Bay of Plenty Coastal Water Quality, 2003 - 2004

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Cover Photo: Looking out to Karewa and Tuhuna (Mayor) Islands from Matakana Island beach. Photo by Sam Stephens.

Executive Summary

A study of the central Bay of Plenty's coastal shelf waters was undertaken to collect data for the support of modelling and estimating the sustainability and carrying capacity of aquaculture. The study included physical and chemical analysis of the waters, quantification of phytoplankton communities, current measurements and temperature profiling of the water column and the use of remote sensing to provide a synopsis of seasonal and spatial patterns of sea surface temperature and chlorophyll-a concentrations. In this report the data gained from physical, chemical and phytoplankton analysis of the water column is presented.

Field work to collect physical, chemical and phytoplankton data was conducted along three transects spanning the coastal shelf out to a depth of 200m at Pukehina, Whakatane and Opotiki. Sampling was also conducted from October 2003 through to May 2004. An additional instrument (CTD) survey was conducted in December 2004 across a wider area of the Bay of Plenty, out towards the east.

Results are similar to the earlier findings of the coastal shelf survey undertaken in 1996/97 in respect of the major seasonal and depth related trends observed in the water column. In this survey the use of a wider range of monitoring equipment to measure many of the parameters means that there is a far better resolution and understanding of the oceanographic processes operating in these waters. The CTD and current measurements show that the shelf waters are a complex system with wide variations around the Bay of Plenty at any one point in time.

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Chapter 1: Introduction

1.1 Scope

This report presents the results of field survey work jointly conducted by Environment Bay of Plenty and ASR Limited staff along a set of transects spanning the Bay of Plenty coastal shelf waters. The work was part of the Aquaculture Management Areas (AMA) science project, collecting physical and biological data (Oct 2003 – December 2004) to support assessment of the productivity and sustainability of coastal shelf waters within the Bay of Plenty. The specific objectives of the projects field surveys were to;

- Provide quantitative data on the spatial and seasonal abundance of phytoplankton species.
- Assess spatial and seasonal patterns of nutrients required for phytoplankton growth.
- Assess spatial and seasonal patterns of physical parameters.
- Measurement of current direction and velocity.
- Improve our understanding of the oceanographic processes and ensure data collection that will support modelling of the shelf system.

The magnitude of the effort and the success with the field measurements is a credit to all staff involved.

Some aspects of the field surveys or other components of the overall project, such as the current and wave data will be reported separately. Other reports being produced by ASR Ltd (Longdill *et.al* 2005a & b, Beamsley *et.al* 2005, Mead *et.al* 2005) on the field data summarise:

- Measurements of currents and temperatures. 12 months of intermittent Acoustic Doppler Current Meter and thermistor records were collected during the 2-year programme.
- Observations with seabed video over the shelf with grain size, mud contents and biological organism assessments.

1.2 AMA Project Background

Aquaculture as an industry in New Zealand has been growing rapidly in recent years and has become a substantial producer and export earner. The industry is still largely dominated by green lipped mussel and salmon farming but has the potential to produce a very wide range of product. In some areas such as the Marlborough Sounds suitable farming space has become limited and is considered a valuable asset. In the Bay of Plenty only around 4 ha of aquaculture existed up until May 2001 at which time it then received two large applications for a total of 8,760 ha.

In March 2002 the government imposed a moratorium on the granting of marine space for the purposes of aquaculture due to the explosion of demand and the complicated and sometimes adhoc approach to the processing of consents. The moratorium was "to provide Regional Councils with the opportunity to plan for Aquaculture Management Areas". It was also intended to remove much of the dual process that currently exists to make it more straight forward and easier for industry to establish.

The moratorium has now meant that Regional Councils must work out where to allow aquaculture to take place and how much. Environment Bay of Plenty is dealing with this task under both a science and planning project. The planning project is defining areas that will be most suitable. The approach taken is to define and map the various values of the marine environment that may potentially clash with aquaculture. This includes ecological, cultural, recreational fishing, commercial fishing, recreational activities, navigation, landscape and water quality values and issues.

Aquaculture can put considerable pressure on some components of the marine environment. Mussel farming for instance can cause phytoplankton depletion, change plankton species composition, result in nutrient changes, deposition of shell and faeces, impacts on water quality and a range of other actual or potential impacts. One of the most important questions is that of sustainability from a productivity view point. For example how much mussel farming could the Bay of Plenty coastal shelf waters support without such farms depleting phytoplankton levels to an extent that other inshore shellfish beds may be impacted, inhibiting their ability to grow at normal rates and sustainable levels.

The aquaculture industry growth and moratorium has imposed an urgent need to obtain a sound understanding of the oceanographic processes, productivity and carrying capacity of the Bay of Plenty coastal waters. The science project being run as part of the whole AMA project is intended to address many of the issues and knowledge gaps mentioned above. It was started in July 2003 and will be concluded at the end of 2005 with a final report in March 2006.

The science project in its first year (2003/4) aimed to set up a wave buoy, current meter and gather data from field surveys on the physical and biological status of the coastal waters during each season of the year. In addition remote sensing data is being used to assist in defining the seasonal and spatial status of Bay of Plenty waters for sea surface temperature and chlorophyll-a levels. Further work on defining the nature of the seabed and benthic communities will also be undertaken.

A large component of the science project will be the development of hydrological and productivity models of the Bay of Plenty. Plankton, nutrient, physical and remote sensing data will all help in developing and calibrating numerical models aimed at estimating impacts, carrying capacity and sustainability of marine farming. Overall the project is primarily aimed at providing information needed to assist Environment Bay of Plenty's planning responsibilities in a way which will also help to safeguard the regions natural marine resources and ecosystems.

Chapter 2: Methods

2.1 Location and Physical Environment

Field sampling for the AMA science project builds upon a previous survey of the coastal shelf waters undertaken in 1996/97 (Park 1998). In Figure 1 below the three transects in the centre of the bay (Pukehina, Whakatane & Opotiki) running from shore (10m depth) out to the edge of the continental shelf (200m depth) were used for the 2003/2004 field surveys. The Tauranga and Whakatane transects were both used in the 1996/97 survey. Grid references for the sampling points along each of these transects are provided in Appendix 1.

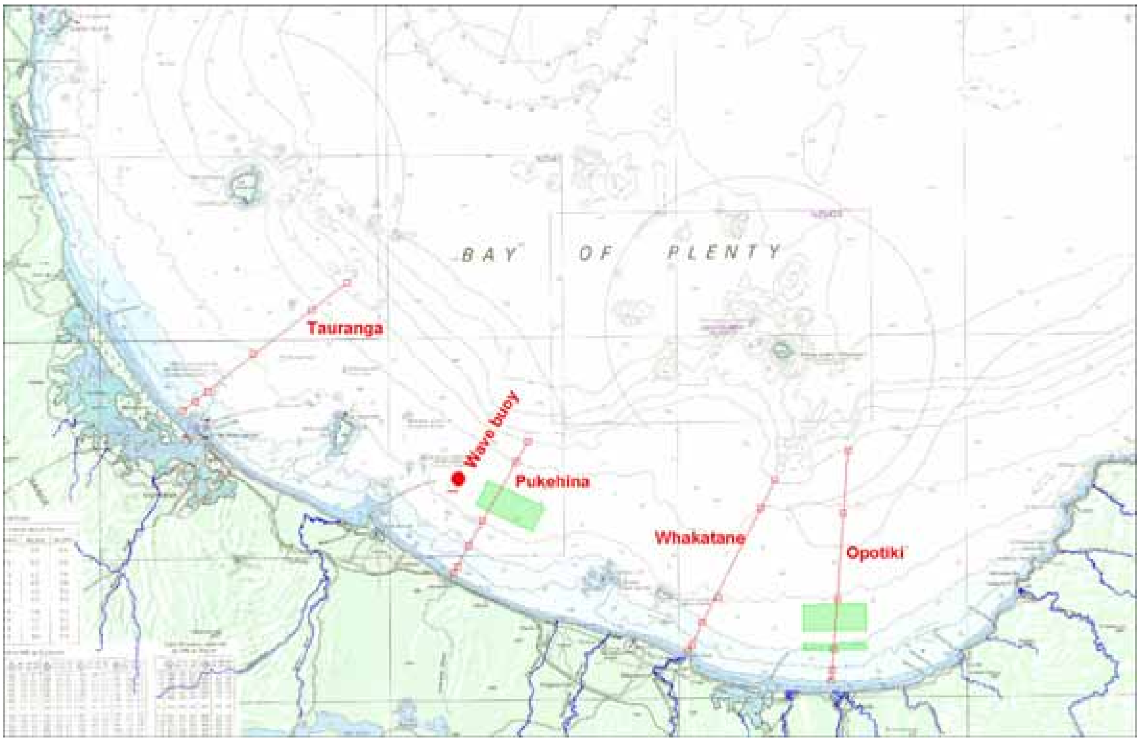

Figure 1 Location of transect sampling sites and the wave buoy in the Bay of Plenty coastal shelf waters

The Bay of Plenty coastline is exposed to wind and waves from the northwest to easterly directions and is a lee shore in respect of New Zealand's prevailing south-westerly wind flows. Offshore waters are predominantly influenced by the East Auckland Current, which flows south-eastward along the north-east coast of the North

Island to East Cape where the main core of the current turns north-eastward (Ridgway and Greig 1986). Influence of the current is thought to be variable with limited penetration inshore.

Inshore currents are highly variable responding to both tidal effects and wind forcing (Healy et al 1988, Harms 1989). During periods of high wind strengths, currents were observed to flow in the direction of the wind with velocities of up to 40 cm sec^{-1}. In addition, periods of onshore bottom current occurred with offshore wind and the reverse with onshore winds. Residual current flows during periods of weak and variable winds appear to be to the south, possibly as an inshore influence of the East Auckland Current. Similar residual currents have been observed from a long-term current observation on the east Coromandel shelf (Bradshaw et al 1991). Initial results collected from this project would also support this synopsis.

The inshore end of the Tauranga transect is influenced by tidal currents and flushing associated with the southern entrance of Tauranga Harbour. A similar situation exists with the Whakatane transect and estuary.

The southern entrance to Tauranga Harbour has a recorded flow of 153 x10^6 m^3 with maximum current speeds of 2.65 $m.s^{-1}$ (Beca Carter Hollings and Ferner Ltd 1978). Freshwater inflows to the southern harbour have been estimated to be around 30.5 m^3s^{-1} (<1% of tidal compartment) with the Wairoa River contributing 58% of the total (McIntosh 1994). The catchment of the northern Tauranga Harbour basin is much smaller with total freshwater inflow of around 4.6 m^3s^{-1}.

In contrast to the Tauranga situation Whakatane Estuary is much smaller with a high riverine influence. The Whakatane River, which flows into the estuary, has a mean flow of 57 m^3s^{-1}. Peak ebb-tide flows from the estuary have been gauged at 140 m^3s^{-1} during river flows of 18 m^3s^{-1} (Healy 1983). Catchment soils are still influenced by volcanic ash but most soils are derived from weathering of the underlying greywacke rocks.

Offshore of Opotiki the situation is similar to that of Whakatane, especially regarding the catchment geology. Opotiki Estuary is even smaller measuring only 0.6 km^2. The freshwater inflow from the Waioeka and Otara Rivers combined is also slightly less with a mean annual flow of 44m^3 s^{-1}. Both these rivers flow through Opotiki Estuary.

At the Pukehina transect there is not a lot of freshwater influence even at the inshore 10m depth site. The Waitahanui Stream is around 1 km away and has a mean annual flow of 6 m^3 s^{-1}. The Kaituna River is 15 km to the northwest and has a mean annual flow of 39 m^3 s^{-1}, but due to the distance it has only a very diffuse effect on salinity.

2.2 Sampling Programme

Field sampling was conducted at sites along each of the Pukehina, Whakatane and Opotiki transects shown in Figure 1. Surveys were conducted four times within a year to obtain data on seasonal variations in water quality and plankton assemblages. Each transect has sampling sites set at the 10, 20, 30, 50, 100 and 200m depth contours. This takes each transect from within a kilometre of the shore out to the edge of the continental shelf. This ensured that neritic coastal waters were fully covered and allows comparison to oceanic water masses.

Samples were obtained on all transects within a day of the following dates:

17th October, 2003, 3rd December 2003, 18th March 2004, 25th May 2004, 1st August 2004.

An additional set of transect were surveyed with CTD instruments on 7-9th December 2004.

At each of the sampling sites instrument readings, water samples, bacterial samples, and plankton samples were taken at specified depths. Appendix 1 sets out the sampling programme in detail listing depths and all chemical, physical, and biological sampling conducted.

The surface sample (0-5m) for all chemistry and plankton samples taken from each sampling location was obtained as a depth integrated tube sample. All other samples from each of the specified depths were point samples taken with a 3 litre van Dorn bottle.

Instruments readings at each site were taken with a SBE 19plus SEACAT Profiler from the surface down to the seabed. This probe recorded temperature, conductivity, pressure (depth), Oxygen (SBE 43), PAR (LI-COR LI-193SA), fluorometer (Turner SCUFA), and OBS (turbidity – Turner SCUFA). In addition temperature and conductivity were recorded from the water samples retrieved with the van Dorn bottles for sample analysis using a hand held YSI meter.

2.3 Methods

The following methods were used to derive the results from the field sampling. All samples for chemical analysis were stored and returned with the time period stipulated according to the method requirements;

Table 1 - Methods used for chemical / biological analysis.

Parameter	Method	Detection Limit†
Suspended Solids	APHA method 2540D	0.1 g/m^3
Total Organic Carbon	catalytic oxidation, IR detection. APHA 5310B 20th ed. 1998	0.5 g/m^3
Dissolved Organic Carbon	0.45 µm nylon filter, catalytic oxidation, IR detection APHA 5310B	0.5 g/m^3
Dissolved Reactive Silica	On-site filtration of sample. Molybdosilicate/ascorbic acid reduction	1 mg/m^3
Dissolved iron	On-site filtration of sample. 0.45 µm filtered sample. ICP MS ultra-trace with dynamic reaction cell. APHA	4 mg/m^3
Total nitrogen	persulphate digestion, auto cadmium reduction, flow injection analyser	1 mg/m^3
Ammonium nitrogen	NWASCO Misc Pub. No. 38, 1982. phenolhypochlorite colorimetry	1 mg/m^3
Oxidised nitrogen	flow injection analyser, APHA 4500 NO3-1	1 mg/m^3
Total Phosphorus	acid persulphate digestion, molybdate colorimetry. Flow injection analyser. APHA 4500-PH	4 mg/m^3
Dissolved Reactive Phosphorus	NWASCO Misc Pub. No. 38, 1982. Antimony – phosphate – molybdate	4 mg/m^3
Dissolved non-		0.5 g/m^3

Non-purgable organic carbon	acid pre-treatment to remove inorganic carbon. Elementar combustion analyser	0.5 g/m^3
Secchi disc	measured in metres (to 0.1m increments) without a viewing tube	
Vlec	vertical light extinction coefficient derived from PAR measurements (LI-COR LI-193SA) for the surface photic zone of the water column using log plot of data	
Enterococci	APHA method 9230c - number cfu/100ml	
pH	pH measurement @ 25°C	
Chlorophyll-a total filterable	total phytoplankton filterable on 0.7µm and above, GFC filtration, acetone pigment extraction, spectrofluorometric measurement	0.1 mg/m^3
Nano-chl-a	as for total Chlorophyll-a but only for plankton 0.7-20µm	0.1 mg/m^3
Micro-chl-a	as for total Chlorophyll-a but only for plankton 20-200 µm	0.1 mg/m^3
Phytoplankton	Phytoplankton samples were collected from set depths using a van Dorn bottle with the exception of the surface (0-5m) sample which was obtained from a depth integrated tube sample. Around 250 ml of sample was preserved with Lugol's Iodine. These samples were then sent to NIWA in Wellington for analysis by either Hoe	

†Detection limit with 95% confidence, some results are below this level

2.3.1 Contour Plot Methods

The raw data from both the CTD (data at each meter down the water column) and also from the water samples (data more sparse at discrete intervals – see Appendix 1) were plotted using Golden Software's Surfer software. Details of the gridding methods and dimensions are tabulated in Table 2.

Table 2 Gridding methods used in the plotting of data.

	Transect	Grid extent	Gridding method	Grid cell size
CTD Data	Opotiki	0 – 38000 m(x), 0 - -210 m(y)	Krigging	300 m(x) x 3 m(y)
	Whakatane	0 – 31000 m(x), 0 - -210 m(y)		
	Pukehina	0 – 25000 m(x), 0 - -210 m(y)		
Chemical Data	Opotiki	0 – 38000 m(x), 0 - -210 m(y)	Triangulation with linear interpolation	3000 m(x) x 15 m(y)
	Whakatane	0 – 31000 m(x), 0 - -210 m(y)		
	Pukehina	0 – 25000 m(x), 0 - -210 m(y)		

Chapter 3: Results

3.1 Physical Attributes

3.1.1 Water Clarity

Results for measurements of Secchi depth and vertical light extinction co-efficient (Vlec) are displayed in Figure 2. All the transects, which ran out from Pukehina, Whakatane and Opotiki, showed a number of consistent trends as expected. All have a significant improvement in water clarity out to the edge of the continental shelf. Inshore (10 m depth contour) Secchi depth measurements ranged from 1 – 7 m while offshore values showed a larger degree of variation. At the 200 m contour visibility reached a maximum of about 30 m in the autumn (March) sampling period.

Overlaid on the inshore offshore trend is the seasonal component. This was most easily seen further offshore at the 200 m contour where there were measurements of only 6-7 m in spring and early summer compared to the autumn maximum of 30 m.

The overall timing and magnitude of the inshore–offshore and seasonal variations are similar to the previous survey that was conducted in 1996/97(Park 1998).

3.1.2 Salinity/conductivity

Salinity profiles for the Pukehina, Whakatane and Opotiki transects are presented in Figures 4 and 5. In addition the profile of the water column at each sampling point along the transects is given in Appendix III.

The predominant feature seen in all plots is the seasonal influence of freshwater input into the Bay of Plenty from land. In the profile plots in Appendix III, there are many examples where salinity changes markedly with depth in association with the different layers of water. Many of these distinct water layers show reversal of current direction (Beamsley et.al 2005). The seasonal pattern is very similar to the findings of a similar survey undertaken in 1996/97 (Park 1998).

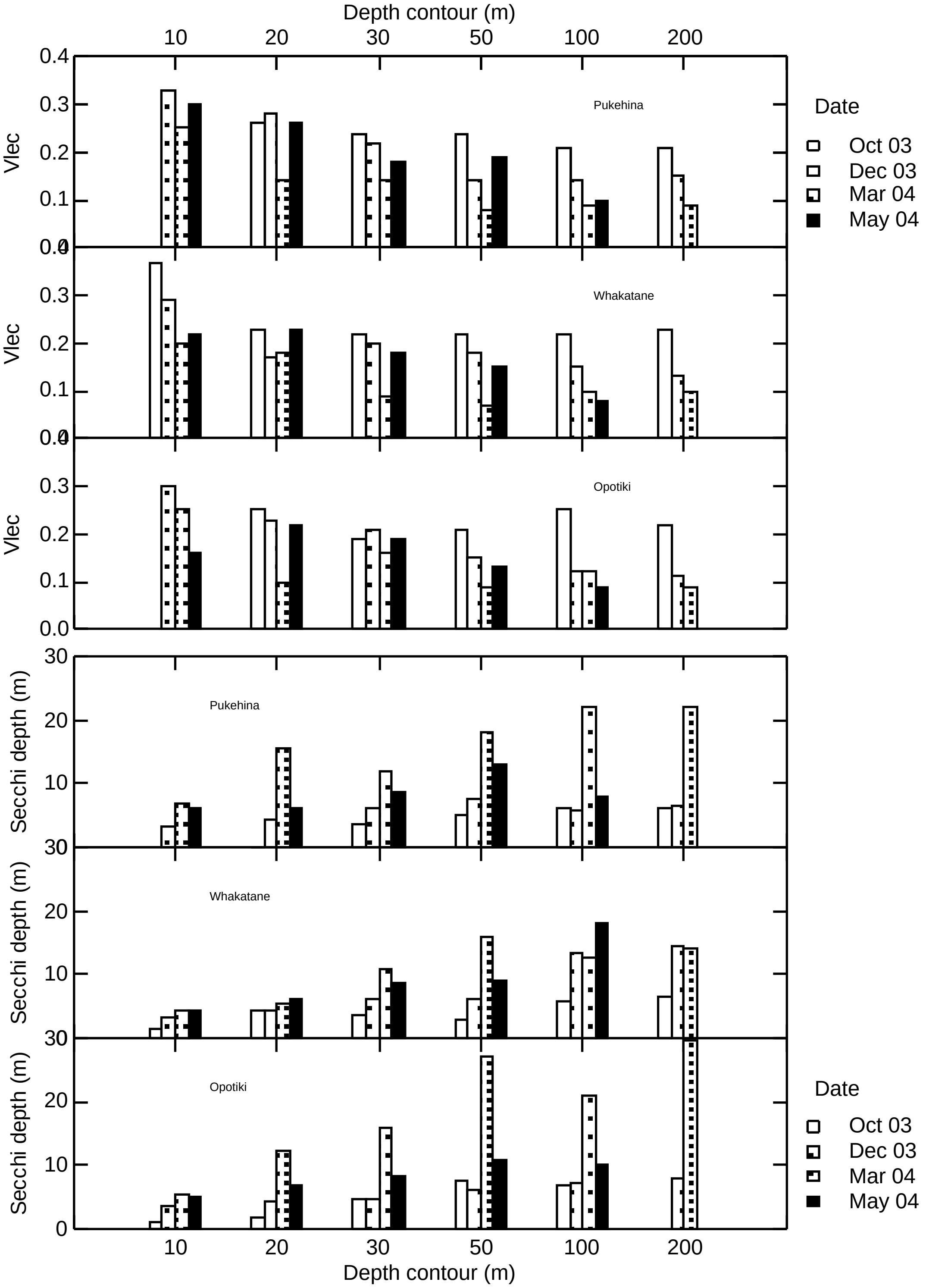

Figure 2 Secchi depth and vertical light extinction coefficients recorded along each of the transects from October 2003 to May 2004.

3.1.3 Temperature

Temperature profiles for the Pukehina, Whakatane and Opotiki transects are presented in Figures 3 providing a visual perspective across the shelf w aters of each transect. All transects show the strong development of a seasonal thermo cline in w hich stratified surface w aters are much w armer than the deep w ater. In summer w ater temperatures are typically 20 –22 °C at the surface with a thermo cline extending from 20 – 50 m depth with at least 2 degrees of temperature variation with the underlying water. The thermo cline tends to increase in depth further out from shore.

Winter water temperatures drop to around 12 –13 °C. In the May 2004 survey of the transects, the surface waters were cooling with the deeper water being slightly warmer. At the edge of the shelf (200m contour) the deep oceanic water could usually be detected and measured around 12.5 at this depth regardless of season.

As shown by the CTD profile plots in Appendix III, temperature can change quite sharply in association with more distinct layers of water. As mentioned above for salinity, some of these water layers are also moving in different directions.

3.1.4 Suspended Solids and turbidity

Figures 7 and 8 present turbidity and suspended solids data. Density of sample points for suspended solids is not high so some of the results appear a little bit variable. Some of the trends noted in previous surveys (Park 1998) are apparent. That is for higher levels of suspended solids to occur both inshore and seasonally in winter and spring.

3.1.5 Dissolved oxygen

Dissolved oxygen profiles (% saturation) for the Pukehina, Whakatane and Opotiki transects are presented in Figure 6 providing a visual perspective across the shelf waters of each transect. A more detailed depth profile relationship between dissolved oxygen and the physical properties of the shelf waters is provided by the graphics in Appendix III.

The general pattern shown by dissolved oxygen is for a seasonal peak to occur in the surface waters in spring and early summer. High concentrations of dissolved oxygen clearly relate to the amount of phytoplankton present. There is also some association of dissolved oxygen levels and the physically separate water bodies which are often present. Figure 6 also shows clearly a high demand for oxygen associated with the seafloor, particularly in the mid-shelf region.

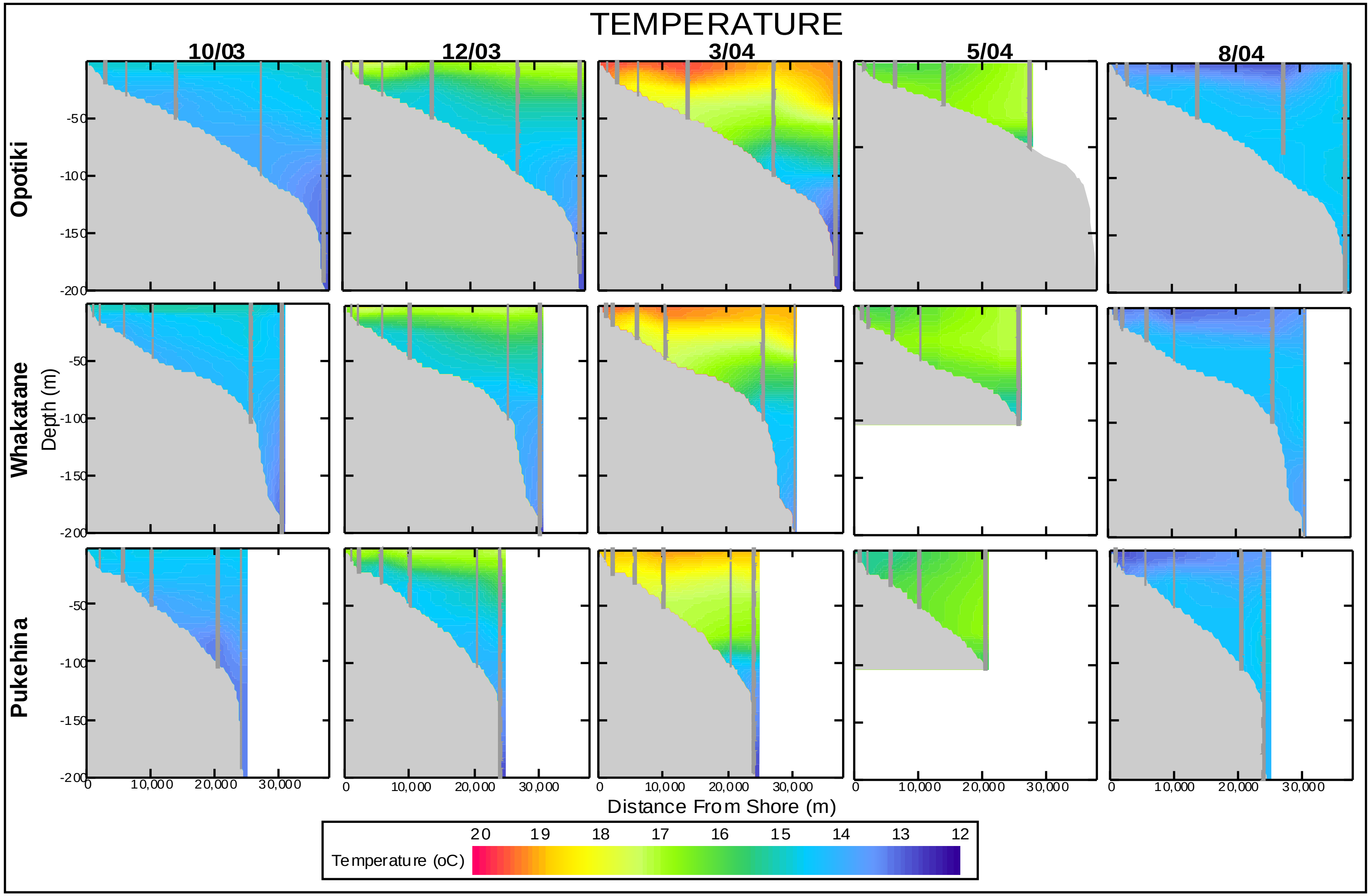

Figure 3 *Temperature (^oC) plots from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.*

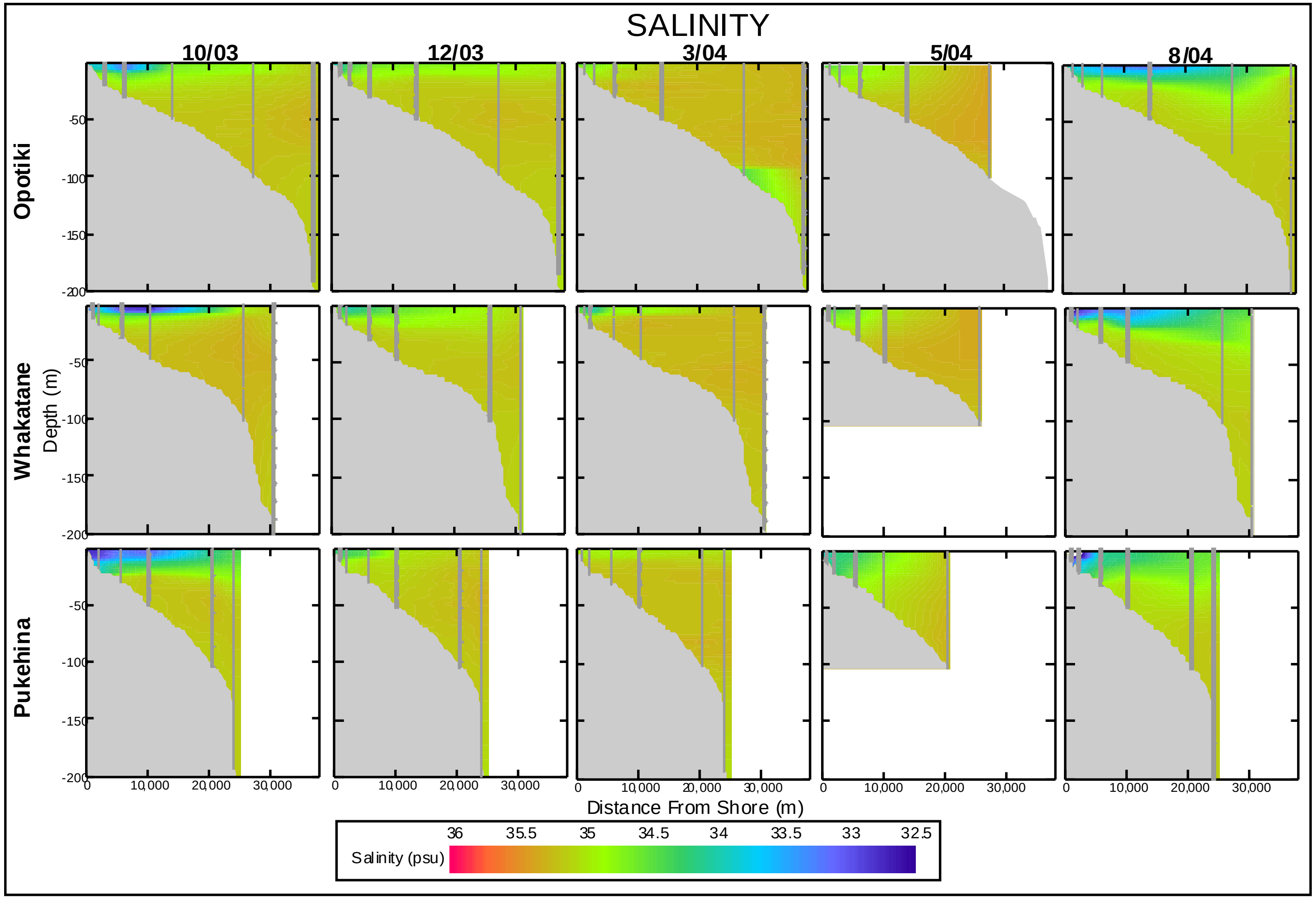

Figure 4 Salinity (psu) plots from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

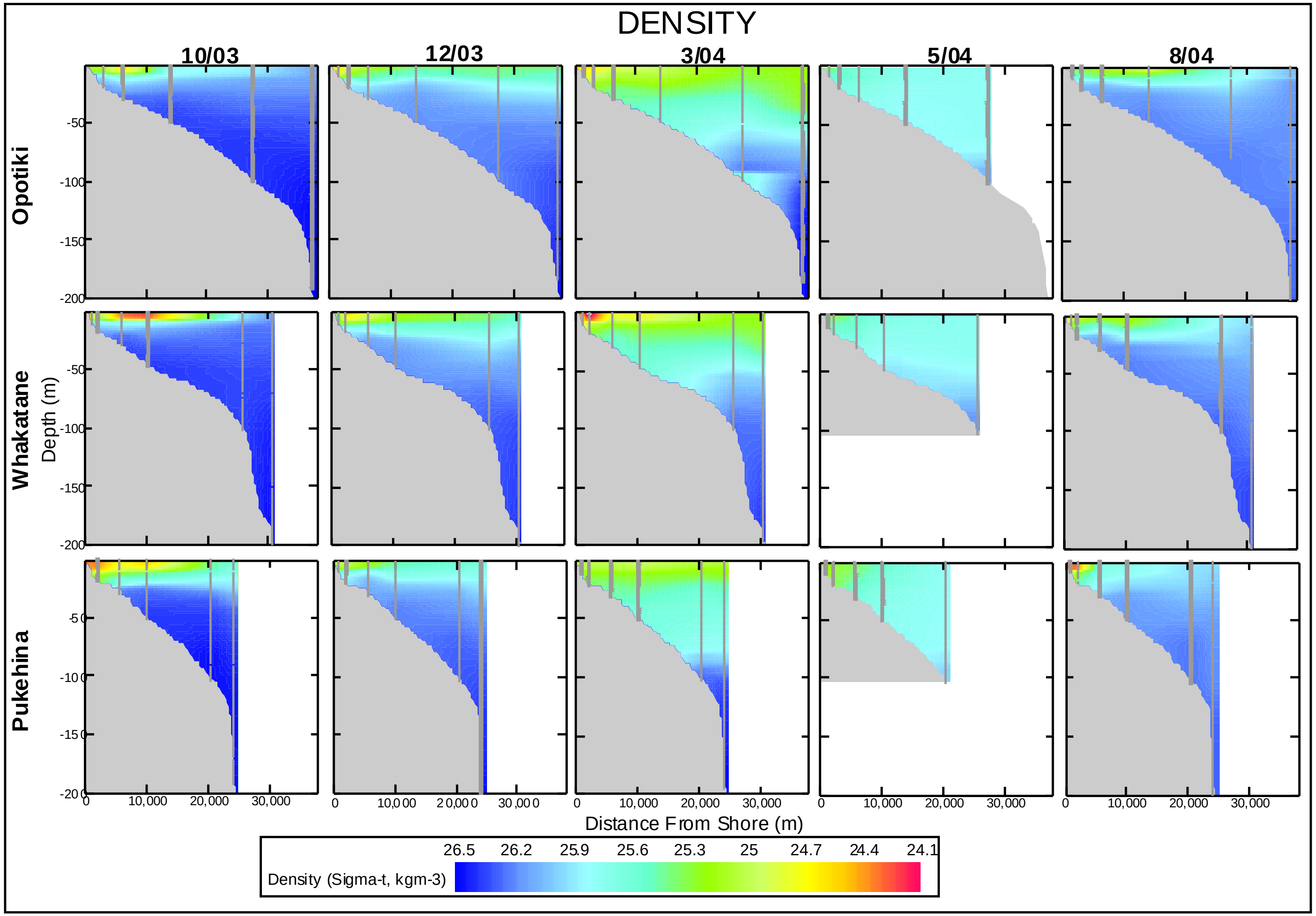

Figure 5 Density (σ_t) plots from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

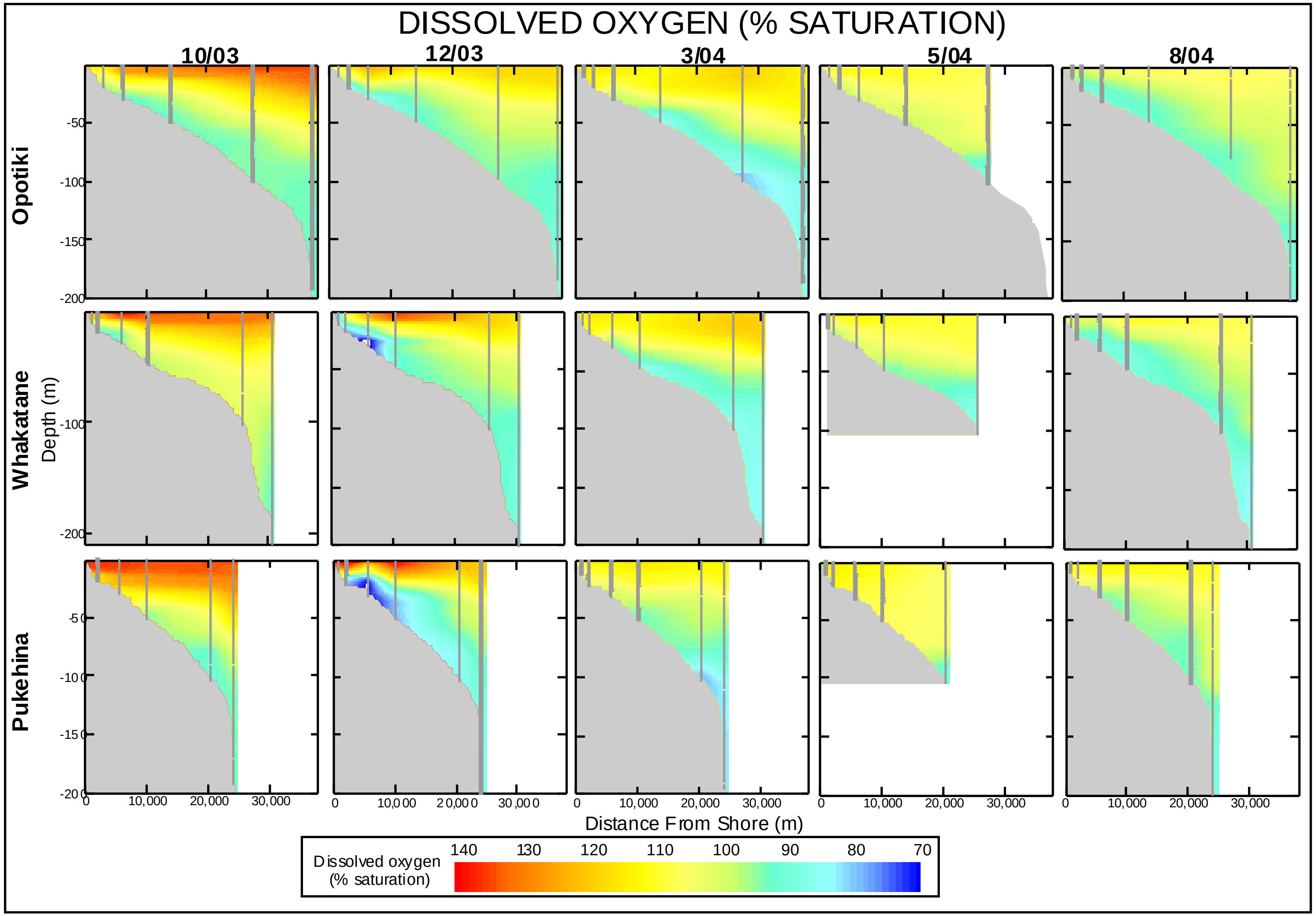

Figure 6 *Dissolved Oxygen (%) plots from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.*

