

APPENDIX 2 – FISHERIES AND BIODIVERSITY

2.3 CTD Deployment Report FV Zeearend

NAMIBIAN MARINE PHOSPHATE

BIODIVERSITY VERIFICATION SURVEY

CTD REPORT

Prepared for:

Namibian Marine Phosphate (Pty) Ltd.

Prepared by:

Lwandle Technologies (Pty) Ltd.



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Job no. 204

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SUMMARY

Namibian Marine Phosphate (NMP) proposes to recover pelletal phosphate from the Sandpiper ore body situated in Mining Licence Area (MLA) 170, offshore of Namibia. An Environmental Impact Assessment (EIA) for the marine component of this project was submitted in 2012. A biodiversity verification survey was conducted to investigate concerns raised during the production of the review of the EIA report. This report details the water column characteristics during the fisheries biodiversity verification survey. This report should be viewed as a supplement to the detailed fisheries biodiversity verification report. Water column characteristics were found to be consistent with those expected of the region. South Atlantic central water was present throughout the survey and relatively low oxygen conditions were experienced near the bottom. In general the bottom water layers were 2.5 to 4 °C cooler than the surface water.



Above: Field Team pictured in front of FV *Zeearend*. From left to right: Kate Munnik, Tim McClurg, Melanie Smith, Victor Ngcongo, Ester Nangolo, Malakia Shimhanda and Robert Williamson.

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1 INTRODUCTION

Namibian Marine Phosphate (NMP) is investigating the possibility of extracting pelletal marine phosphate from the seabed on the continental shelf offshore of Namibia. An environmental impact assessment (EIA) was previously carried out to determine the possible effects of this development on the marine environment and a specialist biodiversity assessment was carried out as part of this process. Concerns as to the confidence of the results of the EIA as reported in the specialists studies of the EIA, along with reviewer concerns, raised a number of issues which are addressed through a series of verification surveys. The biodiversity verification survey, reported on here, was carried out by Capricorn Fisheries Monitoring cc (CapFish) with Lwandle Technologies (Pty) Ltd supplying and operating a CTD (conductivity, temperature and depth meter) instrument in order to conduct water column profiling in conjunction with the biodiversity trawls. This report describes the water column characteristics present during the biodiversity verification survey.

2 SCOPE

Lwandle supplied a CTD (RBR XR 420 and RBR XR 620) instrument with the following sensors for use during the trawl-based biodiversity survey:

- Pressure;
- Temperature;
- Conductivity; and
- Dissolved oxygen

The CTD was attached to the trawl net in order to allow under-way sampling during trawling. This meant the vessel did not have to stop before or after each trawl in order to deploy the CTD. Due to the potential 'hostility' of the survey environment a robust oxygen sensor (OXYGUARD by RBR) was used during the survey.

3 METHODS

The biodiversity verification survey was carried out in the SP-1 within the ML 170 licence area, offshore of Namibia as this is the stated target area for the first 20 years of mining (NMP 2012). A total of 24 trawls was undertaken during the survey with half being carried out at night and the other half in the day time hours.

The CTD was placed in a steel frame and covered with a rope-mesh bag for protection before being attached to the trawl net for each trawl. Initially the field team attempted to attach the CTD and frame to the head rope of the trawl net above its mouth. In theory this was the safest place for the CTD to be positioned as it was clear from most of the metal tickler chains, bobbins and steel cabling. However, due to the configuration of the net setting gear and associated stern rollers, attaching the CTD to this position proved very difficult. During the first deployment the CTD frame was rolled back onto one of the stern rollers as the net was being set. This caused damage to the steel frame as well as possible damage to the RBR unit itself (Figure 1).

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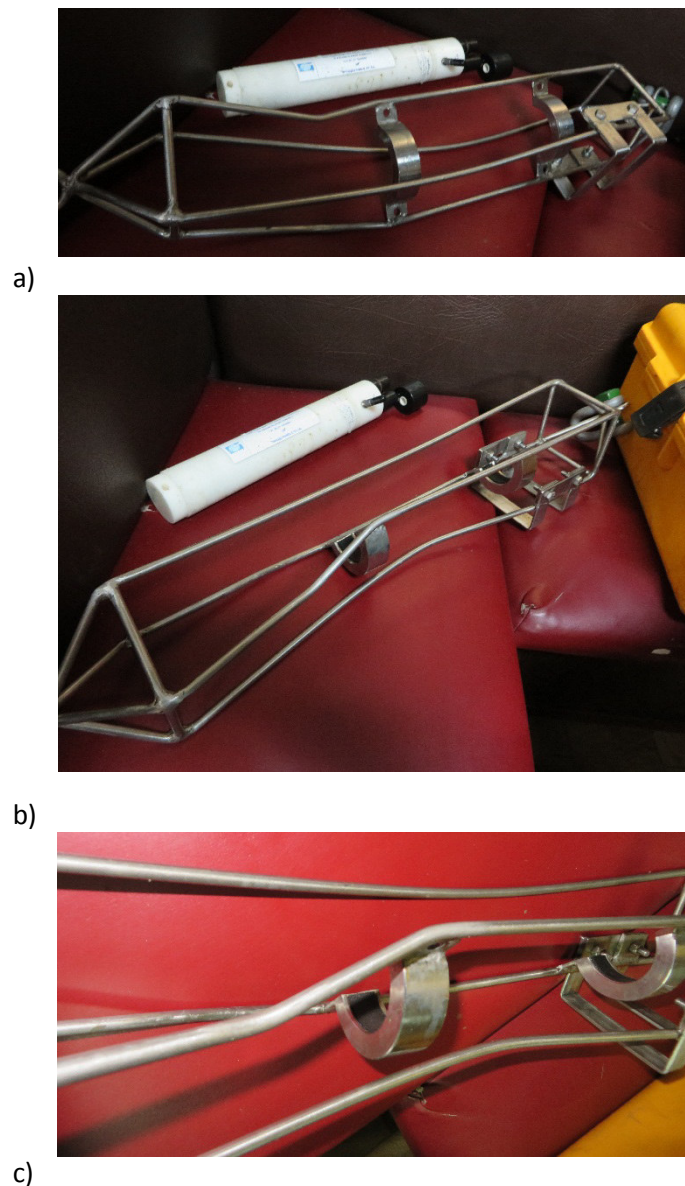


Figure 1: a), b) and c) show the damaged caused to the CTD frame after Trawl 1. Most of the damage is expected to have been caused when the frame was rolled back onto the stern rollers.

A revised position for the CTD was identified further up the head rope, closer to the stern of the vessel. In this position the CTD could easily be attached prior to a trawl and detached as the trawl net was retrieved (Figure 2). Even in this revised position there were still occasions where the CTD and frame were subjected to collisions with other metal elements of the net. Recommendations for avoiding damage to the CTD and ensuring the best possible data return in any future work are provided at the end of this report.

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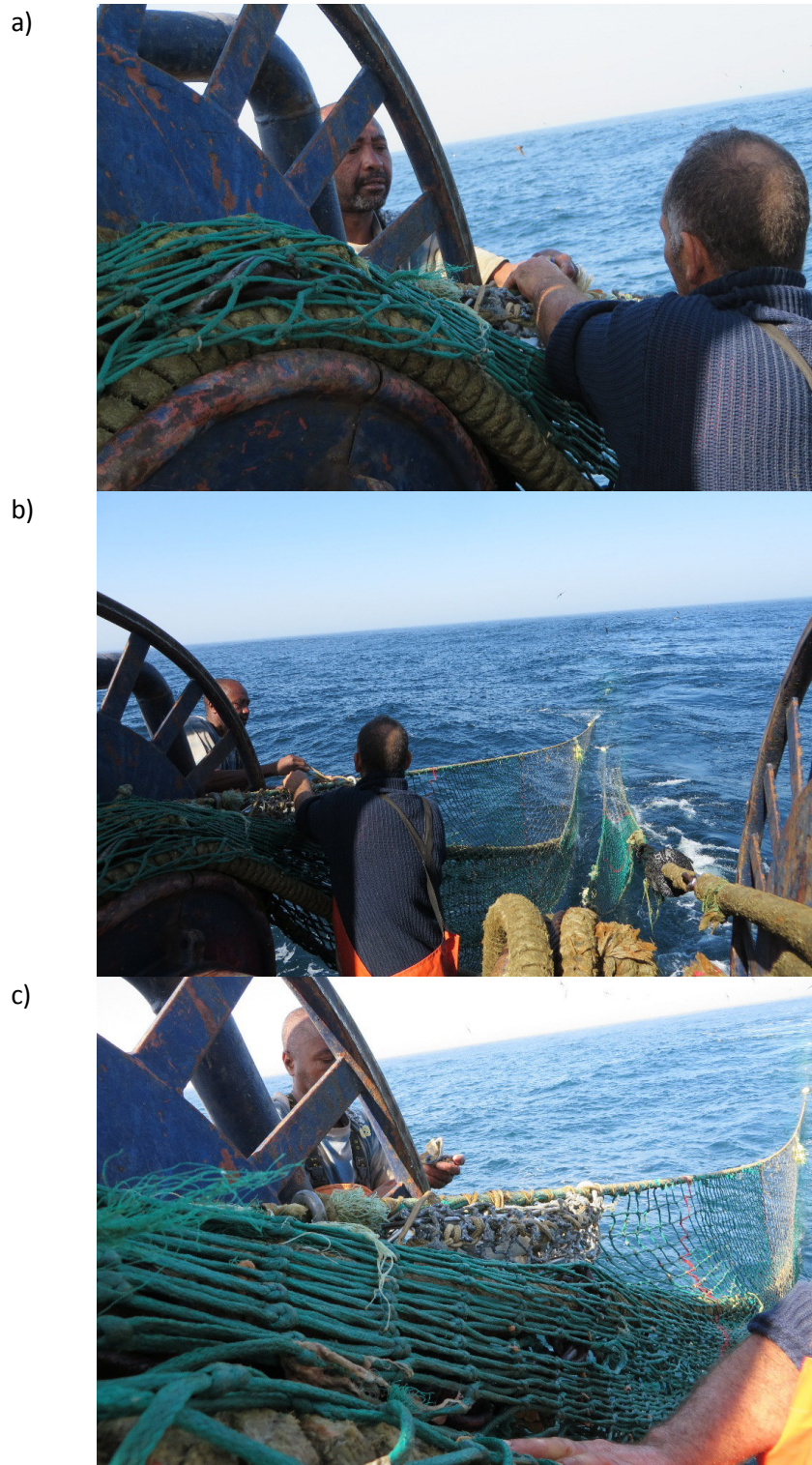


Figure 2: a).b) and c) depict crew members of the *Zeearend* securing the CTD onto the trawl net. The CTD had been placed in a protective steel frame and this frame had been covered with a mesh bag prior to securing it on the trawl net in order to prevent snags on the CTD sensors.

