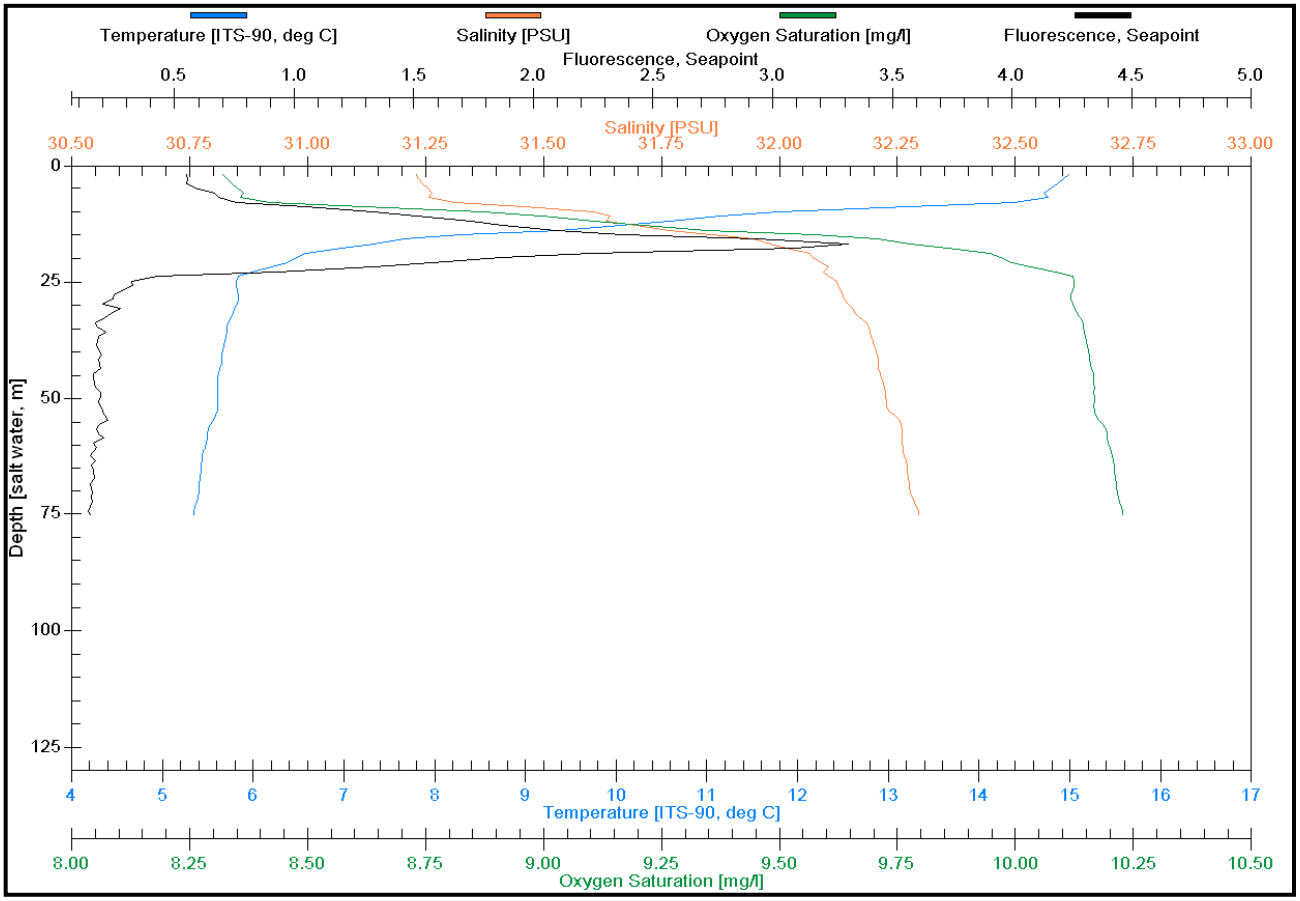
Station 024



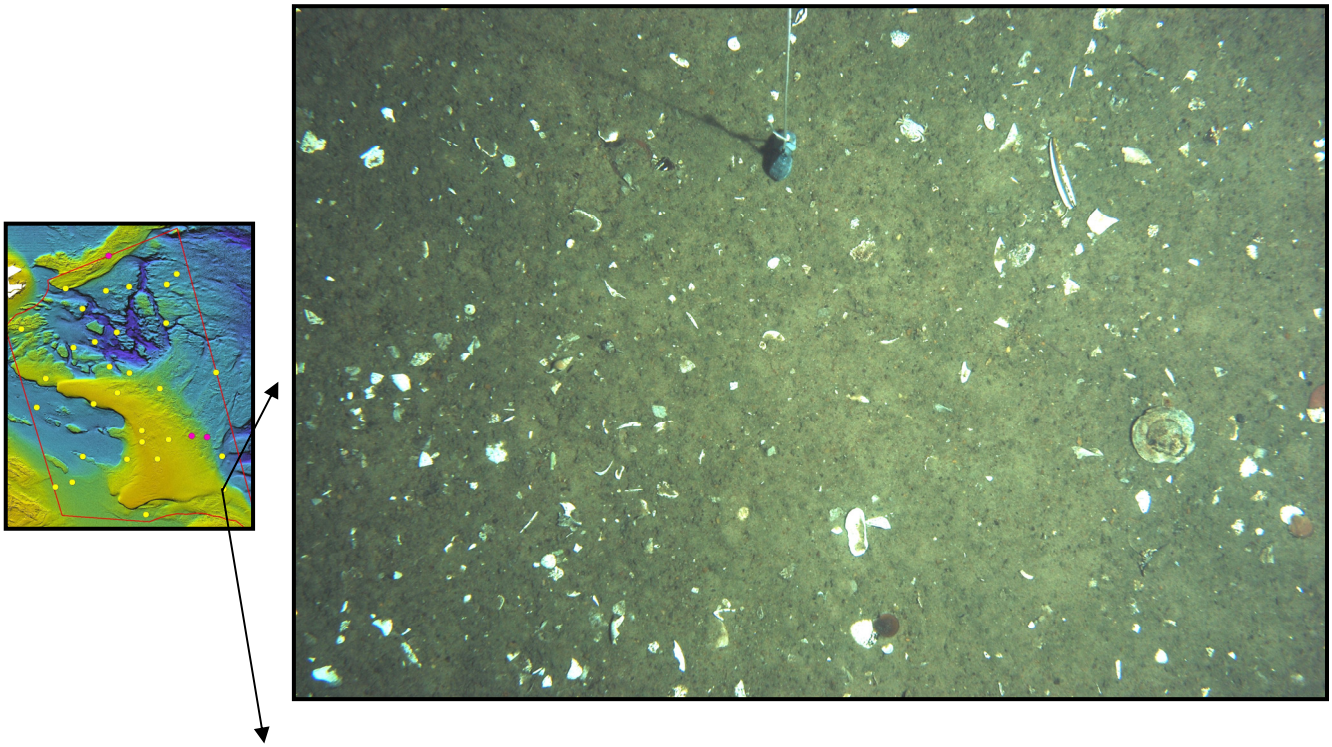

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
Temperature [ITS-90, deg C]
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Oxygen Saturation [mg/l]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50