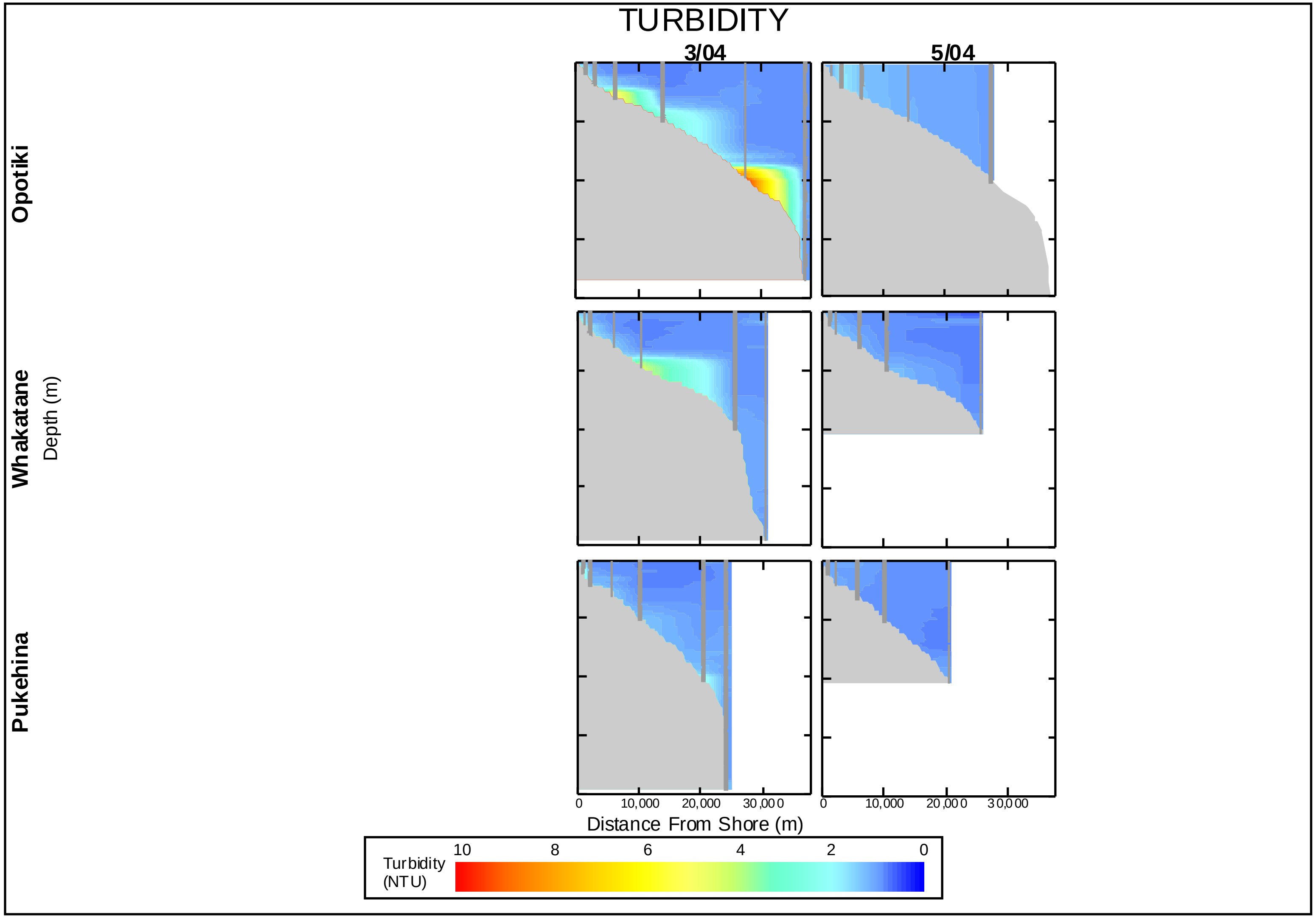
TURBIDITY
3/04
5/04
Opotiki
Whakatane
Pukehina
Depth (m)
0
10,000
20,000
30,000
Distance From Shore (m)
Turbidity (NTU)
10
8
6
4
2
0

Figure 7 Turbidity (NTU) plots from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

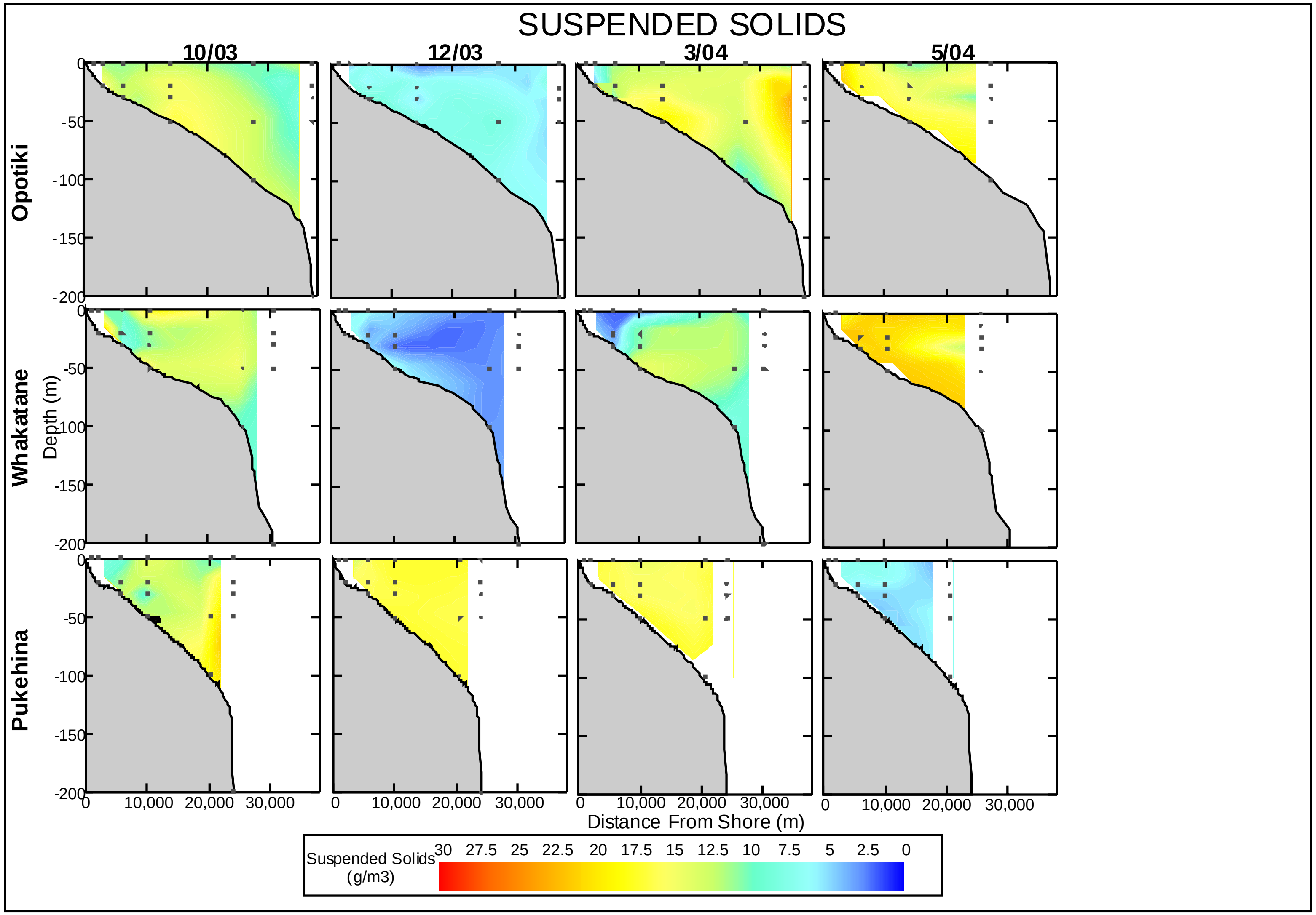

Figure 8 *Suspended solids (g/m³) plots from Opotiki, Whakatane and Pukehina transects n the BOP continental shelf.*

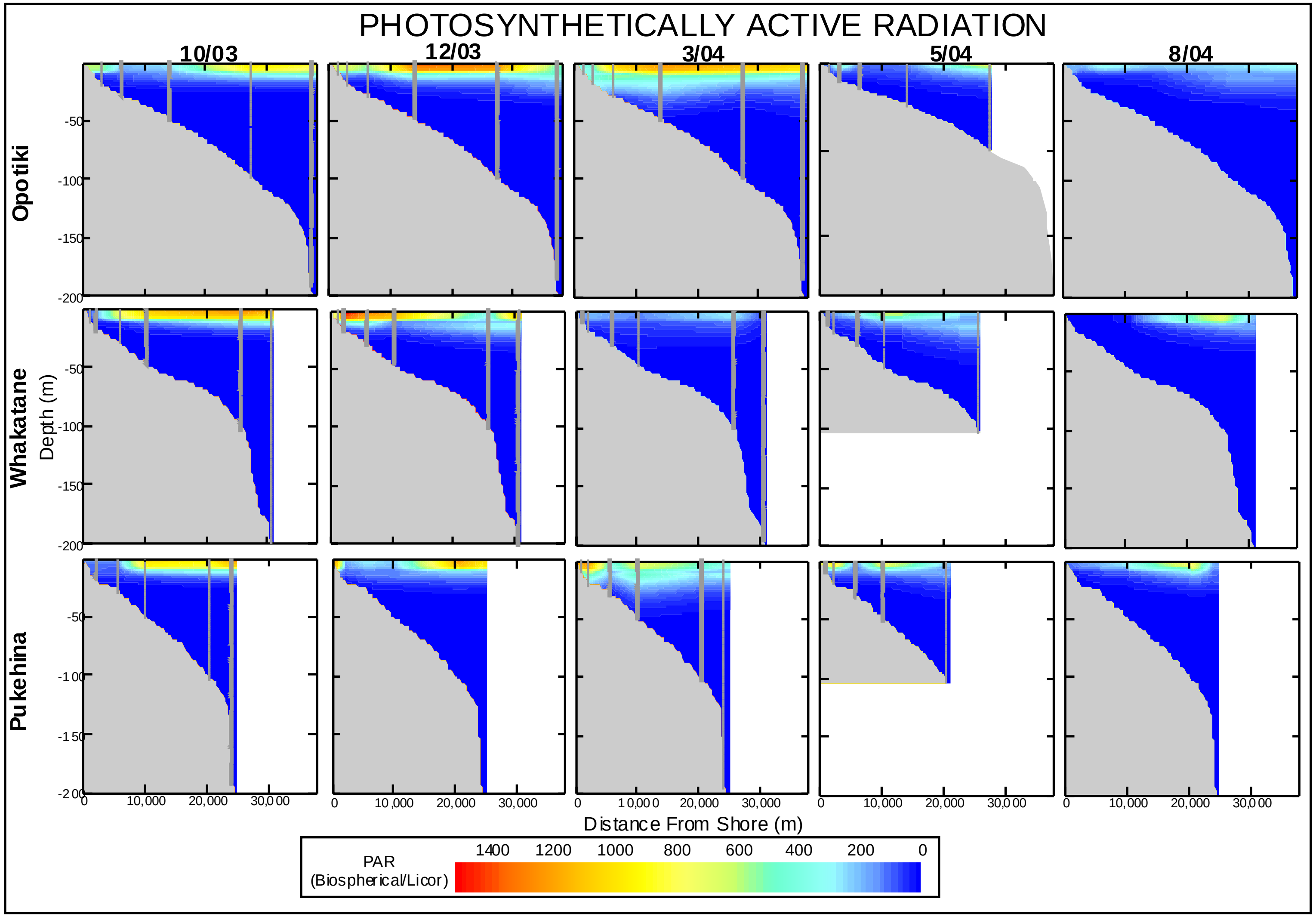

Figure 9 Photosynthetically Active Radiation plots from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

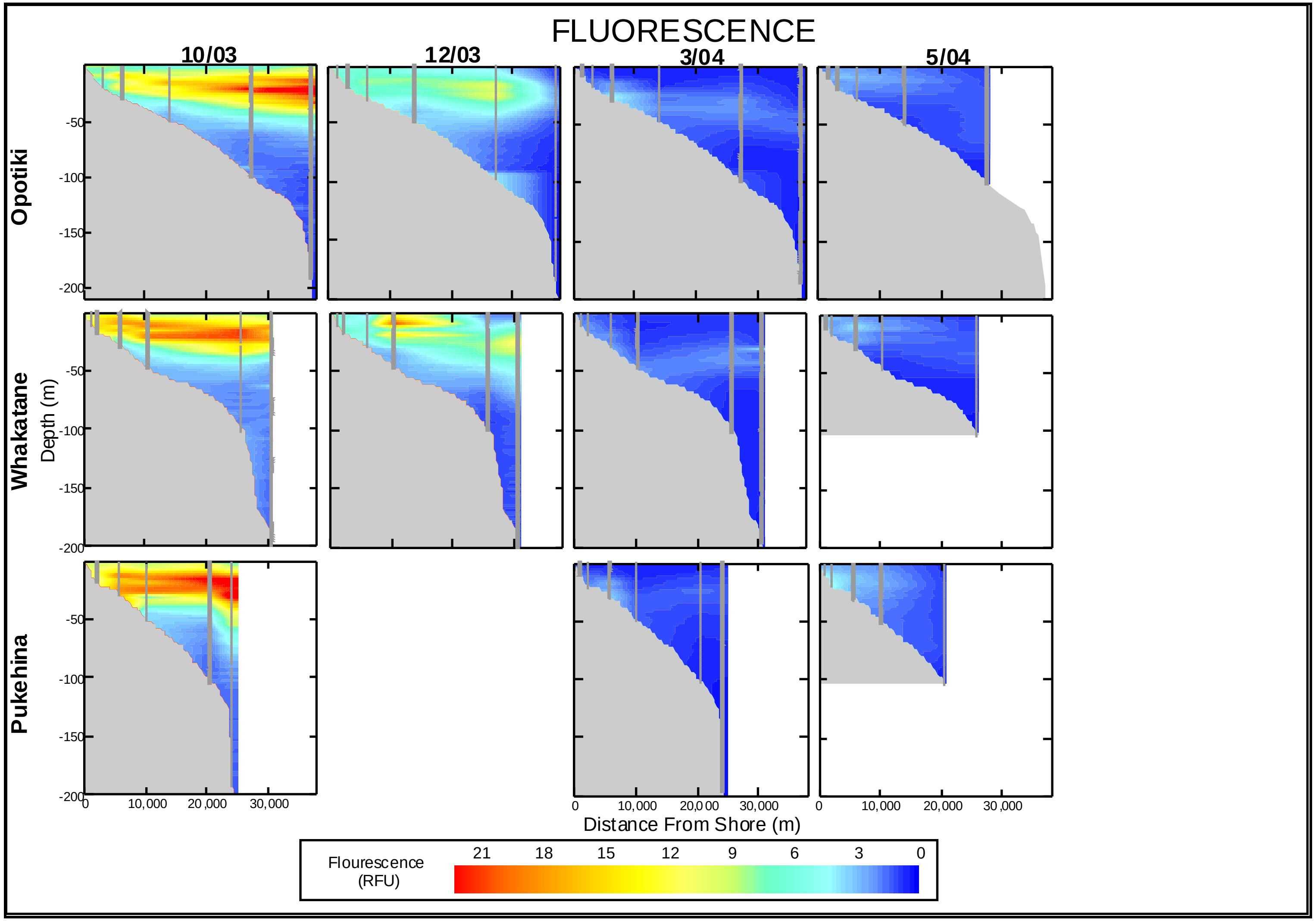

Figure 10 Chlorophyll-a plots (as fluorescence measurements) from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

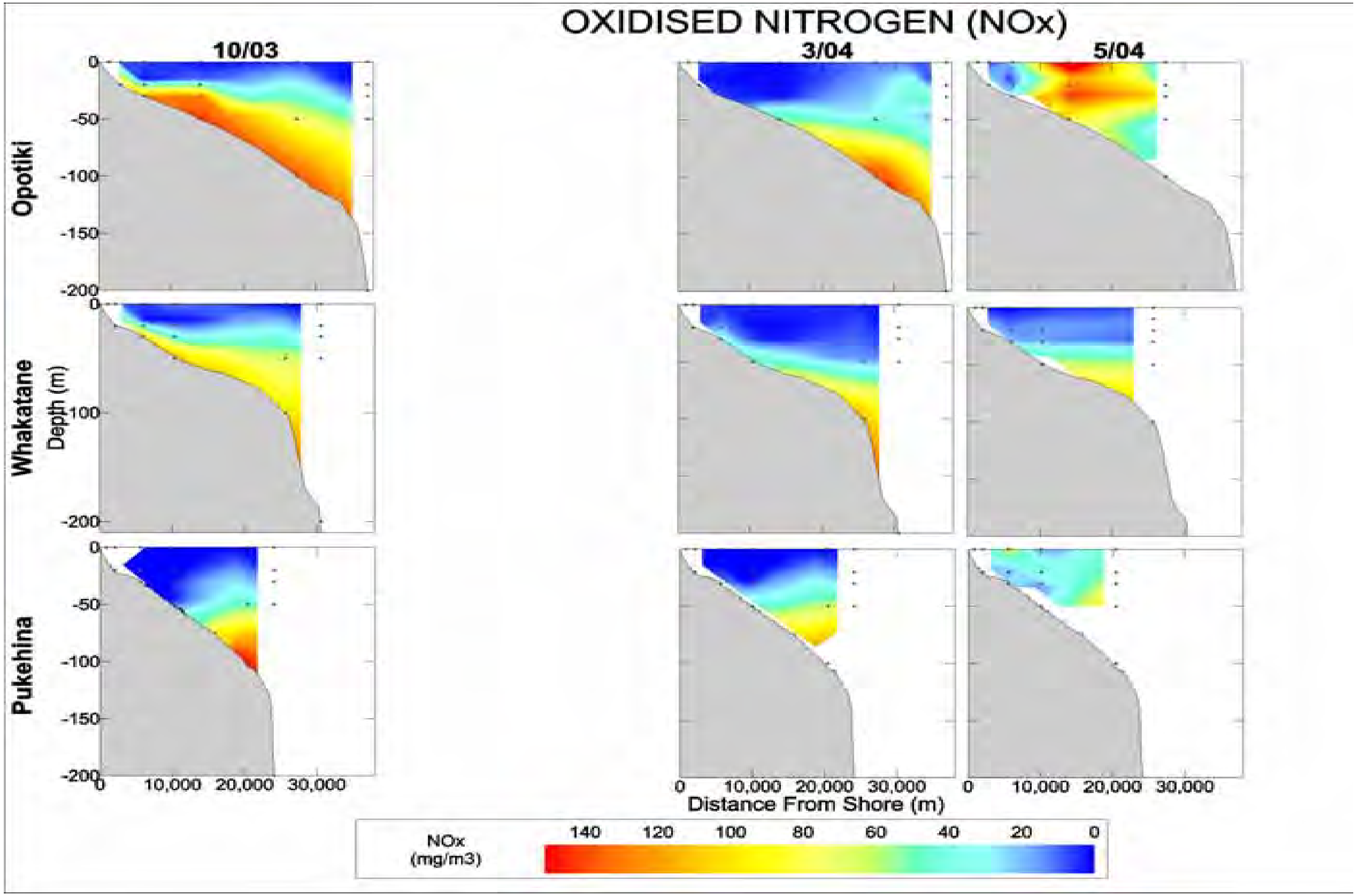

Figure 11 Concentration of oxidised nitrogen from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

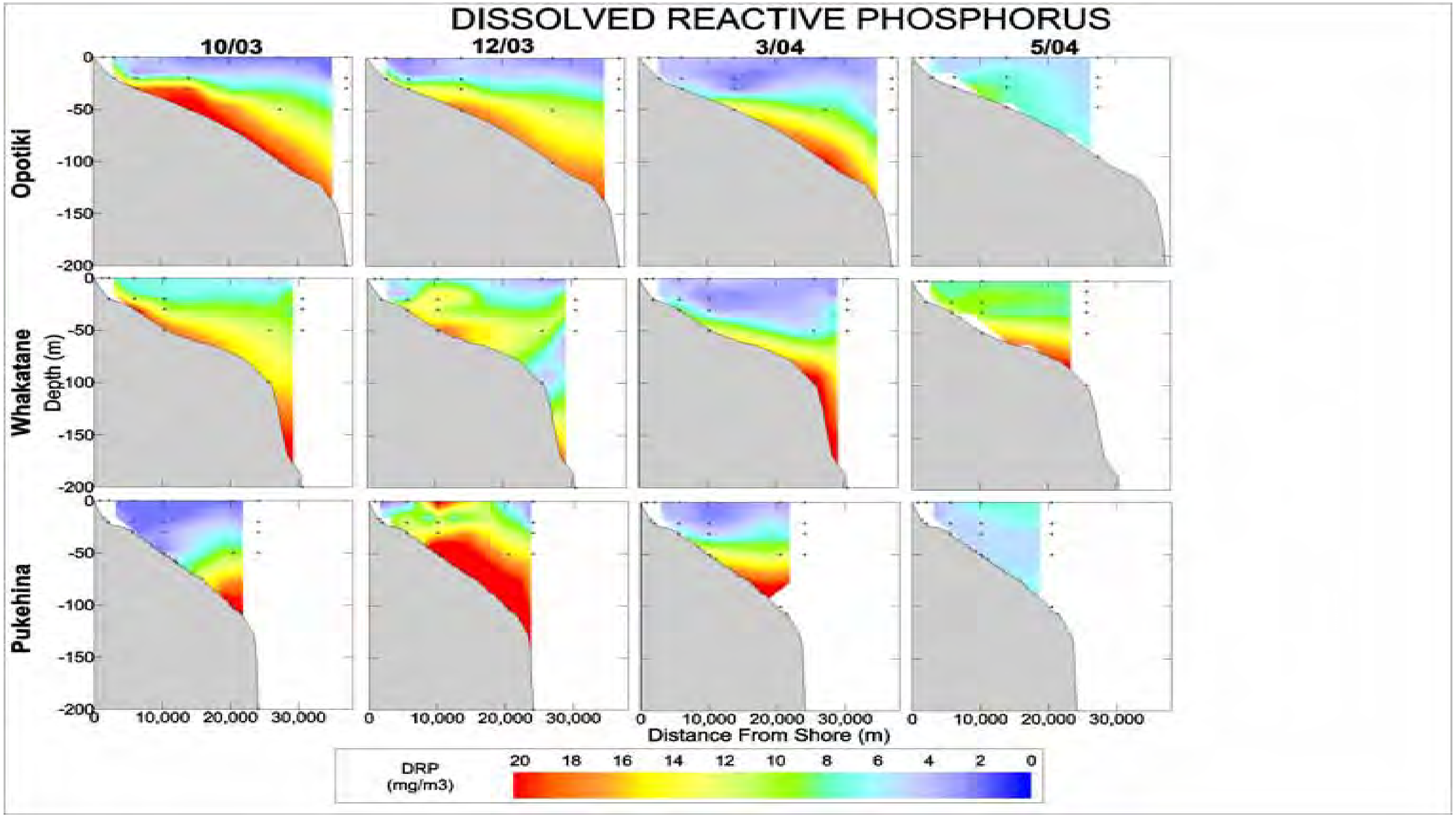

Figure 12 Concentration of dissolved reactive phosphorus from Opotiki, Whakatane and Pukehina transects on the BOP continental shelf.

3.2 Nutrients

Results for all the nutrient analyses undertaken along the transects is provided in Appendix II. Some of the data has been graphically presented to highlight observed patterns.

3.2.1 Dissolved Reactive Silica

The previous study of the Bay of Plenty coastal waters in 1996/97 established a detectable influence of freshwater inputs on Dissolved Reactive Silica levels along the open coast. Closer to shore levels tend to be higher and there is also a seasonal pattern with levels being lower in summer and autumn when freshwater inflows are lower. The general relationship between conductivity and Dissolved Reactive Silica is shown in Figure 13 below.

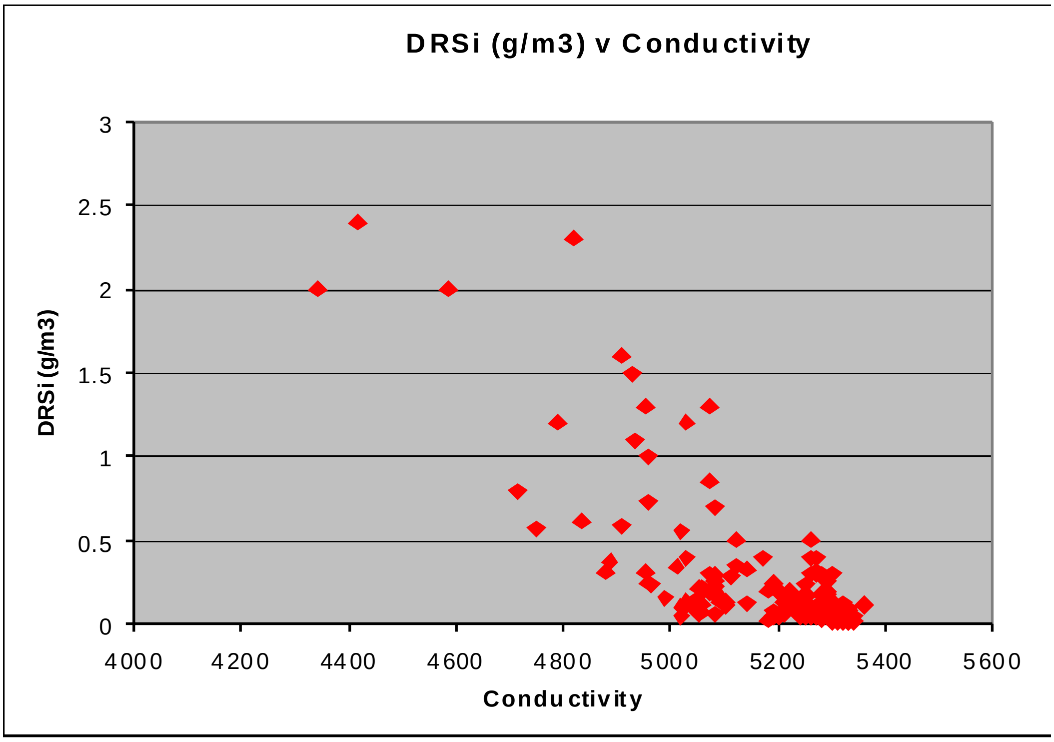

Figure 13 Relationship between Dissolved Reactive Silica and conductivity.

3.2.2 Dissolved Reactive Phosphorus

Contour plots of dissolved reactive phosphorus concentrations out across each transect for the seasonal sampling runs is provided in Figure 12. These plots show that all transects displayed very low concentrations in late summer/early autumn. There were consistently high concentrations in the deep water near the edge of the coastal shelf.

Concentrations of dissolved reactive phosphorus were also consistently higher in the bottom waters across the shelf, which points to replenishment from either the sediments or from deep oceanic water up-welling in across the coastal shelf.

3.2.3 Total Oxidised nitrogen

Contour plots of total oxidised nitrogen concentrations out across each transect for the seasonal sampling runs are provided in Figure 11. Data is missing for the December 2003 runs as all the samples were lost in the laboratory.

Overall trends are similar to the earlier Bay of Plenty study (Park 1998) with a seasonal pattern of depletion in summer within the upper stratified waters. There is also consistently higher concentrations in the bottom waters, particularly near the edge of the coastal shelf. As with dissolved reactive phosphorus, this points to sediment regeneration and up-welling of the deep oceanic water in across the shelf.

3.3 Biological

3.3.1 Chlorophyll-a

Concentrations of chlorophyll-a measured during the year on each of the transects is best shown graphically by results presented in Figure 10 and the water column profiles graphed and presented in Appendix III.

During the course of the field surveys water samples were collected from set points and analysed for chl-a concentrations to assist with both calibration and general validation of instrument readings (see Appendix II). Calibration of the fluorometer is based on 29 samples collected on the 22nd October and 9th December 2005. *In vivo* estimates of chlorophyll concentration were corrected for turbidity effects using a multiple regression model as follows:

$Y = m_x x + m_z z + b$, result obtained for this regression was an r^2 of 0.85877

Where:

Y = corrected chlorophyll value (mg/m^3)

m_x = coefficient (slope) for *in vivo* chl-a = 0.82568

m_z = coefficient (slope) for turbidity = -0.2295

b = y intercept = -0.41137

Throughout most of the transect surveys turbidity was generally very low so a simpler equation of y (chl-a mg/m^3) = 0.82568 * fluorescence value - 0.41137 could be used to convert the fluorescence data. The simpler relationship between just fluorescence and Chlorophyll-a (mg/m^3) is shown in Figure 14 below.

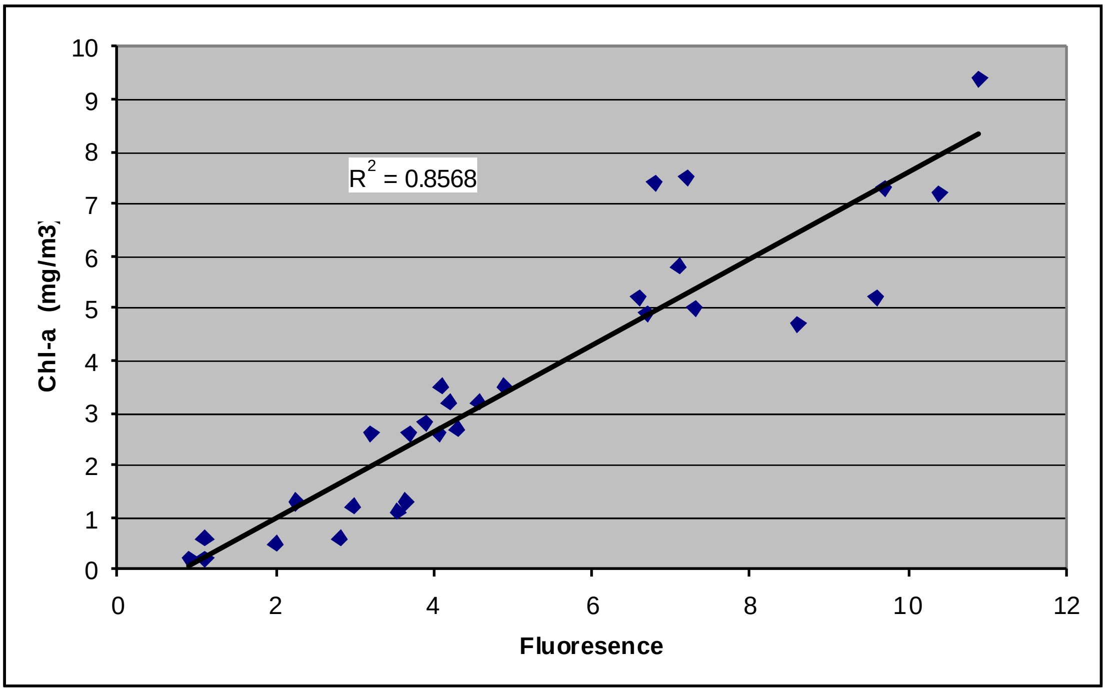

Figure 14 Relationship between instrument fluorescence values and Chl-a (mg/m³).

The highest fluorescence values from the survey were obtained on the 17th October 2003 at the 50 m depth contour on the Whakatane transect. The peak fluorescence value of 40 occurred as a pronounced spike in a very narrow depth range at about 17 m. This maximum converts to just over 30 mg/m³ of chl-a which is very high. Generally peak spring values as measured by fluorometer appeared to be around 18 mg/m³ of chl-a, which is still indicative of high productivity.

Chlorophyll-a concentrations at all sampling sites tended to peak in spring. During summer and autumn measured levels were much lower at around 2 mg/m³.

In the mid shelf area (50 – 100 m depth) the depth at which the chl-a peaks occurred, showed a seasonal change associated with the development of the thermocline. The peak was deepest in summer when a strong and deep thermocline was also present.

3.3.2 Phytoplankton species

Results of the phytoplankton enumeration and identification showed a number of typical trends. Table 3 below contains the list of species identified from the entire survey of the transects. In spring the most abundant species was the diatom *Eucampia zoodiacus*, while the dinoflagellate *Protoperidinium* spp. dominated in summer, then in autumn it was *Nitzschia* spp. followed by *Chaetoceros* spp. in winter. The overall pattern was that the dinoflagellates were more abundant in summer and autumn. This is shown in Table 4 below which provides the seasonal percentage composition of diatoms in the phytoplankton counts. All three transects show that numerically the diatoms were very dominant in spring.

Table 3 *Phytoplankton species list and the seasonal abundance rank obtained from the three transects sampled in Bay of Plenty coastal waters*

Diatoms	**Spring**	**Summer**	**Autumn**	**Winter**
Asterionella glacialis	19		17	6
Cerataulina spp.				15
Cerataulina pelagica	17			
Chaetoceros spp.	5	13	12	1
Coscinodiscus sp.	21		24	27
Detonula spp.	2	8	11	10
Diploneis sp.		15	15	28
Ditylum brightwellii	10			
Ditylum spp.				16
Eucampia zoodiacus	1			
Eucampia sp.		16	14	17
Fragilariopsis sp.		19		
Guinardia spp.	8			19
Lauderia annulata	16			
Lauderia sp.				9
Navicula spp.	9	6	9	14
Nitzschia longisimma	6			
Nitzschia spp.		2	1	8
Odontella mobiliensis	7			
Odontella sp.				7
Pleurosigma spp.		17	21	18
Pseudonitzschia spp.	4	5	4	3
Rhizosolenia imbricata	13			21
Rhizosolenia stolterforthii	12			5
Rhizosolenia spp.		12	20	13
Skeletonema costatum			8	2
Stephanopyxis sp.				11
Thalassosira spp.	3	4	7	4
Dinoflagellates				
Alexandrium sp.			6	22
Ceratium furca	22			32
Ceratium tripos	2	14		29
Ceratium spp.			19	30
Dinophysis sp.			18	31
Gymnodinium spp.		10	16	25
Gyrodinium spp.	14	9	13	26
Oxytoxum sp.			22	
Polykrikos sp.		3		33
Prorocentrum spp.		11	5	20
Protoperidinium spp.	18	1	10	23
Pyraminmonas sp.		18		
Scrippsiella sp.			2	24
Non-photosynthetic species	11			
Unknown dinoflagellates (25 micron)	15			

Micro flagellates				
Cryptomonads		7	3	12
Silicoflagellate				
Dictyocha sp.			23	

Table 4 Overall percentage of diatoms cells in the total number of phytoplankton cells counted from spot samples on each transect.

	Spring	Summer	Autumn	Winter
Pukehina	98	57	56	95
Whakatane	99	27	56	85
Opotiki	98	23	49	93

Results of the numbers of phytoplankton cells present in each of the samples are given in Tables 5-7 below. On each of the transects the seasonal trend in total cell numbers is very similar. Numbers are highest in spring and decline to the lowest levels in autumn.

In terms of spatial distribution there is a pattern of higher phytoplankton cell numbers occurring inshore. However in the spring transect sampling the numbers are just as high well offshore at the 200 m depth contour. The highest recorded cell numbers in any sample was from 20 m depth at the 200 m depth contour around 35 km offshore from Opotiki.

Table 5 Total numbers of phytoplankton cells counted in spot samples from the Pukehina transect.

		Oct 03	**Dec 03**	**Mar 04**	**May 04**
Contour	**depth (m)**	**Number of phytoplankton cells (1,000's/l)**			
10	*0*		200	31	300
20	*0*	122	135	10	186
20	*20*	60	55	14	146
30	*0*	210	13	25	164
30	*20*		10	9	120
50	*0*	234	73	9	223
50	*20*	286	2	2	151
50	30	521	17	6	109
50	*50*	100	2	10	43
100	*20*				5
100	*30*				13
100	*100*	8	7	2	14
200	*0*	326	81	4	
200	*20*	485	86	3	
200	*30*	543	134	5	
200	*50*	121	2	3	
	mean	**251**	**58**	**9**	**123**

Table 6 Total numbers of phytoplankton cells counted in spot samples from the Whakatane transect.

		Oct 03	Dec 03	Mar 04	May 04
Contour	**depth (m)**	**Number of phytoplankton cells (1,000's/l)**			
10	*0*	105	46	17	208
20	*0*	159	58	11	219
20	*20*	32	6	23	34
30	*0*	139	36	3	165
30	*20*	481	31	18	273
50	*0*	203	670	10	90
50	*20*	409	24	5	72
50	30	171	41	14	40
50	*50*	25	3	17	5
100	*10*				2
100	*20*				4
100	*30*				1
100	*100*	15	1	1	1
200	*0*	309	9	4	
200	*20*	250	2	8	
200	*30*	280	4	2	
200	*50*	15	1	17	
	mean	**185**	**67**	**11**	**85**

Table 7 Total numbers of phytoplankton cells counted in spot samples from the Opotiki transect.

		Oct 03	Dec 03	Mar 04	May 04
Contour	**depth (m)**	**Number of phytoplankton cells (1,000's/l)**			
10	*0*	43	20	7	109
20	*0*	151	37	13	224
20	*20*	22	7	6	104
30	*0*	159	69	3	113
30	*20*	601	6	2	201
30	*30*		6		
50	*0*	311	55	2	92
50	*20*	313	39	5	46
50	30	53	19	8	125
50	*50*	3	6	18	55
100	*20*				10
100	*30*				3
100	*100*	8	1	1	4
200	*0*	352	1	2	
200	*20*	672	6	2	
200	*30*	443		3	
200	*50*	189	4	4	
	mean	**237**	**20**	**5**	**91**

Chapter 4: Summary

Results from this survey program have provided a wealth of information on the Bay of Plenty coastal waters. Observed seasonal and spatial trends out across the continental shelf are very similar to those observed in 1996/97. The use of CTD profiling equipment and fluorescence probe has improved the understanding of the vertical structure of the water column. The data will be used to help calibrate a model the physical dynamics of the Bay of Plenty coastal shelf system.

Current records have shown a complex system on the Bay of Plenty continental shelf being driven primarily by wind with tides and external currents (East Auckland Current) also having an influence (Beamsley et al 2005). This confirms the earlier findings of Healy et al (1988).

The major physical patterns within the Bay of Plenty coastal waters are the seasonal changes in water temperature with associated summer thermo cline development. Winter temperatures are usually around 12 – 13 ^{o}C while in summer they reach 21 – 22 ^{o}C. Nutrient levels are generally higher in winter and become depleted in the surface waters over summer. As in the earlier study of 1996/97 (Park 1998) data suggests that nutrient recycling from the sea floor and inputs from the deep oceanic water via up-welling are both important to overall productivity. Water clarity also improves seasonally in late summer and is highest out away from the shore. Influence of terrestrial freshwater inputs and associated nutrient and clarity factors is highest in winter near the coast, often forming very large surface plumes during the larger river fresh or flood events.

Phytoplankton levels are generally highest in late winter and spring showing a pattern of spatial decline out across the shelf. Peak concentrations of around 670,000 cells per litre were recorded from water samples during the surveys but peak levels are likely to be much higher. Diatoms tend to dominate during winter and spring while dinoflagellates are proportionately more abundant in summer.

Fluorometer measurements show that estimated chlorophyll-a concentrations (another measure of phytoplankton productivity) reached peaks of around 15 – 18 mg/m^3. The highest recorded estimate of chlorophyll-a concentration was a very sharp peak of around 40 mg/m^3. During summer fluorometer estimates of maximum chlorophyll-a concentrations tend to be around 1 – 2 mg/m^3. Large and consistent spatial variations also occur across the Bay of Plenty depending on the prevailing weather/current conditions. During the last survey in December 2004 chlorophyll-a concentrations to the east of Whakatane were low right across the shelf (1 – 2 mg/m^3) while the areas to the west showed moderate levels (5 – 10 mg/m^3).

This survey and report form part of the total AMA science project for the Bay of Plenty, which includes work on the currents and temperatures, sediments and biology. It also includes an analysis of remote sensing data to provide a synopsis of seasonal and spatial variability of sea surface temperature and chlorophyll-a within the Bay of Plenty. All the water quality, climatic and current data will be used to develop a productivity model which will allow assessments of the sustainability of aquaculture within this region's coastal shelf waters. The modelling and assessments of sustainability are to be reported on by mid 2006.