Before each trawl the CTD was switched on and set up using RBR's RUSKIN software. The instrument was set to sample at a frequency of 6 Hz (6 times per second). This was the case for all trawls except Trawl 2 (D4) as the RBR XR 420 was used for this trawl and this instrument's maximum sampling frequency is one sample every 10 seconds. Additionally dissolved oxygen data were missing from Trawl 2 (D4) as the XR 420 does not have an oxygen sensor. Trawl 2 was the only trawl for which this instrument configuration was used.

During each trawl the CTD was in logging mode from the moment it was activated by the Lwandle technician until the instrument was recovered and turned off after each trawl. For processing purposes each trawl was divided into three sections (Figure 3) the down cast (A), trawl (C) and up cast (B) sections. All data was processed using RBR's RUSKIN software as well as Mathworks' MATLAB. Salinity values greater than 40 and less than 30 and dissolved oxygen concentrations greater than 110 % were considered erroneous and were removed from the data.

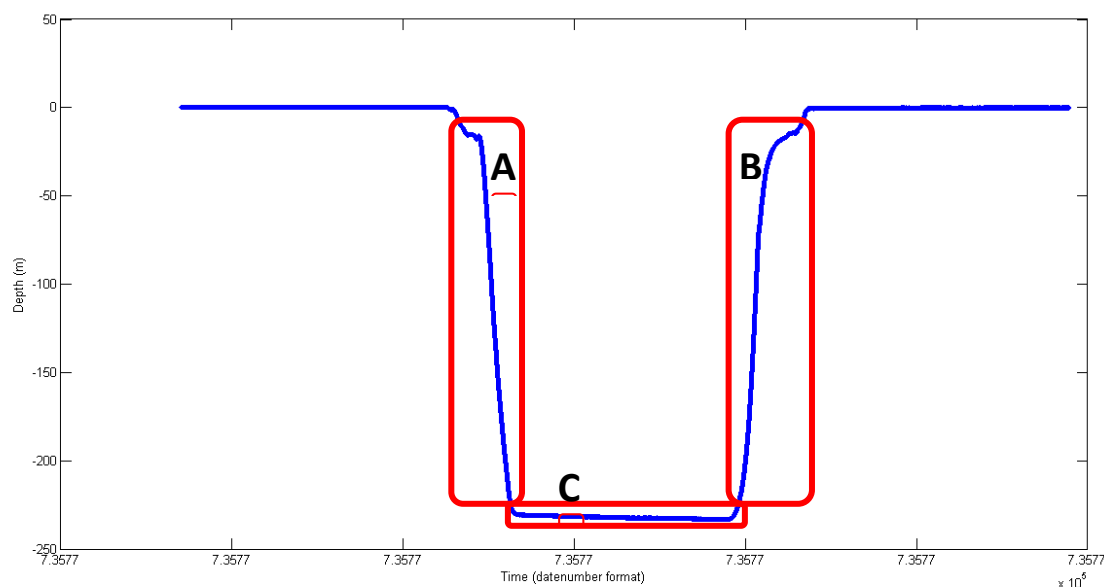


Figure 3: Schematic showing the division of each trawl into sections.
A: Down cast section, B: Up cast section and C: Trawl section.

The CTD did not function properly during the last two trawls (Trawl 23 (N22) and Trawl 24 (N24)) possibly due to previous damage to the unit during trawls. The data from both of these trawls has been discarded.

4 RESULTS

A summary table of results from the Trawl section (Figure 3: C – Trawl Section) excluding the up and down casts) of each trawl is shown below, and the profile images as well as the full results tables from each trawl are presented in Annexures 1 and 2.

A total of 24 trawls was carried out, half were performed during the daylight hours and the remainder at night (Table 1). The trawls are labelled chronologically with Trawl 1 being the first in the survey and Trawl 24 being the last. The salinity, depth and temperature data was within the expected ranges for the majority of the trawls (exceptions are trawls 23 and 24). The dissolved oxygen data however should be viewed with caution as the OXYGAURD sensor did appear to drift (in terms of accuracy) during the survey, likely due to impact of the logger/ sensor in the initial deployments. Trawl 2 does not have oxygen data as the RBR 420 CTD was used for that deployment.

Table 1: Summary statistics of the 'Trawl section' (excluding up and down casts) of each trawl.

Name	Station	Date	Time	Temperature (°C)		Dsvl. Oxygen (%)		Salinity (PSU)	
				Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Trawl 1	N1	18-Jun-14	18:05	10.85	0.05	18.49	0.53	35.12	0.01
Trawl 2	D2	20-Jun-14	07:35	10.01	0.03	N/A	N/A	34.29	0.79
Trawl 3	D3	20-Jun-14	12:35	10.25	1.14	19.48	8.83	35.11	0.21
Trawl 4	D4	20-Jun-14	16:12	10.08	1.07	19.63	6.79	34.99	0.61
Trawl 5	D6	21-Jun-14	07:13	9.86	0.01	2.59	0.16	34.26	1.31
Trawl 6	D7	21-Jun-14	11:56	9.97	0.01	5.14	0.11	34.45	1.27
Trawl 7	D8	21-Jun-14	16:00	10.18	0.02	4.16	0.17	34.99	0.49
Trawl 8	D9	22-Jun-14	07:05	10.57	0.01	5.39	0.16	34.83	0.69
Trawl 9	D10	22-Jun-14	10:22	10.54	0.01	5.34	1.08	34.76	0.75
Trawl 10	D11	22-Jun-14	13:45	10.49	0.01	4.01	0.92	35.18	0.05
Trawl 11	D12	22-Jun-14	17:00	9.72	0.03	2.36	1.70	34.11	1.48
Trawl 12	D17	23-Jun-14	12:55	10.58	0.04	3.45	0.76	34.78	0.82
Trawl 13	N15	23-Jun-14	19:00	10.65	0.02	3.24	0.59	32.68*	1.53
Trawl 14	N16	23-Jun-14	22:20	11.40	0.06	8.20	5.99	33.03*	1.71
Trawl 15	N23	24-Jun-14	01:35	11.36	0.15	1.08	2.10	34.90	0.31
Trawl 16	D5	24-Jun-14	15:05	11.20	0.03	2.51	0.71	34.44	0.87
Trawl 17	N21	24-Jun-14	18:55	11.39	0.02	3.86	2.68	34.00*	1.21
Trawl 18	N14	24-Jun-14	21:55	11.47	0.02	N/A	9.66	34.35	1.05
Trawl 19	N13	25-Jun-14	00:55	10.63	0.05	N/A	10.40	34.84	0.54
Trawl 20	N20	25-Jun-14	17:40	11.38	0.02	N/A	10.00	33.71*	1.47
Trawl 21	N19	25-Jun-14	21:55	11.49	0.66	N/A	17.27	33.31*	1.70
Trawl 22	N18	26-Jun-14	00:55	10.92	0.02	N/A	21.70	34.26	1.24
Trawl 23	N22	26-Jun-14	18:52	N/A	N/A	N/A	N/A	N/A	N/A
Trawl 24	N24	26-Jun-14	22:15	N/A	N/A	N/A	N/A	N/A	N/A

* These values are outside of the salinity range for SACW, and are associated with very high standard deviation values which indicates that they should be viewed with caution.

5 DISCUSSION AND RECOMMENDATIONS

Twenty two of the 24 trawls undertaken during the biomass verification survey provided acceptable results for temperature and 19 trawls yielded reasonable salinity results (with exceptions being: Trawls 13, 14, 17, 20 and 21). The trawls where successful temperature and/or salinity data were recorded can be compared to the fisheries and biomass data from the respective trawls.

Temperature profiles show a well-mixed upper water column in most cases, with slight stratification occurring from Trawl 10 onwards. This is to be expected as the survey took place just after an extended period of rough seas and considerable wave action in the survey area. The weather conditions calmed significantly from trawl 5 onwards and this may have allowed slight stratification of the upper layers of the water column. In general the upper water column was approximately 2.5 – 4 °C warmer than the near seafloor temperatures (> 200 m). Temperature on or near the sea floor throughout the survey averaged at 10.68 °C. This is within the range of expected winter values for the region.

Salinity and temperature data indicated the presence of South Atlantic Central Water (SACW) for the majority of the survey, which is the major water mass present in the region (5 to 18.01 °C, 34.3 to 35.8 PSU, (Emery and Meincke 1986)). The questionable salinity values highlighted in Table 2 above could be a result of the interference of suspended particles or direct interaction with the ocean floor, both of which could occur during trawling. However, the errors could also have been caused by damage to the RBR unit.

The oxygen data from all the trawls should be viewed as general guidance values in the deeper water layers, and mid to upper water column values should be regarded with extreme caution. The dissolved oxygen levels near the seafloor for most of the trawls were reasonably low (~3 to 10%) as can be expected in the continental shelf zone offshore of Namibia.

5.1 RECOMMENDATIONS FOR FUTURE SAMPLING EFFORTS:

Attaching a CTD to the trawl net allows the unique opportunity of collecting temperature, salinity and oxygen data at exactly the same time as biomass information from trawls. The alternative being static profiles at a location either directly before or after each trawl. As each trawl spans a distance of ~ 1.5 nm, static point data would not provide accurate information on the water quality characteristics present during the trawl. Alternative CTD mounting options or an entirely different CTD logging system need to be considered in the future so as to avoid issues with bulky and vulnerable units that can easily be damaged by tickler chains and/or trawl cabling. The most promising solution appears to be using three separate, single channel RBR units which are considerably smaller. These units could be individually housed to ensure complete protection of each sensor, which would still allow easy attachment to (and detachment from) the trawl net. It is recommended that these three units be placed in the same location that was used for the majority of the biomass survey.