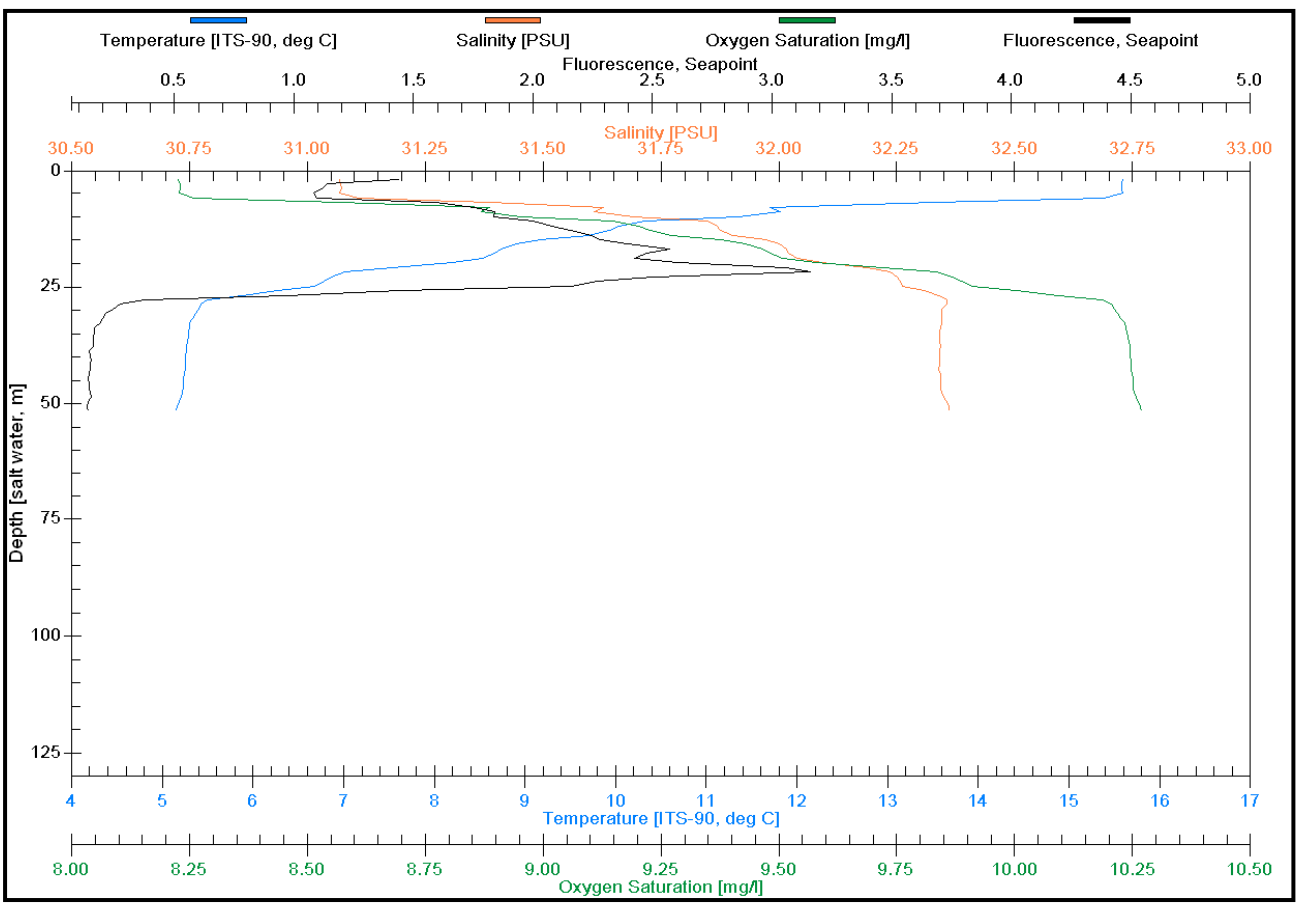
Station 025



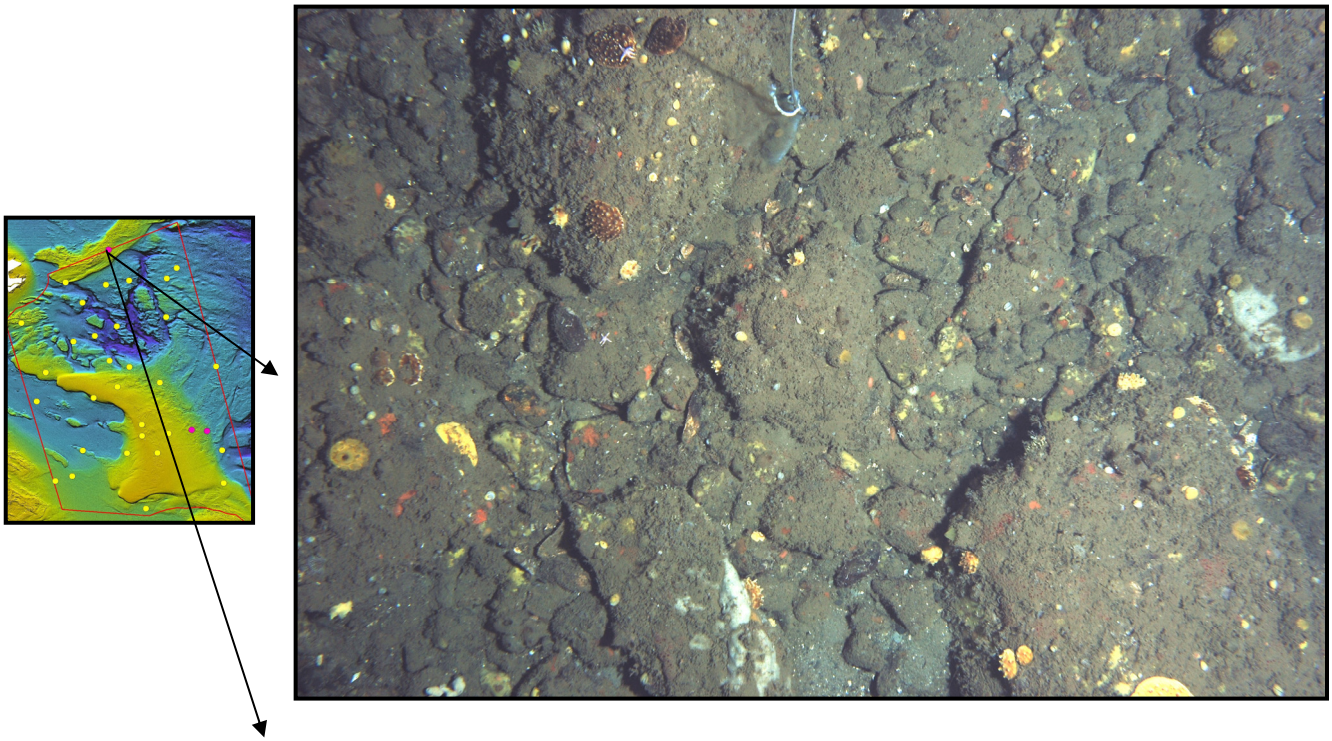

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

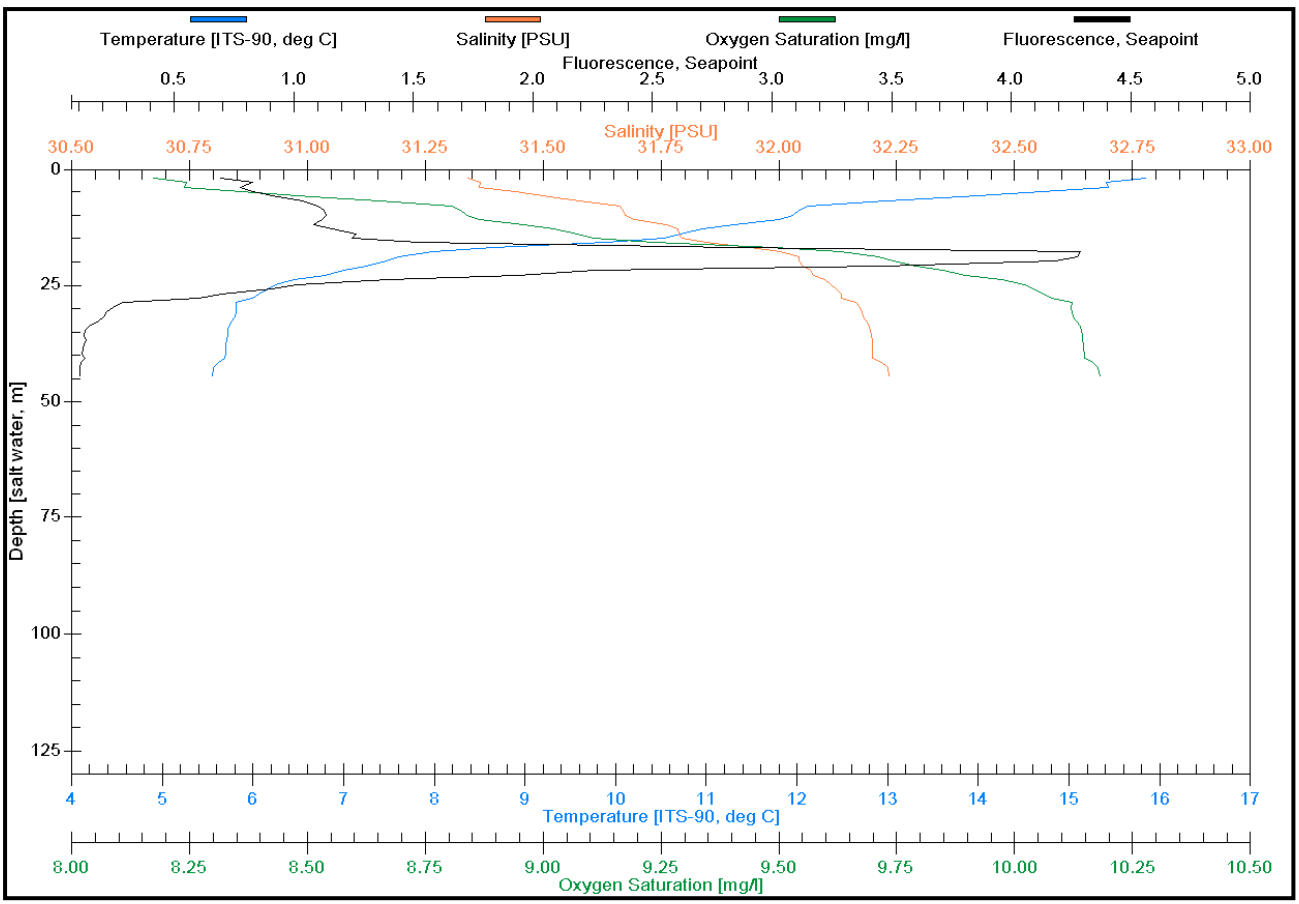
Station 026



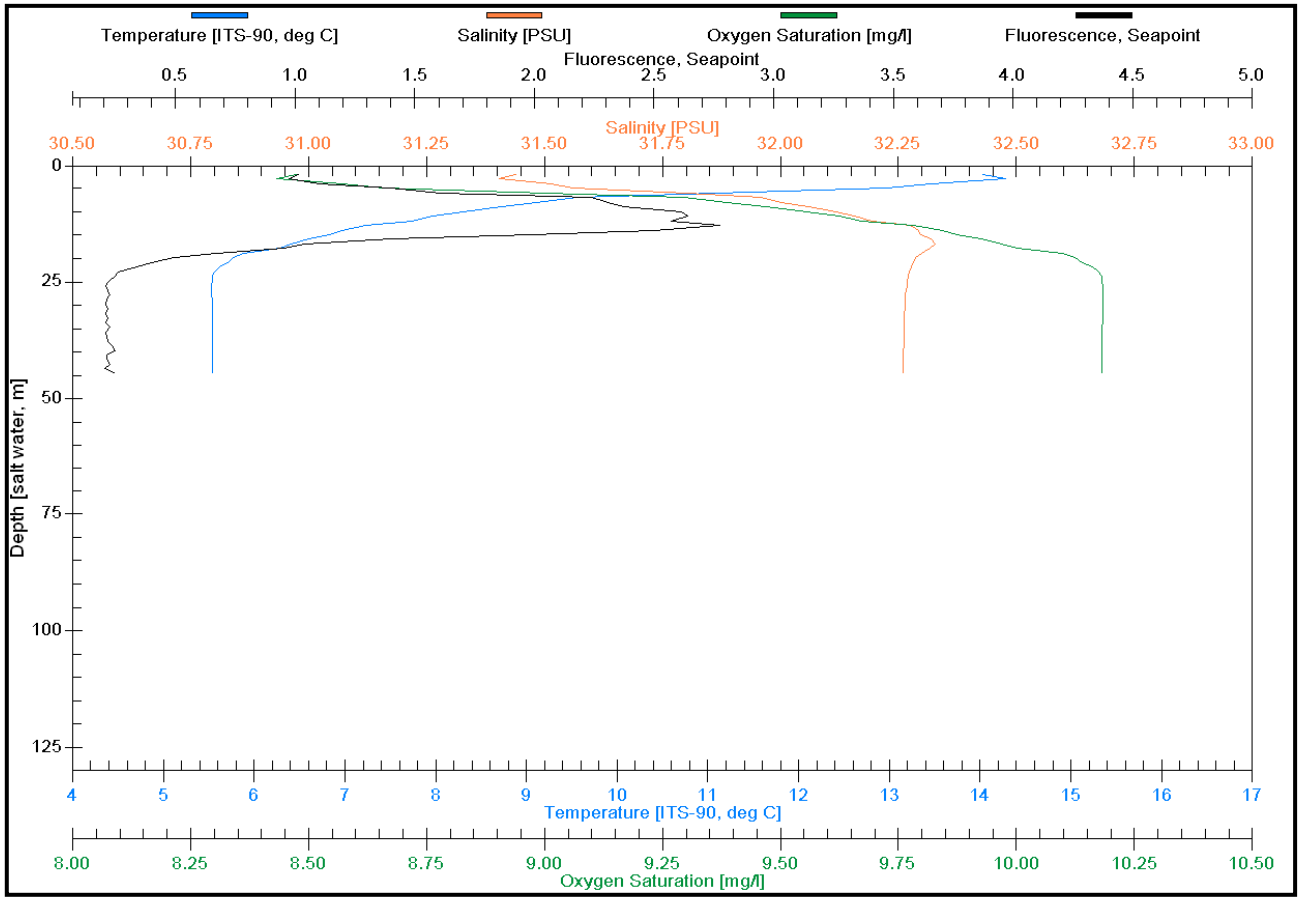