Chapter 5: References

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Appendices

Appendix 1 – Site Location and Sampling Program

Sampling Sites

	Latitude	Longitude	NZMS 260 Grid ref. (m)		labstar #
Tauranga Transect					
10 m depth	37 35 40.9	176 08 34.8	2787737	6395999	730031
20 m	37 34 53.4	176 09 54.0	2789731	6397394	730032
30m	37 34 05.5	176 11 13.2	2791725	6398800	730033
50m	37 31 00.0	176 16 00.0	2798966	6404261	730034
100m	37 27 45.0	176 22 21.0	2808542	6409921	730035
200m	37 25 12.0	176 25 43.0	2813682	6414446	730036
Pukehina Transect					
10m	37 49 25.3	176 36 34.8	2827892	6369054	730043
20m	37 48 51.6	176 36 59.3	2828533	6370066	730044
30m	37 47 11.5	176 38 10.8	2830408	6373078	730045
50m	37 45 05.0	176 39 41.1	2832774	6376884	730046
100m	37 40 12.4	176 43 10.9	2838278	6385687	730047
200m	37 38 30.7	176 44 23.6	2840189	6388745	730048
Whakatane Transect					
10m	37 56 02.0	177 00 53.3	2862982	6355319	730037
20 m	37 55 35.4	177 01 17.3	2863604	6356112	730038
30m	37 53 43.1	177 02 22.4	2865348	6359500	730039
50m	37 51 41.9	177 04 00.0	2867899	6363125	730040
100m	37 44 12.9	177 08 30.5	2875141	6376649	730041
200m	37 41 51.9	177 10 02.0	2877580	6380891	730042
Opotiki Transect					
10m	37 58 41.4	177 15 44.1	2884479	6349415	730049
20m	37 57 50.0	177 15 47.5	2884636	6350990	730050
30m	37 56 04.3	177 15 58.0	2885047	6354233	730051
50m	37 51 55.7	177 16 23.1	2886021	6361859	730052
100m	37 44 42.6	177 17 06.2	2887710	6375147	730053
200m	37 39 27.4	177 17 37.3	2888933	6384817	730054

Sampling program

At each sampling station the following parameters were recorded; vertical light attenuation, secchi depth, and dissolved oxygen, temperature, fluorescence, turbidity and salinity/conductivity profiles. These profiles are based on the down-cast recordings from the SBE 19 Plus probe.

Surface sampling (0-5m) in the plans below is an integrated tube sample except for the Enterococcal samples.

Sampling plan for phytoplankton identification and enumeration, 168 spot samples (14 per transect)

Sample **Sampling Station** (depth contour m)

Depth (m)	10	20	30	50	100	200
0-5 .	x	x	x	x	.	x
10 . .	.	.	.	.	.	.
20		x	x	x	.	x
30			.	x	.	x
50				x	.	x
100				x	.	
200					.	

Sampling plan for phytoplankton size fractionation (Chl-a), 144 spot samples (9 per transect)

Sample	**Sampling Station** (depth contour m)					
Depth (m)	10	20	30	50	100	200
0-5 .	.	x	.	x	.	x
10 . .	.	.	.	.	.	.
20		x	.	x	.	.
30			.	x	.	x
50				x	.	.
100				x	.	
200					.	

Sampling plan for dissolved nutrients DRP, NH4, NO3, 288 spot samples (18 per transect)

Sample	**Sampling Station** (depth contour m)					
Depth (m)	10	20	30	50	100	200
0-5 .	x	x	x	x	x	x
10 . .	.	.	.	.	.	.
20 . . .	x	x	x	.	x	
30			x	x	.	x
50				x	x	x
100					x	.
200						x

Sampling plan for TN, TP, SS, DRSi, DFe and TOC/DOC, 192 spot samples (16 per transect).

Sample	**Sampling Station** (depth contour m)					
Depth (m)	10	20	30	50	100	200
0-5 .	x	x	x	x	x	x
10	.	.	.	.	.	
20		x	x	x	.	.
30			x	x	.	x
50				x	x	.
100					x	.
200						x

Sampling plan for Enterococci bacteria, 96 spot samples (6 per transect).

Sample	**Sampling Station** (depth contour m)					
Depth (m)	10	20	30	50	100	200
0 . . .	x	x	x	x	x	x

Appendix 2 – BOP Offshore Transect Survey Results

In the following results the first column lists the transect sampled (Pukehina, Whakatane & Opotiki) with the depth contour along the transect given in the fourth column, then the actual water depth at that site from which the samples were taken. The following abbreviations and units are used;

Temp	temperature (degrees Celsius)
Cond	conductivity @ 25 ^{o}C
Saln	salinity
Secchi	secchi disc (measured in metres without a viewing tube)
Vlec	vertical light extinction coefficient derived from PAR measurements
Ent	Enterocci number cfu/100ml
PH	pH measurement @ 25^{o}C
SS	Suspended Solids (g/m^3)
TOC	Total Organic Carbon (g/m^3)
DOC	Dissolved Organic Carbon (g/m^3)
DNPOC	Dissolved non-purgable organic carbon (g/m^3)
NPOC	Non-purgable organic carbon (g/m^3)
DRSi	Dissolved Reactive Silica (mg/m^3)
DFe	Dissolved iron (mg/m^3)
TN	Total nitrogen (mg/m^3)
NH4	Ammonium nitrogen (mg/m^3)
NOx	Oxidised nitrogen (mg/m^3)
TP	Total Phosphorus (mg/m^3)
DRP	Dissolved Reactive Phosphorus (mg/m^3)
Chla	Chlorophyll-a total filterable on 0.7µm (mg/m^3)
Nanochla	Chlorophyll-a for plankton 0.7-20µm (mg/m^3)
Microchla	Chlorophyll-a for plankton 20-200 µm (mg/m^3)
Plankton	Phytoplankton (thousands of cells per litre)

Transect	date	sample	contour	depth	Temp	Cond	Saln	Secchi	Vlec	Ent	pH	SS	TOC	DOC	DNPOC	NPOC	DRSi	Dfe	TN	NH4	Nox	TP	DRP	Chla	NanoCh	Microch	plankton
Pukehina	16/10/03	03/4994	10	0																							
Pukehina	16/10/03	03/4995	20	0	15	4929	32.2		0.26	0.5	8.2	8.2	2.8	3.4			1500	5	171	4		20	2	0.9	<0.1	0.9	121.5
Pukehina	16/10/03	03/4996	20	20	15.2	5070	33.2				8.1	7.2	2.5	3.3			1300	5	145	6	0.5	20	5	2.2	0.8	1.4	60.0
Pukehina	16/10/03	03/4997	30	0	14.9	4960	32.5	3.5	0.24	0.5	8.2	7.8	3.1	3.0			1000	5	167	6	0.5	21	2				210.0
Pukehina	16/10/03	03/4998	30	20							8.2	12	2.7	2.3			600	5	141	3	0.5	18	2				
Pukehina	16/10/03	03/4999	30	30	14.9	5120	33.5				8.2	13	2.7	2.7			500	5	174	5	0.5	16	2				
Pukehina	16/10/03	03/5000	50	0	15	4934	32.3	5.2	0.24	0.5	8.2	15	2.5	2.6			1100	5	190	7	0.5	20	2	0.8	0.2	0.6	234.0
Pukehina	16/10/03	03/5001	50	20	14.6	5080	33.3				8.2	14	2.7	2.6			700	5	126	3	0.5	15	2	1.1	0.5	0.6	286.0
Pukehina	16/10/03	03/5002	50	30	14.5	5260	34.7				8.1	8.2	3.0	2.4			50	5	131	9	0.5	17	3	2.3	1.8	0.5	521.0
Pukehina	16/10/03	03/5003	50	50							8.2	12	1.9	1.8			300	5	156	14	0.5	18	2	1.1	0.5	0.6	99.5
Pukehina	16/10/03	03/5004	100	0	15.4	5030	33	6	0.21	0.5	8.2	9.4	2.8	3.8			400	5	132	7	0.5	14	2				
Pukehina	16/10/03	03/5005	100	50	14.8						8.1	14	2.0	2.9			50	5	154	9	48	19	10				
Pukehina	16/10/03	03/5006	100	100	13.8	5260	34.7				8	18	2.4	1.7			300	5	251	6	175	32	24	0.1	0.1	<0.1	8.0
Pukehina	16/10/03	03/5007	200	0	16	5070	33.3	6.3	0.21	0.5	8.2	4.5	7.2	5.1			300	5	189	7	0.5	18	2	1.1	0.6	0.5	326.0
Pukehina	16/10/03	03/5008	200	20	14.8	5160	33.8				8.2								141	4	0.5	15	2				485.0
Pukehina	16/10/03	03/5009	200	30							8.1	27	2.5	2.5			50	5	139	6	0.5	17	3	2.5	2	0.5	543.0
Pukehina	16/10/03	03/5010	200	50	14.2	5300	34.8				8.1								190	14	38	22	10				120.5
Pukehina	16/10/03	03/5011	200	200	13.6	5300	34.1				8	17	2.2	2.5			300	5	263	3	172	37	22				
Whakatane	17/10/03	03/5055	10	0	15.9	4341	28.1	1.4	0.37	13.0	8.2	15	1.8	2.8			2000	5	163	16	10	25	12				104.7
Whakatane	17/10/03	03/5056	20	0	15.8	4817	29.8	4.5	0.23	7.0	8	9.8	2.9	2.1			2300	5	226	9	11	32	8	8.5	6.4	2.1	159.0
Whakatane	17/10/03	03/5057	20	20	14.9	5260	34.7				7.9	30	2.7	1.4			500	5	266	22	104	52	20	1.4	1.2	0.2	32.0
Whakatane	17/10/03	03/5058	30	0	16.5	4415	28.8	3.5	0.22	1.0	8.2	9.6	3.3	2.5			2400	30	261	9	5	34	7				139.3
Whakatane	17/10/03	03/5059	30	20	14.4	5260	34.7				8	7.6	3.0	1.9			50	5	197	7	0.5	27	8				481.0
Whakatane	17/10/03	03/5060	30	30	14.2	5300	34.8				8	7	2.9	1.8			300	5	225	11	109	31	22				
Whakatane	17/10/03	03/5061	50	0	16.4	4585	29.8	2.9	0.22	0.5	8.1	19	2.9	1.5			2000	5	321	9	14	26	7	1.3	0.7	0.6	203.0
Whakatane	17/10/03	03/5062	50	20	14.5	5260	34.7				8	11	1.6	3.3			50	20	141	6	0.5	18	7	1.8	1.1	0.7	408.5
Whakatane	17/10/03	03/5063	50	30	14.6	5280	34.8				8	11	3.3	3.0			50	20	175	10	29	18	10	1.3	0.8	0.5	171.0
Whakatane	17/10/03	03/5064	50	50	14.2	5290	34.9				8	14	2.9	1.7			200	20	230	5	117	31	19	0.4	0.3	0.1	24.5
Whakatane	17/10/03	03/5065	100	0	15.3	5190	34.2	5.8	0.22	20.5	8.2	13	1.9	1.4			50	5	157	5	0.5	14	5				
Whakatane	17/10/03	03/5066	100	50	14.7	5290	34.8				8.1	15	1.6	2.1			50	5	148	6	66	18	12				
Whakatane	17/10/03	03/5067	100	100	14.7	5290	34.8				8	9	1.7	2.5			50	5	184	3	92	21	15	0.1	0.1	<0.1	15.0
Whakatane	17/10/03	03/5068	200	0	15.1	5250	34.8	6.6	0.23		8.1	9.2	1.7	1.8			50	5	296	14	1	18	5	0.9	0.5	0.4	309.0
Whakatane	17/10/03	03/5069	200	20	14.7	5280	34.8				8.2									5	5		12				249.5
Whakatane	17/10/03	03/5070	200	30	14.7	5340	35				8	10	2.0	2.6			50	5	152	12	18	17	8	1.8	1.6	0.2	280.0
Whakatane	17/10/03	03/5071	200	50	14.7	5290	35				8.1										75						15.3
Whakatane	17/10/03	03/5072	200	200	13.3	5290	34.9				8	8.2	1.0	2.4			200	5	222	7	168	29	24				
Opotiki	17/10/03	03/5013	10	0	14.5	4909	32.1	1.1		4.0	8.0	13.0	3.0	1.6			1600	20	199	13	41	39	10				43.5
Opotiki	17/10/03	03/5014	20	0	15.0	4951	32.4	1.8	0.25	8.0	8.0	11.0	3.6	1.4			1300	60	180	8	3	25	5	8.2	7.4	0.8	151.0
Opotiki	17/10/03	03/5015	20	20	14.4	5260	34.7				8.0	16.0	3.4	2.0			400	5	230	126	118	32	17	5.2	4.9	0.3	21.7
Opotiki	17/10/03	03/5016	30	0	15.2	4788	31.2	4.5	0.19	2.0	8.1	11.0	3.9	0.5			1200	5	180	6	8	21	5				158.6
Opotiki	17/10/03	03/5017	30	20	14.5	5200	34.2				8.1	12.0	3.2	1.7			200	5	157	8	0.5	28	2				601.0
Opotiki	17/10/03	03/5018	30	30	14.4	5270	34.7				8.0	10.0	1.4	0.8			400	5	224	3	131	29	19				
Opotiki	17/10/03	03/5019	50	0	15.0	5180	34.1	7.4	0.21	<1	8.1	12.0	2.6	1.4			200	5	157	7	0.5	17	2	6.8	6.5	0.3	310.7
Opotiki	17/10/03	03/5020	50	20	14.9	5250	34.8				8.0	16.0	2.3	1.2			50	5	137	6	12	17	5	6.5	5.3	1.2	313.0
Opotiki	17/10/03	03/5021	50	30	14.1	5270	34.7				8.0	15.0	2.3	2.2			300	5	194	6	130	27	19	7.9	7.7	0.2	53.0
Opotiki	17/10/03	03/5022	50	50	14.8	5280	34.8				8.0	17.0	3.0	3.2			300	5	233	6	145	32	22	1.9	1.8	0.1	3.0
Opotiki	17/10/03	03/5023	100	0	15.0	5200	34.2	6.9	0.25	2.0	8.2	9.4	2.4	3.1			50	20	168	4	5	15	2				
Opotiki	17/10/03	03/5024	100	50	14.5	5270	34.8				8.1	13.0	3.1	3.0			50	10	176	8	79	20	12				
Opotiki	17/10/03	03/5025	100	100	14.0	5280	34.8				8.0	13.0	1.6	1.5			30	5	225	4	140	27	20	1.1	1.1	<0.1	8.0
Opotiki	17/10/03	03/5026	200	0	14.1	5270	34.8		0.22	<1	8.1	13.0	1.9	3.1			50	5	207	6	0.5	20	2	12.6	11.8	0.8	352.0
Opotiki	17/10/03	03/5027	200	20	14.8	5270	34.8				8.2									5	0.5		2				675.0
Opotiki	17/10/03	03/5028	200	30	14.8	5280	34.8				8.1	7.0	2.1	1.4			50	5	158	4	5	18	5	6.1	5.3	0.8	443.0
Opotiki	17/10/03	03/5029	200	50	14.8	5280	34.8				8.1									80	48		7				188.5
Opotiki	17/10/03	03/5030	200	200	13.4	5300	34.8				8.0	15.0	1.6	2.8			20	5	241	2	178	47	25				

Transect	date	sample	contour	depth	Temp	Cond	Saln	Secchi	Vlec	Ent	pH	SS	TOC	DOC	DNPOC	NPOC	DRSi	Dfe	TN	NH4	Nox	TP	DRP	Chla	NanoCh	Microch	plankton
Pukehina	05/12/03	036100	10	0	17.7	5030	33.1	3.4	0.33	2.0	8.3	8.7	4.4	3.7			1200	2	233	6		28	2				199.5
Pukehina	05/12/03	036101	20	0	18.2	5070	33.3	4.2	0.28	1.0	8.4	11.0	3.9	3.2			853	2	212	4		23	2	2.3	1.6	0.7	135.0
Pukehina	05/12/03	036102	20	20	15.5	5270	34.8				7.9	18.0	3.9	2.9			319	2	157	2		24	8	2.4	1.8	0.6	54.6
Pukehina	05/12/03	036103	30	0	18.1	5020	33.0	6.3	0.22	<1	8.3	16.0	4.1	3.1			561	2	140	3		16	3				13.0
Pukehina	05/12/03	036104	30	20	15.1	5280	34.9				7.9	15.0	4.4	3.4			286	2	118	4		24	14				10.0
Pukehina	05/12/03	036105	30	30	15	5300	35.1				7.9	16.0	3.1	3.0			305	2	135	7		22	12				
Pukehina	05/12/03	036106	50	0	17.3	5240	34.6	7.6	0.14	<1	8.2	17.0	4.0	3.3			140	2	672	46		13	22	1.0	0.9	0.1	73.0
Pukehina	05/12/03	036107	50	20	16	5250	34.7				8.1	17.0	2.2	3.3			180	2	144	7		17	8	2.1	1.9	0.2	1.5
Pukehina	05/12/03	036108	50	30	15.2	5290	34.9				7.9	16.0	2.3	3.1			175	2	158	2		26	14	1.1	1	0.1	17.0
Pukehina	05/12/03	036109	50	50	14.6	5290	34.9				8.0	17.0	1.6	2.4			255	2	219	3		31	26	0.3	0.2	0.05	1.7
Pukehina	05/12/03	036110	100	0	17.1	5030	33.1	5.8	0.14	2.0	5.8	17.0	2.0	3.5			116	2	177	6		13	5				
Pukehina	05/12/03	036111	100	50	14.9	5250	34.7				8.1	16.0	1.5	2.8			86	2	179	6		25	163				
Pukehina	05/12/03	036112	100	100	14.5	5280	34.8				8.0	17.0	1.9	3.0			180	2	210	2		33	26	0.1	0.05	0.05	7.1
Pukehina	05/12/03	036113	200	0	17.2	5270	34.7	6.6	0.15	0.5	6.6	18.0	2.0	3.1			56	2	212	7		13	3	0.5	0.3	0.2	81.0
Pukehina	05/12/03	036114	200	20	16.3	5270	34.8				8.1									3			3				86.0
Pukehina	05/12/03	036115	200	30	16.1	5280	34.8				8.1	16.0	1.7	3.0			47	2	129	3		15	8	1.8	0.9	0.9	134.0
Pukehina	05/12/03	036116	200	50	15.5	5280	34.9				8.1	16.0								4			14				2.3
Pukehina	05/12/03	036117	200	200	13.1	5290	34.9				8.0	16.0	1.5	2.0			135	2	258	5		33	27				
Opotiki	03/12/03	035979	10	0	19.1	4750	31	3.7	0.30	<1	8.1	4.7	2.4	2.6			575	2	302	15		29	3				20.0
Opotiki	03/12/03	035980	20	0	19.1	4886	32	4.4	0.23	3.0	8.1	4.2	3.0	3.8			377	2	409	12		39	3	1.3	1.1	0.2	37.0
Opotiki	03/12/03	035981	20	20	15.8	5060	33.1				7.9	8.6	2.3	2.7			224	2	145	13		26	12	0.5	0.4	0.1	7.0
Opotiki	03/12/03	035982	30	0	17.8	4958	32.6	4.6	0.21	<1	8.2	7.2	2.3	2.7			251	2	251	4		23	2				68.7
Opotiki	03/12/03	035983	30	20	16.3	5030	33				8.1	6.0	2.6	3.3			130	2	152	6		16	3				6.3
Opotiki	03/12/03	035984	30	30	15.4	5070	33.4				8.0	9.4	2.1	1.8			191	2	145	7		27	14				6.0
Opotiki	03/12/03	035985	50	0	17.7	4955	32.5	6.2	0.15	<1	8.1	2.2	3.1	3.3			311	2	216	9		22	5	1.2	0.9	0.3	55.0
Opotiki	03/12/03	035986	50	20	15.8	4990	32.8				8.0	7.6	2.3	2.6			163	11	149	4		17	5	1.1	0.6	0.5	39.0
Opotiki	03/12/03	035987	50	30	15.6	5040	33				8.0	5	2.4	1.8			99	2	167	3		22	12	0.6	0.4	0.2	19.3
Opotiki	03/12/03	035988	50	50	15.3	5050	33.1				8.0	7.6	2.1	1.8			161	2	207	2		37	19	0.3	0.2	0.05	5.5
Opotiki	03/12/03	035989	100	0	17.7	4963	32.5	7.2	0.12		8.1	5	2.4	2.7			238	2	154	6		14	2				
Opotiki	03/12/03	035990	100	50	15.9	5080	33.3				8.1	8.2	2.2	2.4			62	2	171	5		17	12				
Opotiki	03/12/03	035991	100	100	15.6	5050	33.2				8.0	6.6	2.0	1.8			111	2	285	7		29	17	0.1	0.05	0.05	0.7
Opotiki	03/12/03	035992	200	0	17.6	5030	33	8.1	0.11	<1	8.1	6	2.9	0.0			139	2	186	6		15	3	0.7	0.6	0.05	0.5
Opotiki	03/12/03	035993	200	20	17.1	5010	33				8.0	8.4								3			3				5.5
Opotiki	03/12/03	035994	200	30	16.4	5020	33				8.1	4.8	2.8	2.3			52	2		4			5	1.2	1.1	0.1	
Opotiki	03/12/03	035995	200	50	15.9		33				8.1	4.6								4			10				3.5
Opotiki	03/12/03	035996	200	200	13.9	5100	33.5				8.1	7.2	3.0	2.3			135	2	216	5		31	26				
Whakatane	04/12/03	036080	10	0	19.5	4714	30.8	3.3	0.29	<1	8.1	5	3.9	3.5			797	2	299	9		40	8				46.0
Whakatane	04/12/03	036081	20	0	19.1	4833	31.6	4.5	0.17	<1	8.0	4.8	3.1	3.1			618	2	324	5		39	5	2.0	1.7	0.3	58.0
Whakatane	04/12/03	036082	20	20	15.7	5080	33.3				7.9	9.6	3.1	2.9			264	2	290	6		51	5	0.8	0.6	0.2	6.0
Whakatane	04/12/03	036083	30	0	18.2	4910	32.1	6.1	0.20	<1	8.1	6.2	3.0	3.0			591	2	232	4		26	7				36.0
Whakatane	04/12/03	036084	30	20	15.6	5080	33.4				8.0	2.6	3.1	3.2			176	2	155	5		19	3				31.0
Whakatane	04/12/03	036085	30	30	15.2	5110	33.5				7.9	4.4	2.9	3.2			287	2	172	3		30	17				
Whakatane	04/12/03	036086	50	0	18.1	5010	32.8	6.3	0.18	<1	8.2	4.8	4.1	3.7			347	2	253	6		23	7	4.2	2.1	2.1	669.6
Whakatane	04/12/03	036087	50	20	15.8	5050	33.1				8.0	3.8	3.1	3.6			214	2	162	2		20	17	1.8	1.4	0.4	24.0
Whakatane	04/12/03	036088	50	30	15.5	5090	33.4				8.0	1.6	3.2	3.6			134	2	140	1		22	10	0.5	0.4	0.05	41.0
Whakatane	04/12/03	036089	50	50	15.1	5090	33.5				8.0	6.4	3.0	3.0			169	2	207	4		27	20	0.2	0.1	0.05	2.6
Whakatane	04/12/03	036090	100	0	18	5030	33	13.4	0.15	<1	8.1	2.4	3.4	2.6			130	2	127	4		10	3				
Whakatane	04/12/03	036091	100	50	15.6	5060	33.2				8.0	2.8	3.2	1.9			77	2	180	3		19	12				
Whakatane	04/12/03	036092	100	100	14.6	5100	33.5				8.0	2.6	3.7	2.4			116	2	191	4		24	4	0.1	0.05	0.05	1.0
Whakatane	04/12/03	036093	200	0	17.9	5020	33	14.3	0.13	<1	8.1	2.4	3.9	2.0			107	2	146	3		10	2	0.3	0.3	0.05	9.3
Whakatane	04/12/03	036094	200	20	16.7	5060	33.3				8.1									2			12				2.3
Whakatane	04/12/03	036095	200	30	16.3	5050	33.1				8.0	3.4	4.2	2.6			66	2	143	4		14	12	1.2	1.1	0.05	4.0
Whakatane	04/12/03	036096	200	50	15.4	5100	33.5				8.1									3			2				1.0
Whakatane	04/12/03	036097	200	200	14.1	5060	33.2				8.0	4.2	3.9	2.6			118	2	229	0.5		29	22				

Transect	date	sample	contour	depth	Temp	Cond	Saln	Secchi	Vlec	Ent	pH	SS	TOC	DOC	DNPOC	NPOC	DRSi	Dfe	TN	NH4	Nox	TP	DRP	Chla	NanoCh	Microch	plankton
Pukehina	15/03/04	04/1584	10	0	19.4	5220	34.3	6.8	0.25	0.5	8.2	15	1.9	3.5			198	6	13	18	6	15	2				30.5
Pukehina	15/03/04	04/1585	20	0	19.2	5250	34.6	15.4	0.14	0.5	8.1	17	1.8	3.2			113	20	135	5	0.5	14	2	0.8	0.7	0.1	9.6
Pukehina	15/03/04	04/1586	20	20	18.5	5320	35.1				8.1	16	2.3	3.1			125	2	138	16	1	20	7	1.9	1.5	0.4	13.5
Pukehina	15/03/04	04/1587	30	0	19.2	5250	34.6	12.0	0.14	0.5	8.2	16	2.3	2.8		2.7	239	11	158	8	0.5	16	4				24.8
Pukehina	15/03/04	04/1588	30	20	18.5	5320	35.1				8.1	16	1.7	3.0			76	2	144	20	0.5	17	4				8.6
Pukehina	15/03/04	04/1589	30	30	18.2	5330	35.2				8.1	16	2.1	2.7		2.0	76	150	196	11	17	21	7				
Pukehina	15/03/04	04/1590	50	0	19.1	5250	34.6	18.0	0.08	0.5	8.1	14	1.5	2.3		2.0	164	5	307	20	0.5	16	2	0.4	0.3	0.05	9.0
Pukehina	15/03/04	04/1591	50	20	18.7	5320	35.1				8.1	15	1.6	2.2			38	6	113	18	0.5	14	2	0.3	0.2	0.05	2.1
Pukehina	15/03/04	04/1592	50	30	18.3	5320	35.1				8.1	15	1.3	2.4			50	12	119	18	0.5	17	4	0.5	0.4	0.05	5.8
Pukehina	15/03/04	04/1593	50	50	17.6	5320	35.1				8	18	1.9	2.0			92	2	173	15	45	27	14			0.2	9.8
Pukehina	15/03/04	04/1594	100	0	19.1	5300	35	22.0	0.09	0.5	8.1	16	2.0	2.3			92	4	175	16	0.5	14	4				
Pukehina	15/03/04	04/1595	100	50	17.4	5320	35.1				8.1	15	1.7	1.8			78	2	211	11	61	20	11				
Pukehina	15/03/04	04/1596	100	100	15.5	5330	35.2				8	17	2.0	1.6		1.8	99	4	263	20	146	35	25	0.1	0.05	0.05	2.0
Pukehina	15/03/04	04/1597	200	0	19.1	5290	34.9	22.0	0.09	0.5	8.1	16	2.6	1.8			107	2	113	9	0.5	12	2	0.4	0.3	0.05	3.6
Pukehina	15/03/04	04/1598	200	20	18.4	5330	35.1				8.1									6	0.5		2				3.0
Pukehina	15/03/04	04/1599	200	30	17.9	5330	35.1				7.9	18	1.5	2.0			30	2	24	8	26	16	7	0.6	0.5	0.05	5.1
Pukehina	15/03/04	04/1600	200	50	17.3	5320	35.2				8.1									6	78		14				2.6
Pukehina	15/03/04	04/1601	200	200	19.2	5290	34.9				8.2	17	2.3	2.0			167	2	135	13	0.5	14	4				
Opotiki	16/03/04	04/1652	10	0	20.3	5320	35	5.4	0.25		8.1	9.8	2.6	2.9	1.1	1.9	66	2	136	12	18	19	4				6.7
Opotiki	16/03/04	04/1653	20	0	20.2	5210	34.5	12.4	0.10		8.2	6.8	2.2	3.0			131	2	166	15	8	16	4	0.3	0.2	0.05	12.5
Opotiki	16/03/04	04/1654	20	20	20.0	5240	34.5				8.1	2.8	2.4	2.5	1.5	1.5	131	2	126	13	0.5	15	4	0.8	0.7	0.05	6.3
Opotiki	16/03/04	04/1655	30	0	20.0	5280	34.8	15.8	0.16		8.2	12	2.0	2.3	1.2	1.5	117	5	163	12	4	13	4				2.5
Opotiki	16/03/04	04/1656	30	20	18.6	5310	35.3				8.1	13	2.1	2.0	1.1	1.3	48	2	111	18	0.5	18	4				2.1
Opotiki	16/03/04	04/1657	30	30	18.6	5330	35.2				8.1	15	2.4	2.3	1.3	1.8	88	2	127	10	2	21	7				
Opotiki	16/03/04	04/1658	50	0	20.0	5310	35	27.0	0.09		8.1	12	2.0	2.3	1.0	1.6	70	5	126	11	1	15	4	0.3	0.2	0.05	2.3
Opotiki	16/03/04	04/1659	50	20	20.1	5330	35.2				8.1	14	2.2	2.4			29	2	109	15	0.5	12	2	0.3	0.2	0.05	4.5
Opotiki	16/03/04	04/1660	50	30	18.3	5330	35.1				8.1	16	2.0	2.6			14	2	121	11	0.5	14	2	1.4	0.4	1	7.8
Opotiki	16/03/04	04/1661	50	50	17.4	5360	35.1				8	20	1.5	1.8	1.2	1.5	117	5	203	12	60	32	16	0.7	0.4	0.3	17.8
Opotiki	16/03/04	04/1662	100	0	19.6	5340	35.3	20.8	0.12		8.2	14	1.7	1.9	1.1	1.3	14	2	161	17	13	12	2				
Opotiki	16/03/04	04/1663	100	50	17.0	5330	35.7				8.1	13	1.7	2.3			19	2	130	20	31	21	9				
Opotiki	16/03/04	04/1664	100	100	15.5	5330	35.4				8	8.1	1.6	1.7	0.9	1.1	76	2	361	25	152	33	21	0.1	0.05	0.05	0.7
Opotiki	16/03/04	04/1665	200	0	19.2	5340	35.2	29.5	0.09		8.1	8.5	1.5	1.9	1.0	1.4	22	2	176	37	8	11	4	0.3	0.2	0.05	2.1
Opotiki	16/03/04	04/1666	200	20	19.2	5340	35.2				8.2									65	0.5		4				1.5
Opotiki	16/03/04	04/1667	200	30	19.1	5310	35				8.1	27	2.7	2.7	1.6	1.6	28	2	410		60	15	4	0.4	0.3	0.05	2.8
Opotiki	16/03/04	04/1668	200	50	17.4	5330	35.3				8.1									5	0.5		2				3.6
Opotiki	16/03/04	04/1669	200	200	13.9	5300	35.1				8	5.9	2.0	2.3			133	2	317	6	184	36	23				
Whakatane	17/03/04	04/1705	10	0	19.9	4880		4.4	0.20	13	8.1	4.7	2.0	2.5	1.5		314	2	418	58	71	22	7				16.5
Whakatane	17/03/04	04/1706	20	0	19.4	5080		5.5	0.18	16	8.1	3	2.8	2.5	0.2	1.6	292	4	149	19	7	22	5	0.8	0.7	0.1	10.5
Whakatane	17/03/04	04/1707	20	20	18.5	5320					8.1	6.5	5.5	5.6	1.3		81	2	122	11	0.5	21	5	1.3	0.8	0.5	23.3
Whakatane	17/03/04	04/1708	30	0	19.9	5240		11.0	0.09	0.5	8.2	1.8	5.6	5.6	1.4	1.4	138	2	132	17	4	15	3				2.5
Whakatane	17/03/04	04/1709	30	20	18.0	5330					8	1.7	5.8	5.4	1.2	1.4	37	2	122	11	15	17	5				17.6
Whakatane	17/03/04	04/1710	30	30	17.8	5330					8.1	3.4	6.0	5.6	1.4	1.7	89	2	178	5	36	23	10				
Whakatane	17/03/04	04/1711	50	0	19.8	5230		16.0	0.07	0.5	8.1	2.5	3.6	5.3	1.0	1.2	161	2	188	11	5	13	5	0.4	0.3	0.05	9.6
Whakatane	17/03/04	04/1712	50	20	18.9	5330					8.1	12.4	3.5	3.5	1.2	1.2	18	2	131	10	1	14	2	0.3	0.2	0.05	4.5
Whakatane	17/03/04	04/1713	50	30	18.3	5180					8.1	11.7	3.5	2.9	1.0	1.4	23	2	113	7	0.5	15	3	0.6	0.5	0.05	14.0
Whakatane	17/03/04	04/1714	50	50	17.6	5320					8	14.8	3.9	3.4	1.1	1.2	79	2	208	7	56	28	14	1.0	0.7	0.3	17.1
Whakatane	17/03/04	04/1715	100	0	18.9	5320		12.5	0.10	0.5	8.2	12	3.8	3.4	1.1	1.3	17	5	189	16	4	15	3				
Whakatane	17/03/04	04/1716	100	50	17.1	5320					8.1	12.1	3.6	3.6	1.1	1.2	19	20	151	8	16	16	5				
Whakatane	17/03/04	04/1717	100	100	15.0	5320					8	6.9	3.2	3.2	0.7	1.0	59	34	235	7	127		22	0.1	0.05	0.05	0.2
Whakatane	17/03/04	04/1718	200	0	18.9	5310		14.0	0.10	0.5	8.2	3.6	3.7	3.6	1.2	1.3	13	2	185	6	1	13	3	0.4	0.3	0.05	3.8
Whakatane	17/03/04	04/1719	200	20	18.9	5320					8.2									3	0.5		2				7.8
Whakatane	17/03/04	04/1720	200	30	18.8	5340					8.2	9.5	2.7	3.1	1.2	1.4	23	6	133	3	0.5	12	10	0.5	0.4	0.05	1.8
Whakatane	17/03/04	04/1721	200	50	17.3	5350					8.1									6	13		7				16.5
Whakatane	17/03/04	04/1722	200	200	14.7	5320					8	11.4	2.8	2.9	0.9		61	2	251	5	148	34	22				

Transect	date	sample	contou	depth	Temp	Cond	Saln	Secchi	Vlec	Ent	pH	SS	TOC	DOC	DNPOC	NPOC	DRSi	Dfe	TN	NH4	Nox	TP	DRP	Chla	NanoCh	Microch	plankton
Whakatane	24/05/04	043057	10	0	15.4	5080	31.5	4.2	0.22		8.1	11			1.4	1.2	228	2	141	8	3	17	8				207.5
Whakatane	24/05/04	043058	20	0	15.5	5140	33.8	6.3	0.23		8.1	16			1.3	1.3	128	2	154	6	1	13	8	2.2	1.54	0.66	218.5
Whakatane	24/05/04	043059	20	20	16.4	5250	34.6				8	22			1.3	1.2	120	2	205	13	33	21	14	1.3	0.81	0.46	34.3
Whakatane	24/05/04	043060	30	0	15.7	5190	34.2	8.6	0.18		8.1	20			1.3	1.2	79	2	135	4	0.5	14	8				165.0
Whakatane	24/05/04	043061	30	20	16.0	5210	34.4				8.1	23			1.3	1.2	90	2	282	11	14	16	8				273.0
Whakatane	24/05/04	043062	30	30	16.3	5270	34.8				8.1	20			1.4	1.5	103	2	145	11	21	17	12				
Whakatane	24/05/04	043063	50	0	16.0	5230	34.5	9.2	0.15		8.1	22			1.2	1.2	85	2	139	3	4	13	8	2.3	1.81	0.48	90.3
Whakatane	24/05/04	043064	50	20	16.1	5210	34.3				8.1	20			1.2	1.1	76	2	179	7	20	14	10	1.0	0.52	0.46	71.8
Whakatane	24/05/04	043065	50	30	16.4	5270	34.8				8.1	21			1.3	1.1	83	2	166	4	14	12	8	1.5	1.02	0.52	39.8
Whakatane	24/05/04	043066	50	50	16.4	5280	34.9				8.1	22			1.3	1.1	107	2	183	3	68	17	17	0.2	0.1	0.14	5.0
Whakatane	24/05/04	043067	100	0	17.2	5270	34.8	18.2	0.08		8.1	20			1.2	1.1	47	2	113	7	9	11	8				
Whakatane	24/05/04	043070	100	10	17.1	5270	34.8				8.2	18			1.6	1.6	67	2	180	3	10	15	8	0.5	0.07	0.46	1.8
Whakatane	24/05/04	043071	100	20	17.1	5270	34.8				8.1	24			1.4	1.4	111	2	330	5	20	27	8				3.8
Whakatane	24/05/04	043072	100	30	17.1	5260	34.7				8.1	10			2.4	2	49	2	155	7	9	12	8	0.5	0.07	0.4	1.0
Whakatane	24/05/04	043068	100	50	16.6	5240	34.6				8.1	20			1.3	1.3	45	11	290	3	66	10	12				
Whakatane	24/05/04	043069	100	100	15.5	5300	35.0				8	22			1.2	1.1	49	2	146	7	123	11	24	0.1	0.01	0.04	0.2
Opotiki	25/05/04	043107	10	0	15.2			5.2	0.16	0.5	8.1	9			1.7	1.4	191	2	200	9	19	15	5				109.0
Opotiki	25/05/04	043108	20	0	15.8			6.8	0.22	0.5	8.1	20			1.9	1.6	93	2	234	8	4	14	5	2.0	1.39	0.59	224.0
Opotiki	25/05/04	043109	20	20	16.5						8.1	22			1.9	1.5	114	2	360	12	36	18	8	3.3	2.67	0.61	103.5
Opotiki	25/05/04	043110	30	0	15.9			8.2	0.19	0.5	8.1	16			1.6	1.5	87	2	194	8	20	15	5				112.3
Opotiki	25/05/04	043111	30	20	16.0						8.1	17			1.1	1	89	2	202	6	3	15	5				201.5
Opotiki	25/05/04	043112	30	30	16.6						8.1	17			1.7	1.6	125	2	206	9	23	17	10				
Opotiki	25/05/04	043113	50	0	16.1			11.0	0.13	0.5	8.1	9.4			1.4	1.3	66	2	423	9	195	12	5	1.6	1.14	0.5	91.5
Opotiki	25/05/04	043114	50	20	16.2						8.1	15			1.6	1.3	77	2	452	10	92	15	8	1.3	0.86	0.4	46.0
Opotiki	25/05/04	043115	50	30	16.4						8.1	15			1.8	1.6	65	2	464	12	156	18	8	1.5	1.03	0.5	125.0
Opotiki	25/05/04	043116	50	50	16.6						8.1	17			1.3	1.5	70	2	333	9	82	17	8	0.9	0.59	0.31	54.5
Opotiki	25/05/04	043117	100	0	17.0	5290	34.9	10.1	0.09	0.5	8.1	15			1.4	1.4	41	2	187	3	16	11	5				
Opotiki	25/05/04	043118	100	20	17.0	5290	34.9				8.1	18			1.3	1.4	47	2	274	7	36	13	5	0.5	0.05	0.4	9.5
Opotiki	25/05/04	043119	100	30	17.0	5290	34.9				8.1	9			1.4	1.4	49	2	247	2	114	12	5	0.4	0.04	0.4	2.8
Opotiki	25/05/04	043120	100	50	17.0	5280	34.9				8.1	16			1.3	1.3	49	2	175	2	19	14	5				
Opotiki	25/05/04	043121	100	100	16.8	5280	34.8				8.1	20			1.6	1.6	55	2	324	6	48	16	7	0.3	0.03	0.24	3.7
Pukehina	26/05/04	043127	10	0	15.9	4957	33.2	6.3	0.30	2.0	8.2	9			1.4	1.3	734	2	279	11	8	16	5				300.0
Pukehina	26/05/04	043128	20	0	15.5	5140	33.4	6.2	0.26	1.0	8.2	5.8			1	1.3	327	2	253	11	26	14	3	2.9	1.73	1.12	186.0
Pukehina	26/05/04	043129	20	20	15.5	5170	33.9				8.2	8.2			1.4	1.2	400	2	259	12	19	14	3	3.0	1.79	1.18	145.5
Pukehina	26/05/04	043130	30	0	15.2	5120	33.6	8.7	0.18	0.5	8.2	7.4			1.2	1.1	349	2	417	14	64	14	5				163.5
Pukehina	26/05/04	043131	30	20	15.5	5190	34.1				8.2	5.6			1.2	1	248	2	316	12	6	14	5				120.0
Pukehina	26/05/04	043132	30	30	15.7	5200	34.2				8.2	4.8			1.1	1.1	195	2	258	4	21	16	5				
Pukehina	26/05/04	043133	50	0	15.8	5210	34.2	13.1	0.19	1.0	8.2	7			1.1	1	140	2	178	8	6	13	8	2.9	2.06	0.86	223.0
Pukehina	26/05/04	043134	50	20	15.9	5220	34.4				8.2	6.6			1.4	1.1	142	2	366	19	30	14	5	2.7	1.74	0.99	151.0
Pukehina	26/05/04	043135	50	30	16.1	5230	34.5				8.2	4.8			1.2	1	135	2	208	10	6	15	5	2.0	1.38	0.64	108.5
Pukehina	26/05/04	043136	50	50	16.1	5260	34.7				8.1	4			1.4	1.1	105	2	282	11	14	13	5	1.6	0.95	0.62	43.0
Pukehina	26/05/04	043137	100	0	16.5	5290	34.9	8.1	0.10	0.5	8.1	2.8			1.3	0.9	63	2	175	7	40	14	7				
Pukehina	26/05/04	043138	100	20	16.5	5290	34.9				8.2	3.6			1	1	66	2	174	6	42	14	7	0.5	0.09	0.36	5.3
Pukehina	26/05/04	043139	100	30	16.5	5290	34.9				8.1	4.8			1.2	1	79	2	6040	6	5630	15	5	0.5	0.12	0.34	13.0
Pukehina	26/05/04	043140	100	50	16.6	5270	34.8				8.2	6.6			1	0.9	67	2	246	7	82	14	5				
Pukehina	26/05/04	043141	100	100	16.4	5210	34.4				7.7	6			1.1	1.1	62	2	3920	8	3050	15	7	0.7	0.09	0.58	14.4

Appendix 3 – CTD Profiles From Transect Surveys

CTD transect data covers the period from October 2003 up to December 2004.