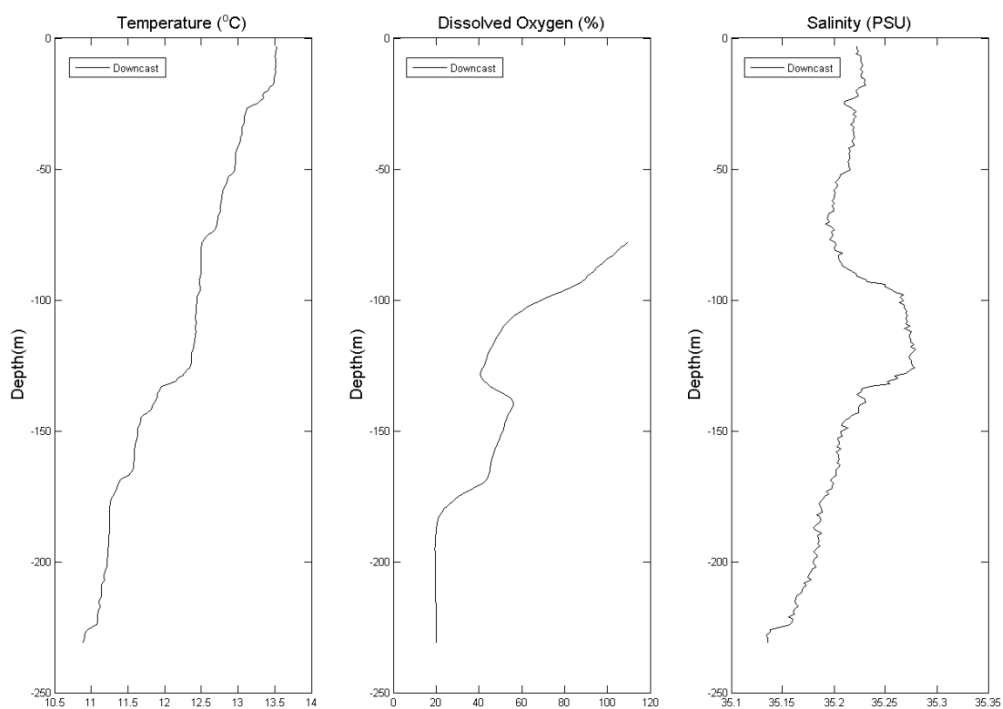
6 REFERENCES

- Emery W.J, Meincke J. 1986. Global water masses: Summary and review. Department of Oceanography, University of British Columbia, Vancouver, B.C., V6T 1W5, Canada.
- NMP 2012 – Environmental Impact Assessment for the proposed dredging of phosphate enriched sediments from Marine Licence Area No. 170. Namibian Marine Phosphate (PTY) Ltd. Namibia.

Annexure 1: CTD Profiles

Down cast data are presented for each trawl in a cross-section view, temperature, dissolved oxygen and salinity data are shown.

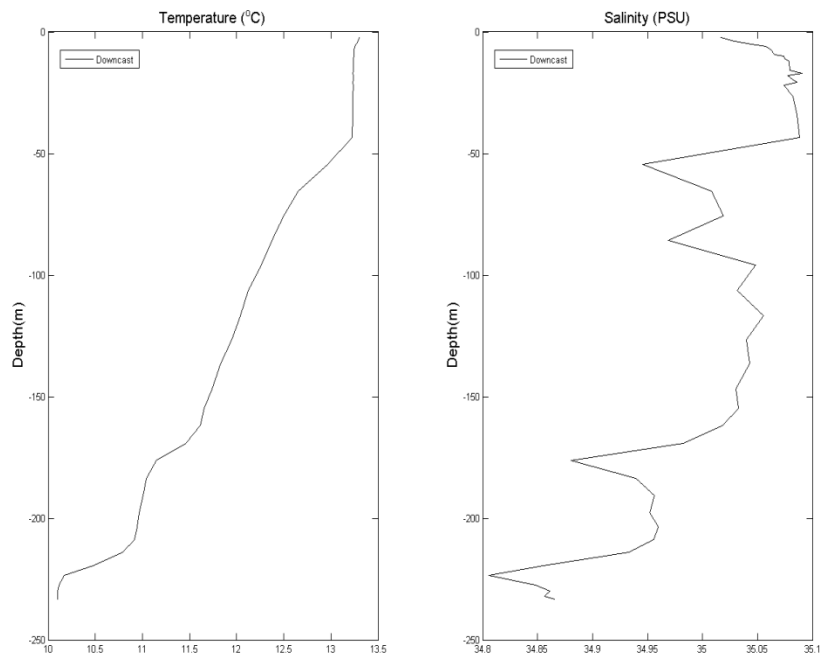
Trawl 1 (N1)



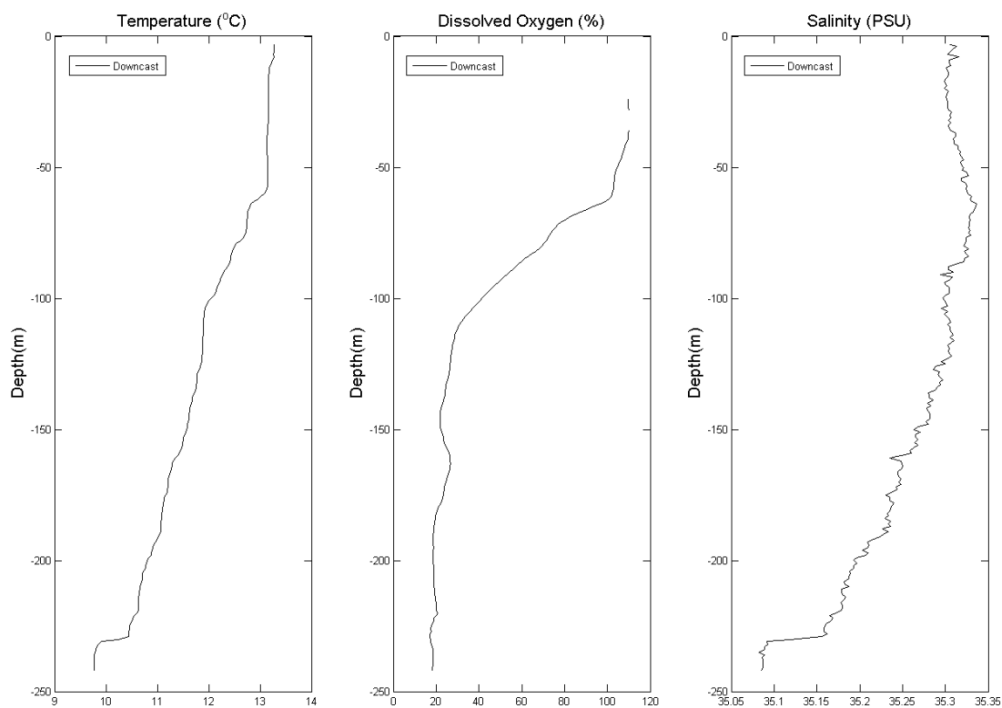
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ANNEXURE 1: CTD PROFILES – continued...

Trawl 2 (D2)

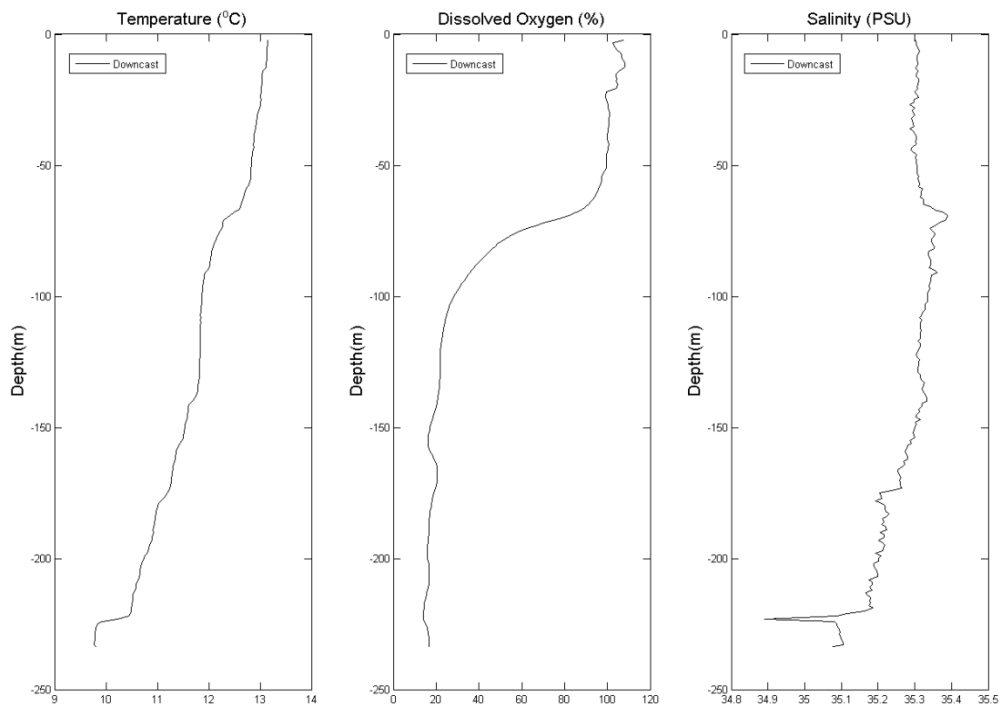


Trawl 3 (D3)

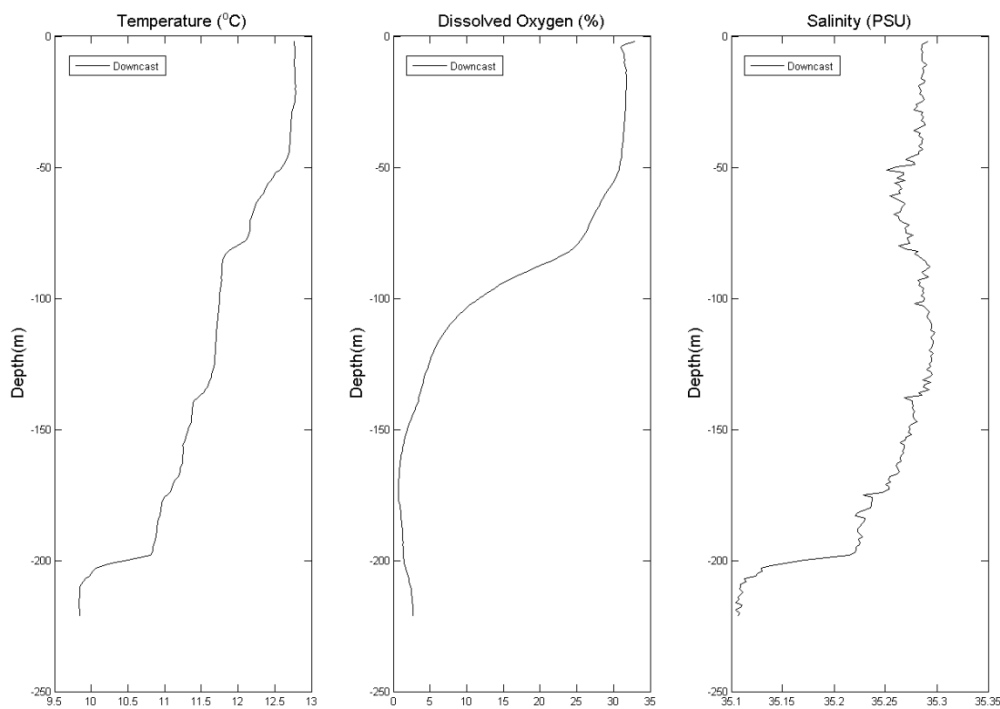


ANNEXURE 1: CTD PROFILES – continued...