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station 027

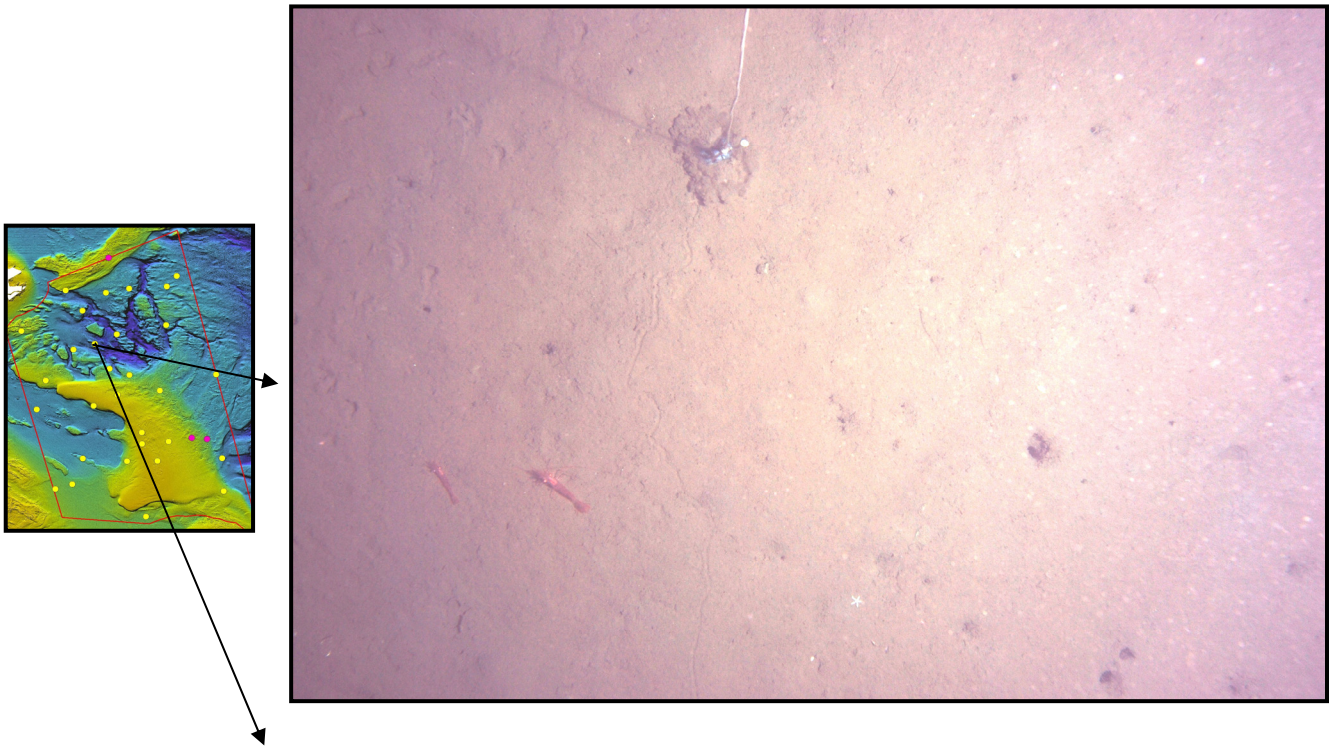


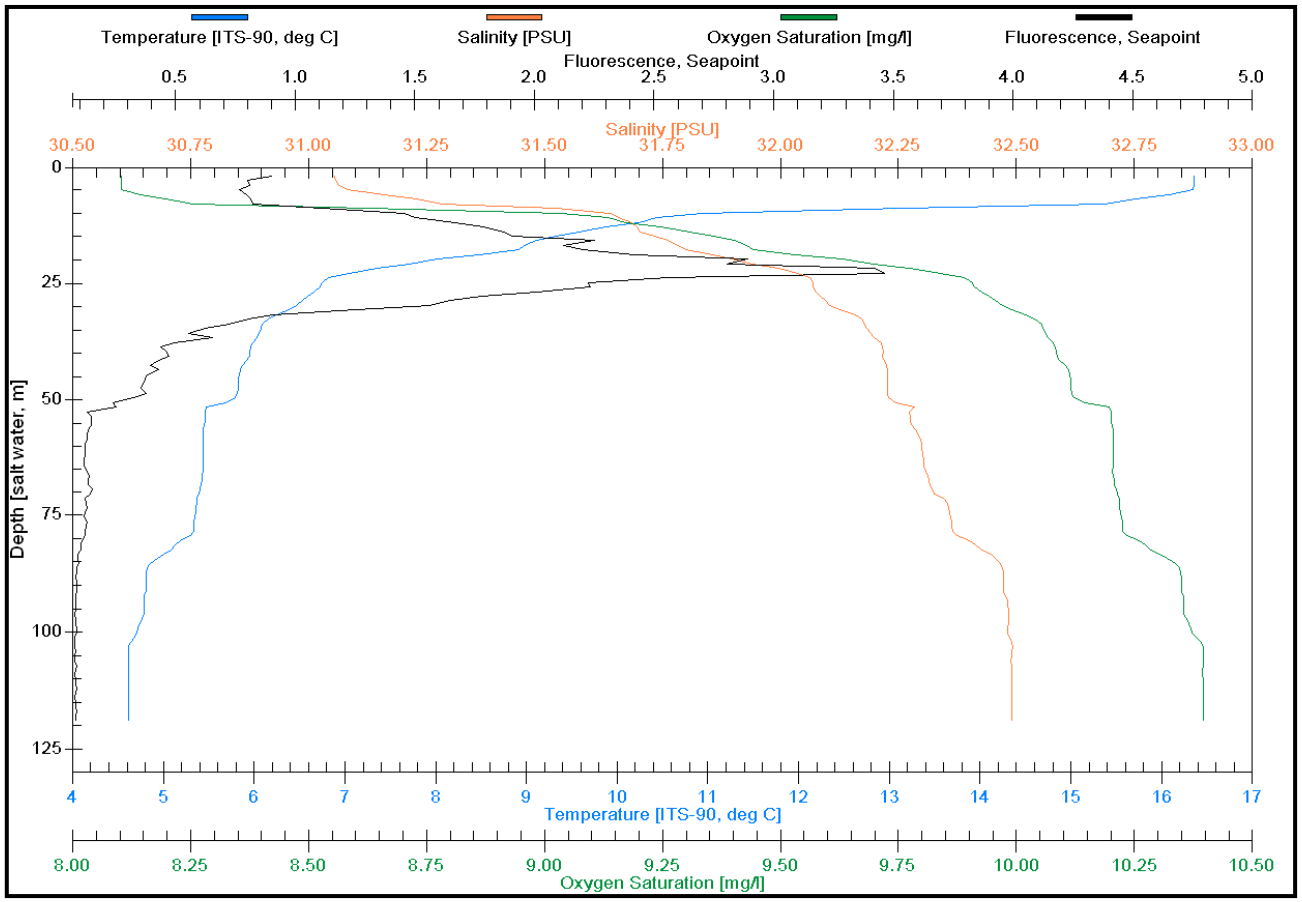

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station 028