Graph titles start with the transect;

"Opo" = Opotiki, "Whk" = Whakatane, "Puk" = Pukehina.

Next in graph title is the depth contour and then the date of sampling. The bin.cnv can be ignored, although the "bin" indicates that that the graph is based on averaging the data over 1 m depth intervals.

For example "Opo20_171003bin.cnv" is data from the 20 m depth contour on the Opotiki transect sampled on the 17th October 2003.

In graphs Whk30_041203 and puk200_051203 there are what should be obvious fluorescence signal errors in the upper water column. On the August 2004 run of the transects the fluorometer was not functioning correctly so no data was obtained.

There are additional transects profiled for 7-9th December 2004 labelled T05 – T15, and these correspond to the ASR Ltd shelf sediment survey as follows;

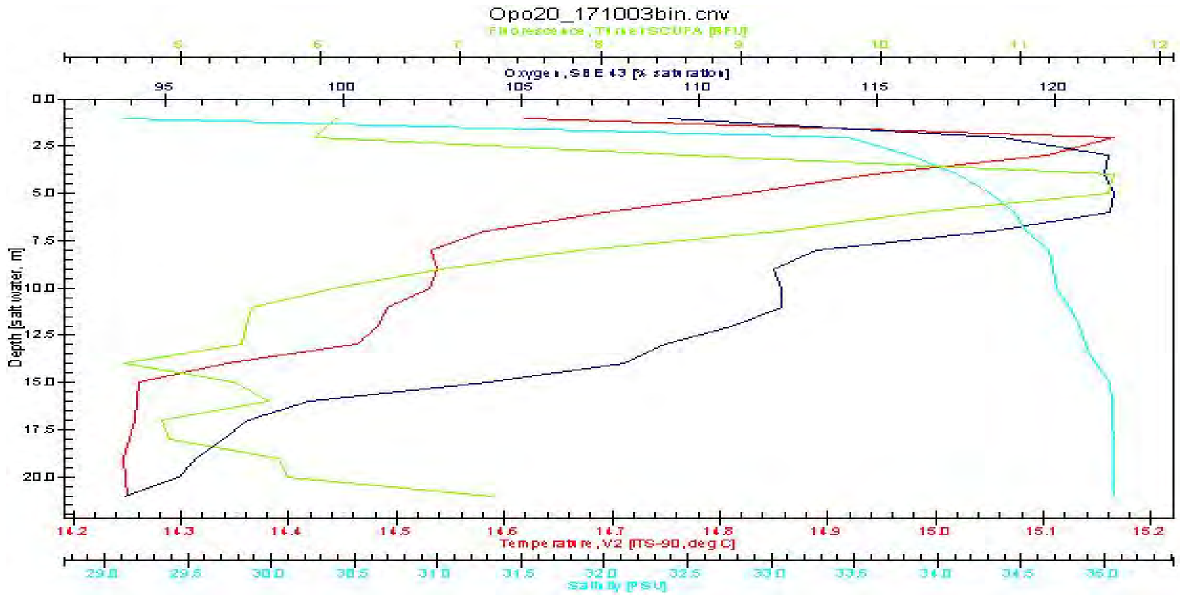
T05 = "C" and is off Matata

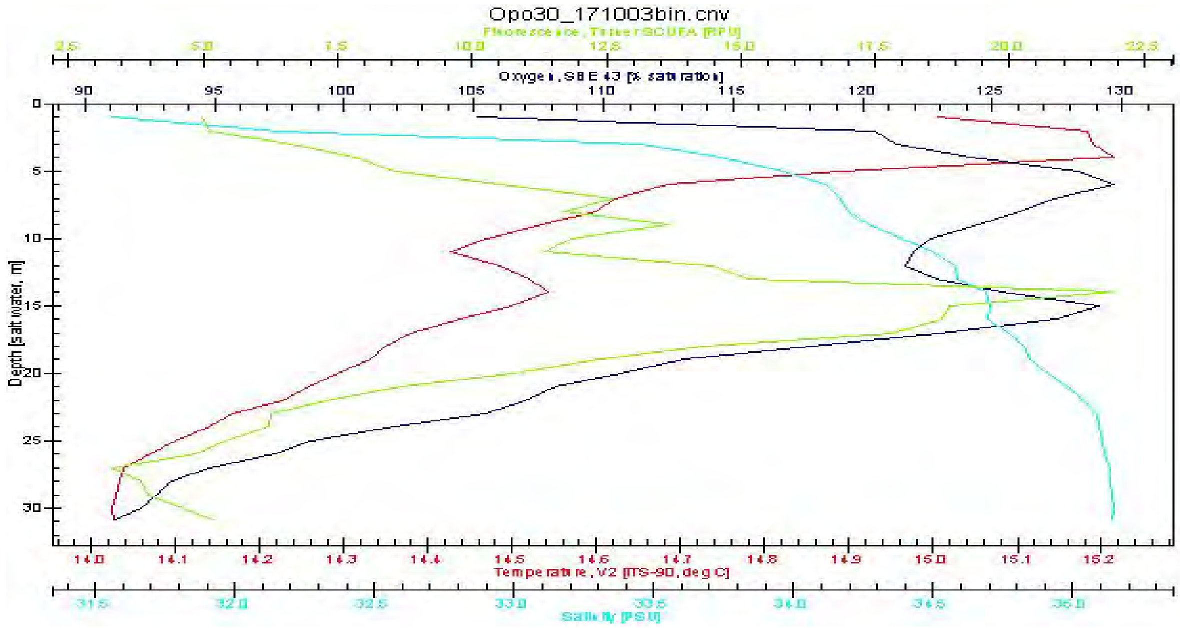
TO6 = "D" and is off Thornton

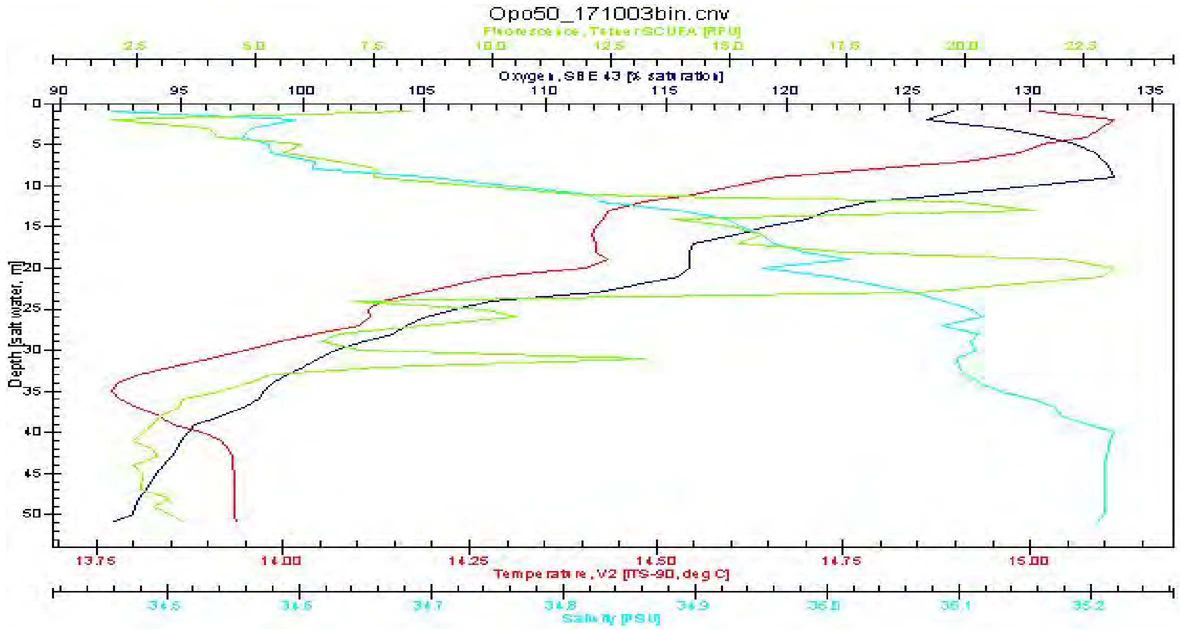
T11 = "I" and is off Opape

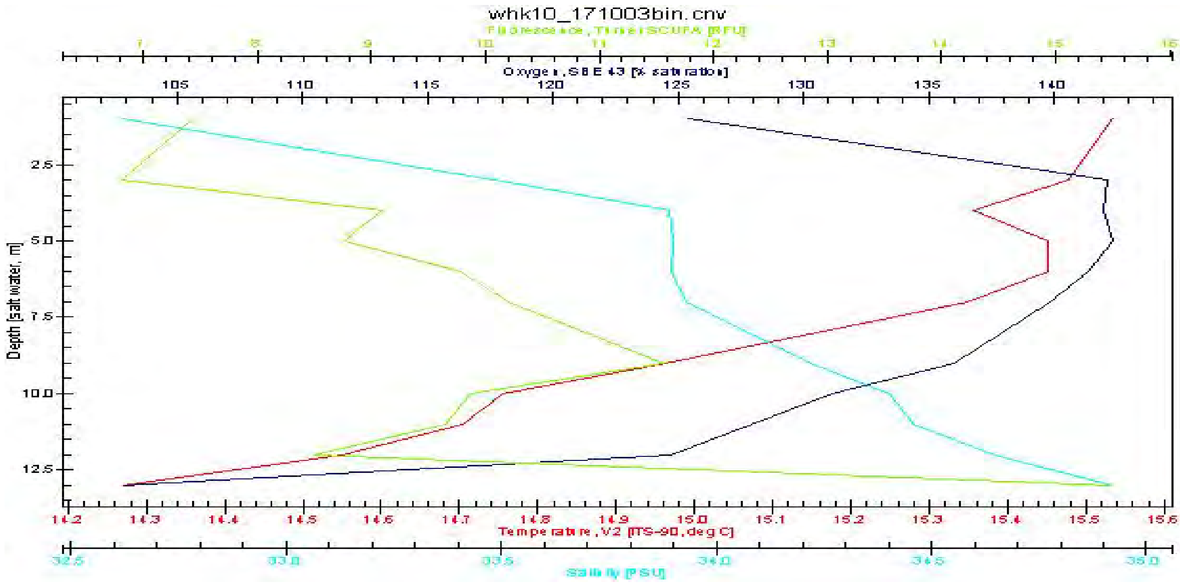
T13 = "K" and is off Omaio Bay

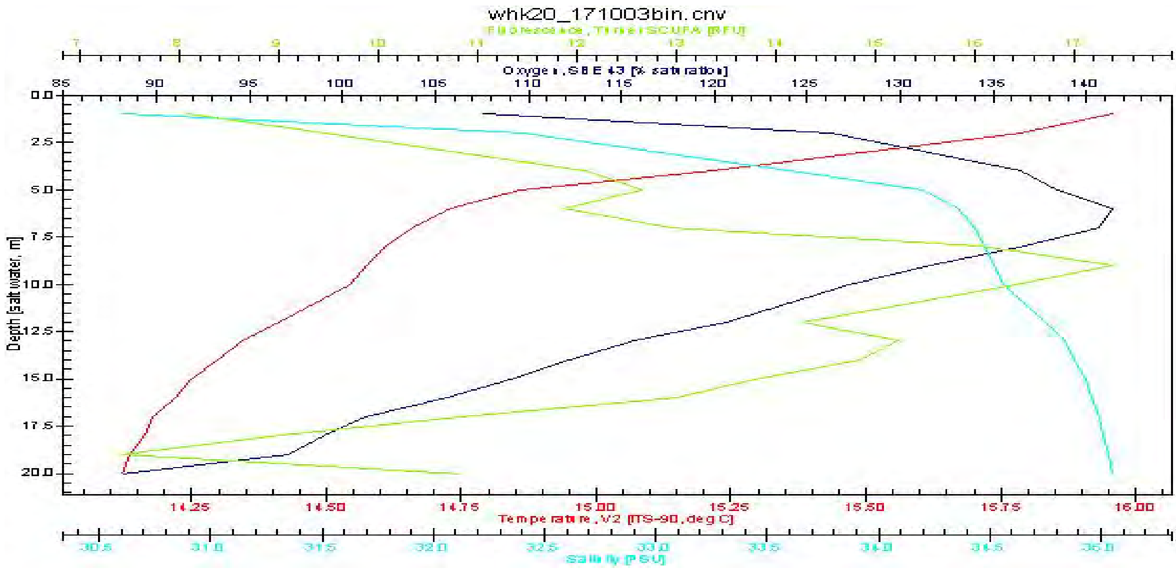
T15 = "M" and is off Raukokore

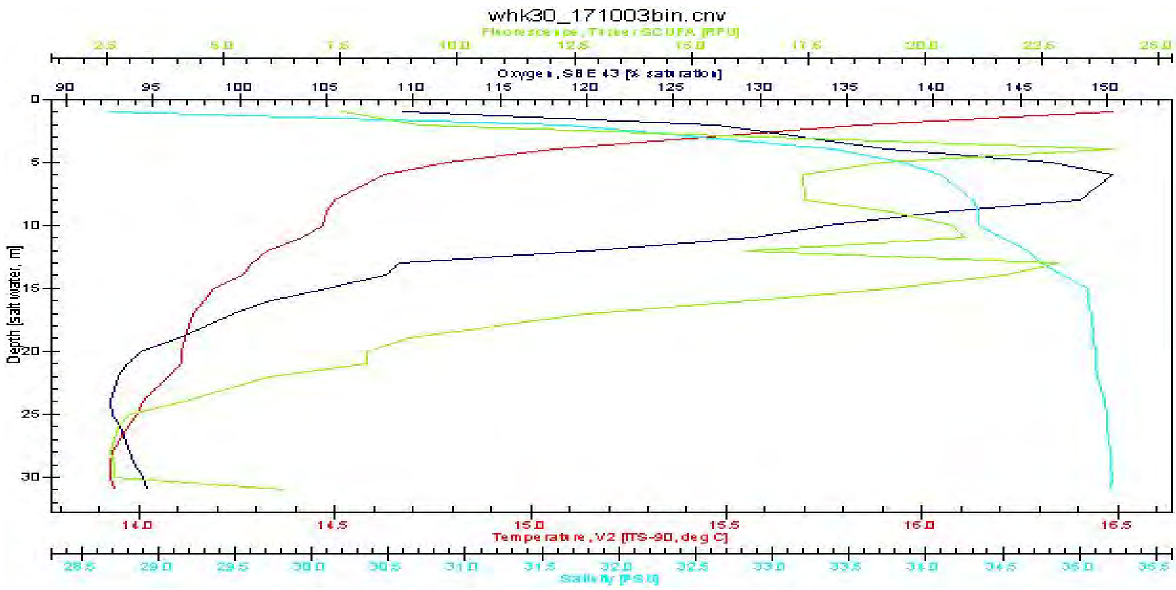

Opo20_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

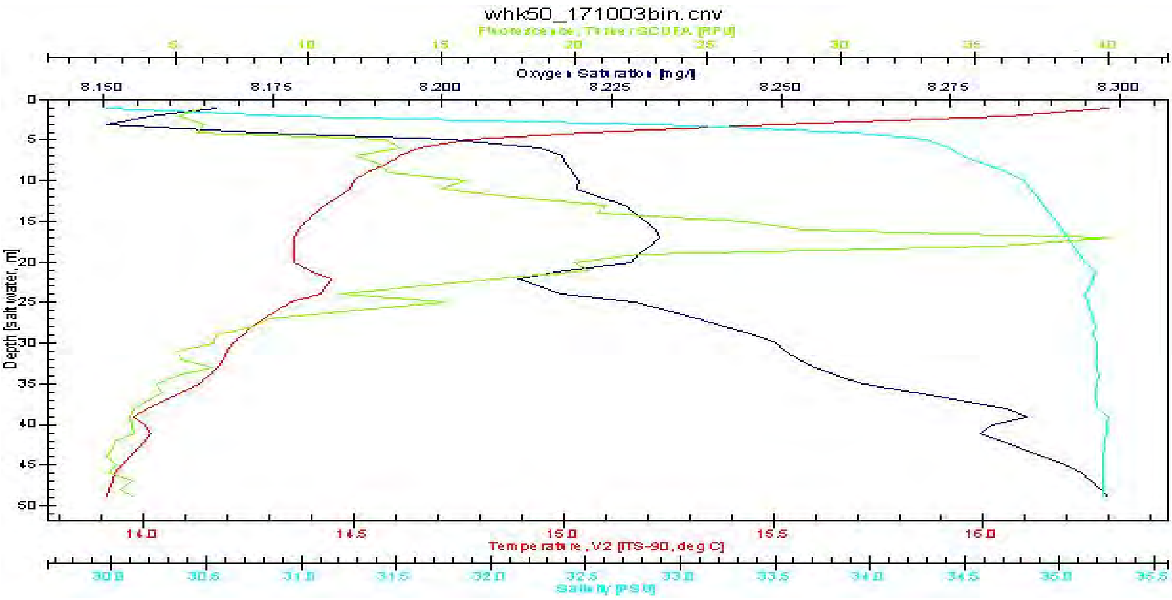

Opo30_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

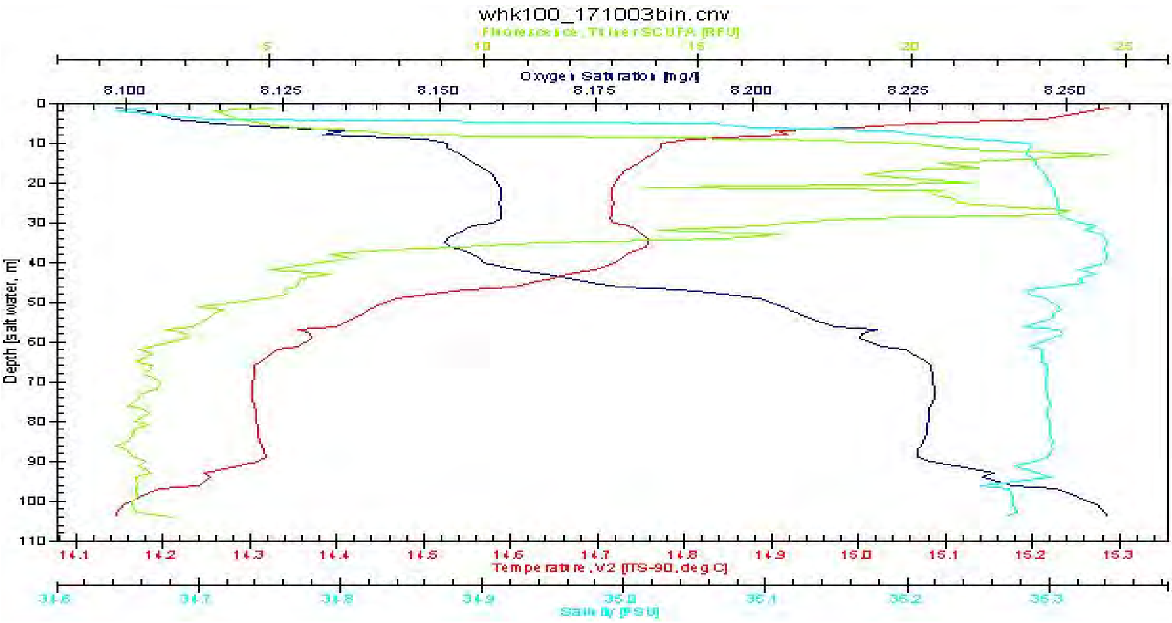

Opo50_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

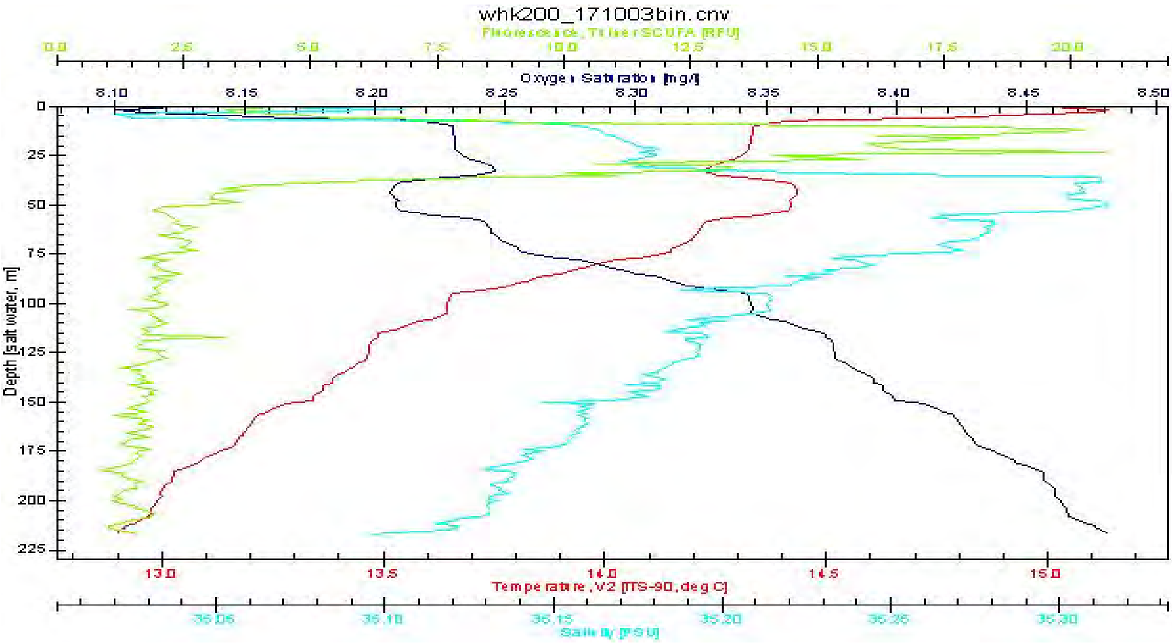

whk10_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

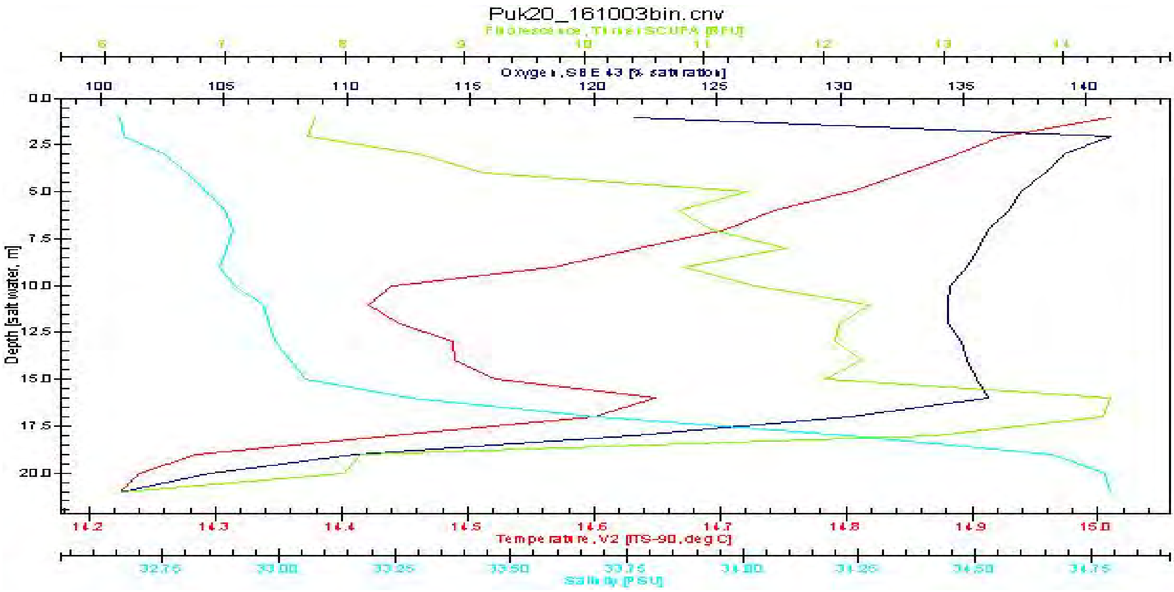

whk20_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

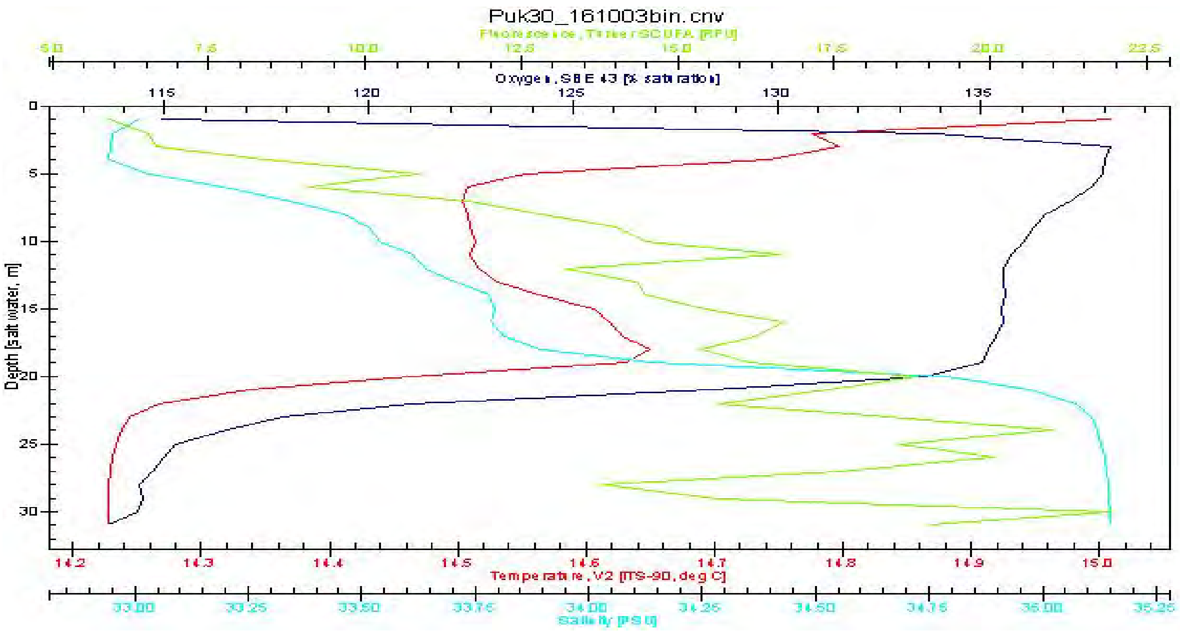

whk30_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

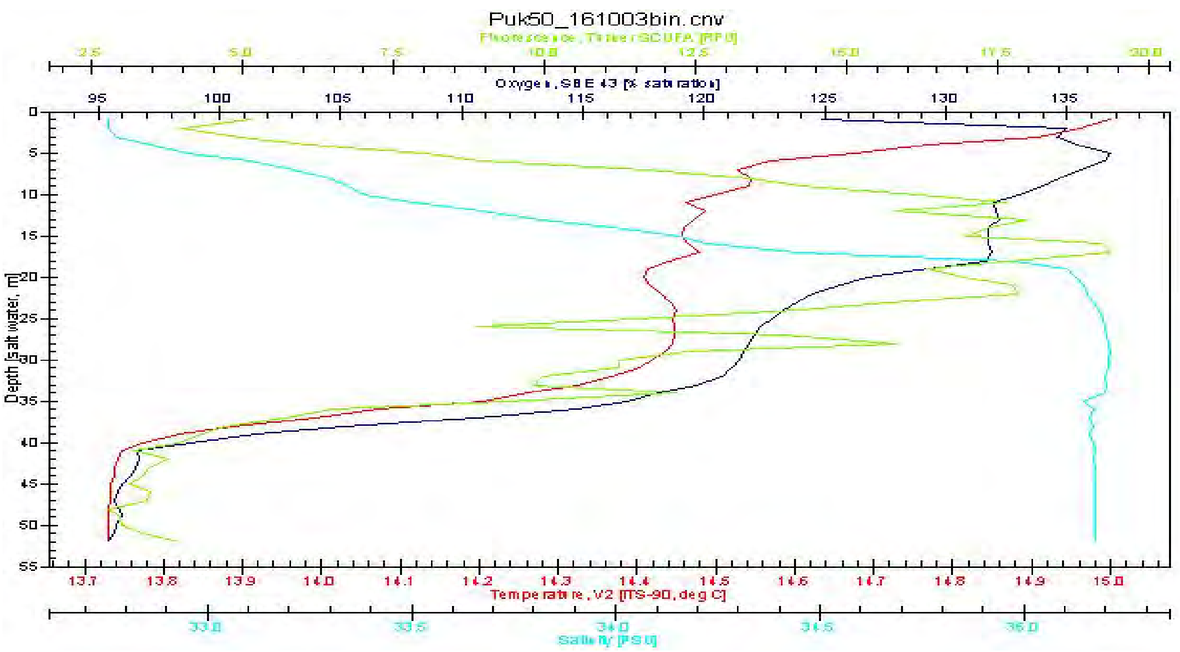

whk50_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen Saturation [mg/l]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

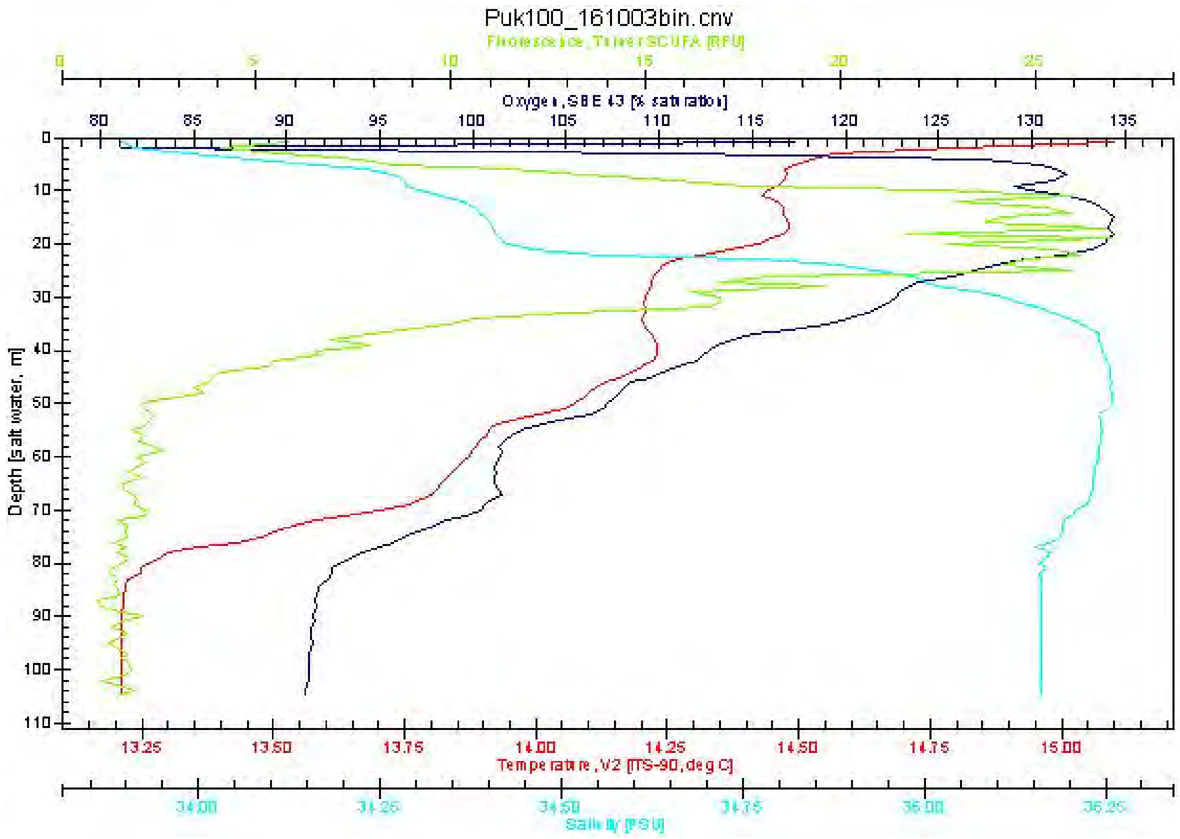

whk100_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen Saturation [mg/l]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


whk200_171003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen Saturation [mg/l]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

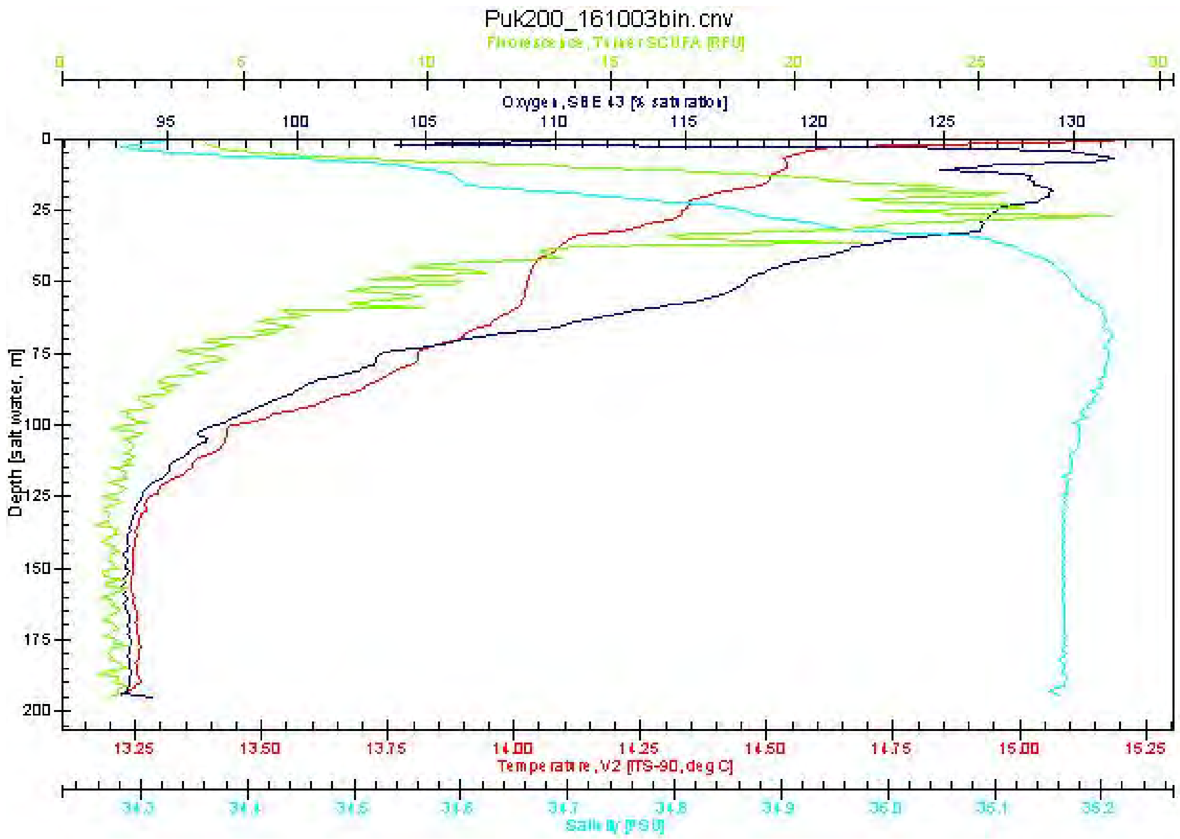

Puk20_161003bin.cnv
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


Puk30_161003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

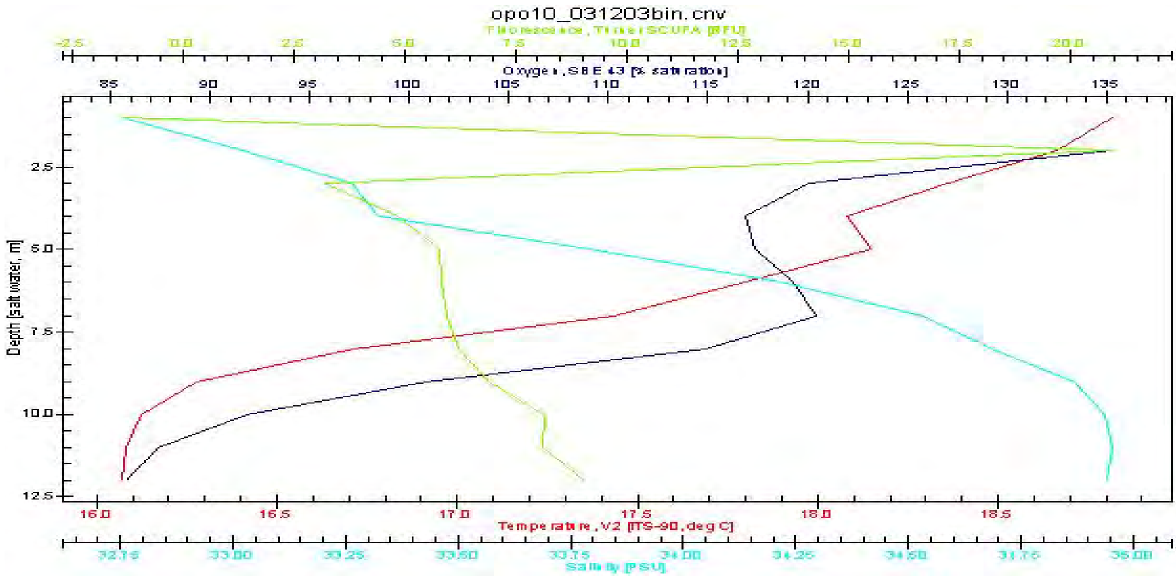

Puk50_161003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

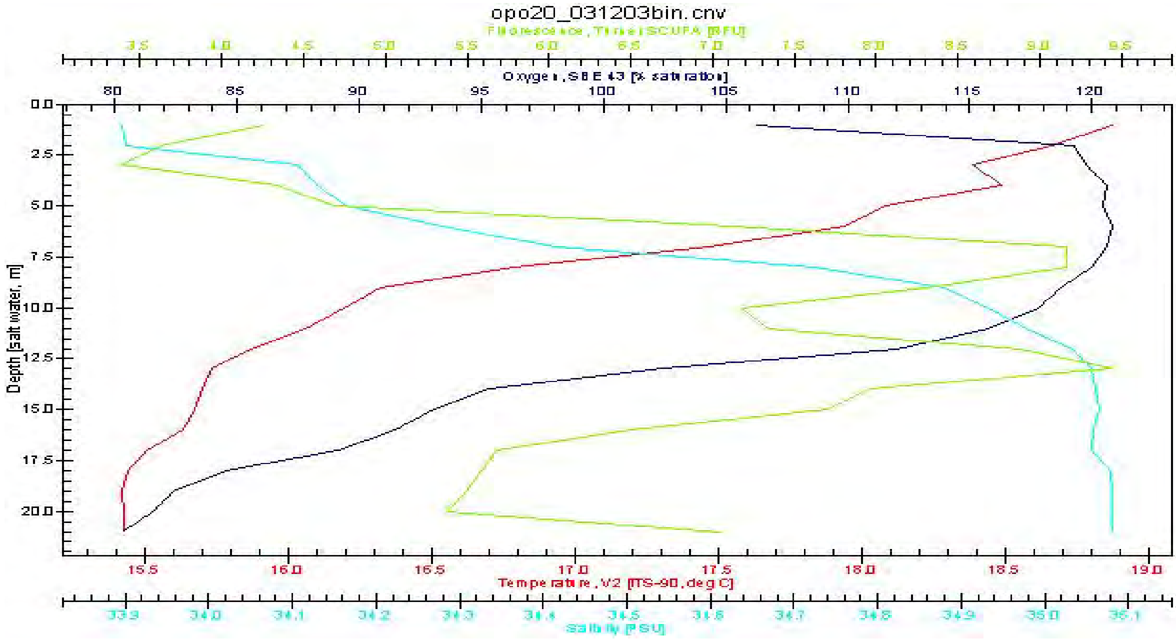


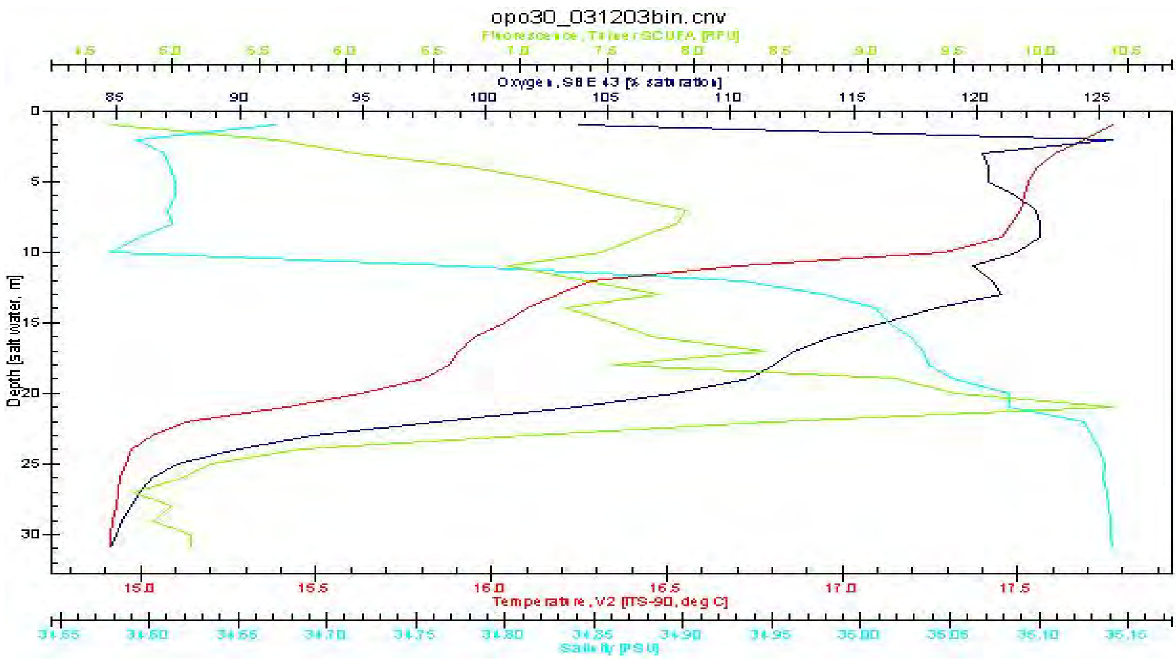
Puk100_161003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