Trawl 4 (D4)

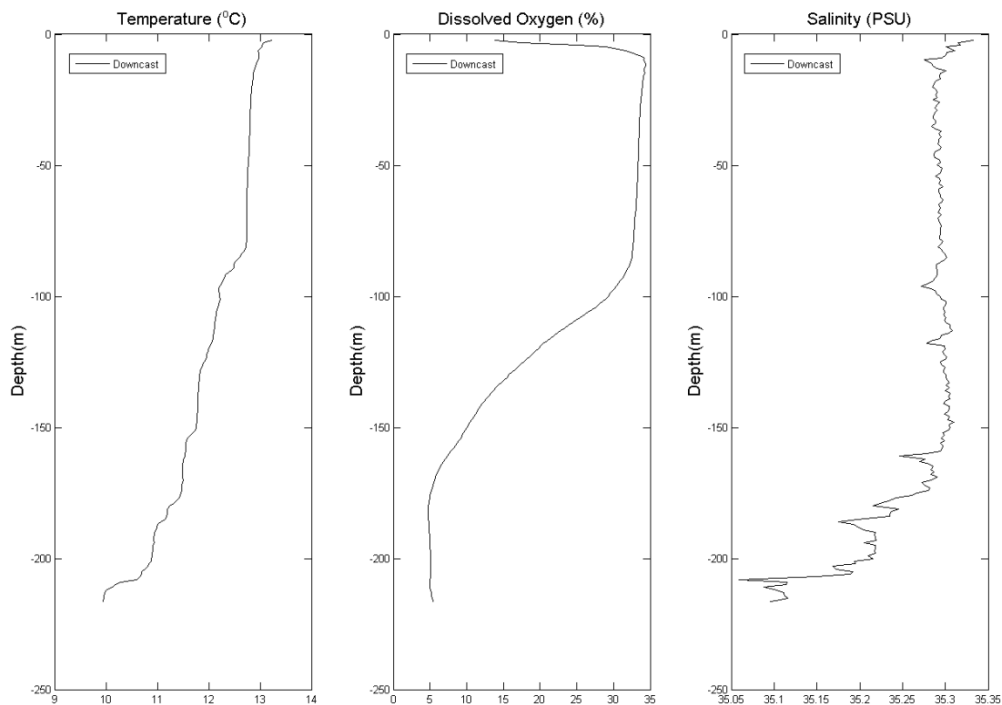


Trawl 5 (D6)

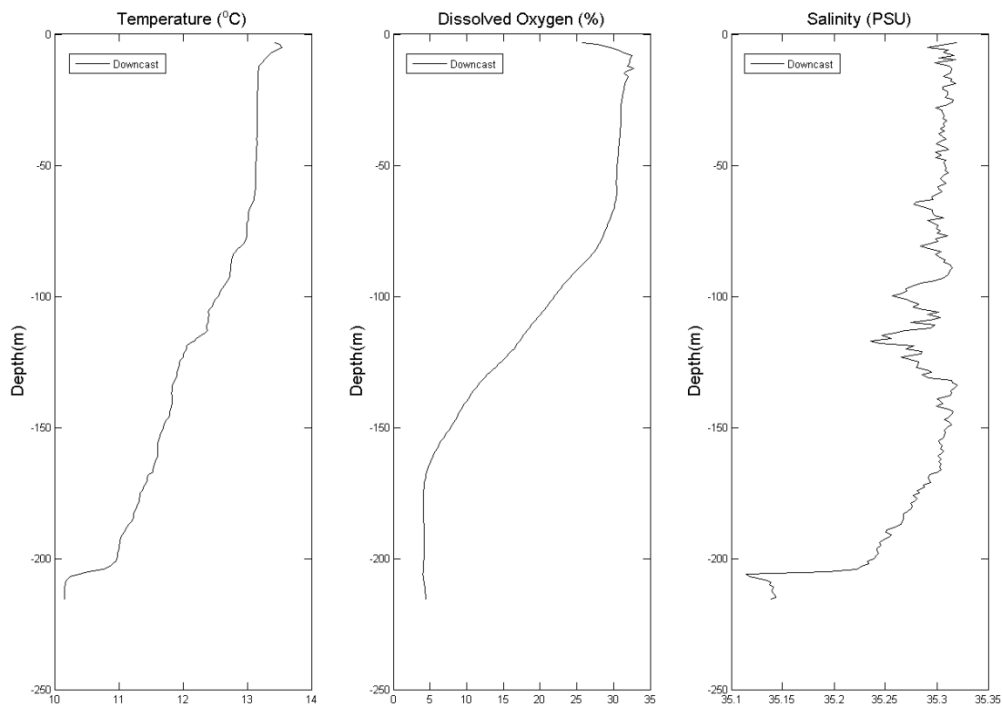


ANNEXURE 1: CTD PROFILES – continued...

Trawl 6 (D7)

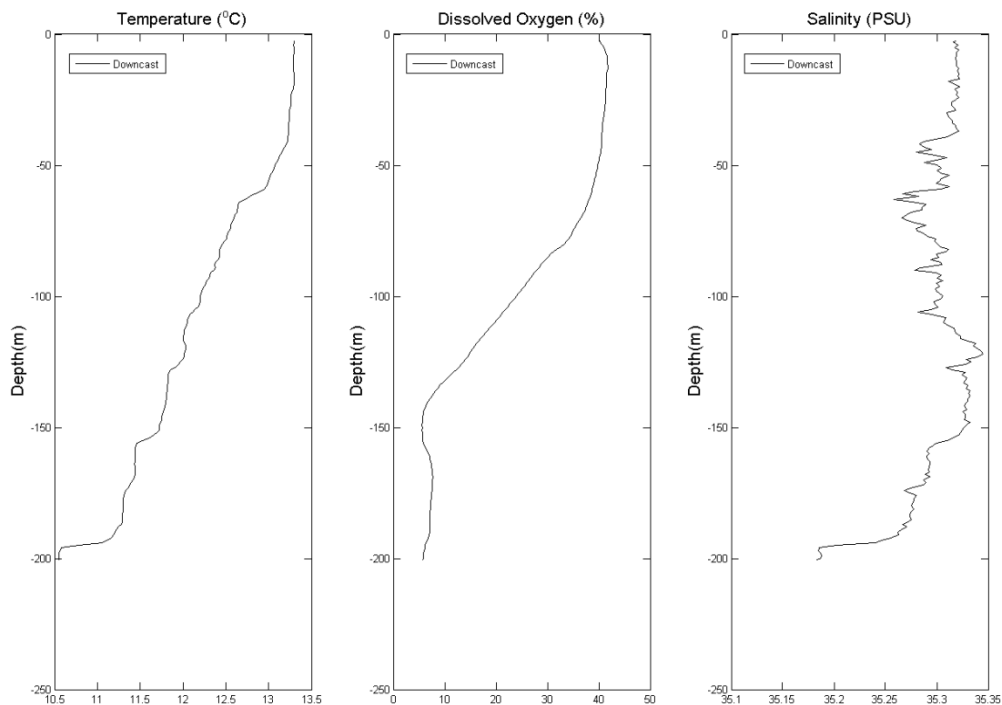


Trawl 7 (D8)

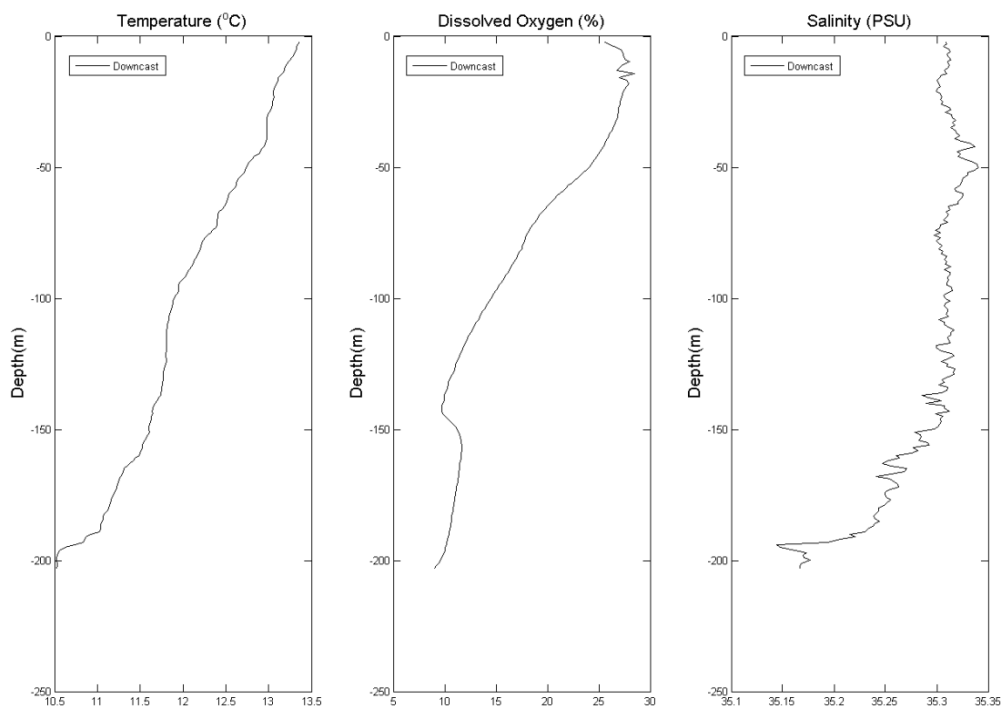


ANNEXURE 1: CTD PROFILES – continued...

Trawl 8 (D9)

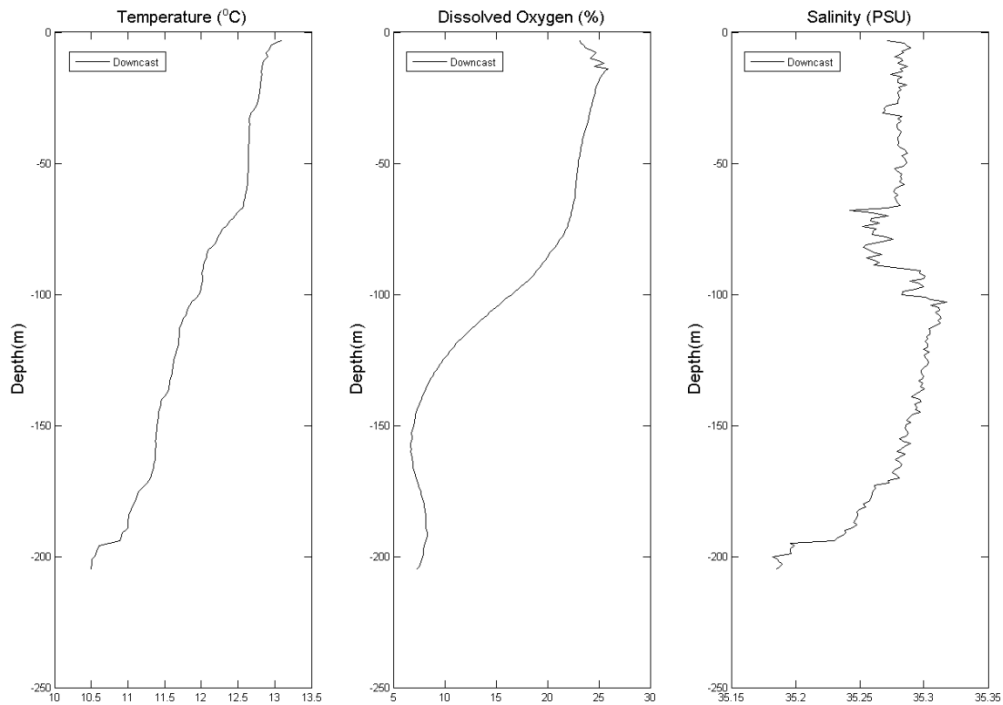


Trawl 9 (D10)