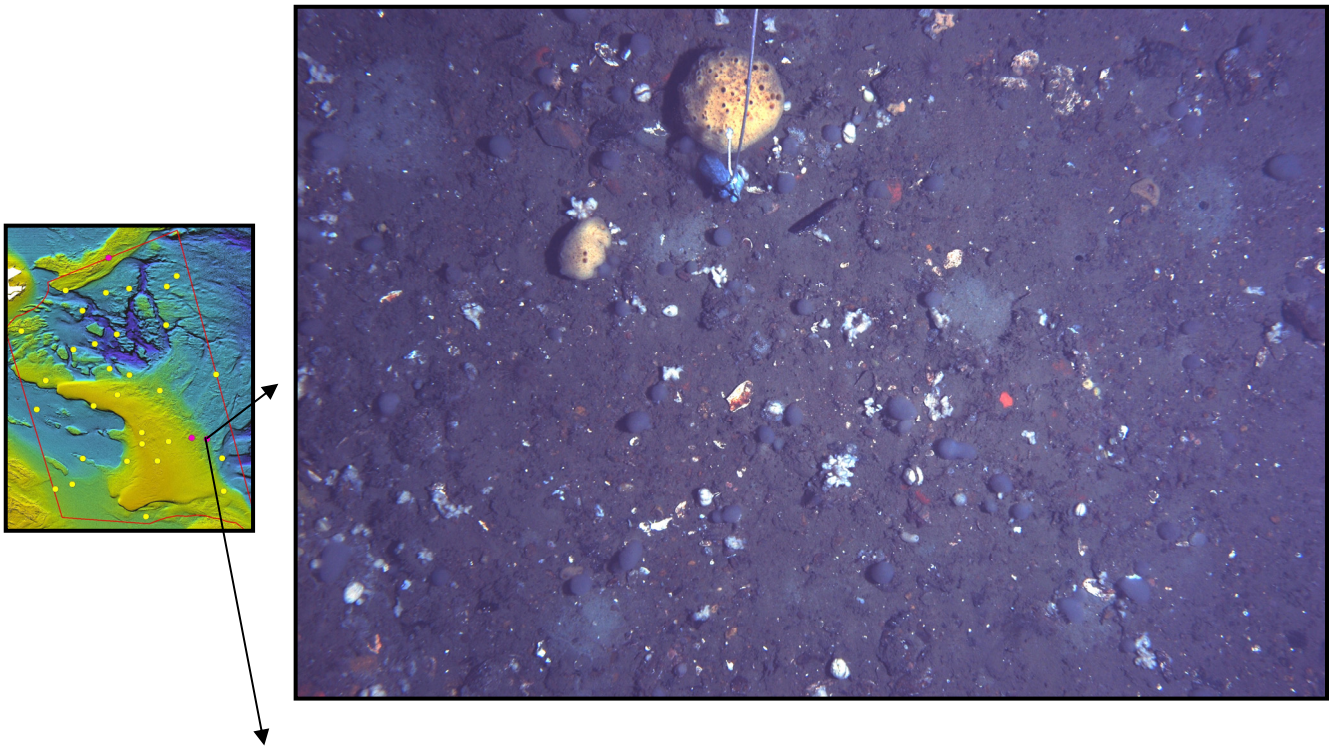

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

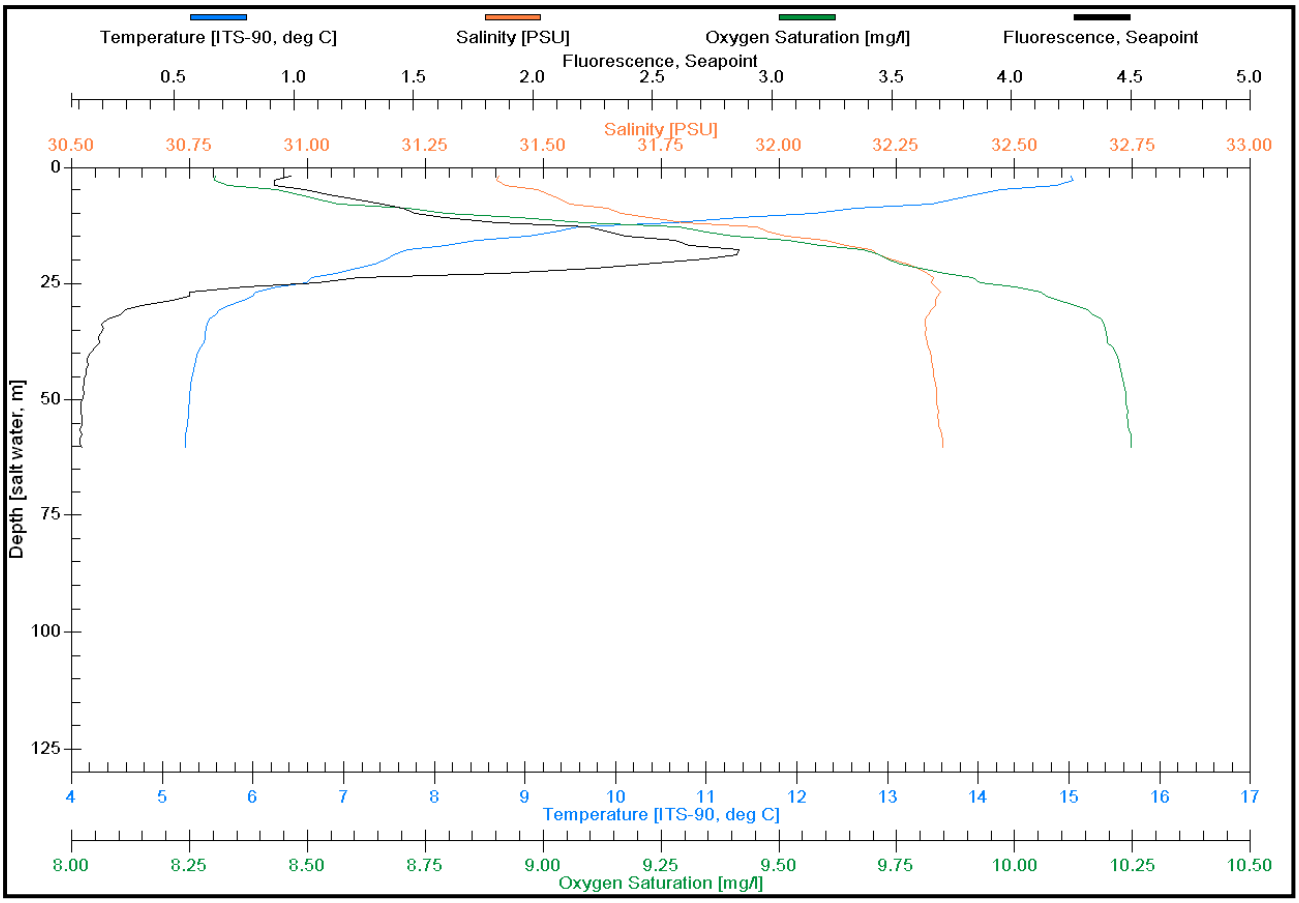
Station 029



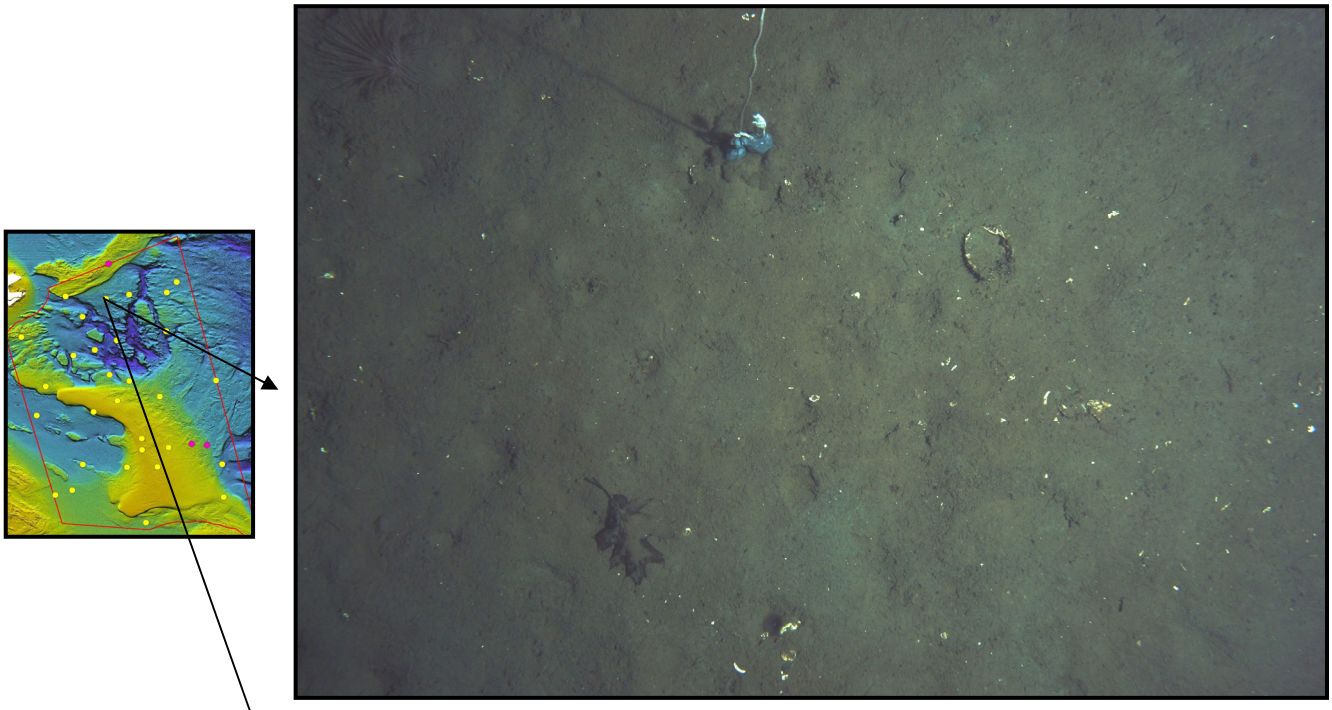

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