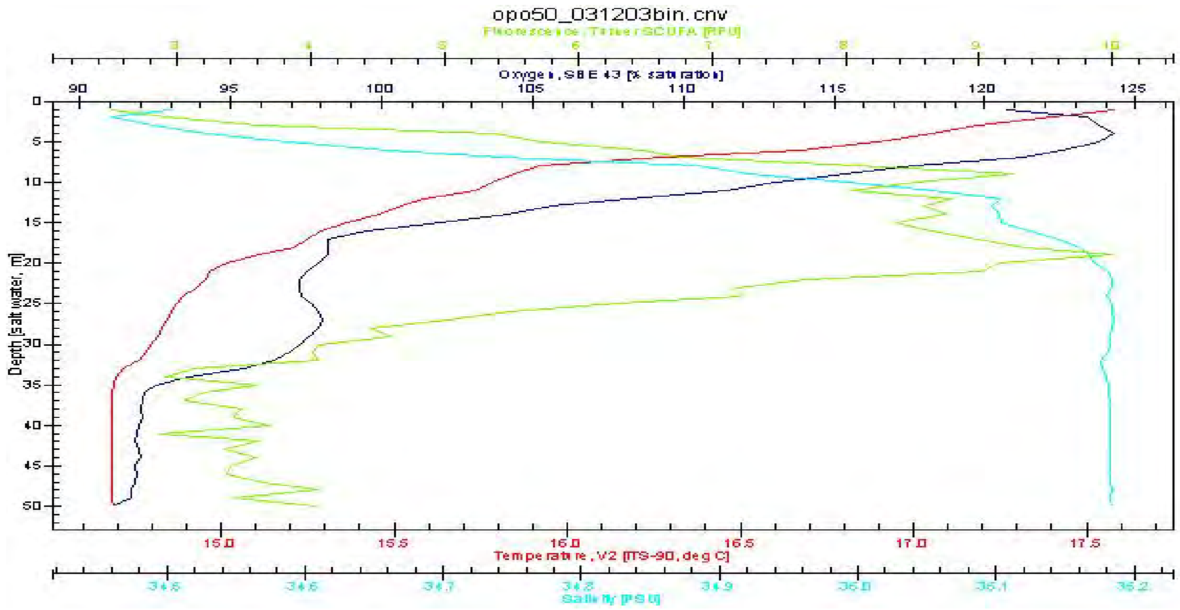


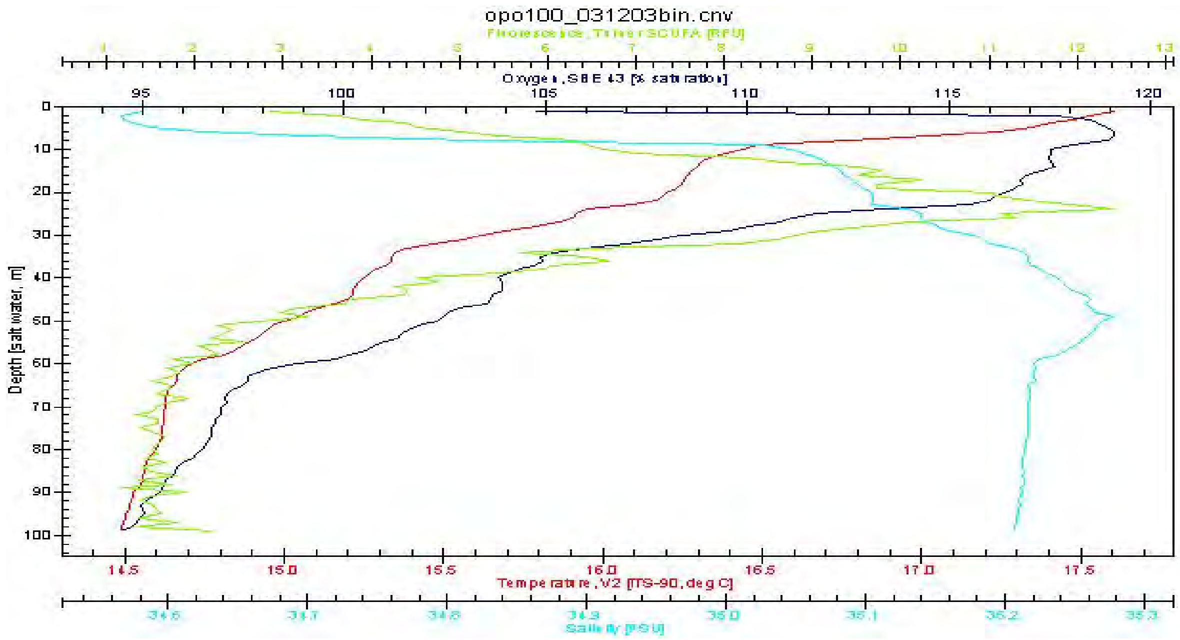
Puk200_161003bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

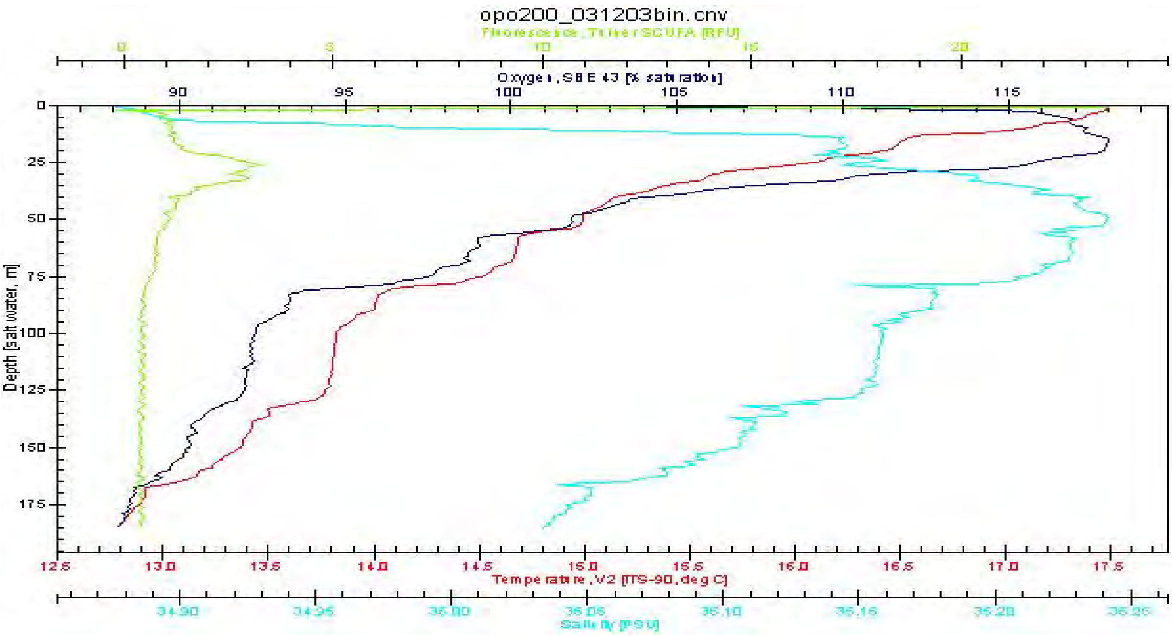

opo10_031203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

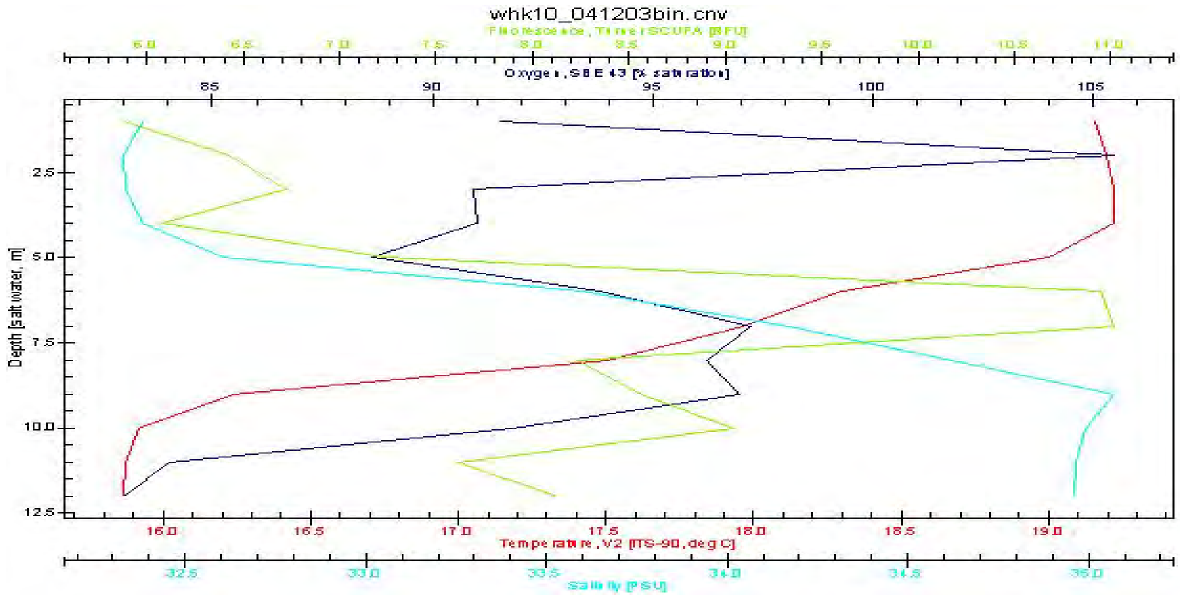

opo20_031203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

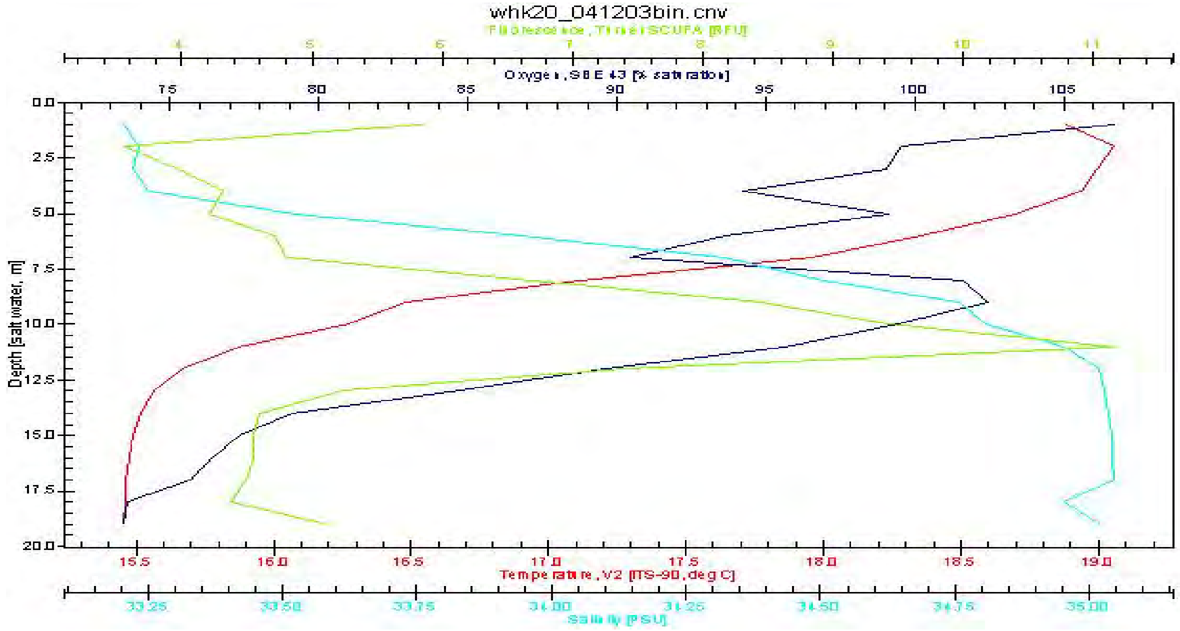

opo30_031203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

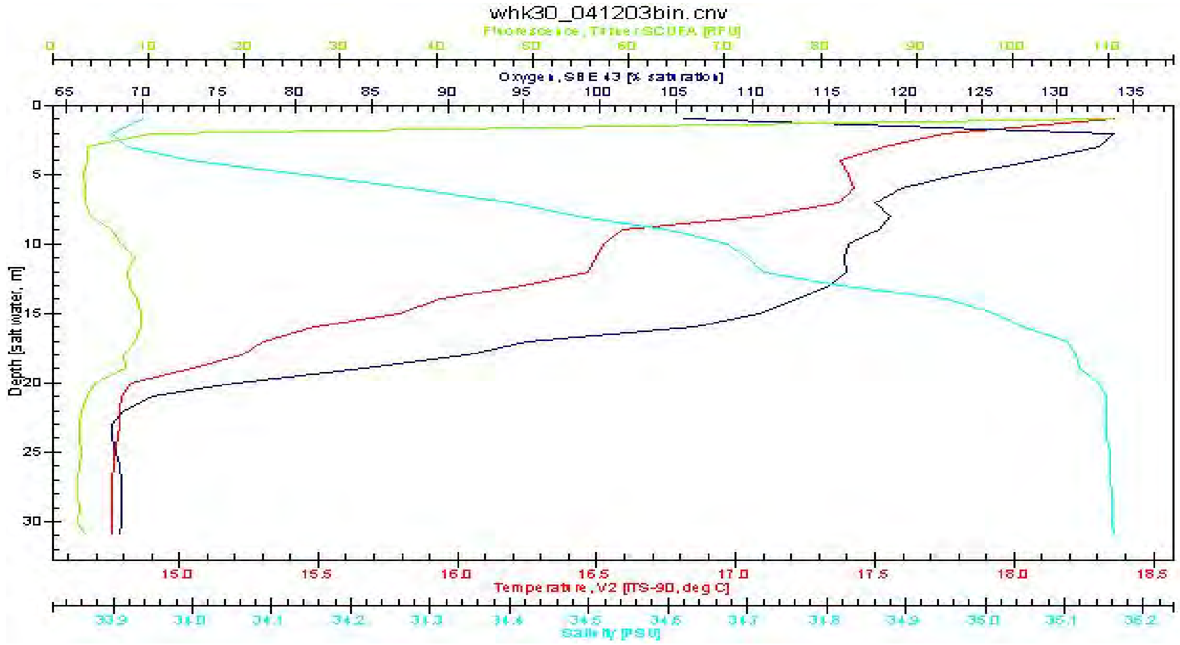

opo50_031203bin.cnv
Fluorescence, Turner SCUFA [RFU]
3 4 5 6 7 8 9 10
Oxygen, SBE 43 [% saturation]
90 95 100 105 110 115 120 125
Depth [salt water, m]
0 5 10 15 20 25 30 35 40 45 50
15.0 15.5 16.0 16.5 17.0 17.5
Temperature, V2 [ITS-90, deg C]
34.5 34.6 34.7 34.8 34.9 35.0 35.1 35.2
Salinity [PSU]

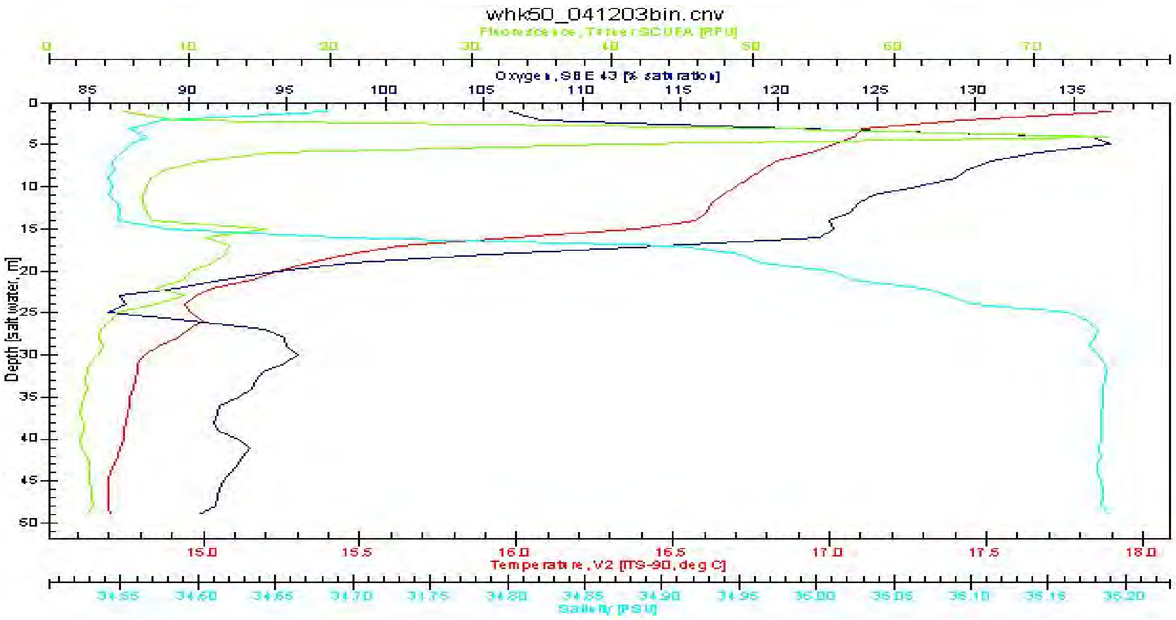

opo100_031203bin.cnv
Fluorescence, Turner SCUFA [RFU]
1 2 3 4 5 6 7 8 9 10 11 12 13
Oxygen, SBE 43 [% saturation]
95 100 105 110 115 120
Depth [salt water, m]
0 10 20 30 40 50 60 70 80 90 100
14.5 15.0 15.5 16.0 16.5 17.0 17.5
Temperature, V2 [ITS-90, deg C]
34.6 34.7 34.8 34.9 35.0 35.1 35.2 35.3
Salinity [PSU]

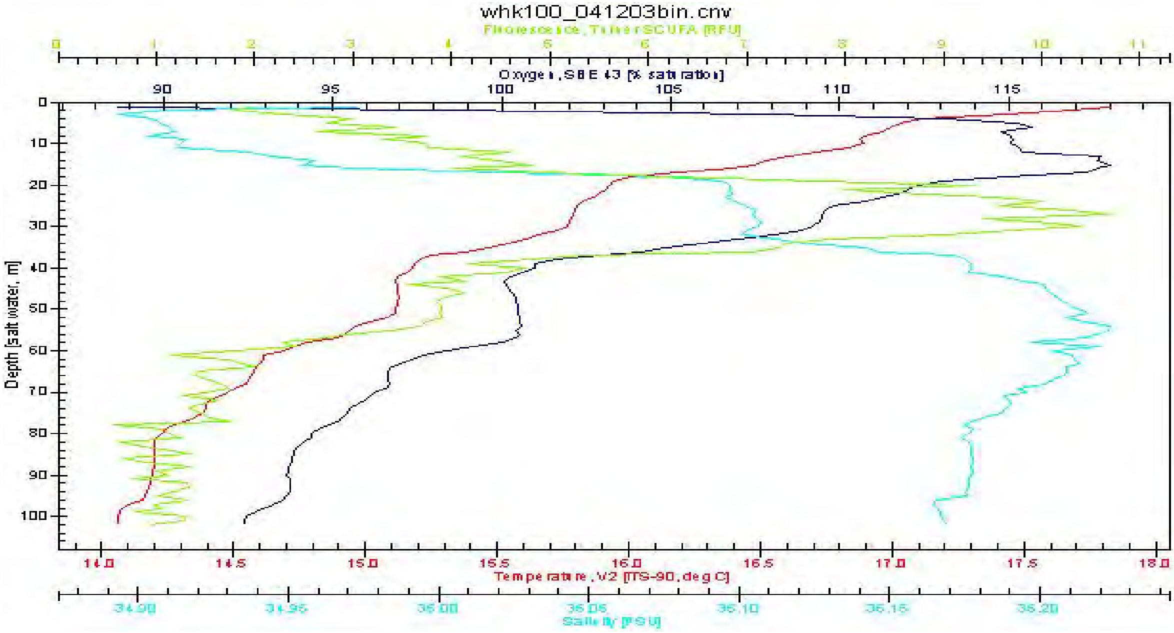

opo200_031203bin.cnv
Oxygen, SBE 43 [% saturation]
90 95 100 105 110 115
Depth [salt water, m]
0 25 50 75 100 125 150 175
12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

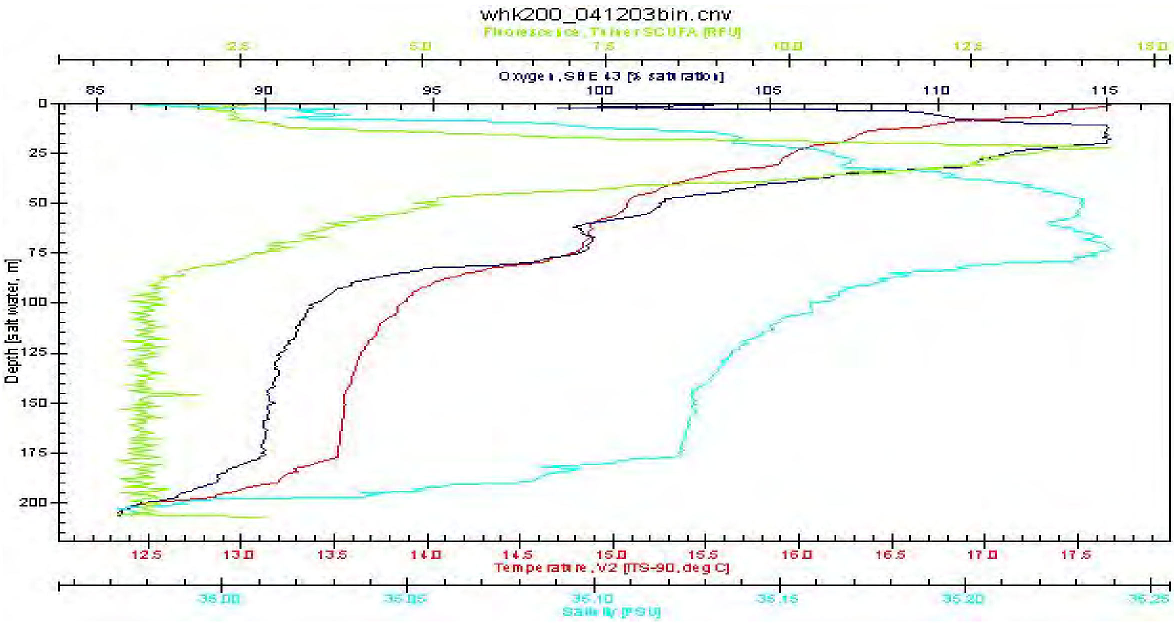

whk10_041203bin.cnv
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

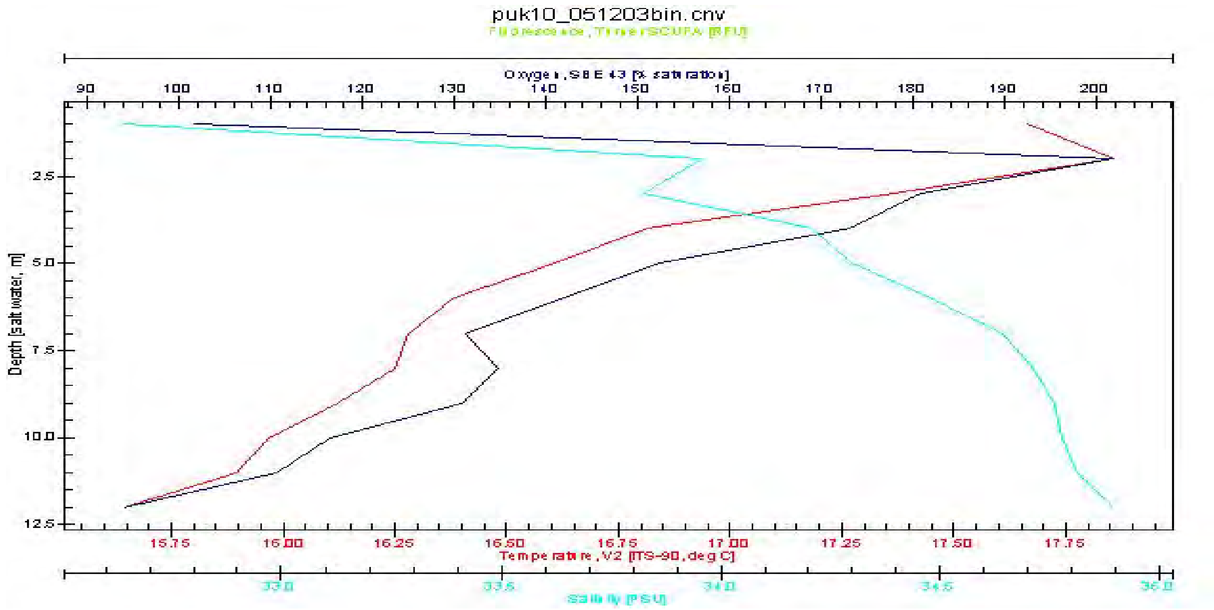

whk20_041203bin.cnv
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

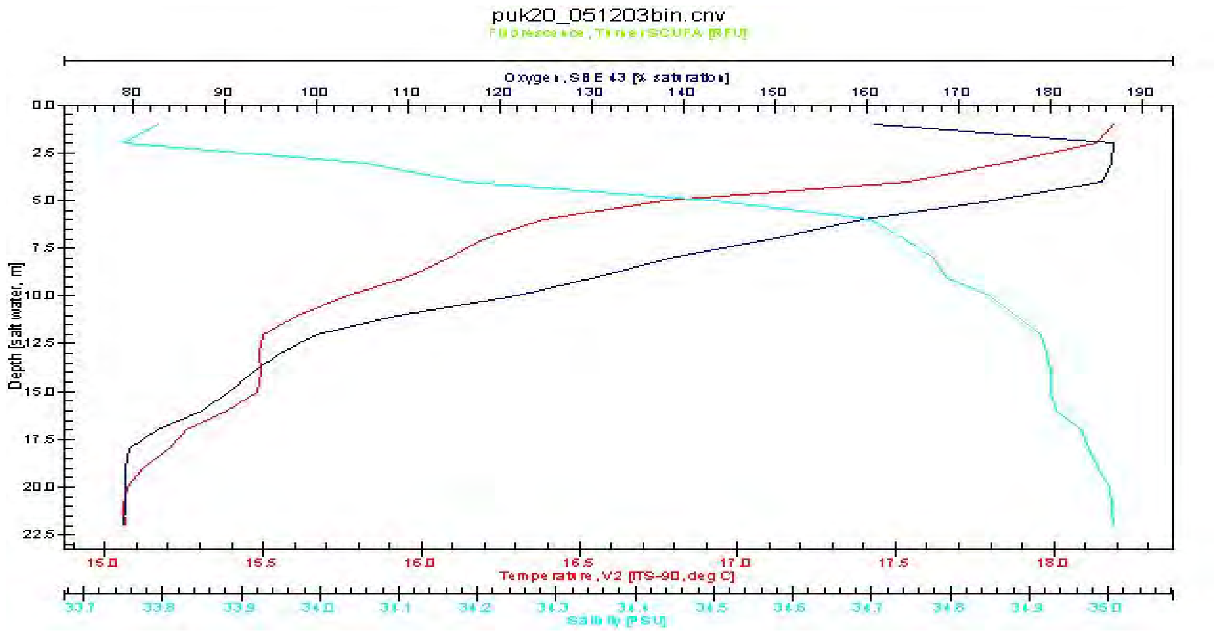

whk30_041203bin.cnv
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

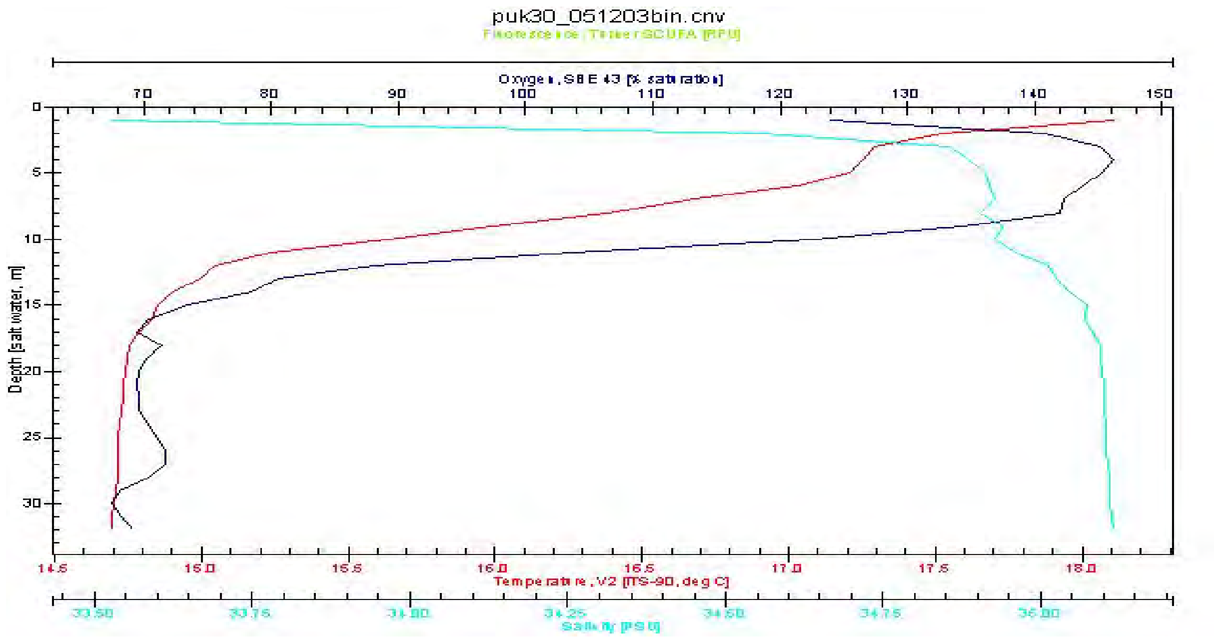

whk50_041203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

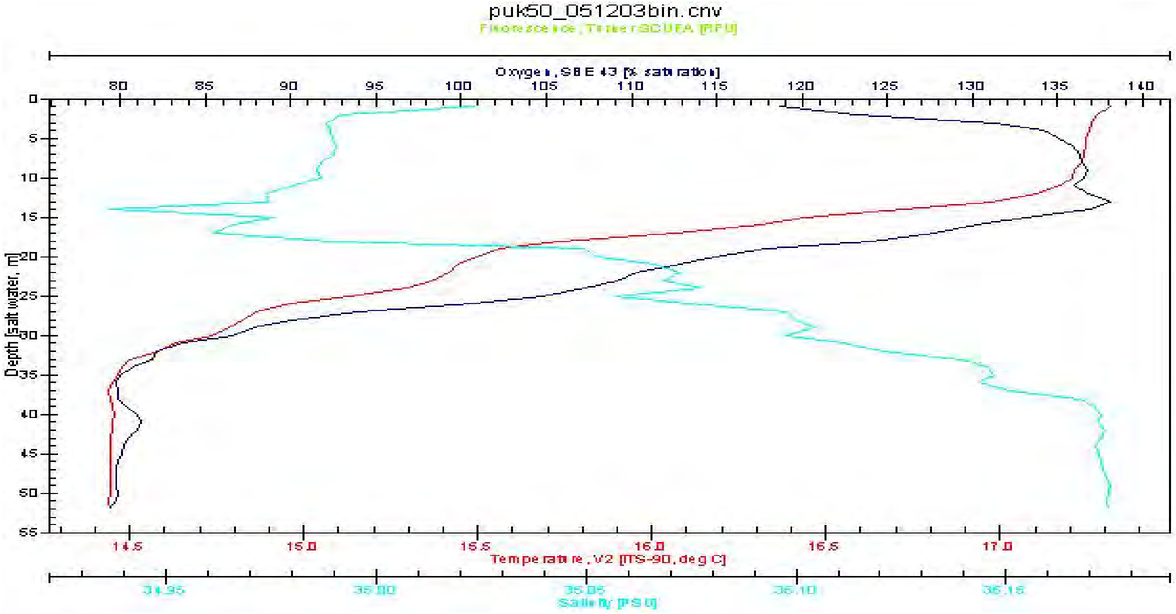

whk100_041203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


whk200_041203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

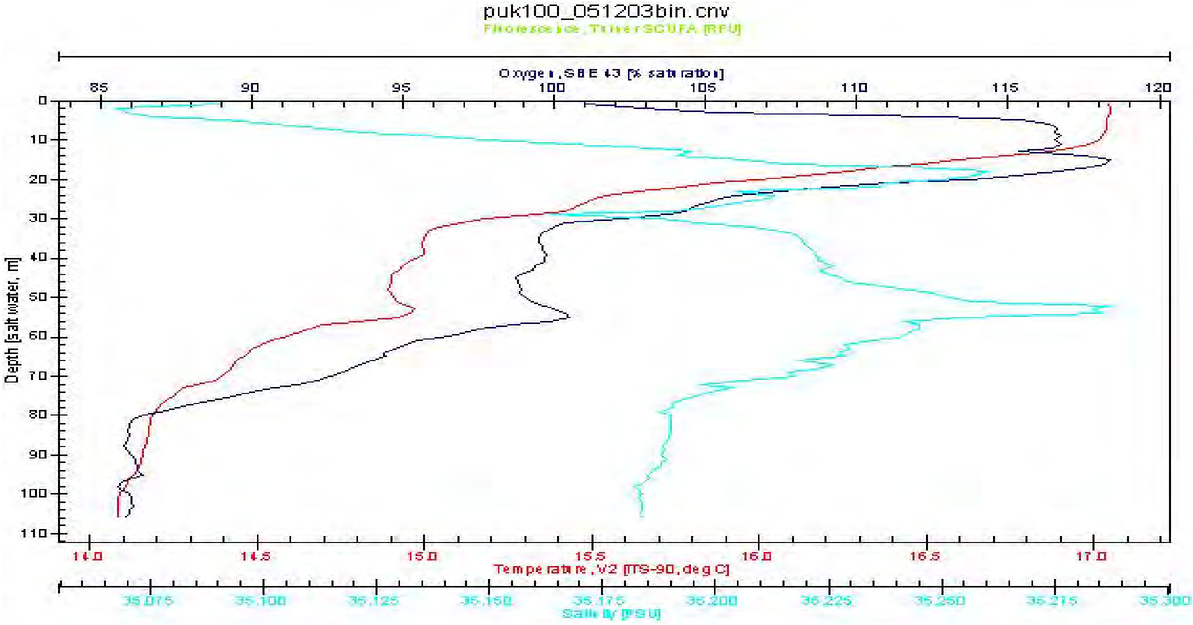

puk10_051203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
90 100 110 120 130 140 150 160 170 180 190 200
Depth [salt water, m]
2.5 5.0 7.5 10.0 12.5
15.75 16.00 16.25 16.50 16.75 17.00 17.25 17.50 17.75
Temperature, V2 [ITS-90, deg C]
33.0 33.5 34.0 34.5 35.0
Salinity [PSU]


puk20_051203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
80 90 100 110 120 130 140 150 160 170 180 190
Depth [salt water, m]
0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
15.0 15.5 16.0 16.5 17.0 17.5 18.0
Temperature, V2 [ITS-90, deg C]
33.7 33.8 33.9 34.0 34.1 34.2 34.3 34.4 34.5 34.6 34.7 34.8 34.9 35.0
Salinity [PSU]