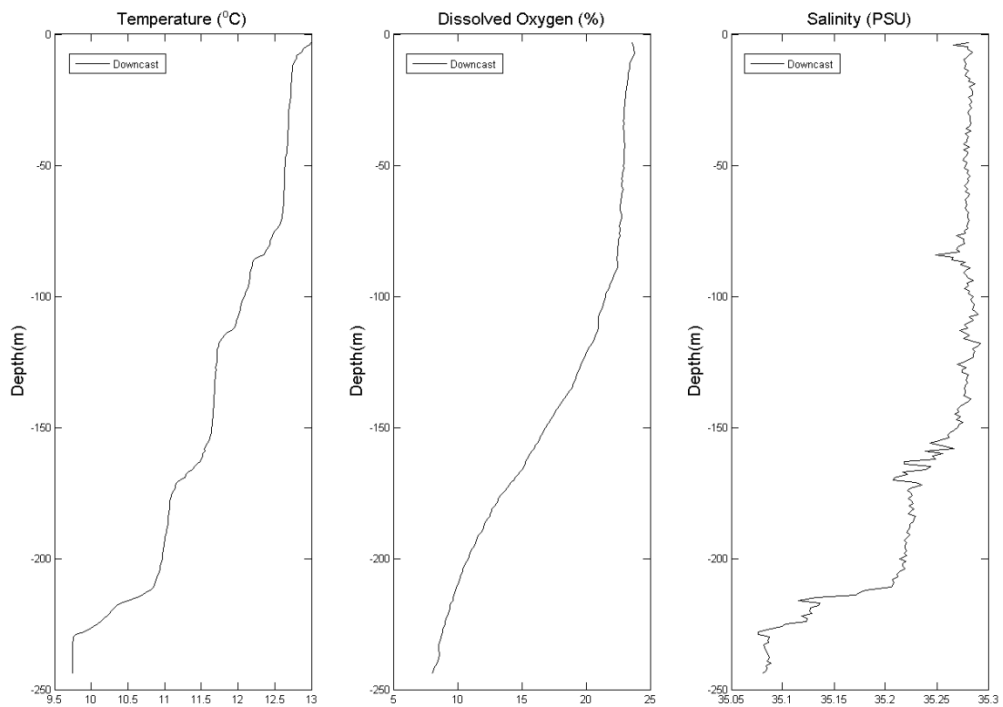


ANNEXURE 1: CTD PROFILES – continued...

Trawl 10 (D11)

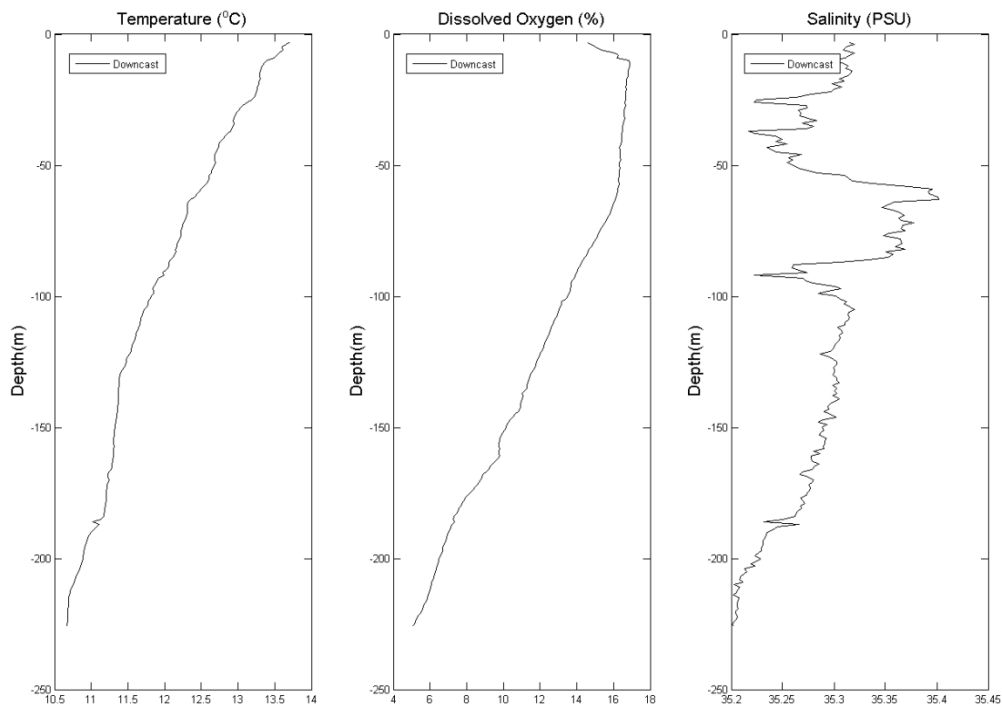


Trawl 11 (D12)

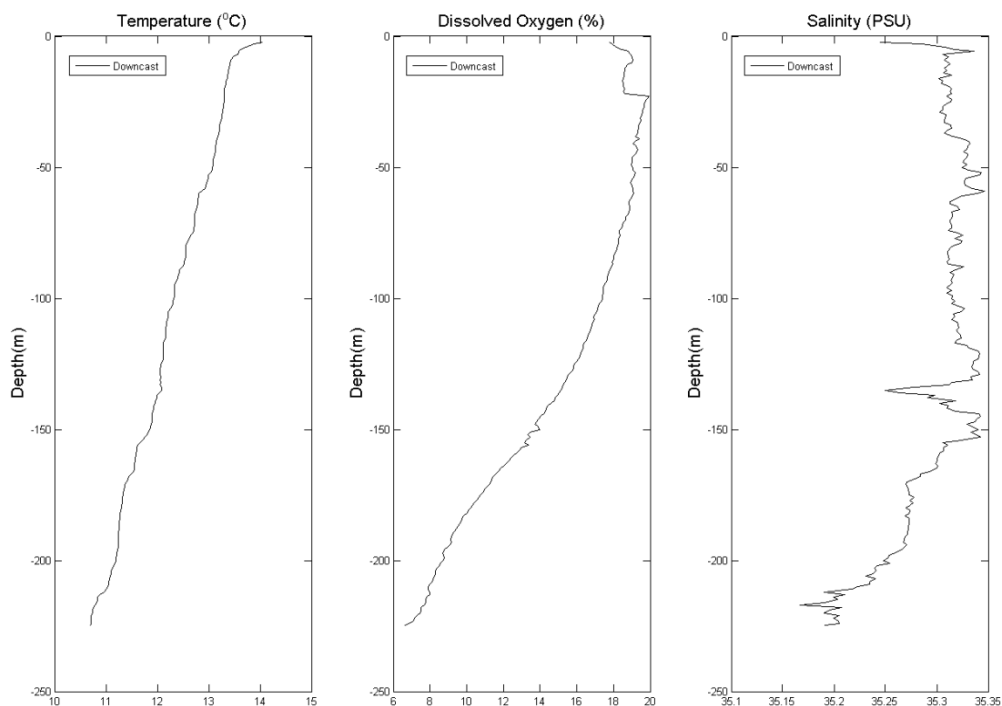


ANNEXURE 1: CTD PROFILES – continued...

Trawl 12 (D17)

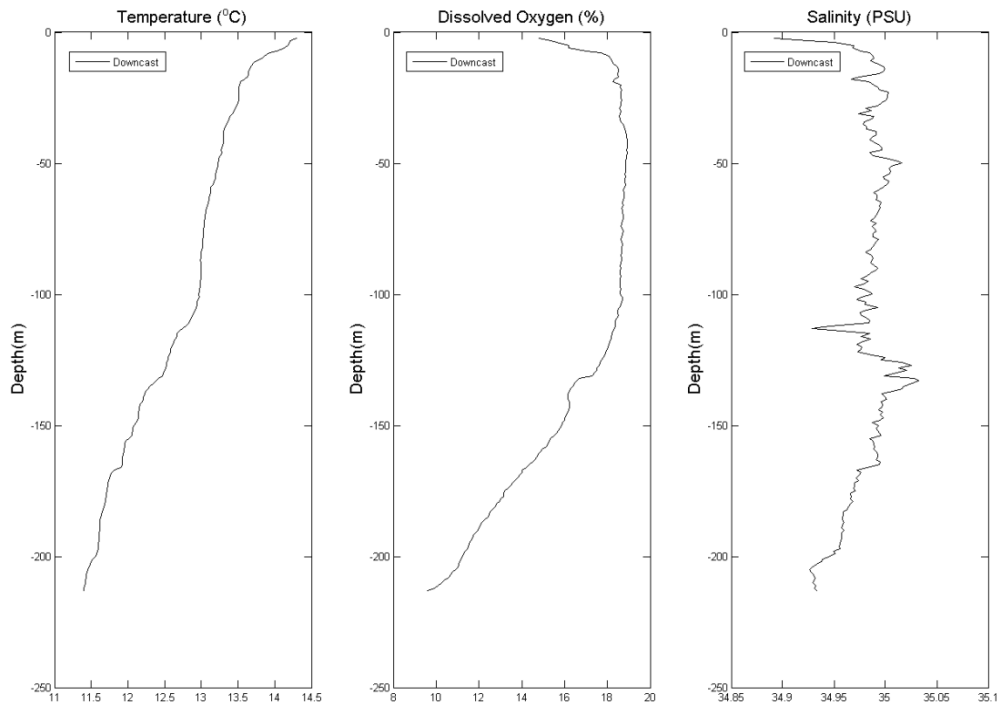


Trawl 13 (N15)

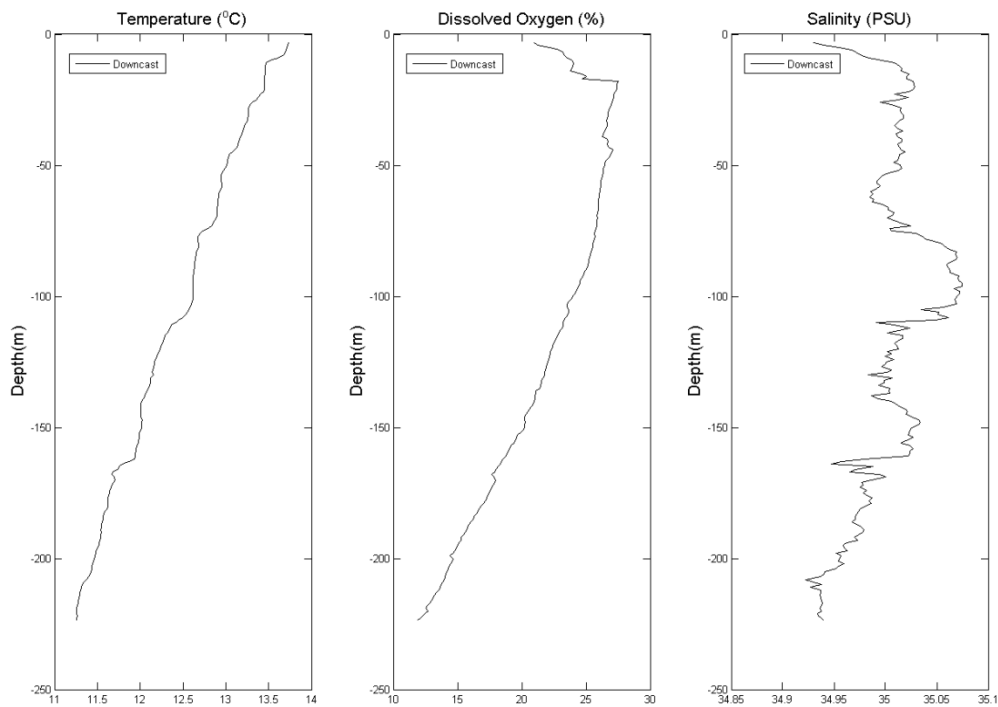


ANNEXURE 1: CTD PROFILES – continued...