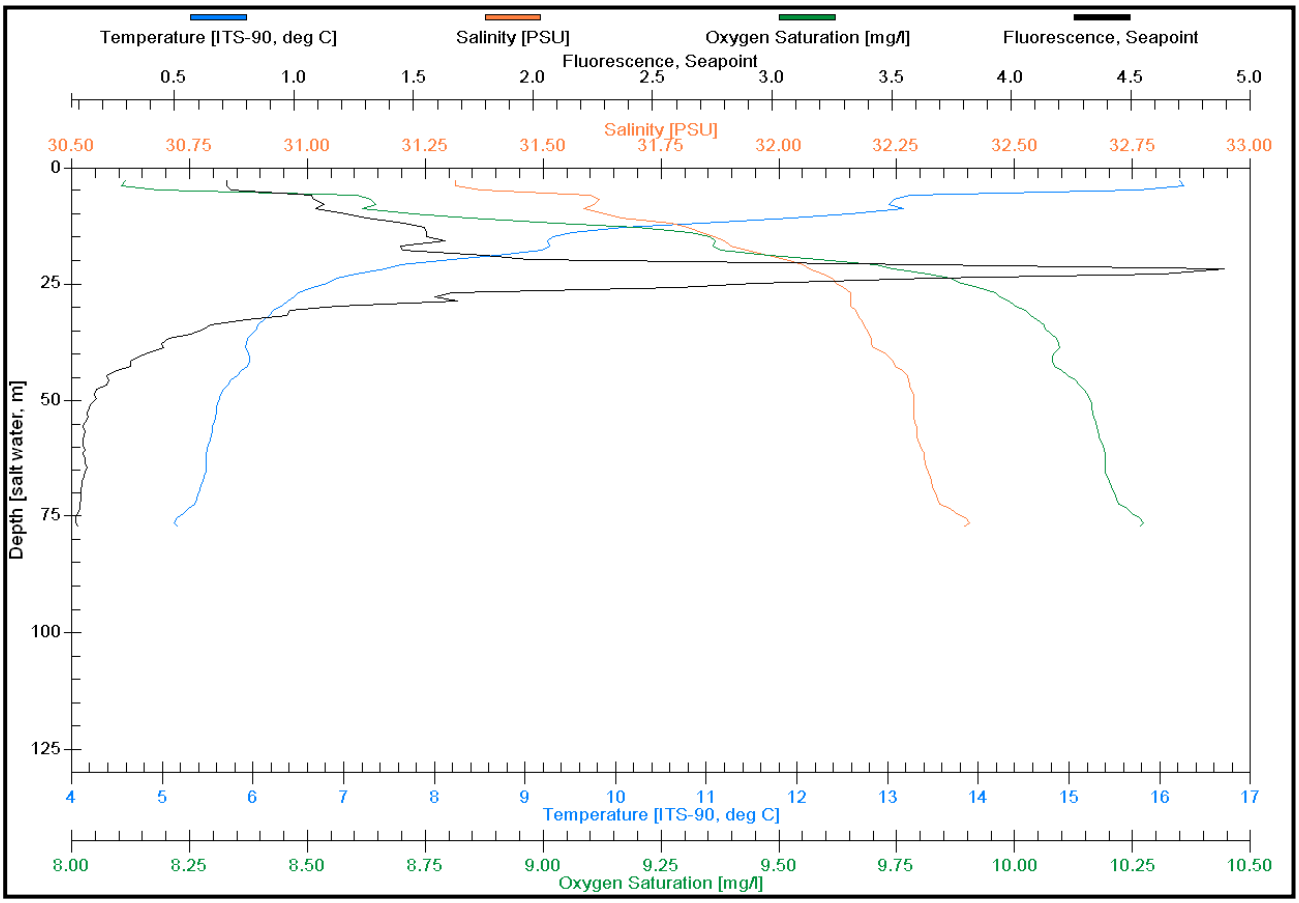
Station 030



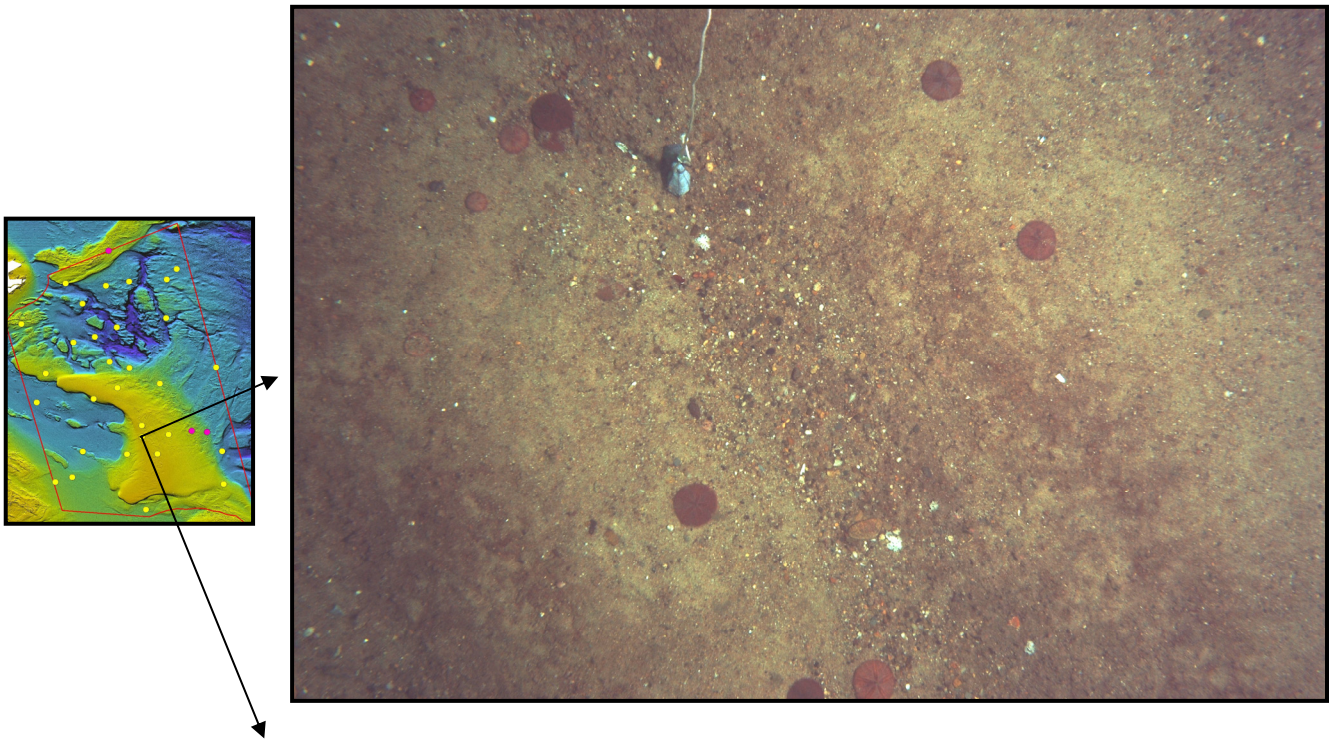

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

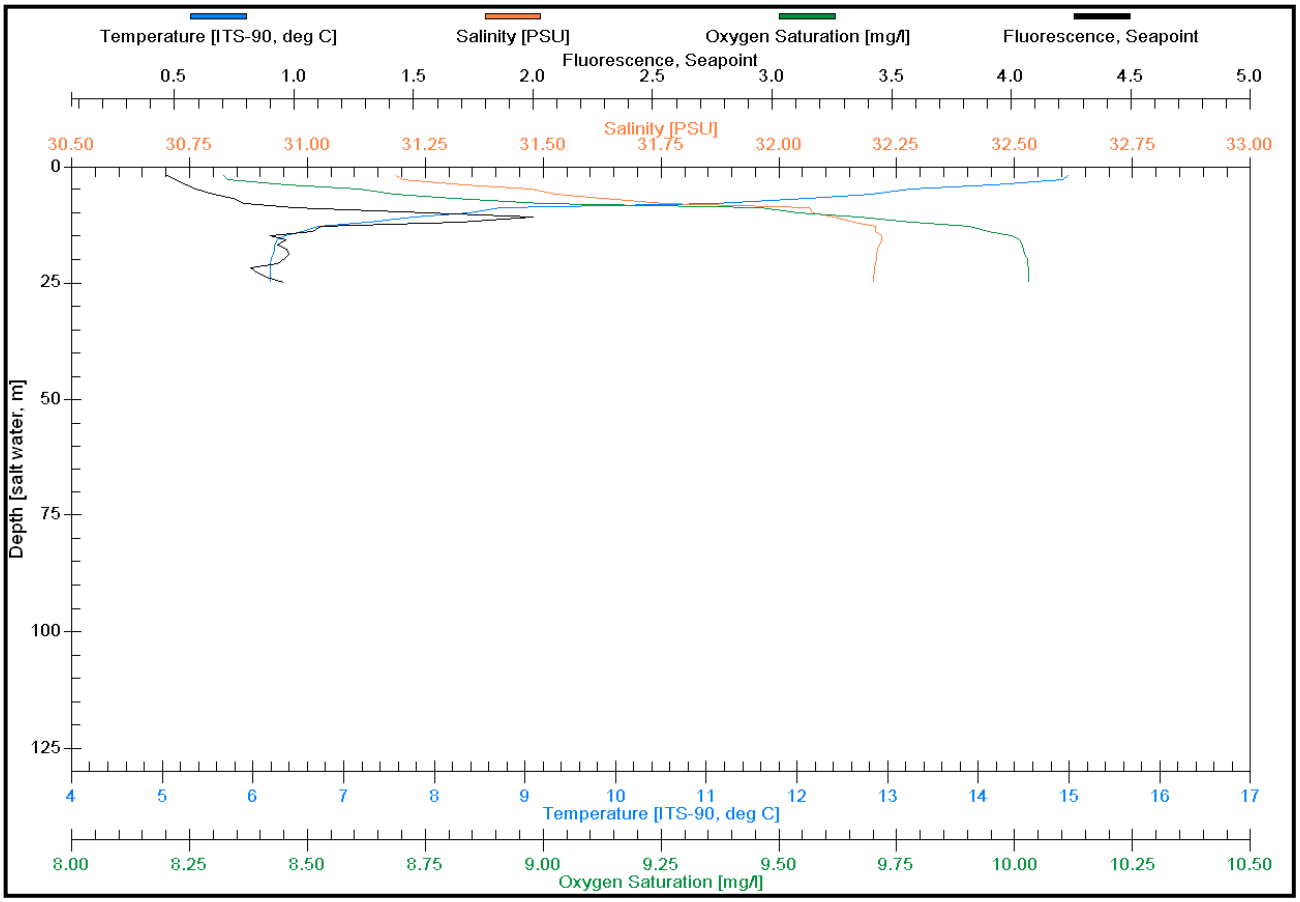
Station A02