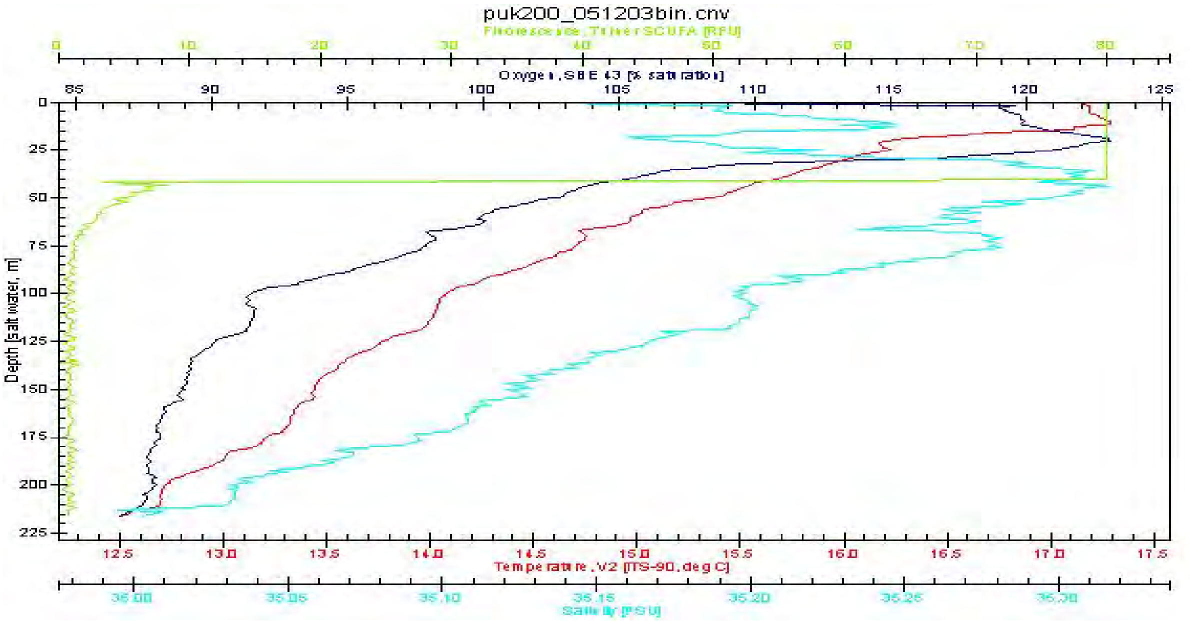

puk30_051203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
70 80 90 100 110 120 130 140 150
Depth [salt water, m]
0 5 10 15 20 25 30
14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0
Temperature, V2 [ITS-90, deg C]
33.50 33.75 34.00 34.25 34.50 34.75 35.00
Salinity [PSU]



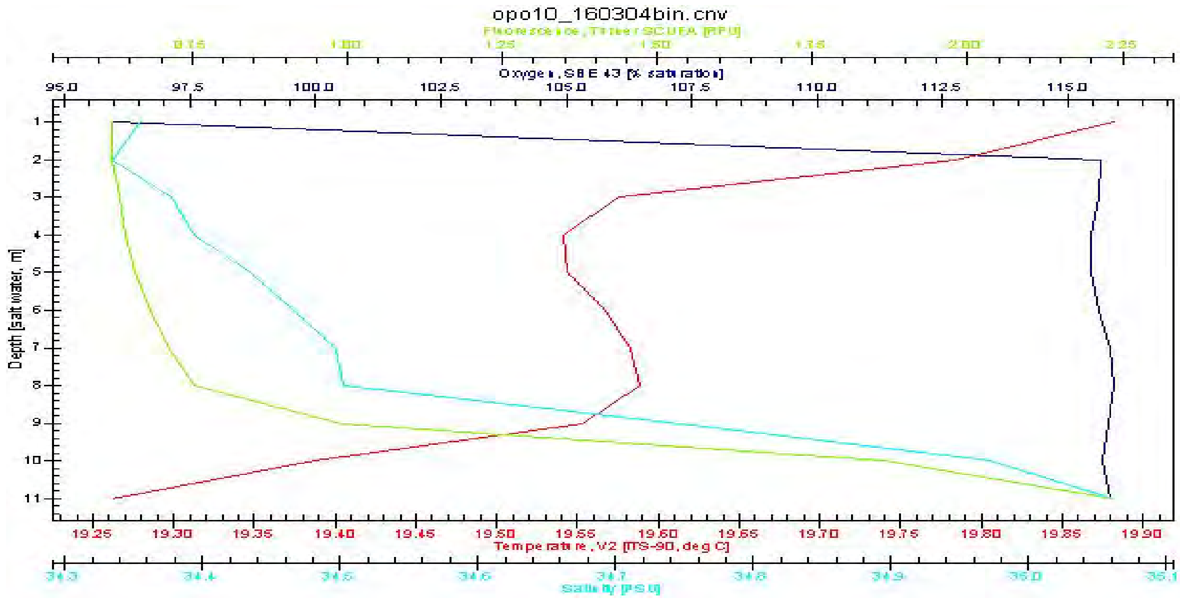
puk50_051203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]



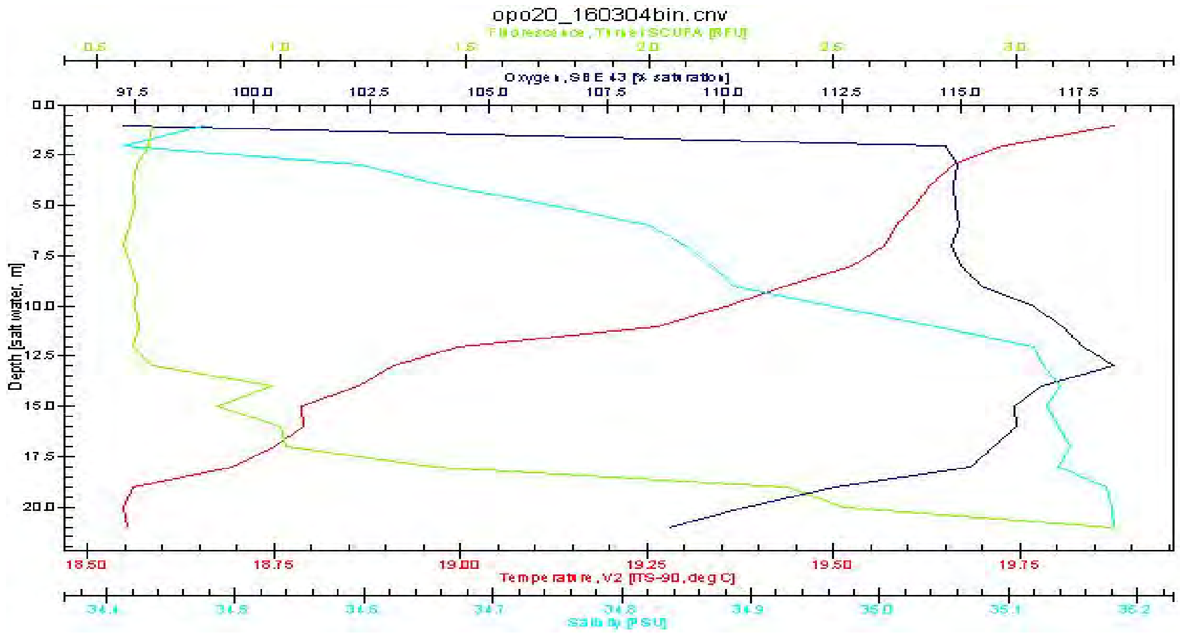
puk100_051203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]



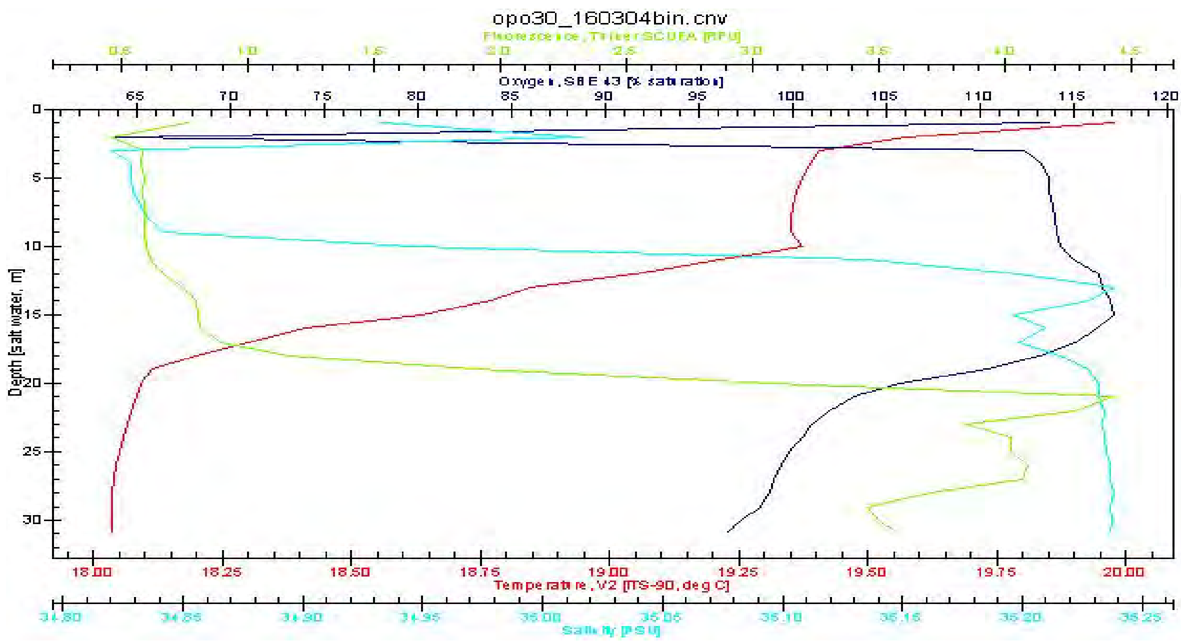
puk200_051203bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]



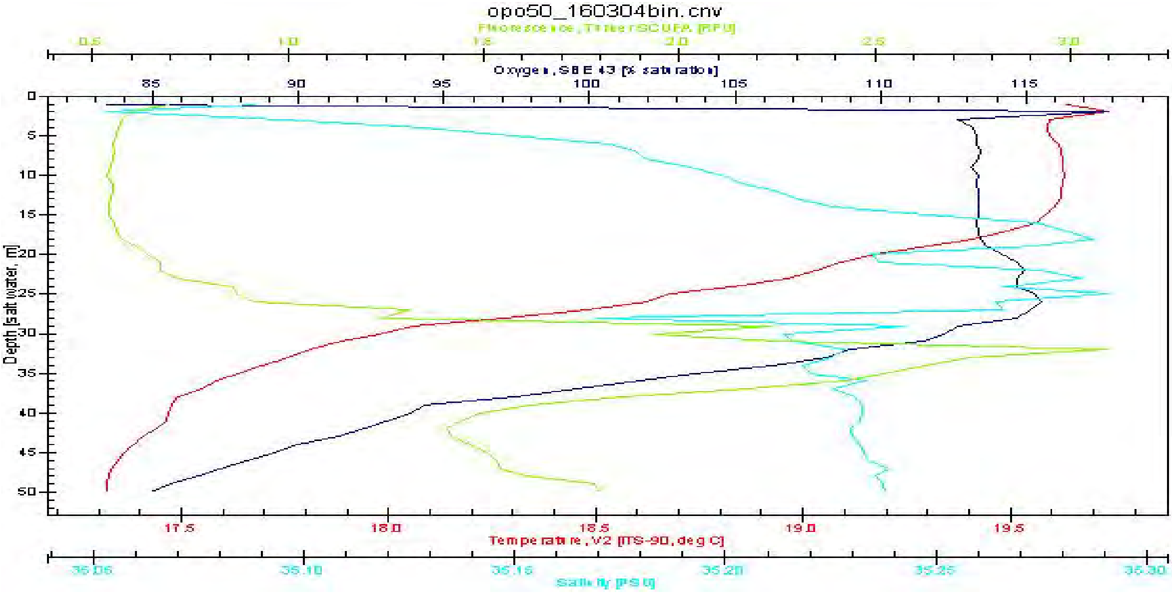
opo10_160304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
95.0 97.5 100.0 102.5 105.0 107.5 110.0 112.5 115.0
Depth [salt water, m]
1 2 3 4 5 6 7 8 9 10 11
19.25 19.30 19.35 19.40 19.45 19.50 19.55 19.60 19.65 19.70 19.75 19.80 19.85 19.90
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

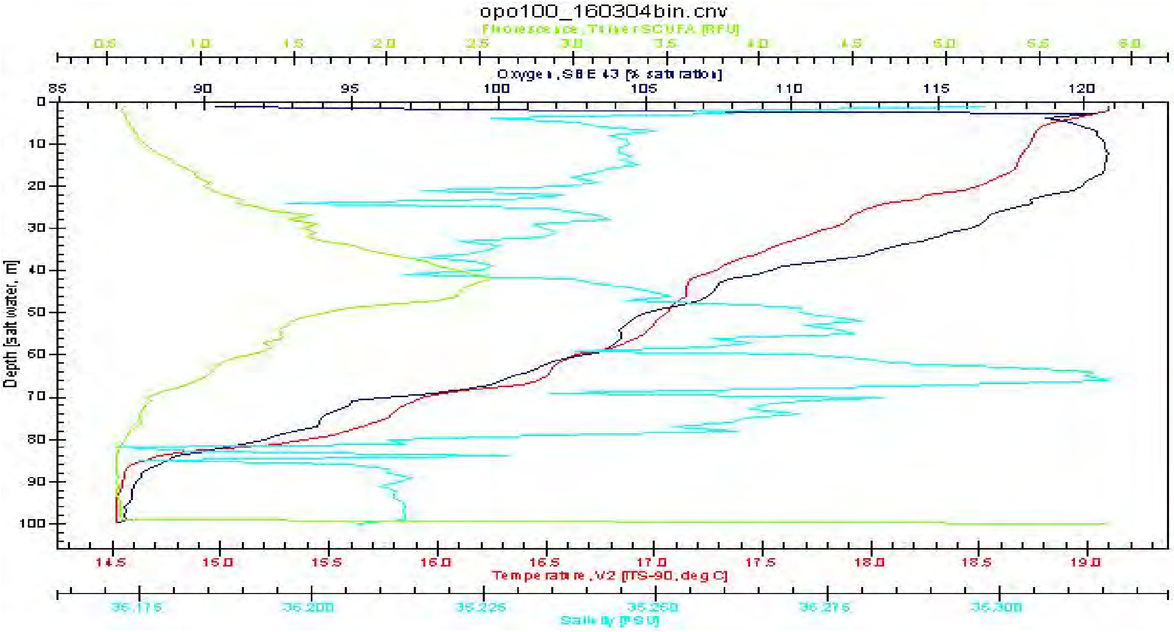


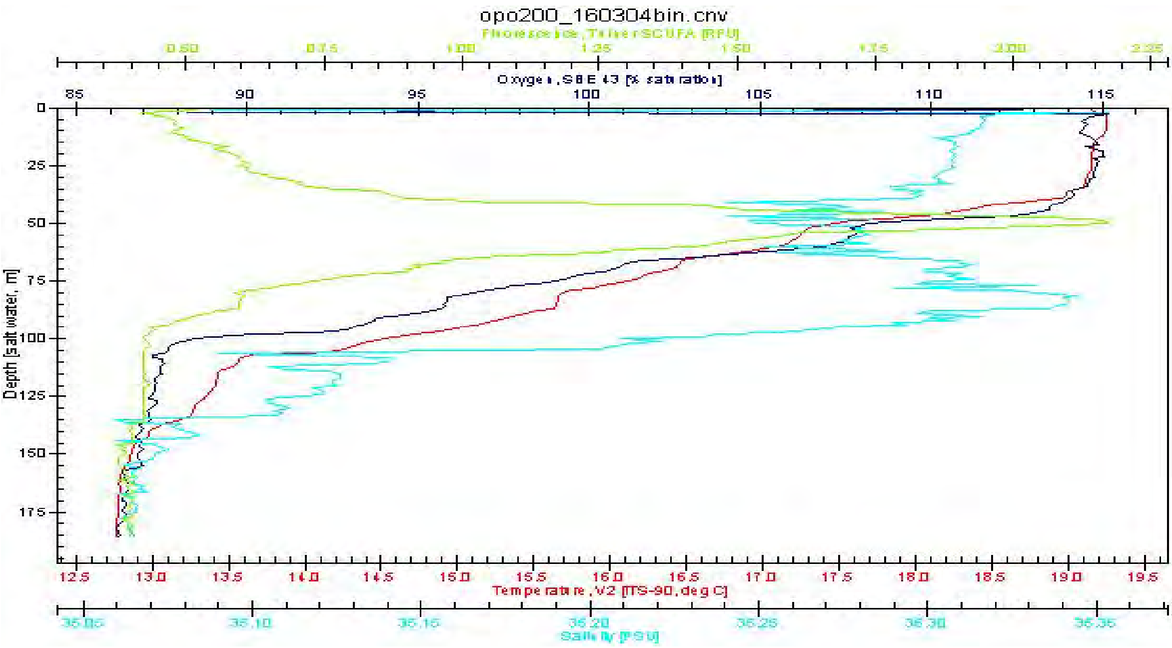
opo20_160304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
97.5 100.0 102.5 105.0 107.5 110.0 112.5 115.0 117.5
Depth [salt water, m]
0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0
18.50 18.75 19.00 19.25 19.50 19.75
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

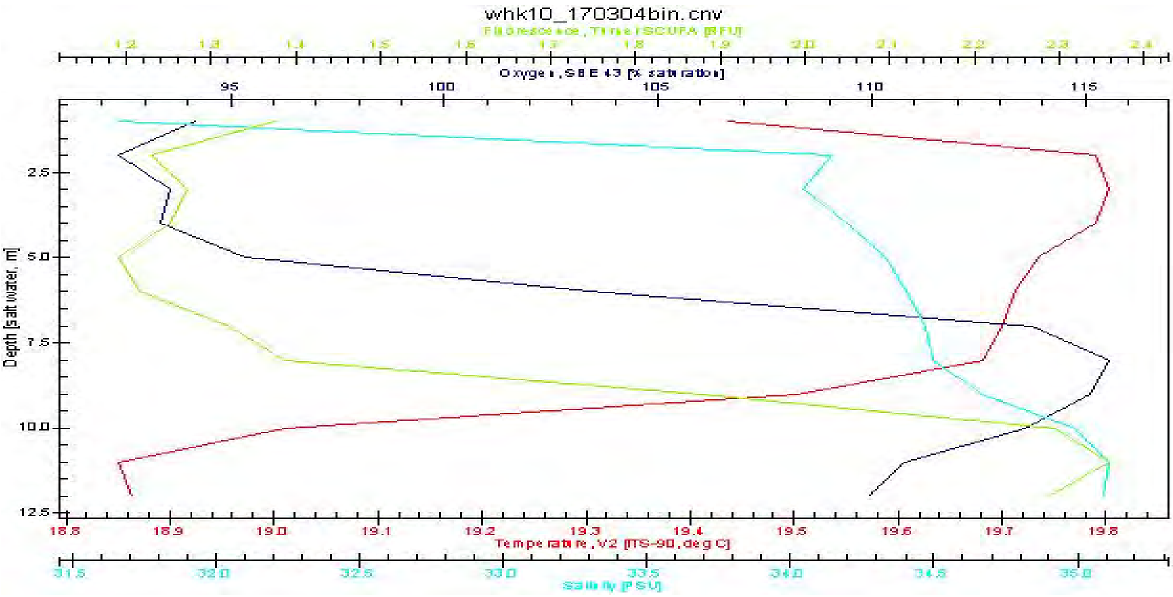


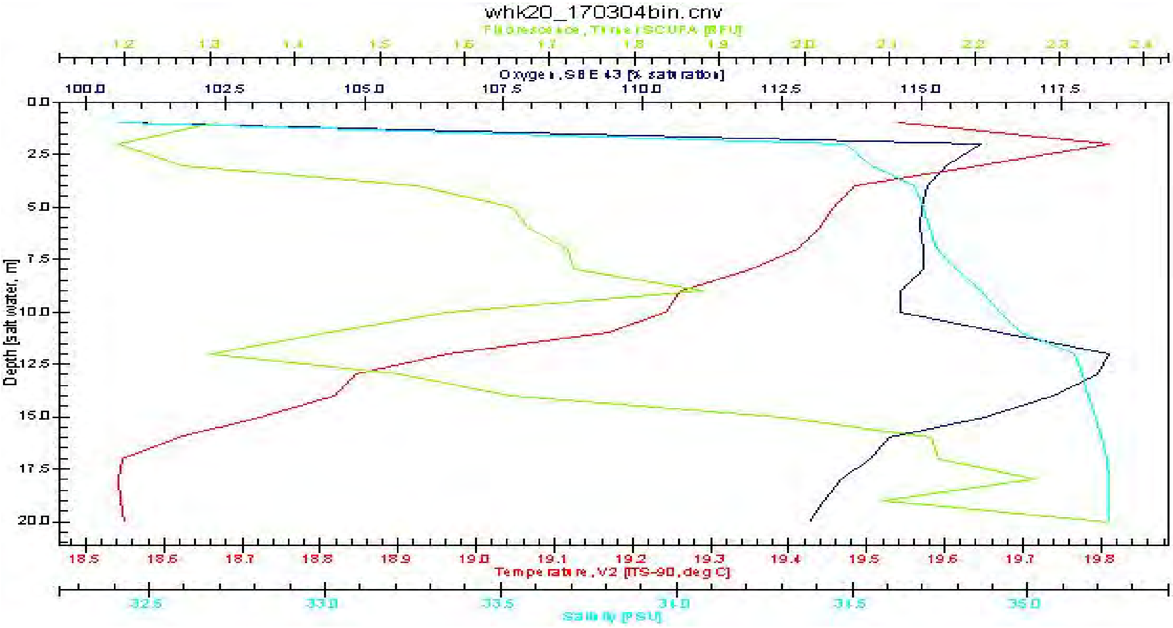
opo30_160304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
65 70 75 80 85 90 95 100 105 110 115 120
Depth [salt water, m]
0 5 10 15 20 25 30
18.00 18.25 18.50 18.75 19.00 19.25 19.50 19.75 20.00
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

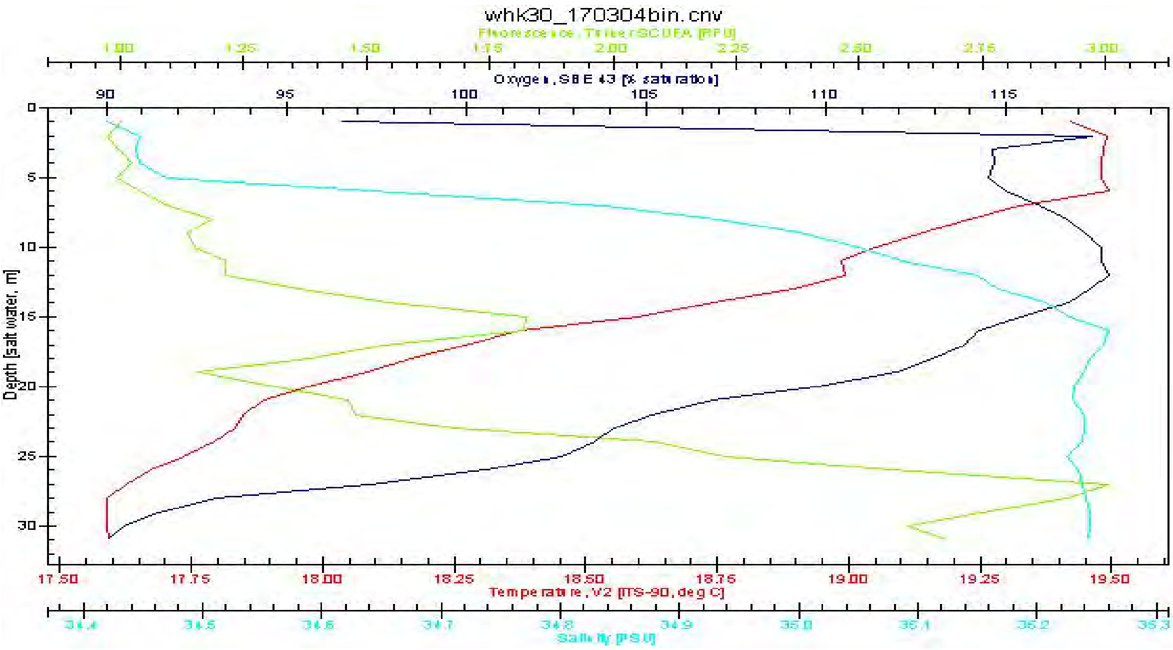

opo50_160304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

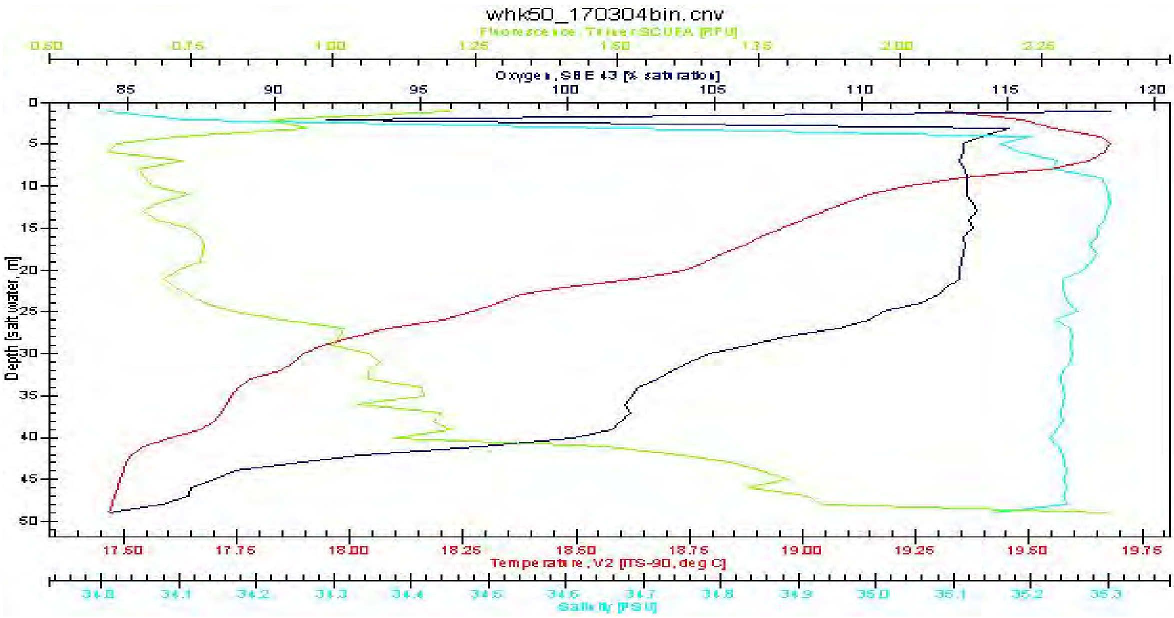

opo100_160304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

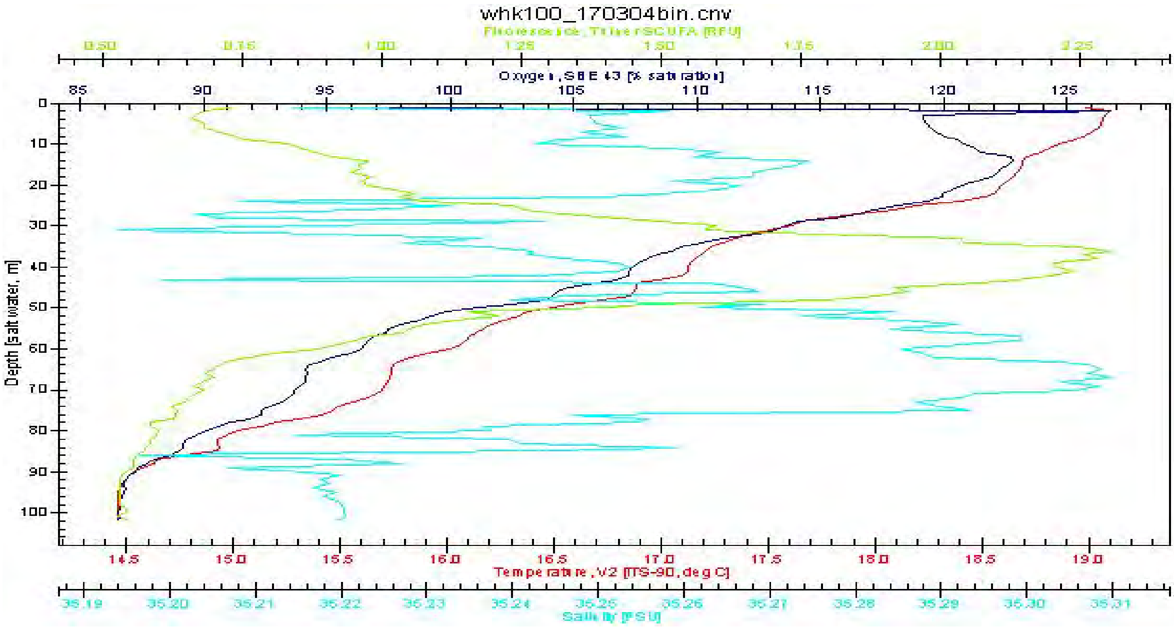

opo200_160304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

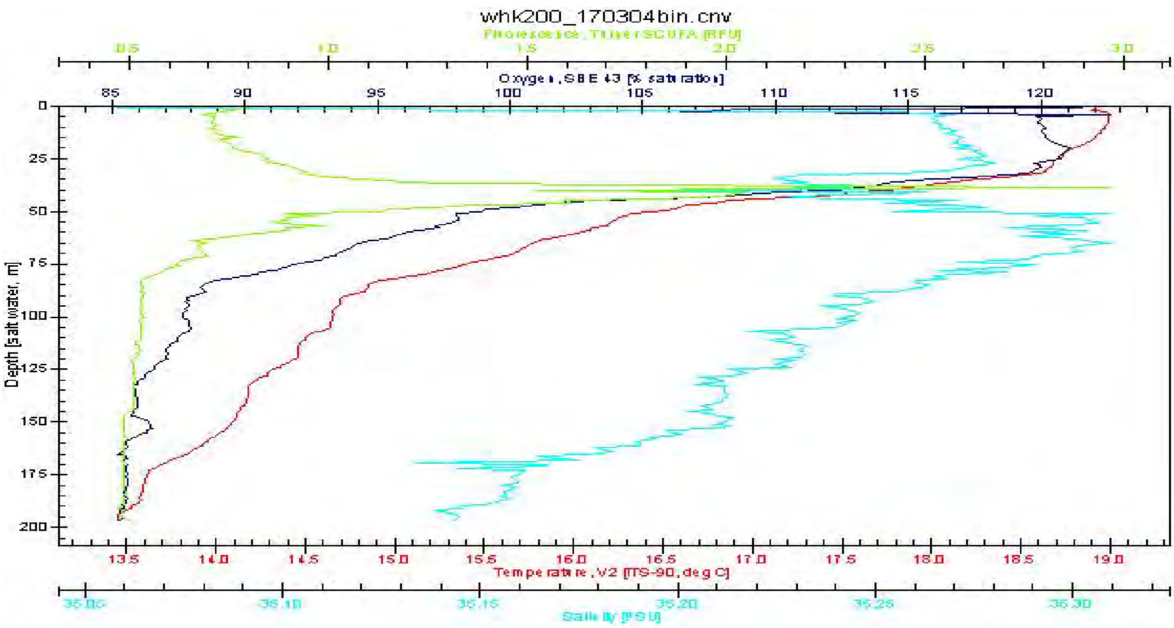

whk10_170304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

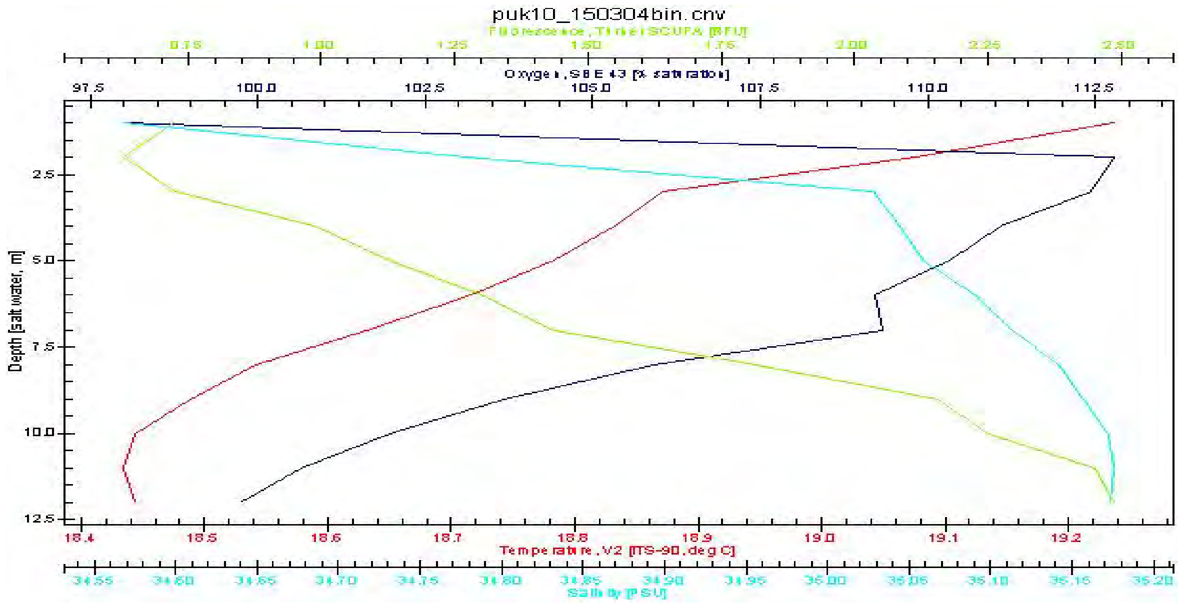

whk20_170304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

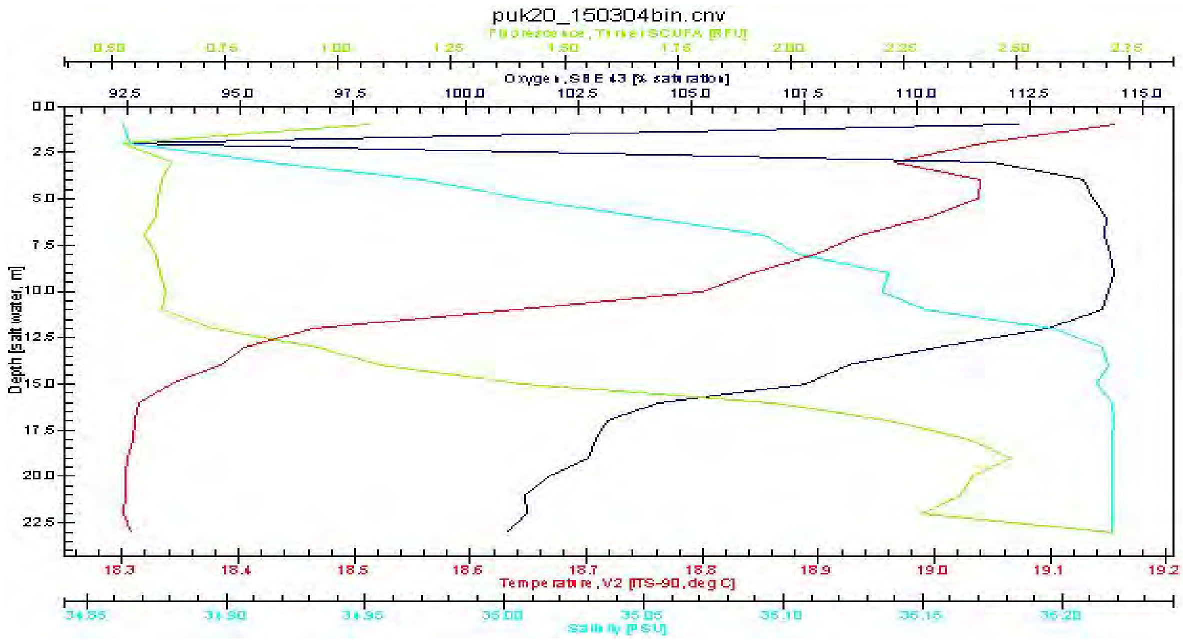

whk30_170304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


whk50_170304bin.cnv
Fluorescence, Turner SCUFA [RFU]
0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25
Oxygen, SBE 43 [% saturation]
85 90 95 100 105 110 115 120
Depth [salt water, m]
0 5 10 15 20 25 30 35 40 45 50
17.50 17.75 18.00 18.25 18.50 18.75 19.00 19.25 19.50 19.75
Temperature, V2 [ITS-90, deg C]
34.0 34.1 34.2 34.3 34.4 34.5 34.6 34.7 34.8 34.9 35.0 35.1 35.2 35.3
Salinity [PSU]


whk100_170304bin.cnv
Fluorescence, Turner SCUFA [RFU]
0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25
Oxygen, SBE 43 [% saturation]
85 90 95 100 105 110 115 120 125
Depth [salt water, m]
0 10 20 30 40 50 60 70 80 90 100
14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0
Temperature, V2 [ITS-90, deg C]
35.19 35.20 35.21 35.22 35.23 35.24 35.25 35.26 35.27 35.28 35.29 35.30 35.31
Salinity [PSU]


whk200_170304bin.cnv
Fluorescence, Turner SCUFA [RFU]
0.5 1.0 1.5 2.0 2.5 3.0
Oxygen, SBE 43 [% saturation]
85 90 95 100 105 110 115 120
Depth [salt water, m]
0 25 50 75 100 125 150 175 200
13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0
Temperature, V2 [ITS-90, deg C]
35.05 35.10 35.15 35.20 35.25 35.30
Salinity [PSU]