Trawl 14 (N16)

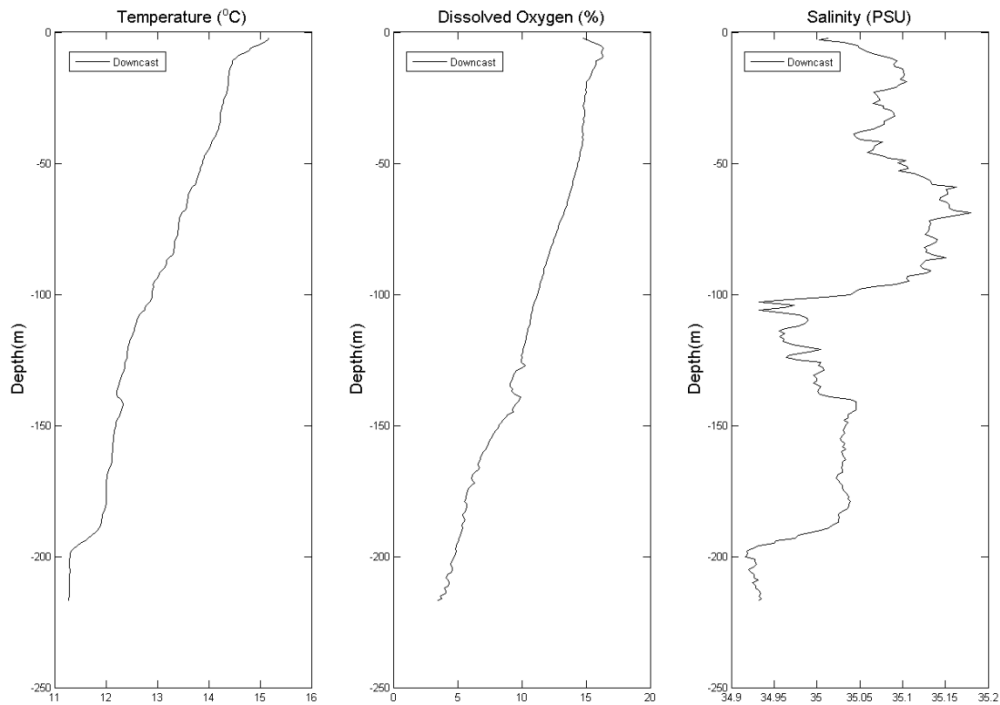


Trawl 15 (N23)

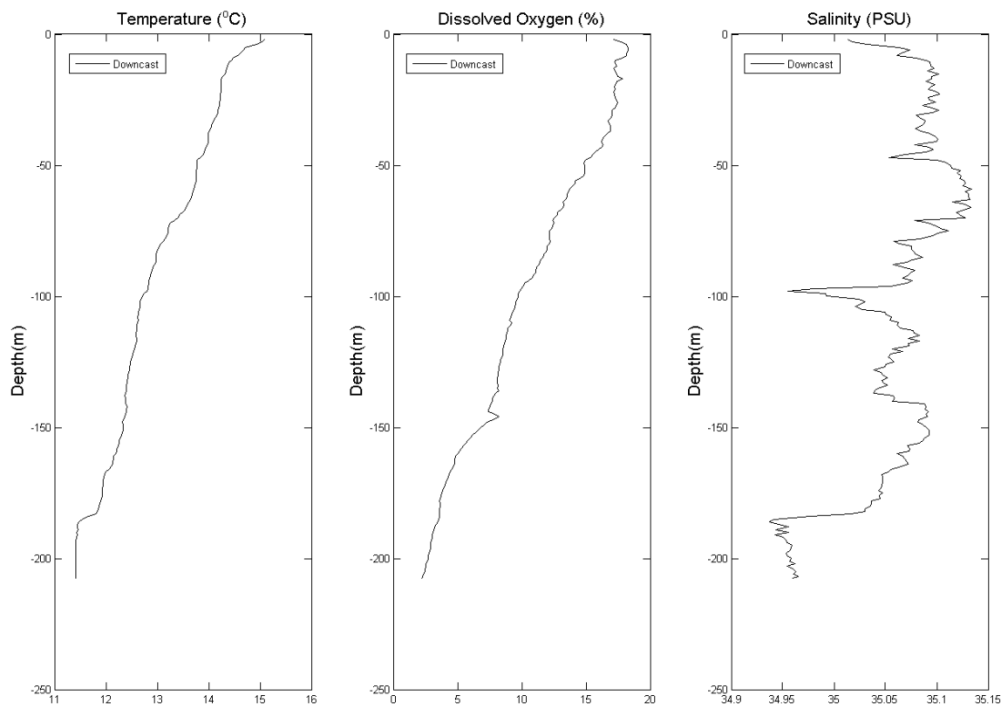


ANNEXURE 1: CTD PROFILES – continued...

Trawl 16 (D5)

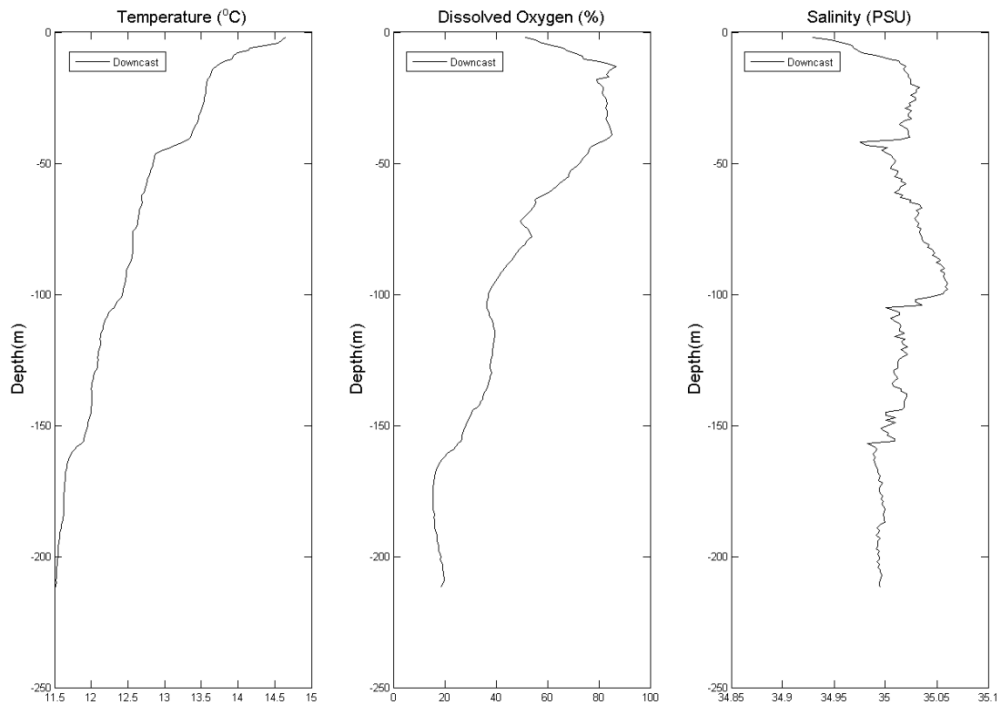


Trawl 17 (N21)

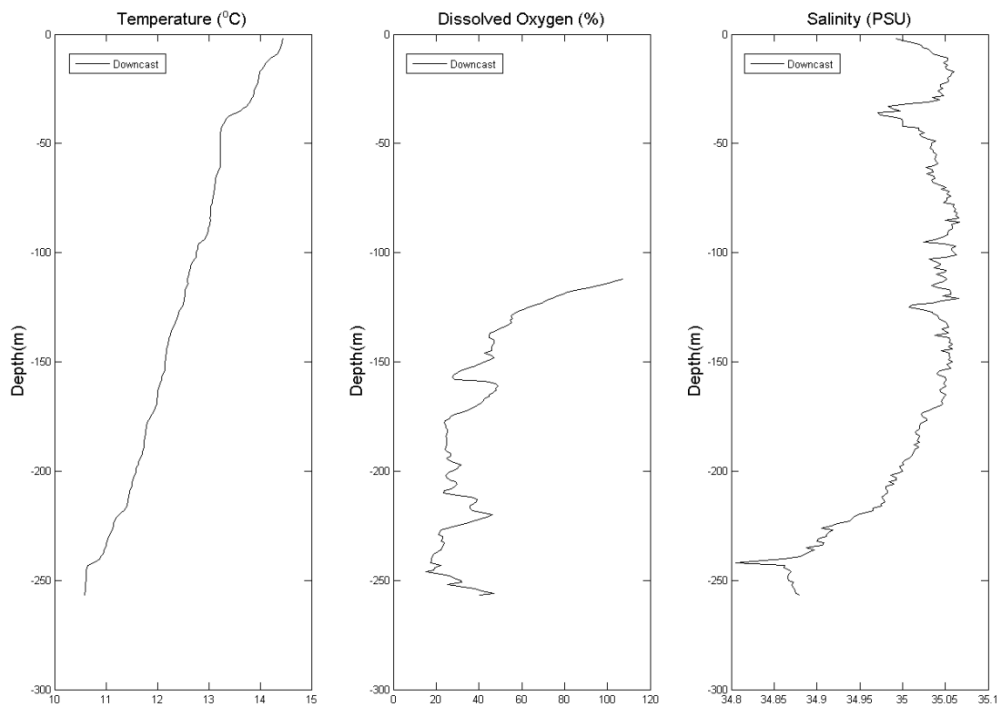


ANNEXURE 1: CTD PROFILES – continued...