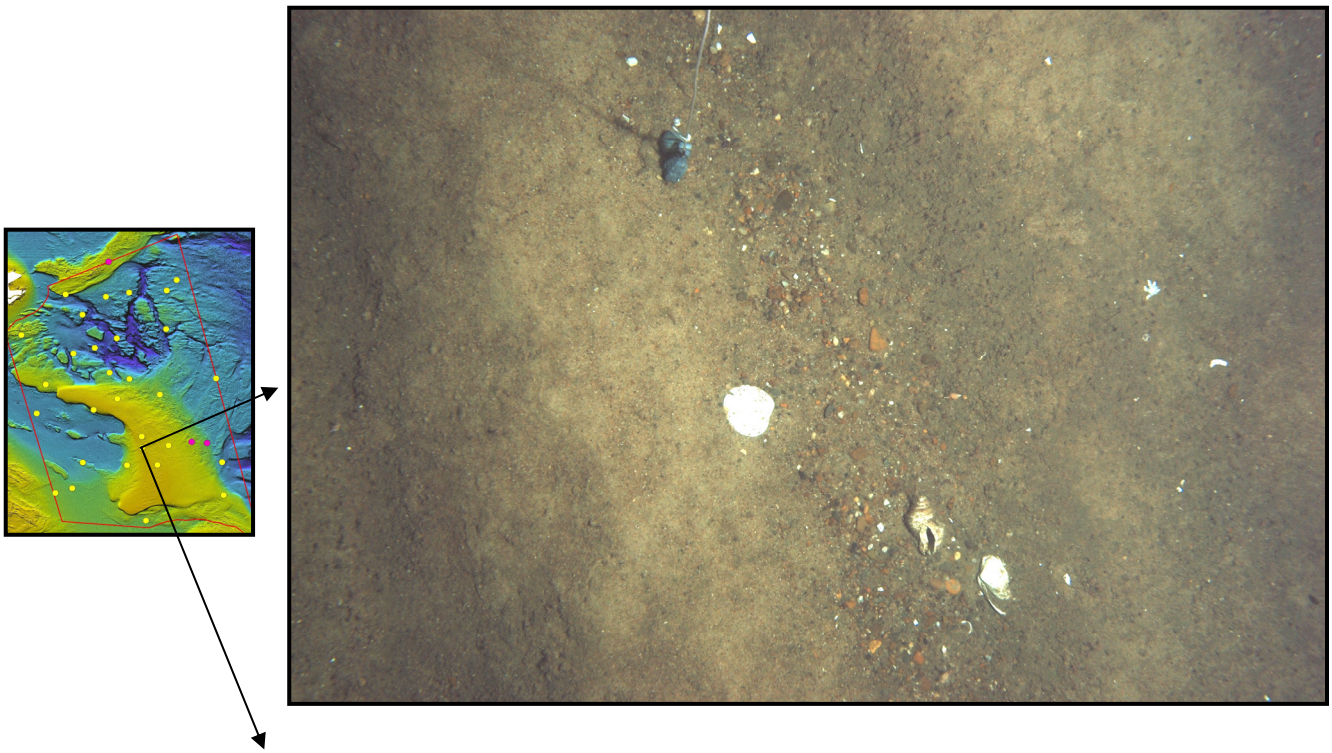

Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

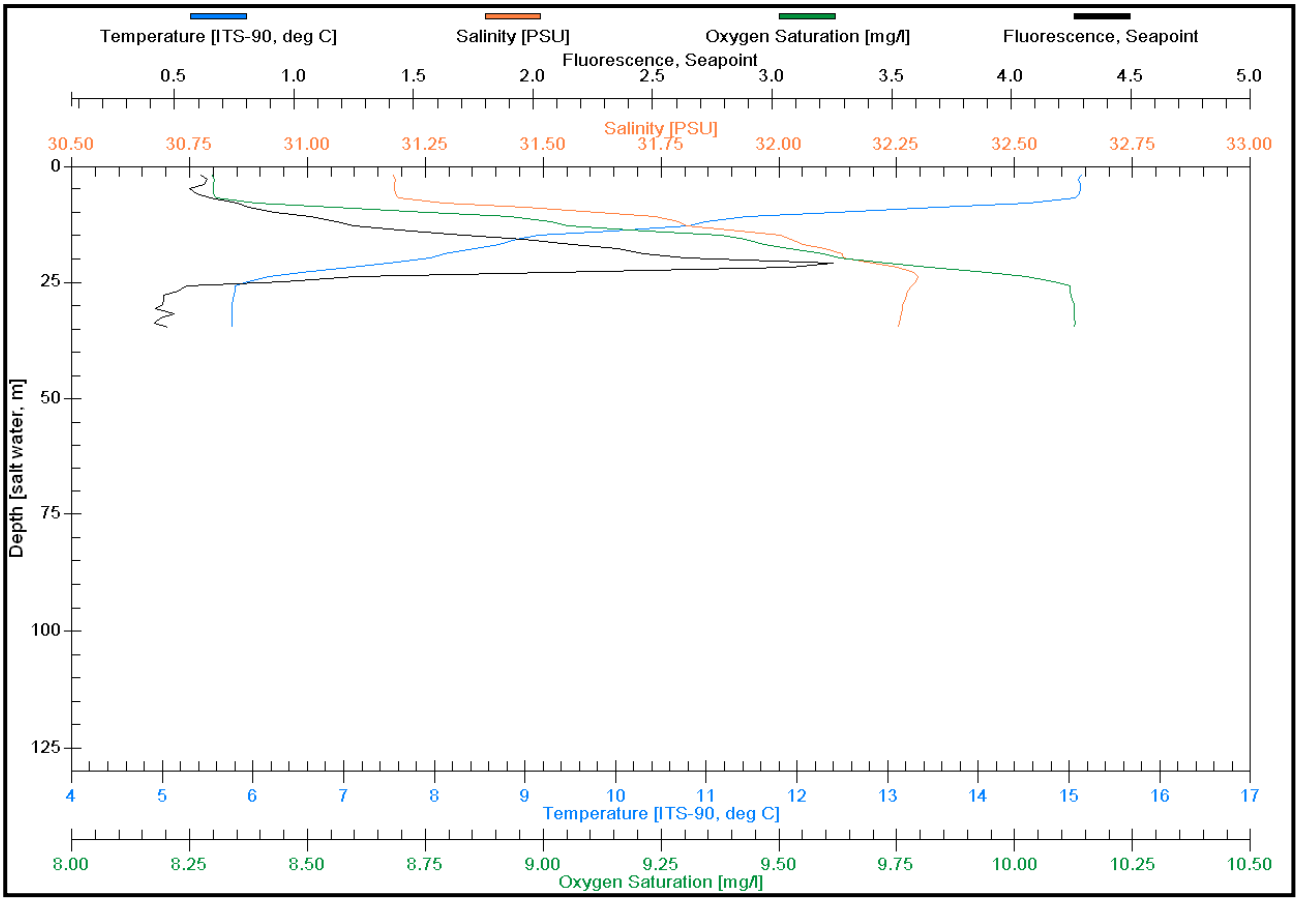
Station A07




Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

Station A25




Temperature [ITS-90, deg C]
Salinity [PSU]
Oxygen Saturation [mg/l]
Fluorescence, Seapoint
Fluorescence, Seapoint
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Salinity [PSU]
30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00
Depth [salt water, m]
0 25 50 75 100 125
4 5 6 7 8 9 10 11 12 13 14 15 16 17
Temperature [ITS-90, deg C]
8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50
Oxygen Saturation [mg/l]

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