puk10_150304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]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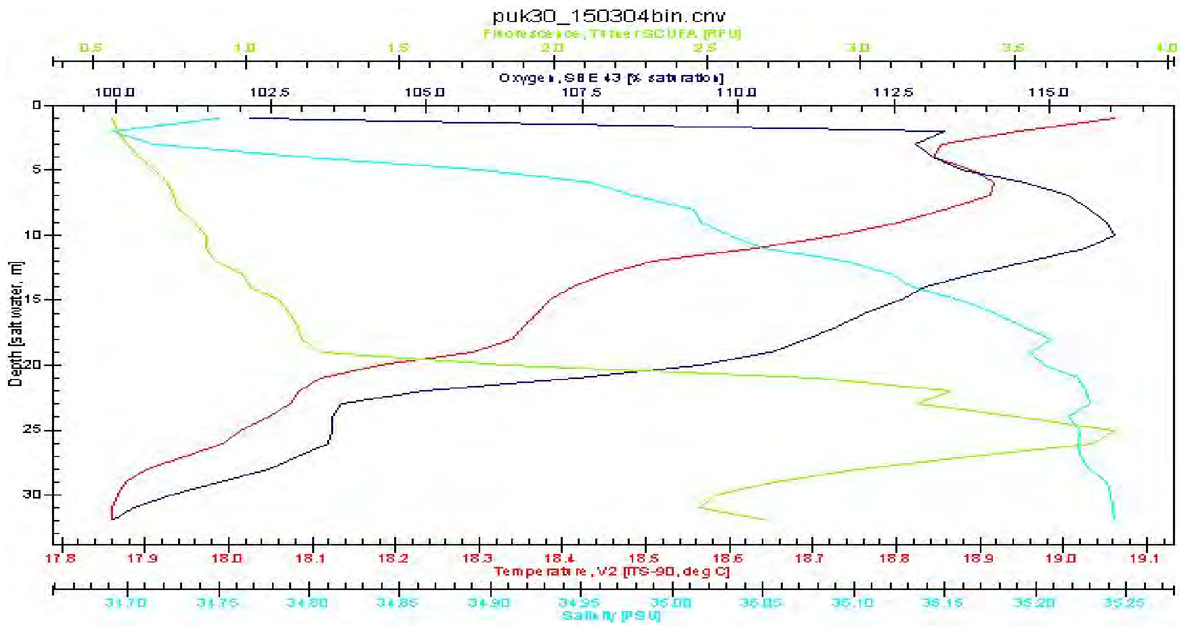
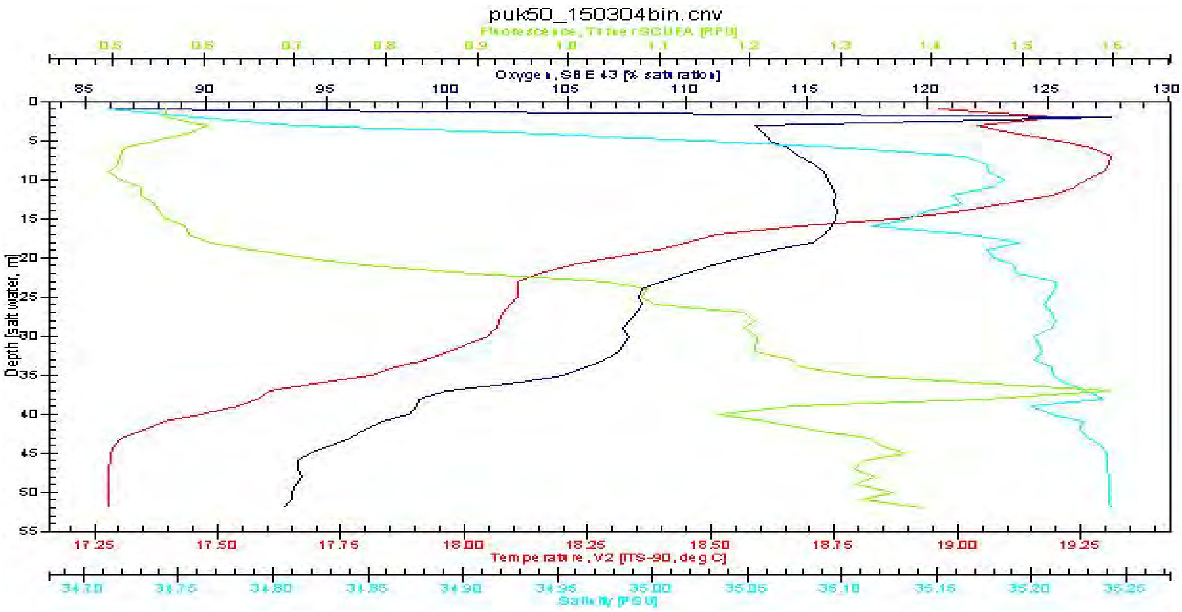
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


puk30_150304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]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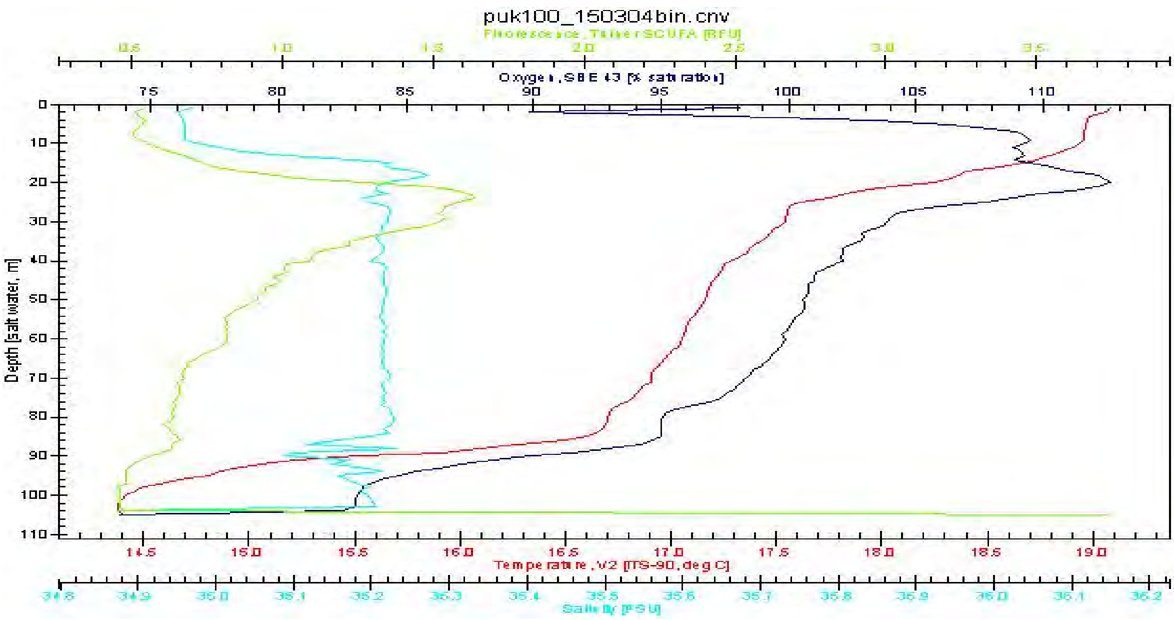
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]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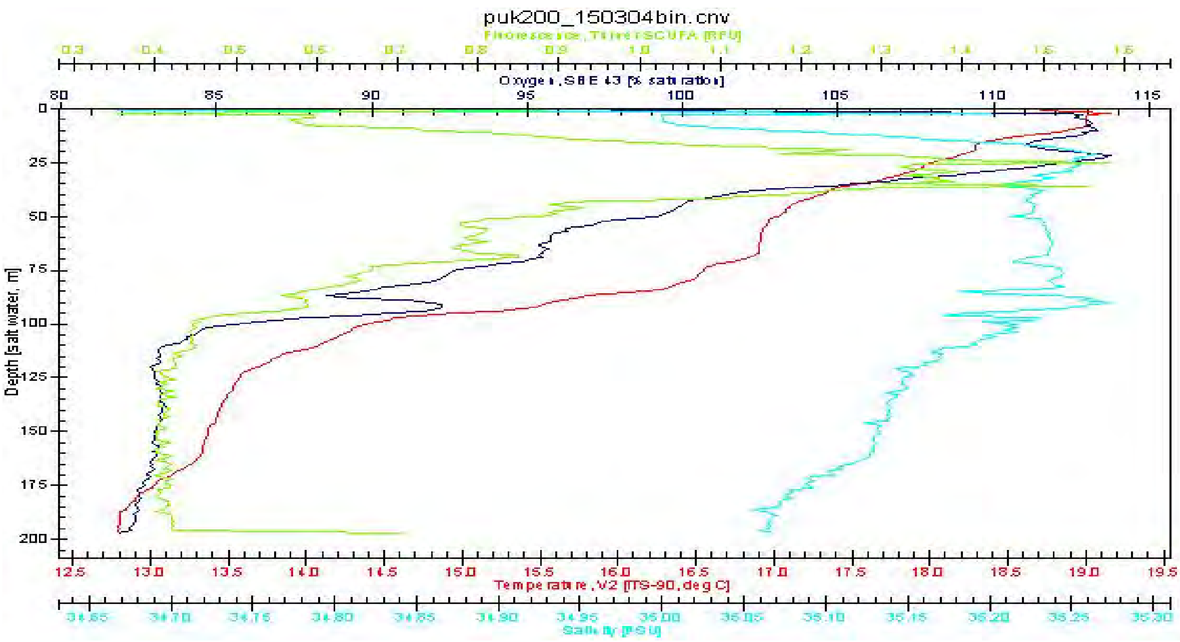
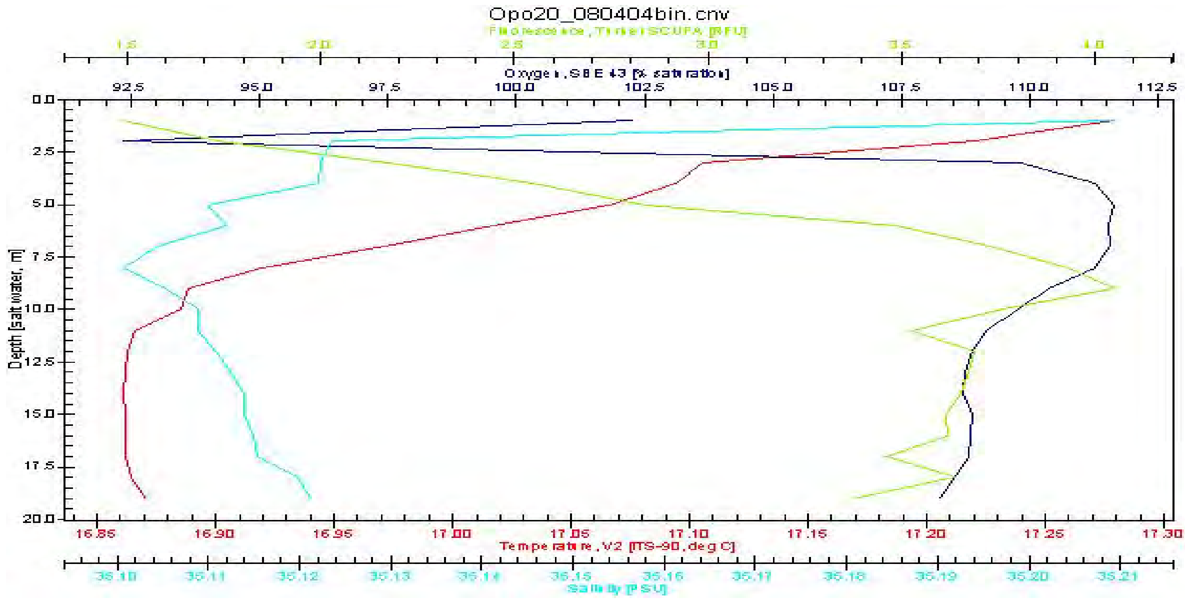
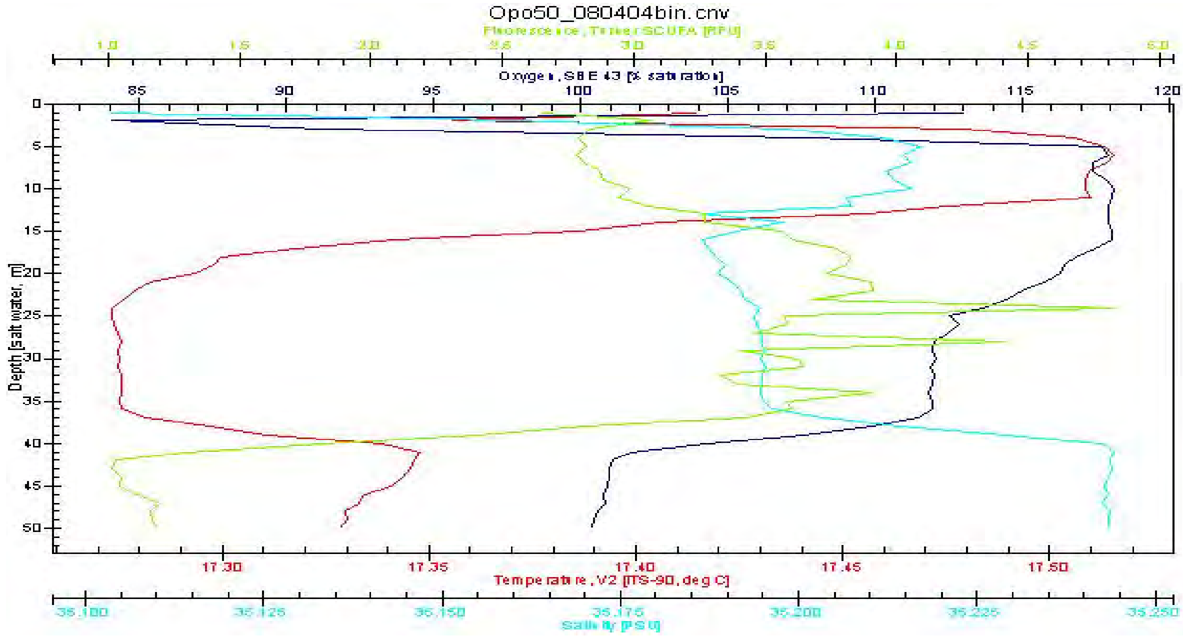
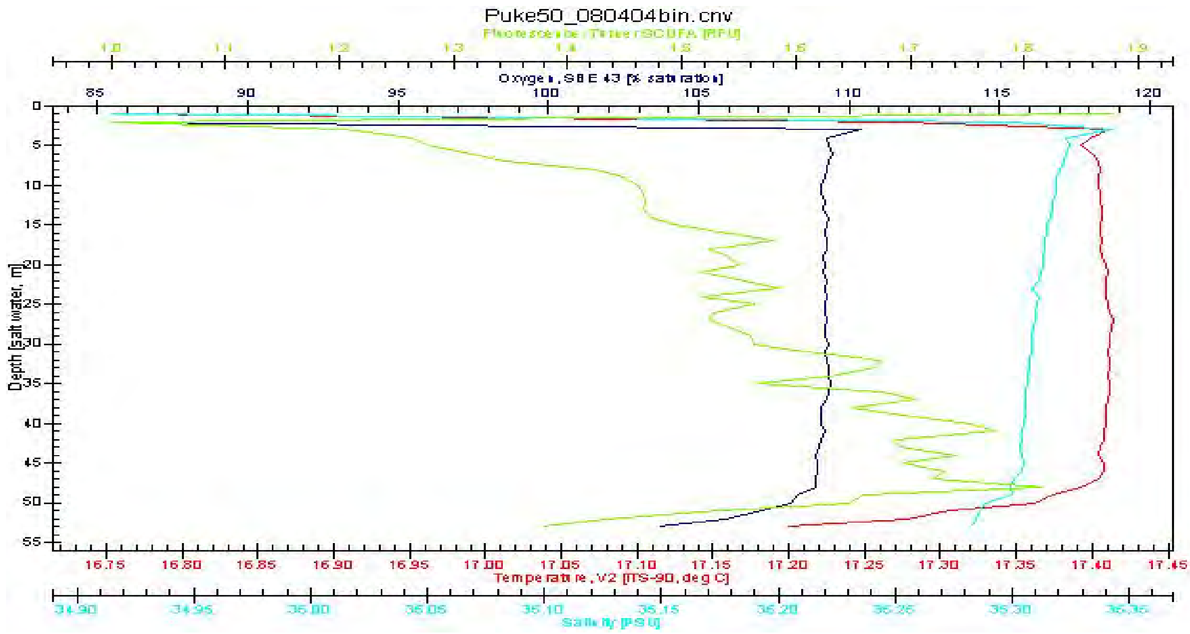
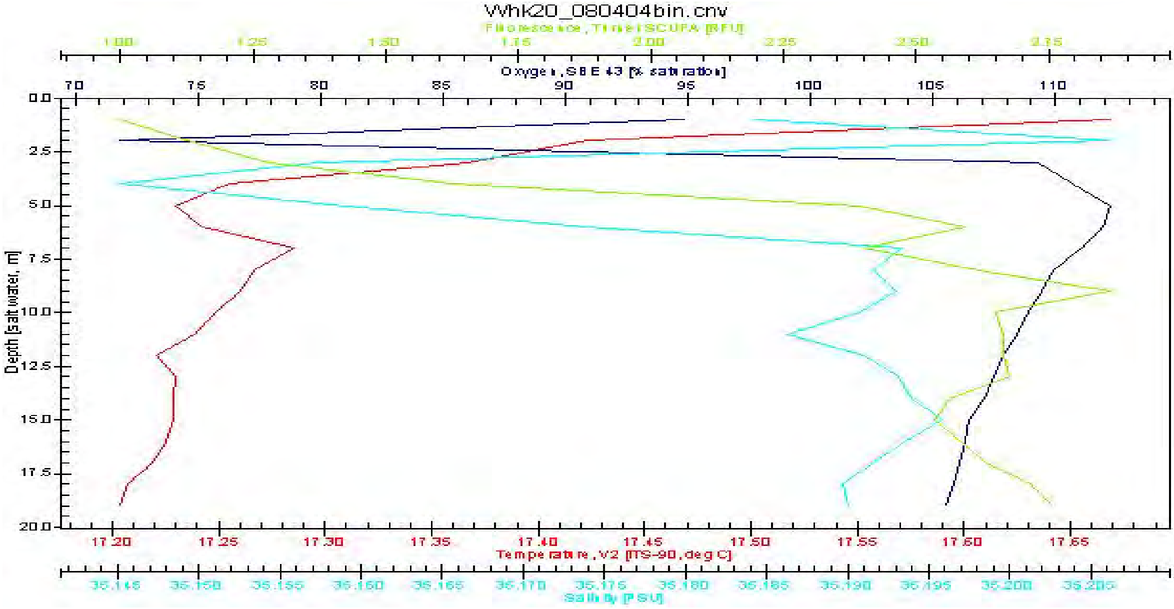
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