Trawl 18 (N14) [Don't use O2 data]

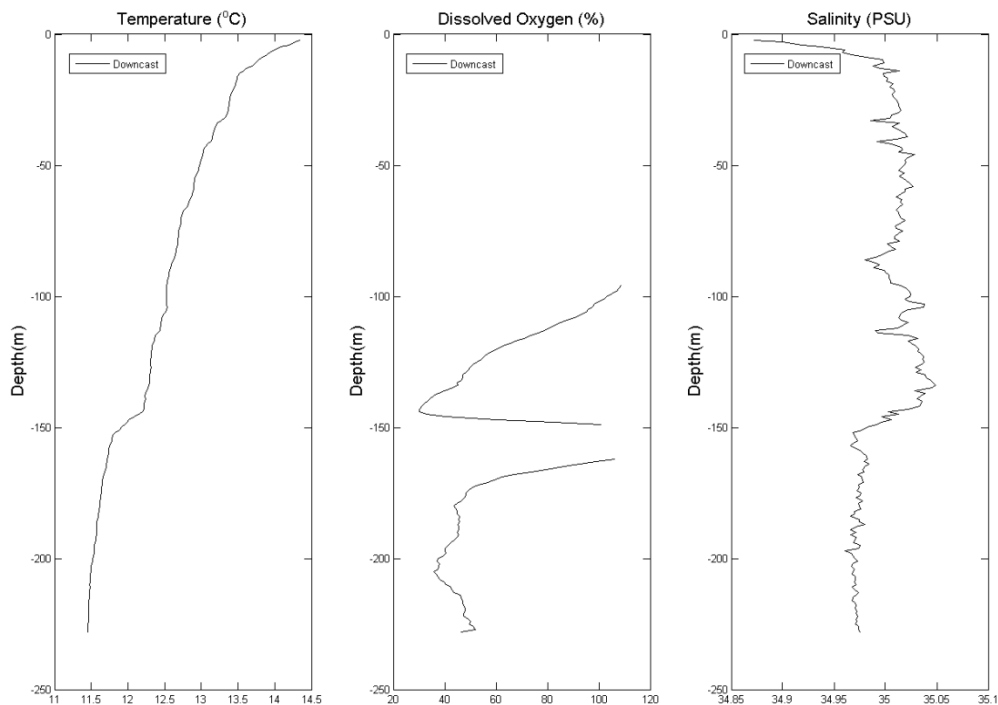


Trawl 19 (N13) [Don't use O2 data]

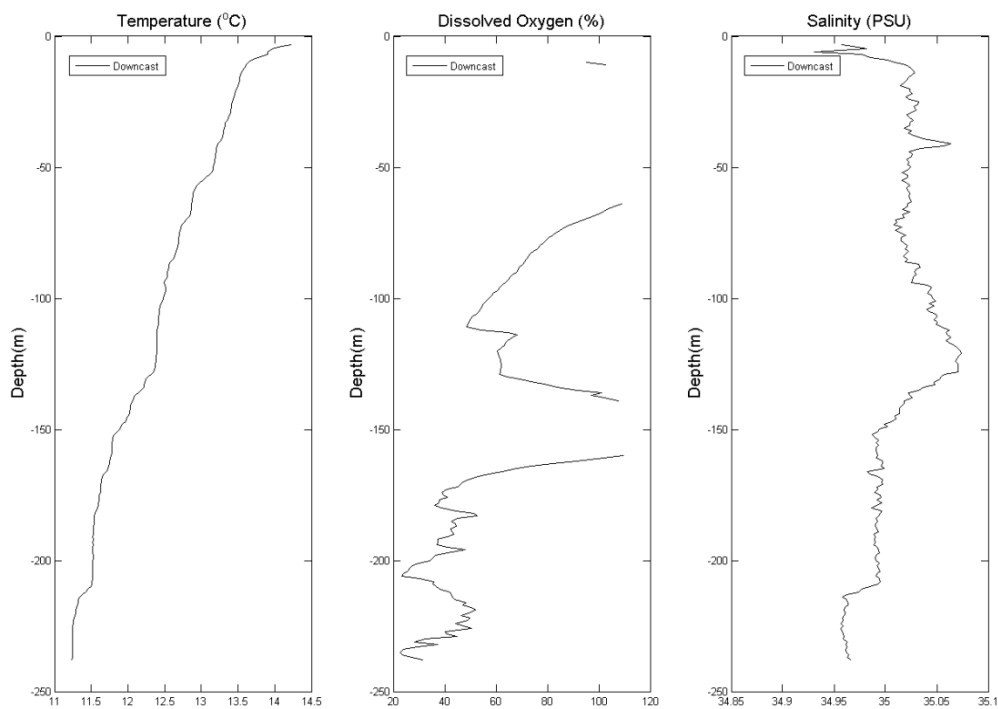


ANNEXURE 1: CTD PROFILES – continued...

Trawl 20 (N20) [Don't use O2 data]

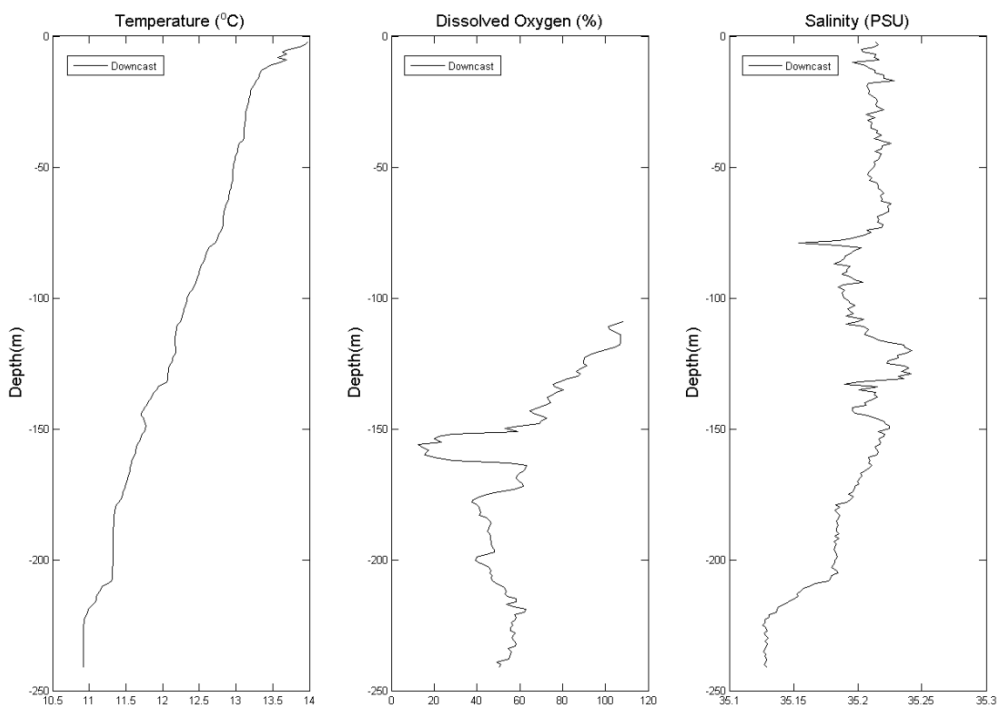


Trawl 21 (N19) [Don't use O2 data]



ANNEXURE 1: CTD PROFILES – continued...

Trawl 22 (N18) [Don't use O2 data]



Trawl 23 (N22)

DATA OF POOR QUALITY

Trawl 24 (N24)

DATA OF POOR QUALITY

Annexure 2: Detailed statistics from all trawls

Detailed statistics of all processed trawls are provided in tabular format below. The trawls are each divided into three sections (down cast, up cast and trawl) as per Figure 3.

Trawl 1 - Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.52	10.89	12.17	0.79	229
	Up cast	13.67	10.75	12.15	0.85	233
	Trawl	10.94	10.75	10.85	0.05	13124
Dissolved Oxygen (%)	Down cast	109.44	19.49	44.74	24.54	154
	Up cast	104.70	17.84	48.37	29.91	188
	Trawl	20.06	17.73	18.49	0.53	13124
Salinity (PSU)	Down cast	35.28	35.13	35.21	0.03	229
	Up cast	35.27	35.11	35.20	0.03	233
	Trawl	35.15	35.10	35.12	0.01	13124
Trawl 2 - Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.30	10.10	12.12	1.15	44
	Up cast	13.22	9.97	12.02	1.25	48
	Trawl	10.10	9.97	10.01	0.03	237
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	N/A
	Up cast	N/A	N/A	N/A	N/A	N/A
	Trawl	N/A	N/A	N/A	N/A	N/A
Salinity (PSU)	Down cast	35.09	34.81	35.00	0.08	44
	Up cast	35.27	34.93	35.13	0.09	48
	Trawl	34.94	31.06	34.29	0.79	212
Trawl 3 - Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.28	9.77	11.87	1.01	240
	Up cast	13.13	9.66	11.75	0.94	246
	Trawl	13.15	9.66	10.25	1.14	15461
Dissolved Oxygen (%)	Down cast	109.99	17.10	43.37	32.20	212
	Up cast	108.16	15.77	41.48	24.49	172
	Trawl	109.43	12.96	19.48	8.83	13491
Salinity (PSU)	Down cast	35.34	35.08	35.27	0.06	240
	Up cast	35.39	35.04	35.28	0.07	246
	Trawl	35.46	30.16	35.11	0.21	15438
Trawl 4 - Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.15	9.78	11.80	0.91	233
	Up cast	12.86	9.44	11.75	0.90	234
	Trawl	12.87	9.42	10.08	1.07	15859
Dissolved Oxygen (%)	Down cast	108.20	14.12	46.06	36.28	233
	Up cast	109.00	16.63	36.55	22.07	167
	Trawl	109.67	14.42	19.63	6.79	14101
Salinity (PSU)	Down cast	35.39	34.89	35.28	0.07	233
	Up cast	35.42	35.08	35.28	0.06	234
	Trawl	35.46	30.01	34.99	0.61	15388

Annexure 2 – continued...

Trawl 5- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	12.78	9.84	11.67	0.84	220
	Up cast	13.04	9.84	11.82	0.83	221
	Trawl	9.90	9.84	9.86	0.01	12251
Dissolved Oxygen (%)	Down cast	32.83	0.70	14.12	12.95	220
	Up cast	28.85	2.21	7.42	6.04	221
	Trawl	3.00	1.83	2.59	0.16	12251
Salinity (PSU)	Down cast	35.30	35.10	35.26	0.05	220
	Up cast	35.33	35.11	35.28	0.04	221
	Trawl	35.13	30.00	34.26	1.31	11624
Trawl 6- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.23	9.95	12.04	0.79	216
	Up cast	13.35	9.95	11.96	0.87	217
	Trawl	9.99	9.94	9.97	0.01	12209
Dissolved Oxygen (%)	Down cast	34.39	4.75	20.90	12.11	216
	Up cast	31.53	4.31	9.55	7.01	217
	Trawl	5.62	4.85	5.14	0.11	12209
Salinity (PSU)	Down cast	35.33	35.06	35.27	0.05	216
	Up cast	35.38	35.10	35.30	0.05	217
	Trawl	35.14	30.00	34.45	1.27	10936
Trawl 7- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.55	10.15	12.22	0.91	214
	Up cast	13.66	10.15	12.16	0.90	215
	Trawl	10.23	10.15	10.18	0.02	11911
Dissolved Oxygen (%)	Down cast	32.78	4.04	18.26	11.20	214
	Up cast	24.84	4.18	8.30	5.04	215
	Trawl	5.41	3.32	4.16	0.17	11911
Salinity (PSU)	Down cast	35.32	35.11	35.28	0.04	214
	Up cast	35.36	35.14	35.30	0.04	215
	Trawl	35.17	30.04	34.99	0.49	11779
Trawl 8- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.30	10.55	12.24	0.77	200
	Up cast	13.26	10.56	12.08	0.78	201
	Trawl	10.59	10.54	10.57	0.01	12141
Dissolved Oxygen (%)	Down cast	41.83	5.60	23.48	14.57	200
	Up cast	32.02	5.41	10.38	5.54	201
	Trawl	6.39	4.81	5.39	0.16	12141
Salinity (PSU)	Down cast	35.34	35.18	35.30	0.03	200
	Up cast	35.36	34.53	35.25	0.19	201
	Trawl	35.21	30.01	34.83	0.69	12055
Trawl 9- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.35	10.52	12.04	0.75	202
	Up cast	12.91	10.54	11.85	0.71	202
	Trawl	10.55	10.52	10.54	0.01	12660
Dissolved Oxygen (%)	Down cast	28.49	9.00	16.69	6.54	202
	Up cast	21.56	4.13	6.48	4.47	202

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	Trawl	8.94	4.00	5.34	1.08	12660
Salinity (PSU)	Down cast	35.34	35.14	35.29	0.04	202
	Up cast	35.32	35.17	35.28	0.04	202
	Trawl	35.19	30.07	34.76	0.75	12556
Trawl 10- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.09	10.50	11.91	0.69	203
	Up cast	13.32	10.47	11.80	0.72	204
	Trawl	10.53	10.47	10.49	0.01	13390
Dissolved Oxygen (%)	Down cast	25.90	6.69	15.48	7.20	203
	Up cast	20.11	3.39	5.25	3.78	204
	Trawl	7.33	3.22	4.01	0.92	13390
Salinity (PSU)	Down cast	35.32	35.18	35.28	0.03	203
	Up cast	35.36	35.18	35.29	0.04	204
	Trawl	35.21	33.92	35.18	0.05	13390
Trawl 11- Stats	Profile	Min	Mean	Std dev.	n	Max
	Down cast	13.00	9.74	11.71	0.90	242
	Up cast	14.11	9.80	11.70	0.96	245
	Trawl	9.80	9.68	9.72	0.03	12899
Dissolved Oxygen (%)	Down cast	23.75	8.04	17.78	5.39	242
	Up cast	22.08	1.90	5.75	4.59	245
	Trawl	8.10	0.54	2.36	1.70	12899
Salinity (PSU)	Down cast	35.29	35.08	35.24	0.06	242
	Up cast	35.34	35.10	35.26	0.06	245
	Trawl	35.11	30.00	34.11	1.48	4136
Trawl 12- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.70	10.67	11.84	0.83	224
	Up cast	13.59	10.54	11.96	0.83	227
	Trawl	10.67	10.53	10.58	0.04	12511
Dissolved Oxygen (%)	Down cast	16.88	5.08	12.05	3.84	224
	Up cast	29.50	4.15	8.73	6.64	227
	Trawl	5.21	1.78	3.45	0.76	12511
Salinity (PSU)	Down cast	35.40	35.20	35.28	0.05	224
	Up cast	35.33	33.97	35.19	0.16	227
	Trawl	35.22	30.02	34.78	0.82	12088
Trawl 13- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	14.03	10.70	12.20	0.83	224
	Up cast	14.03	10.62	12.20	0.88	224
	Trawl	10.70	10.61	10.65	0.02	12501
Dissolved Oxygen (%)	Down cast	19.94	6.64	15.05	4.10	224
	Up cast	19.07	2.74	5.87	4.43	224
	Trawl	6.58	2.66	3.24	0.59	12501
Salinity (PSU)	Down cast	35.35	35.17	35.30	0.04	224
	Up cast	35.38	35.20	35.31	0.04	224
	Trawl	35.22	30.00	32.68	1.53	9853
Trawl 14- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	14.30	11.40	12.64	0.74	212

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	Up cast	14.09	11.40	12.46	0.78	212
	Trawl	11.58	11.30	11.40	0.06	13003
Dissolved Oxygen (%)	Down cast	18.93	9.59	16.54	2.74	212
	Up cast	44.88	6.47	13.08	8.66	212
	Trawl	34.50	2.31	8.20	5.99	13003
Salinity (PSU)	Down cast	35.03	34.89	34.98	0.02	212
	Up cast	35.13	34.31	35.07	0.16	25
	Trawl	34.94	30.00	33.03	1.71	101
Trawl 15- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.74	11.25	12.37	0.70	222
	Up cast	13.87	11.13	12.36	0.78	224
	Trawl	11.61	11.10	11.36	0.15	13768
Dissolved Oxygen (%)	Down cast	27.56	11.89	21.60	4.55	222
	Up cast	33.92	1.19	8.29	7.20	224
	Trawl	11.91	0.00	1.08	2.10	13040
Salinity (PSU)	Down cast	35.07	34.92	35.00	0.04	222
	Up cast	35.28	32.33	35.09	0.20	224
	Trawl	34.95	30.48	34.90	0.31	217
Trawl 16- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	15.17	11.28	12.88	1.03	216
	Up cast	15.00	11.18	12.54	0.85	216
	Trawl	11.29	11.17	11.20	0.03	13971
Dissolved Oxygen (%)	Down cast	16.34	3.45	10.42	3.79	216
	Up cast	33.95	2.02	7.48	7.12	216
	Trawl	5.82	1.26	2.51	0.71	13971
Salinity (PSU)	Down cast	35.18	34.92	35.04	0.07	216
	Up cast	35.28	34.97	35.13	0.07	216
	Trawl	35.00	30.00	34.44	0.87	13604
Trawl 17- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	15.08	11.41	12.89	0.96	207
	Up cast	14.94	11.38	12.56	0.85	207
	Trawl	11.49	11.37	11.39	0.02	13199
Dissolved Oxygen (%)	Down cast	18.30	2.20	10.09	5.02	207
	Up cast	62.56	2.20	14.62	13.88	207
	Trawl	11.89	0.54	3.86	2.68	13199
Salinity (PSU)	Down cast	35.13	34.94	35.06	0.05	207
	Up cast	35.26	34.96	35.09	0.07	207
	Trawl	35.01	30.01	34.00	1.21	10148
Trawl 18- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	14.64	11.52	12.43	0.75	211
	Up cast	13.68	11.49	12.34	0.66	211
	Trawl	11.52	11.44	11.47	0.02	12472
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	211
	Up cast	N/A	N/A	N/A	N/A	34
	Trawl	N/A	N/A	N/A	N/A	12412
Salinity (PSU)	Down cast	35.06	34.93	35.01	0.02	211

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	Up cast	35.15	34.91	35.09	0.04	211
	Trawl	35.05	30.00	34.35	1.05	11871
Trawl 19- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	14.45	10.59	12.41	1.00	256
	Up cast	13.73	10.59	12.24	0.88	255
	Trawl	10.86	10.57	10.63	0.05	13421
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	146
	Up cast	N/A	N/A	N/A	N/A	132
	Trawl	N/A	N/A	N/A	N/A	13421
Salinity (PSU)	Down cast	35.07	34.81	35.01	0.06	256
	Up cast	35.18	31.15	35.00	0.56	255
	Trawl	34.95	30.00	34.84	0.54	10837
Trawl 20- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	14.34	11.45	12.39	0.72	227
	Up cast	13.64	11.35	12.15	0.72	228
	Trawl	11.45	11.35	11.38	0.02	12423
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	121
	Up cast	N/A	N/A	N/A	N/A	206
	Trawl	N/A	N/A	N/A	N/A	12423
Salinity (PSU)	Down cast	35.05	34.87	35.00	0.03	227
	Up cast	35.23	34.98	35.10	0.05	228
	Trawl	35.03	30.01	33.71	1.47	10778
Trawl 21- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	14.22	11.24	12.33	0.76	236
	Up cast	13.93	11.24	12.34	0.73	238
	Trawl	-	11.23	11.49	0.66	16149
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	157
	Up cast	N/A	N/A	N/A	N/A	180
	Trawl	N/A	N/A	N/A	N/A	14750
Salinity (PSU)	Down cast	35.07	34.93	35.01	0.03	236
	Up cast	35.33	34.96	35.11	0.05	238
	Trawl	35.42	30.00	33.31	1.70	12582
Trawl 22- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	13.97	10.92	12.14	0.81	240
	Up cast	13.89	10.92	12.04	0.86	240
	Trawl	10.97	10.89	10.92	0.02	10850
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	133
	Up cast	N/A	N/A	N/A	N/A	162
	Trawl	N/A	N/A	N/A	N/A	10850
Salinity (PSU)	Down cast	35.24	35.13	35.20	0.03	240
	Up cast	35.29	35.10	35.20	0.04	240
	Trawl	35.15	30.01	34.26	1.24	9461
Trawl 23- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	N/A	N/A	N/A	N/A	232
	Up cast	N/A	N/A	N/A	N/A	238
	Trawl	N/A	N/A	N/A	N/A	241

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Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	249
	Up cast	N/A	N/A	N/A	N/A	225
	Trawl	N/A	N/A	N/A	N/A	228
Salinity (PSU)	Down cast	N/A	N/A	N/A	N/A	217
	Up cast	N/A	N/A	N/A	N/A	39
	Trawl	N/A	N/A	N/A	N/A	42
Trawl 24- Stats	Profile	Max	Min	Mean	Std dev.	n
	Down cast	N/A	N/A	N/A	N/A	0
	Up cast	N/A	N/A	N/A	N/A	0
	Trawl	N/A	N/A	N/A	N/A	0
Dissolved Oxygen (%)	Down cast	N/A	N/A	N/A	N/A	176
	Up cast	N/A	N/A	N/A	N/A	180
	Trawl	110.00	16.98	66.55	24.66	10983
Salinity (PSU)	Down cast	N/A	N/A	N/A	N/A	0
	Up cast	N/A	N/A	N/A	N/A	0
	Trawl	N/A	N/A	N/A	N/A	0