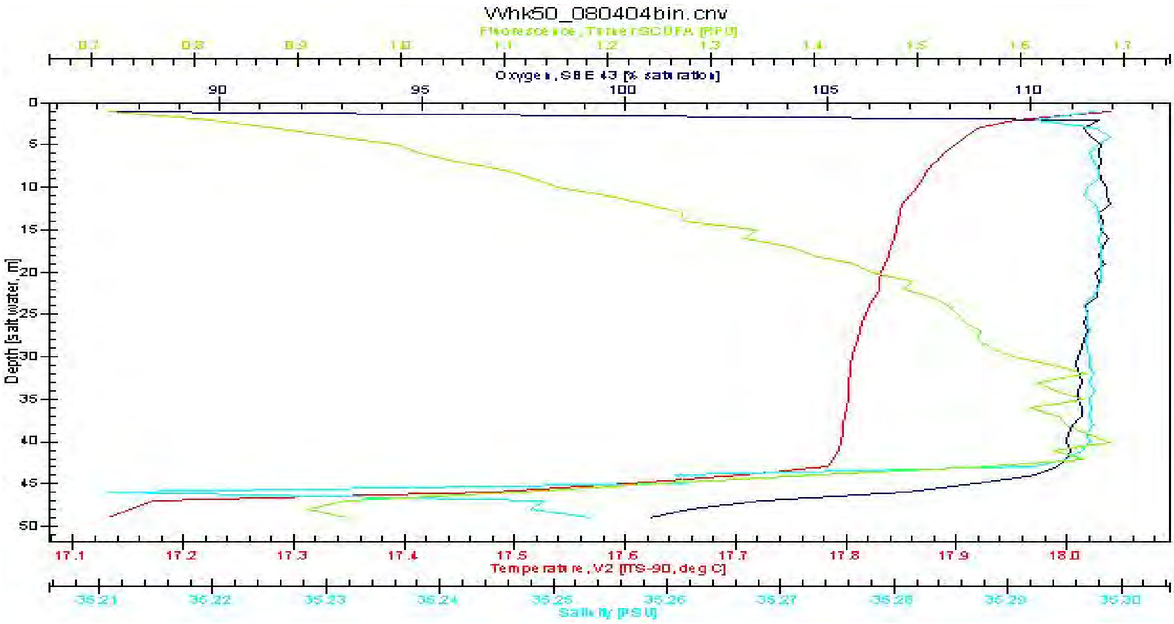

puk200_150304bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

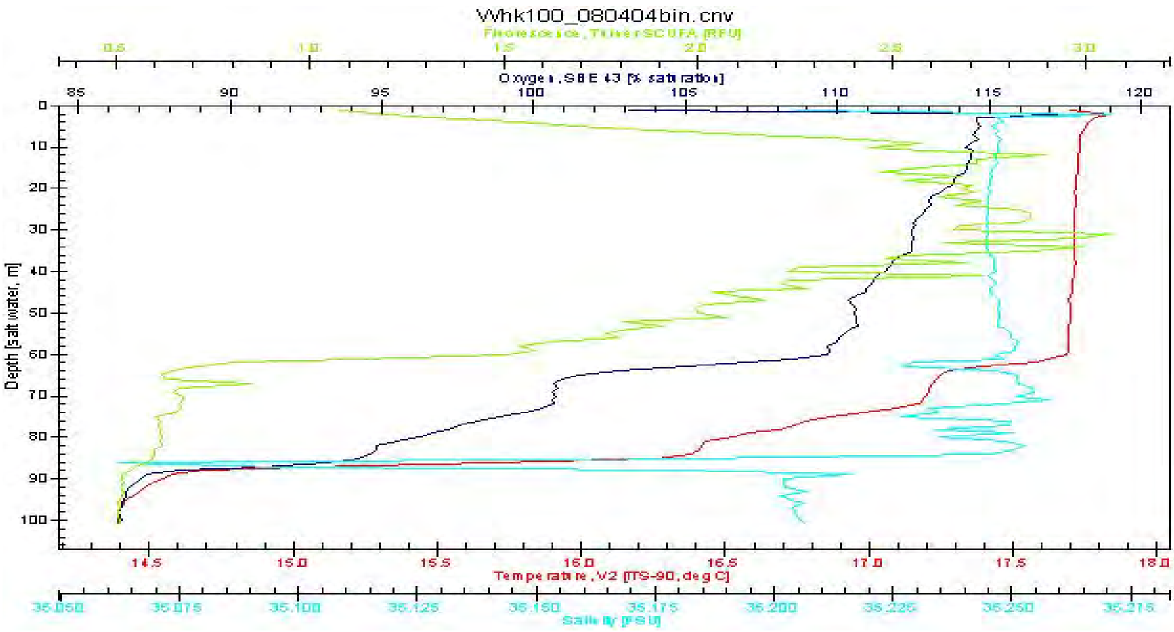

Opo20_080404bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

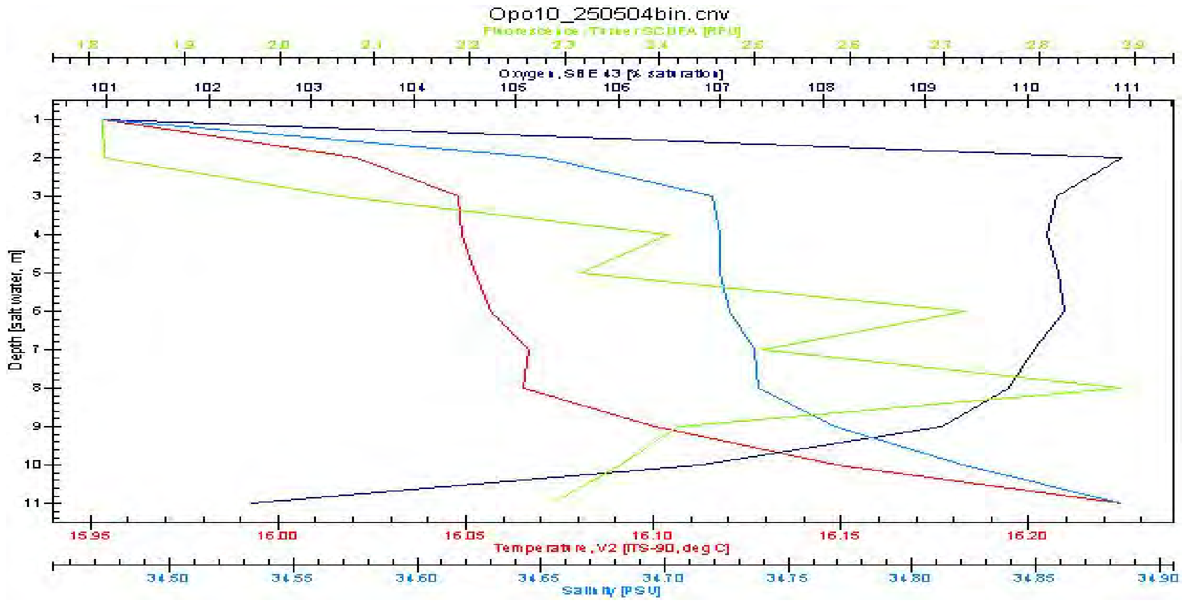

Opo50_080404bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

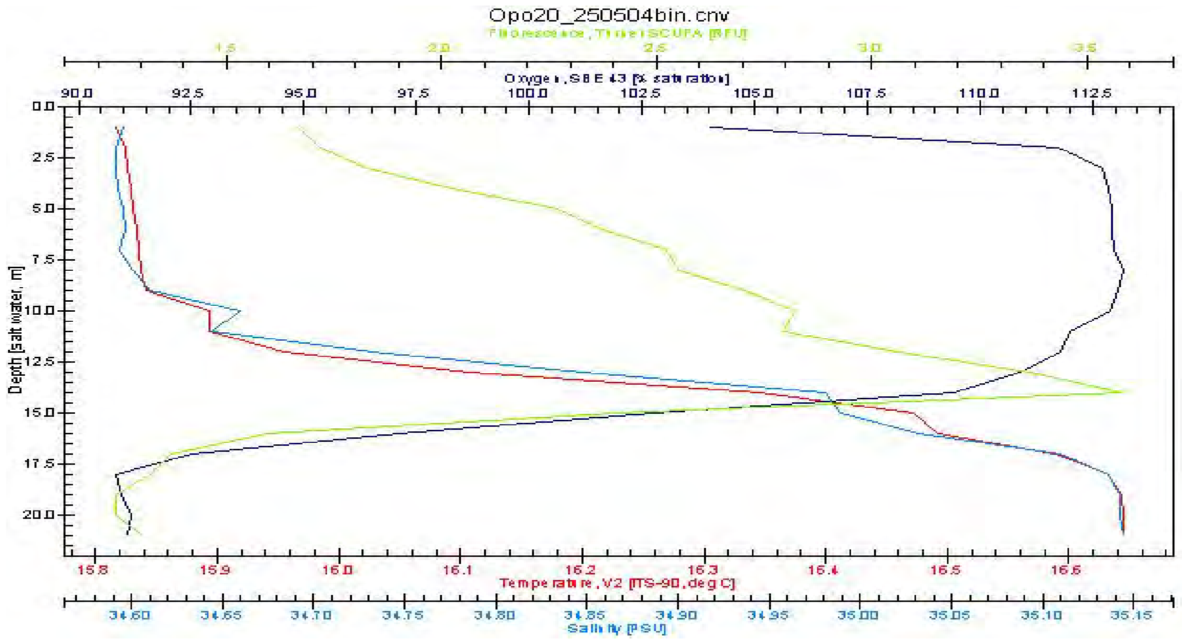

Puke50_080404bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

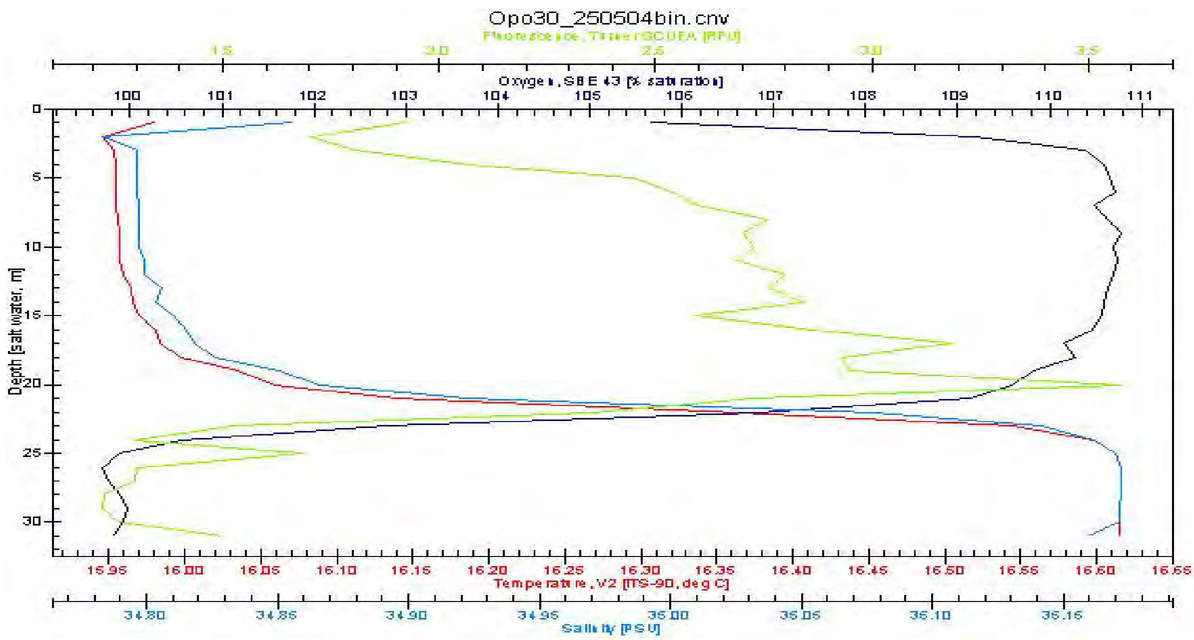

Whk20_080404bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

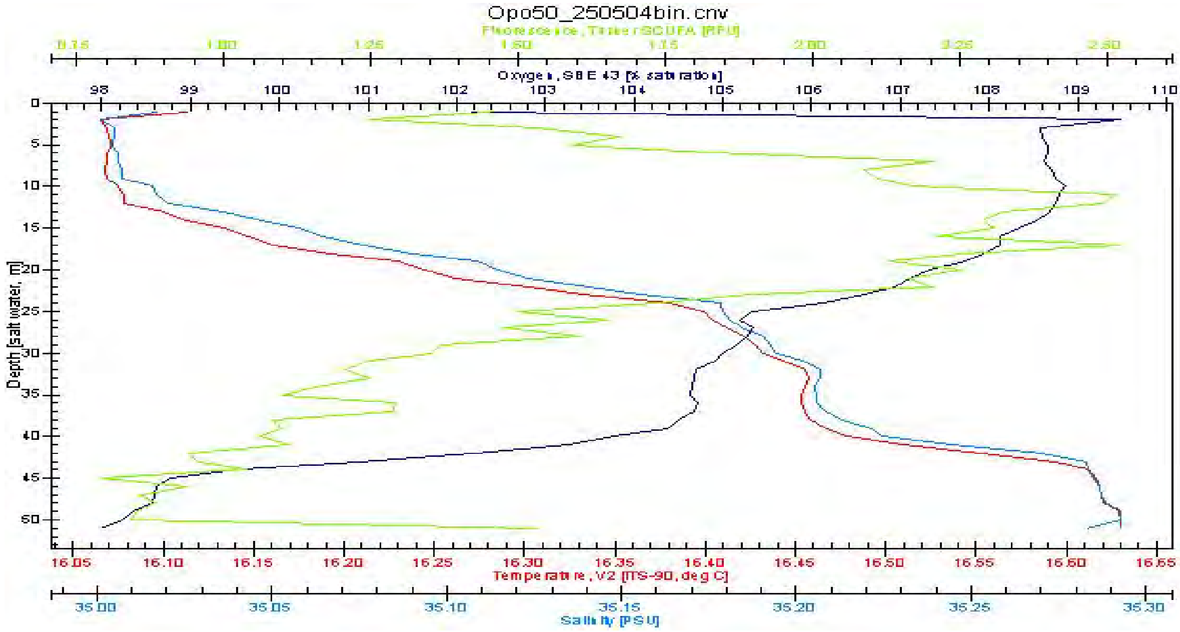

Whk50_080404bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

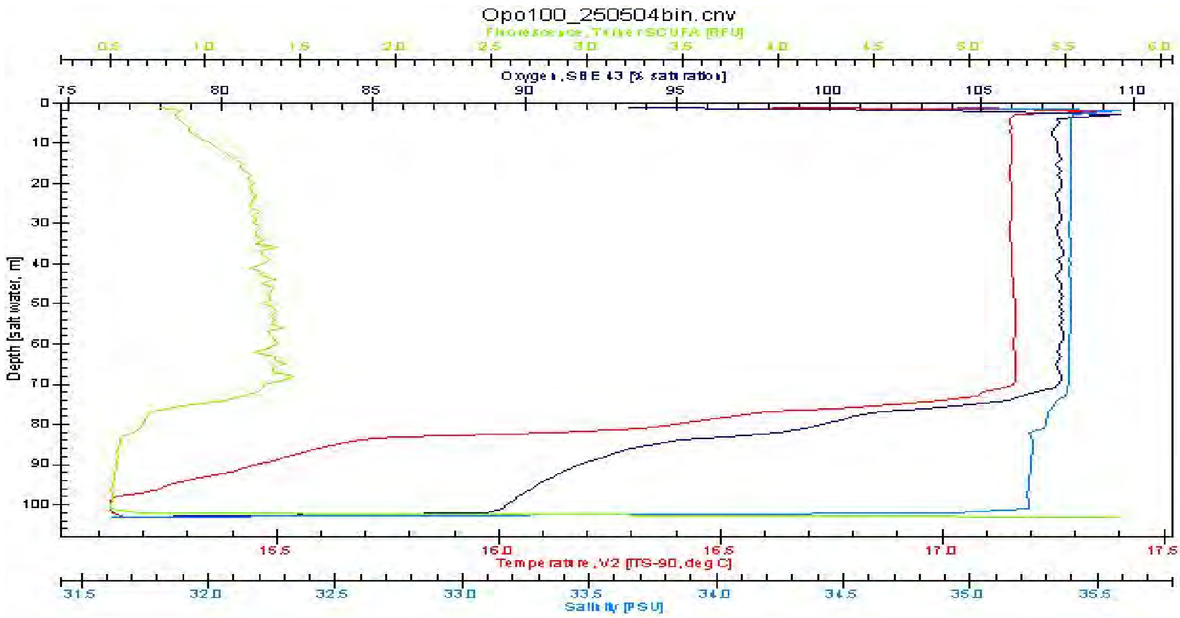

Whk100_080404bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

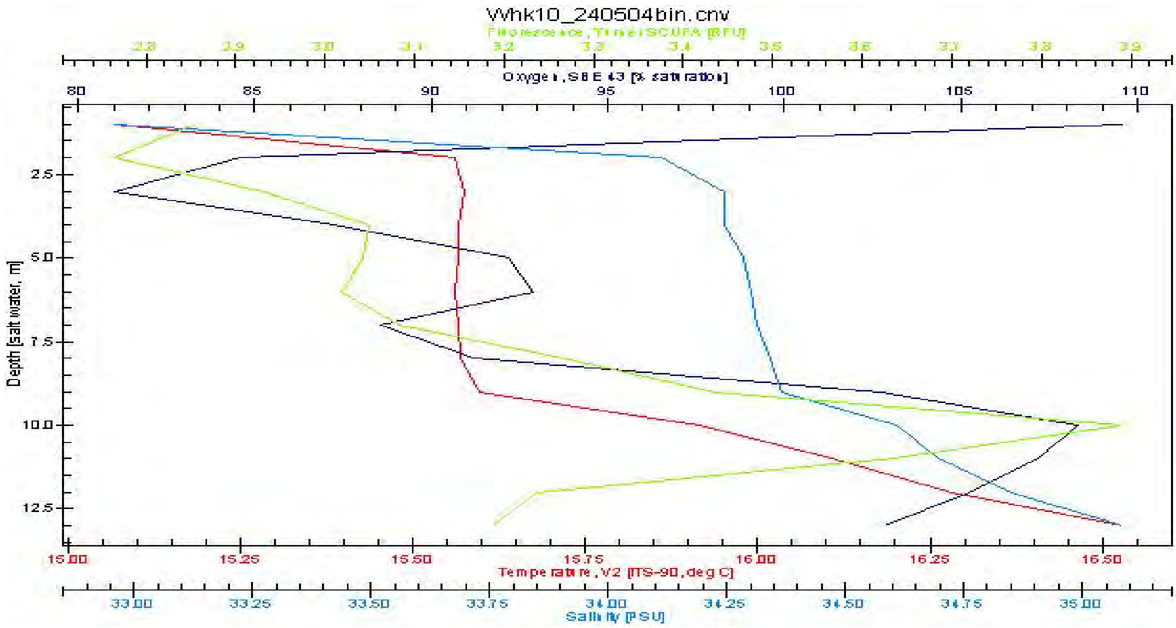

Opo10_250504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

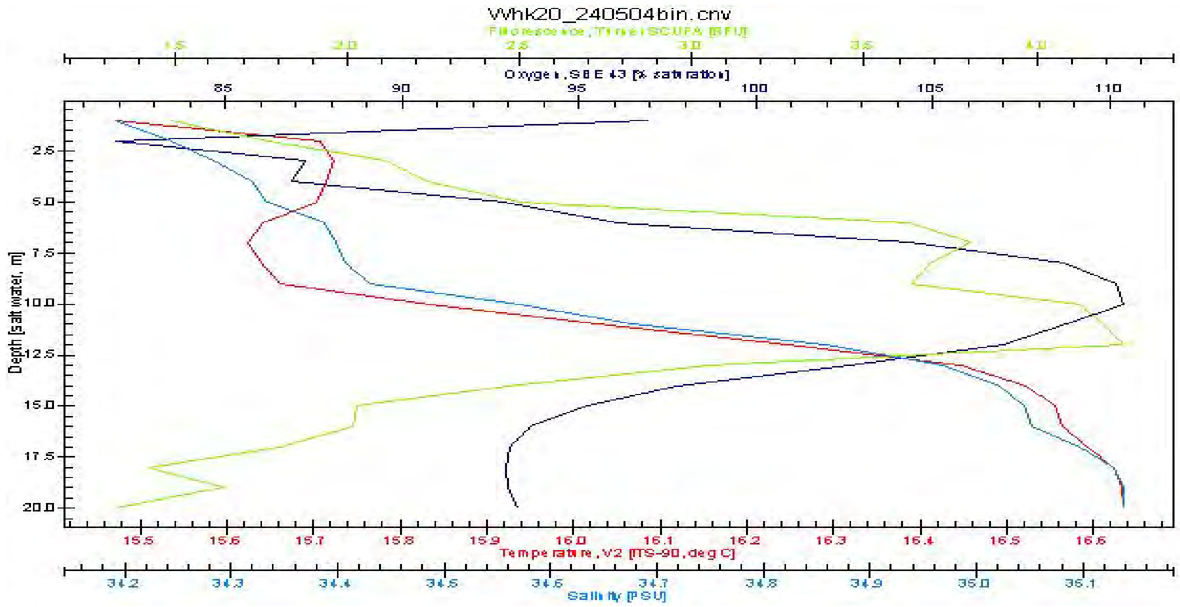

Opo20_250504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

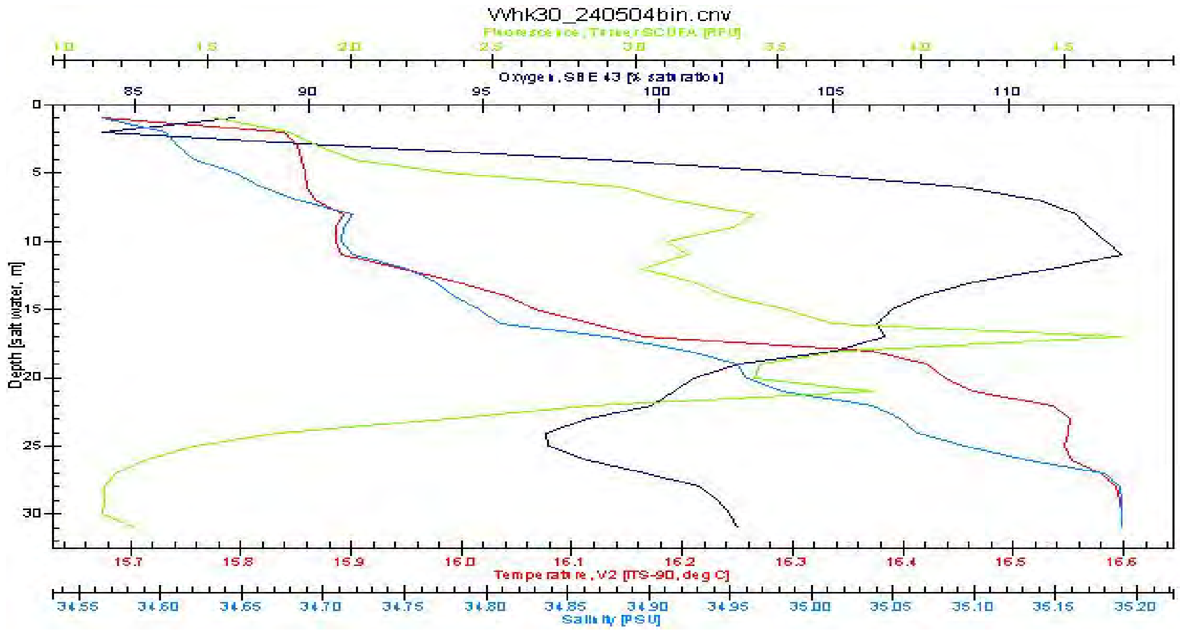

Opo30_250504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

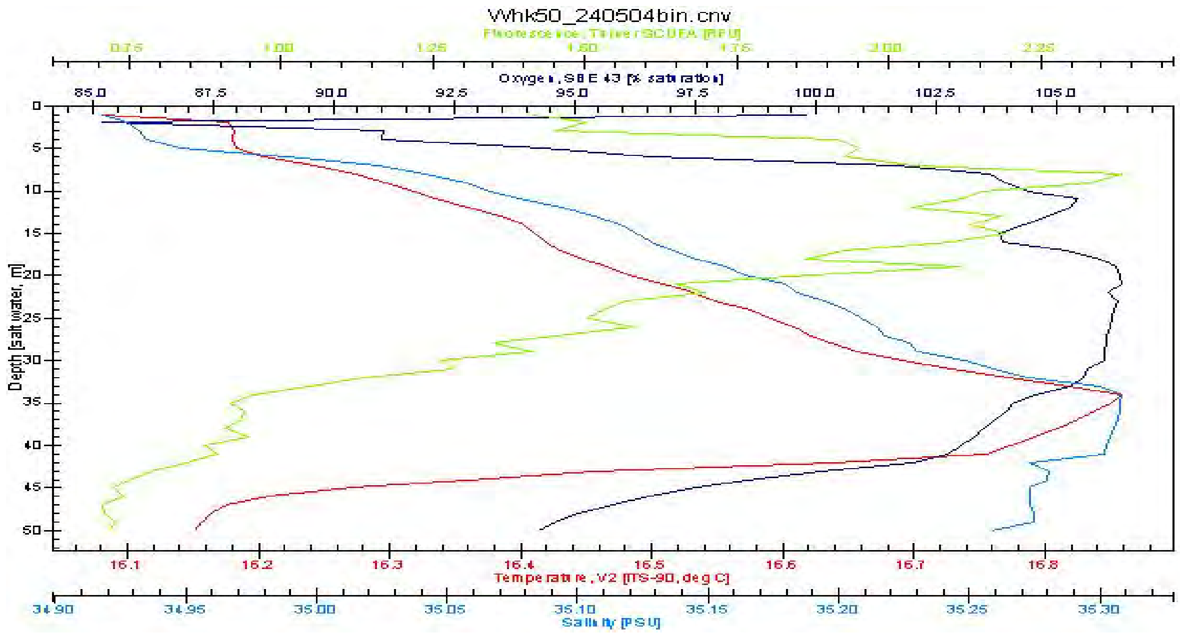

Opo50_250504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

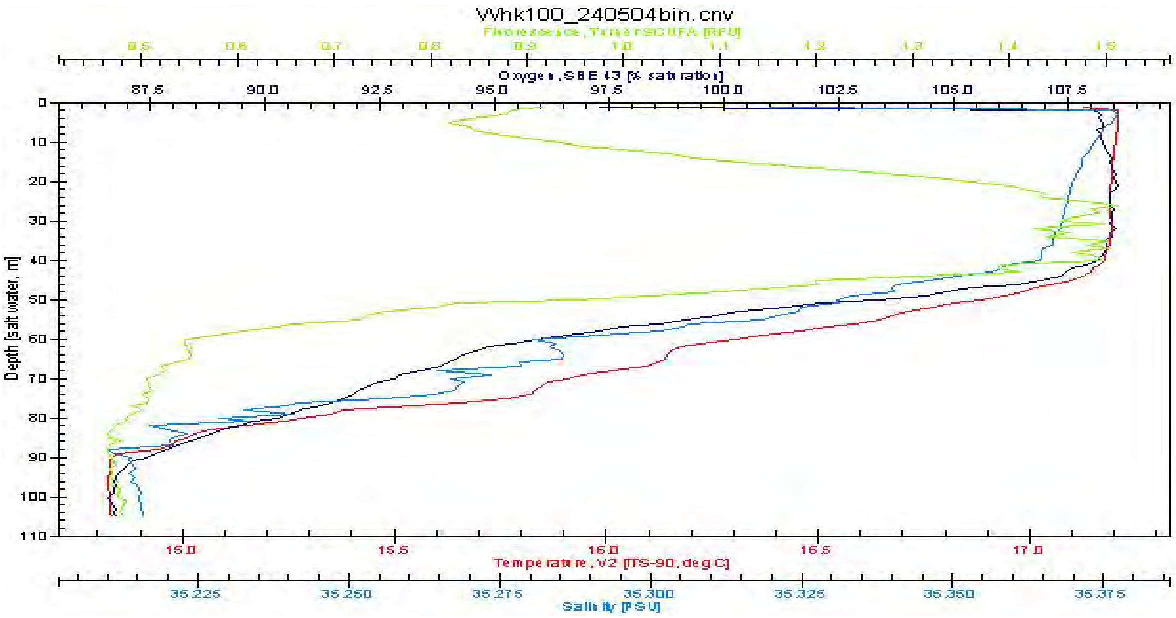

Opo100_250504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

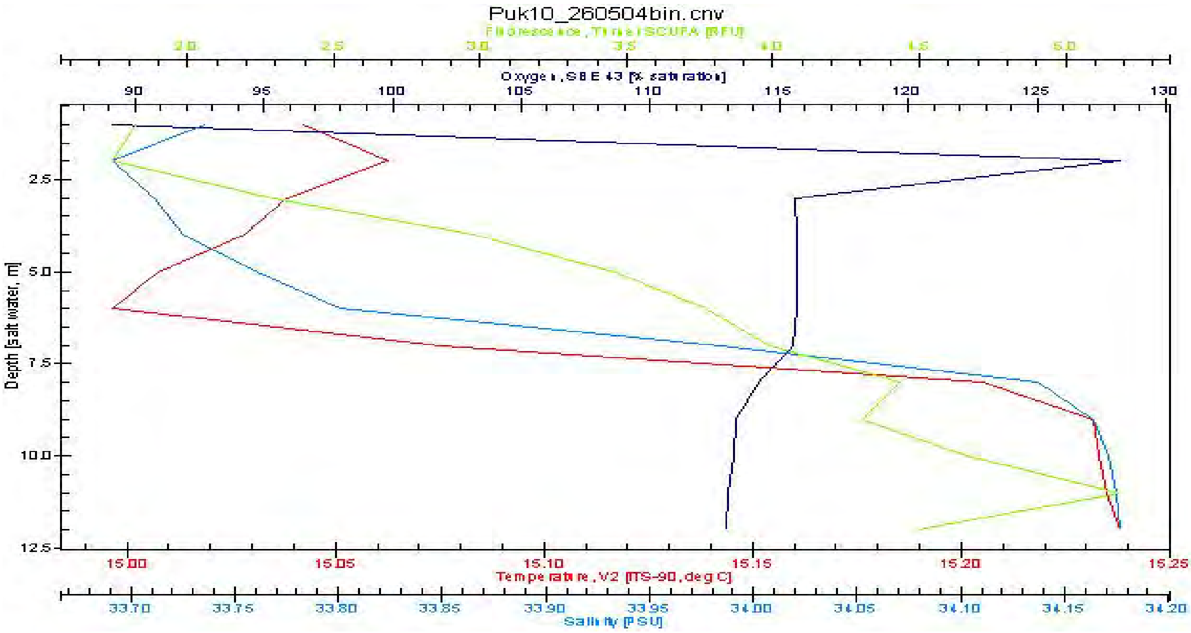

Whk10_240504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

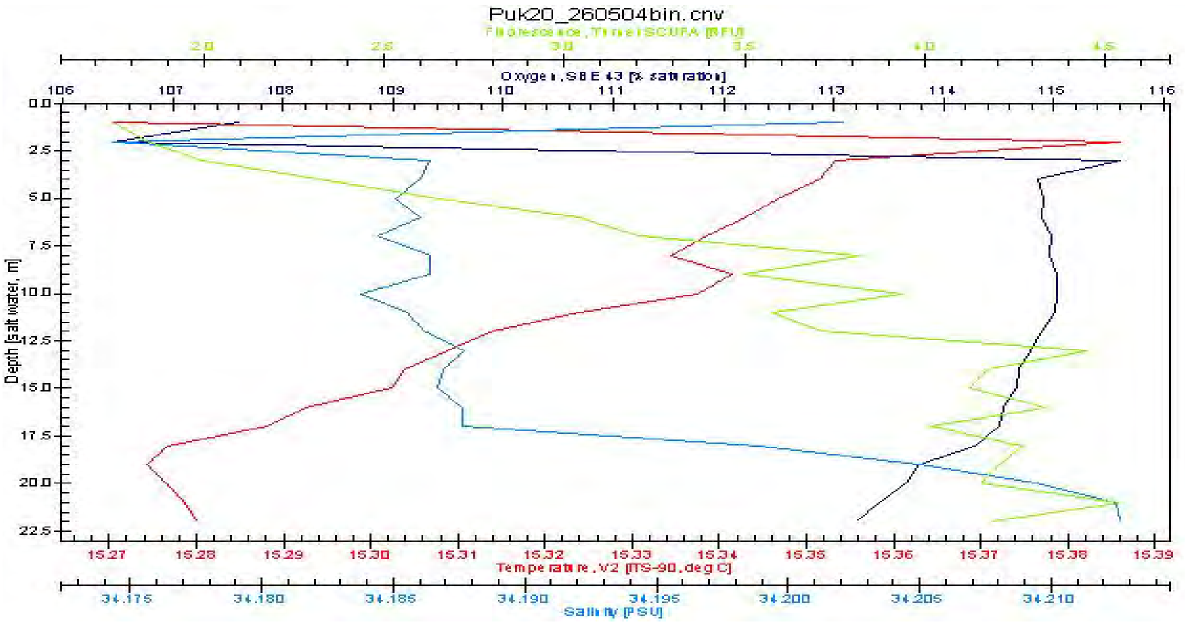

Whk20_240504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

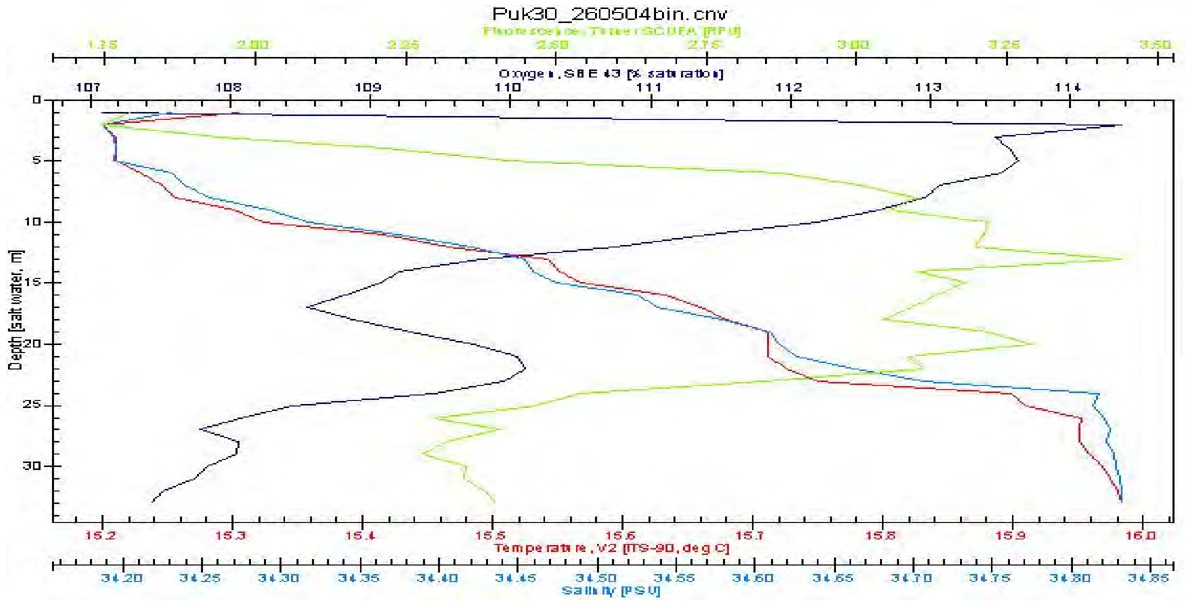

Whk30_240504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

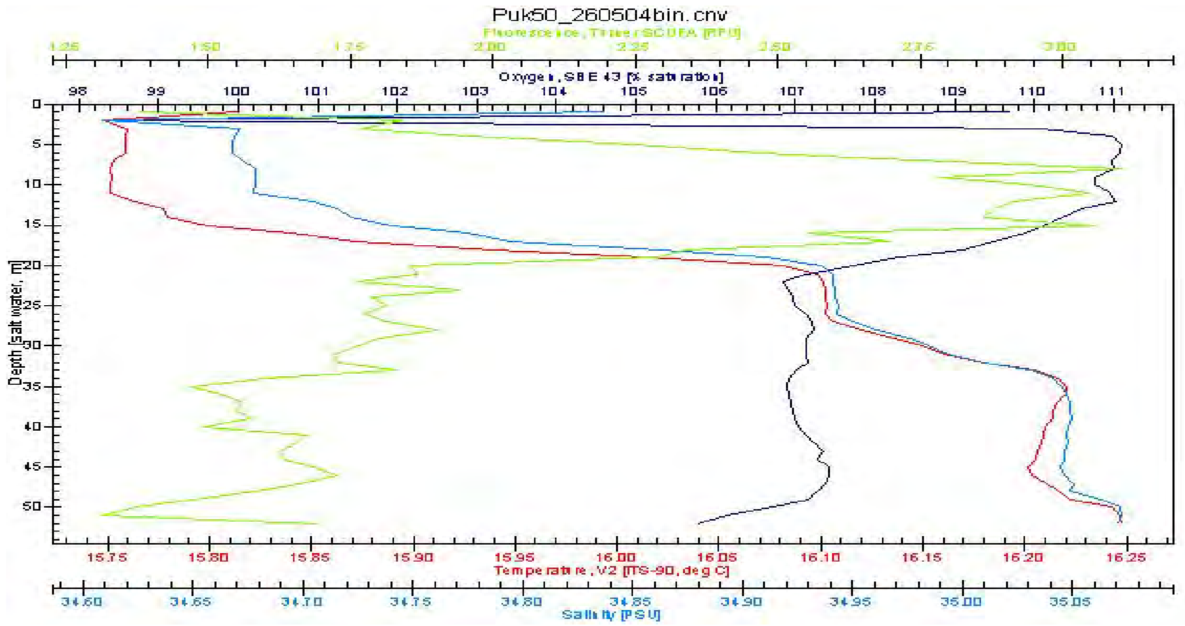

Whk50_240504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

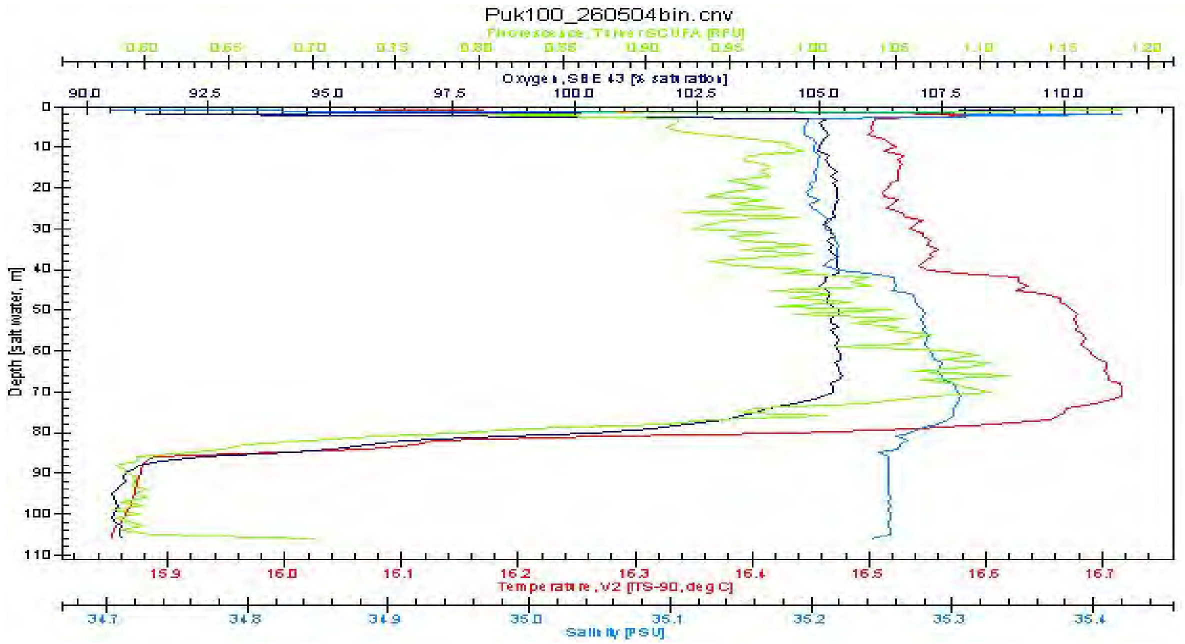

Whk100_240504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

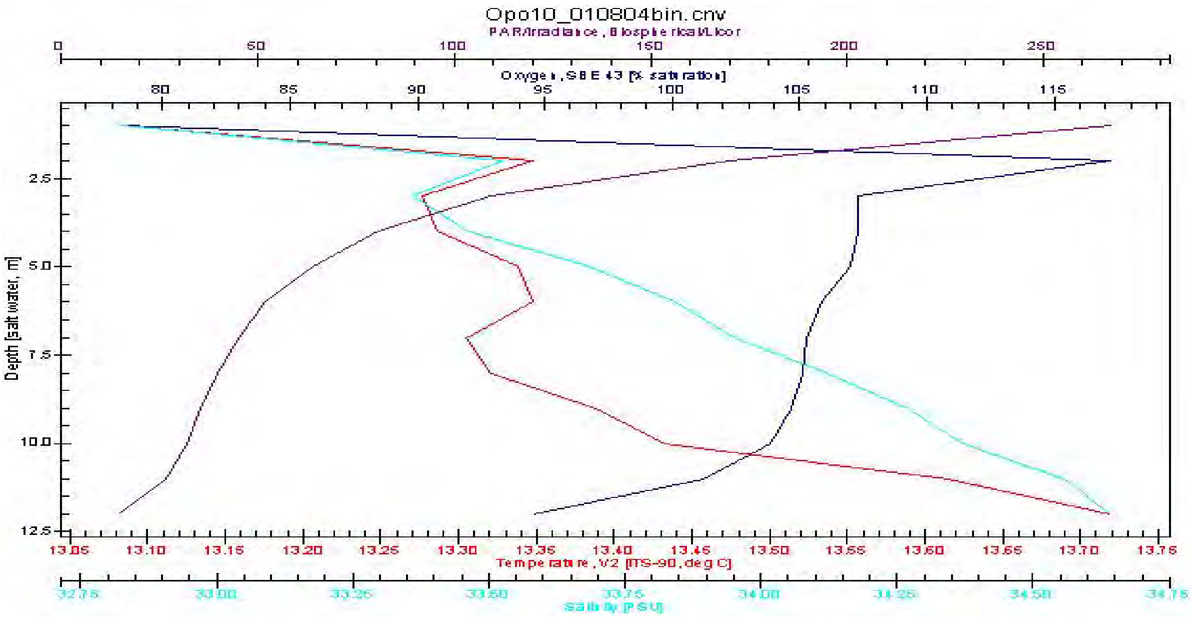

Puk10_260504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

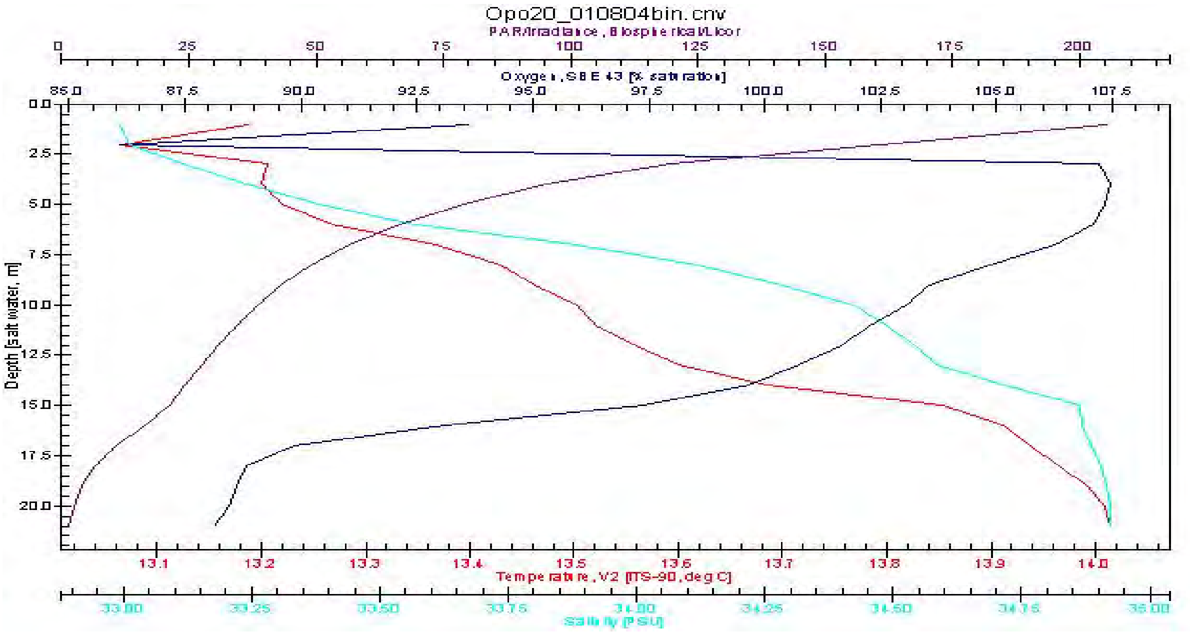

Puk20_260504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

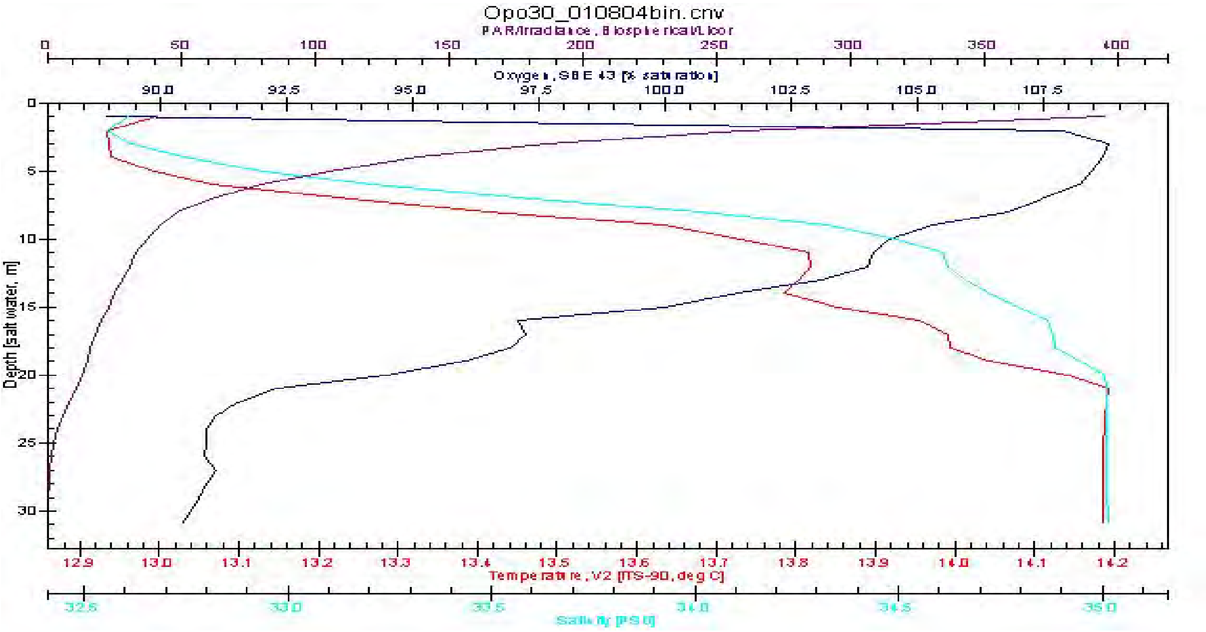

Puk30_260504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

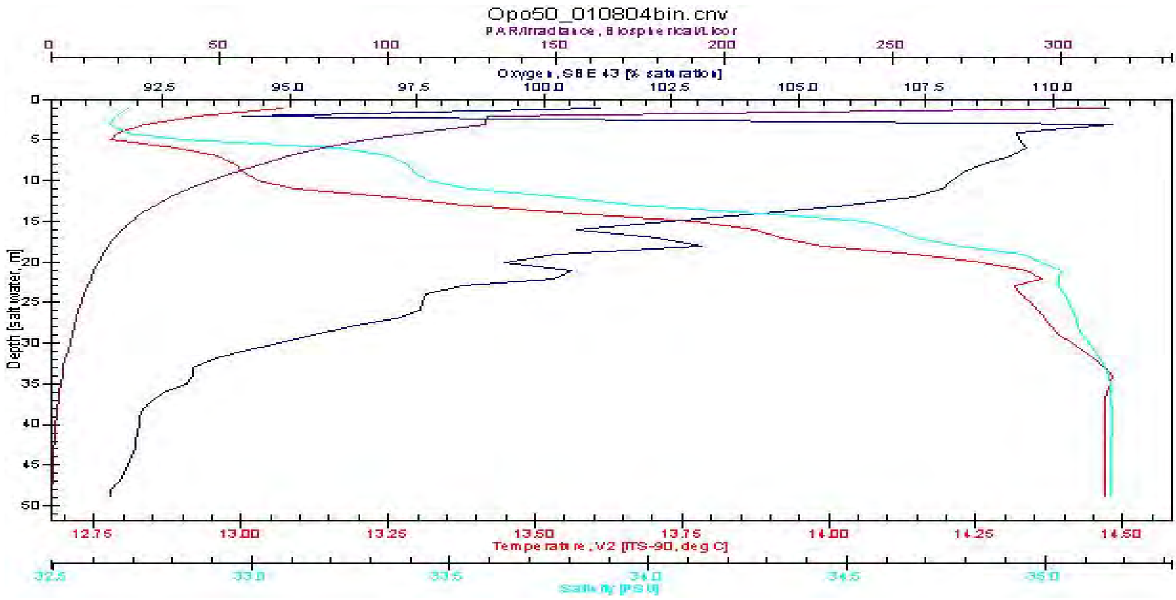

Puk50_260504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

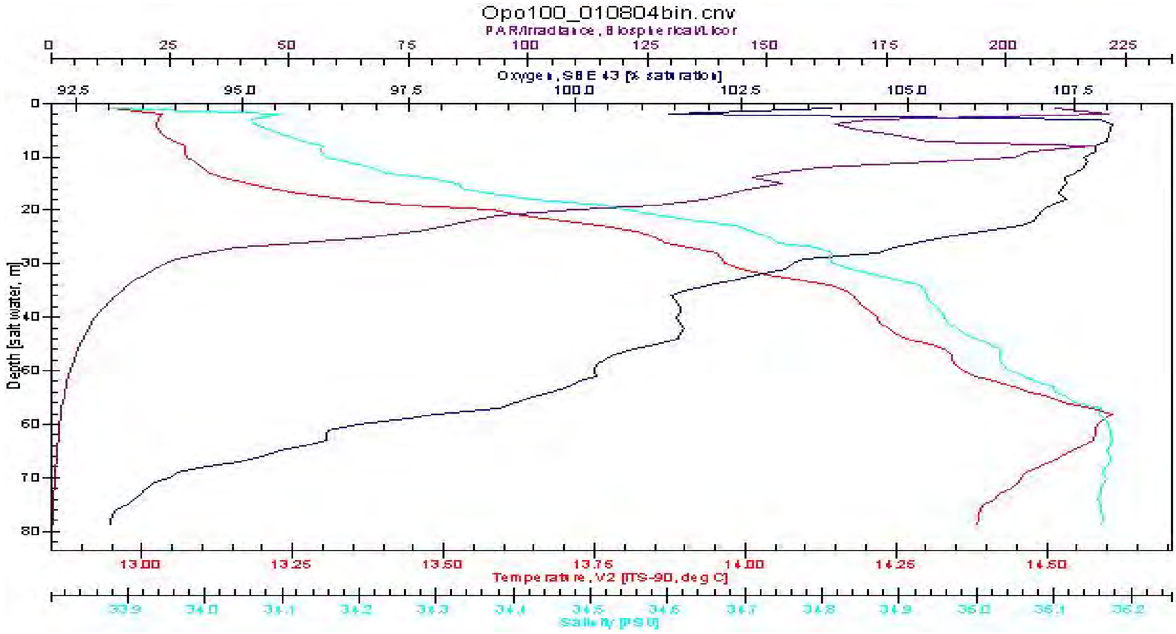

Puk100_260504bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

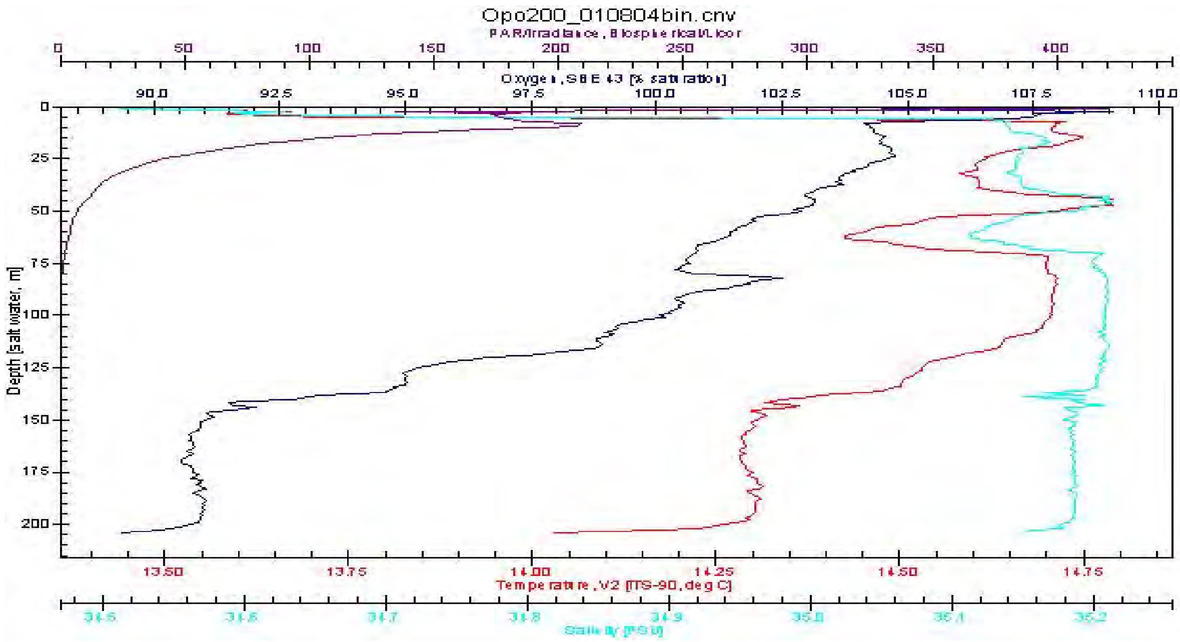

Opo10_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
0
50
100
150
200
250
Oxygen, SBE 43 [% saturation]
80
85
90
95
100
105
110
115
Depth [salt water, m]
2.5
5.0
7.5
10.0
12.5
13.05
13.10
13.15
13.20
13.25
13.30
13.35
13.40
13.45
13.50
13.55
13.60
13.65
13.70
13.75
Temperature, V2 [ITS-90, deg C]
32.75
33.00
33.25
33.50
33.75
34.00
34.25
34.50
34.75
Salinity [PSU]

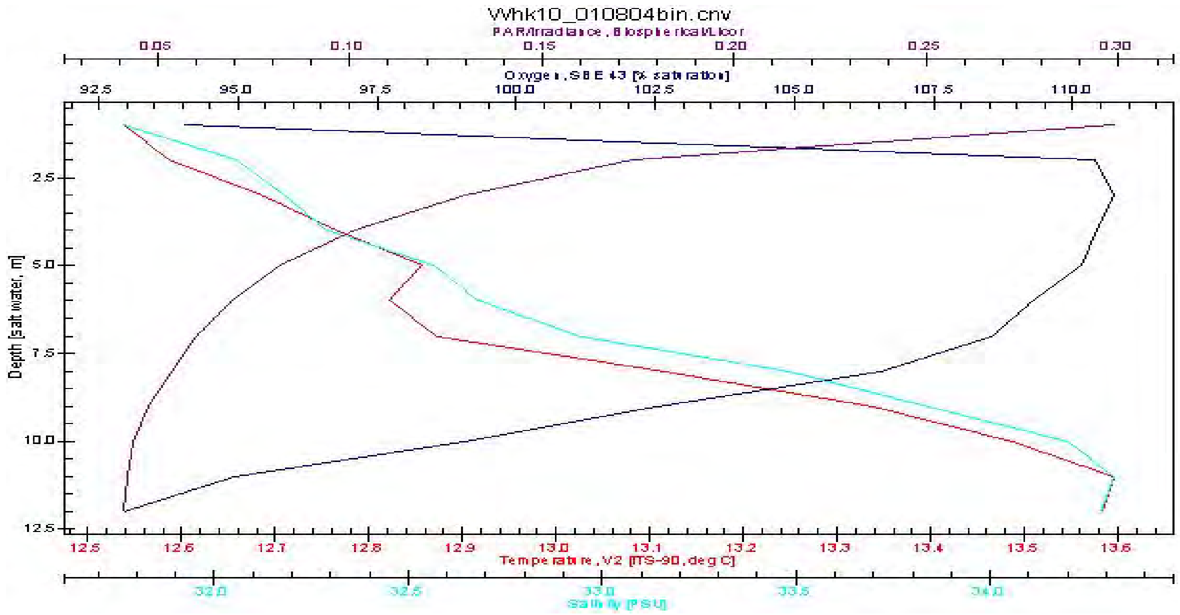

Opo20_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
0
25
50
75
100
125
150
175
200
Oxygen, SBE 43 [% saturation]
85.0
87.5
90.0
92.5
95.0
97.5
100.0
102.5
105.0
107.5
Depth [salt water, m]
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
13.1
13.2
13.3
13.4
13.5
13.6
13.7
13.8
13.9
14.0
Temperature, V2 [ITS-90, deg C]
33.00
33.25
33.50
33.75
34.00
34.25
34.50
34.75
35.00
Salinity [PSU]

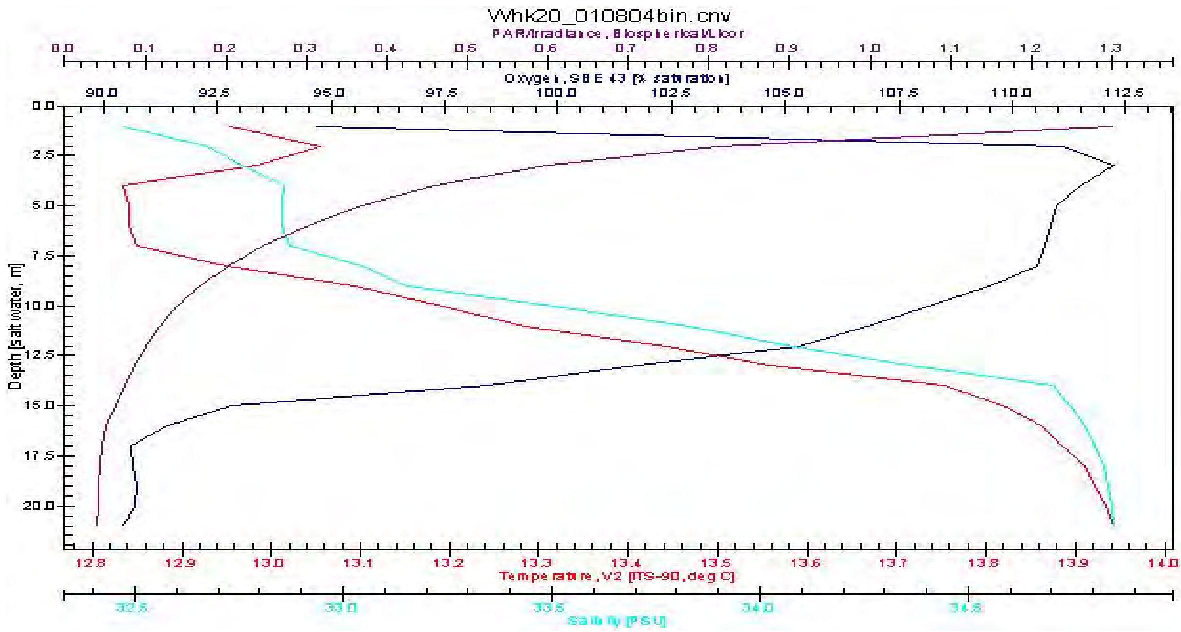

Opo30_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

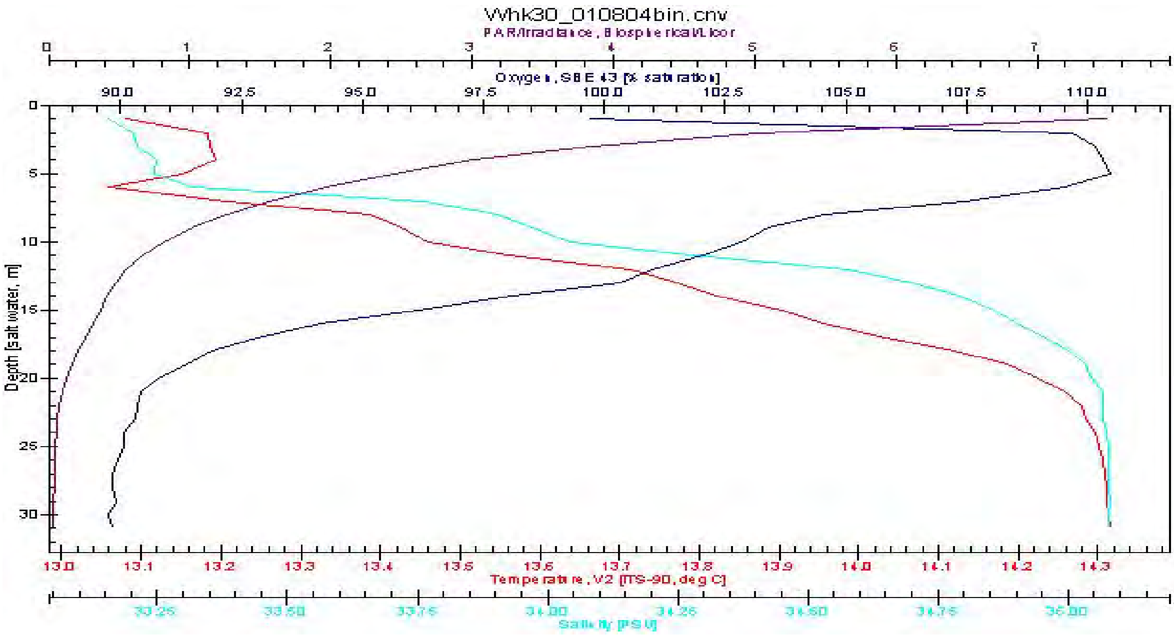

Opo50_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

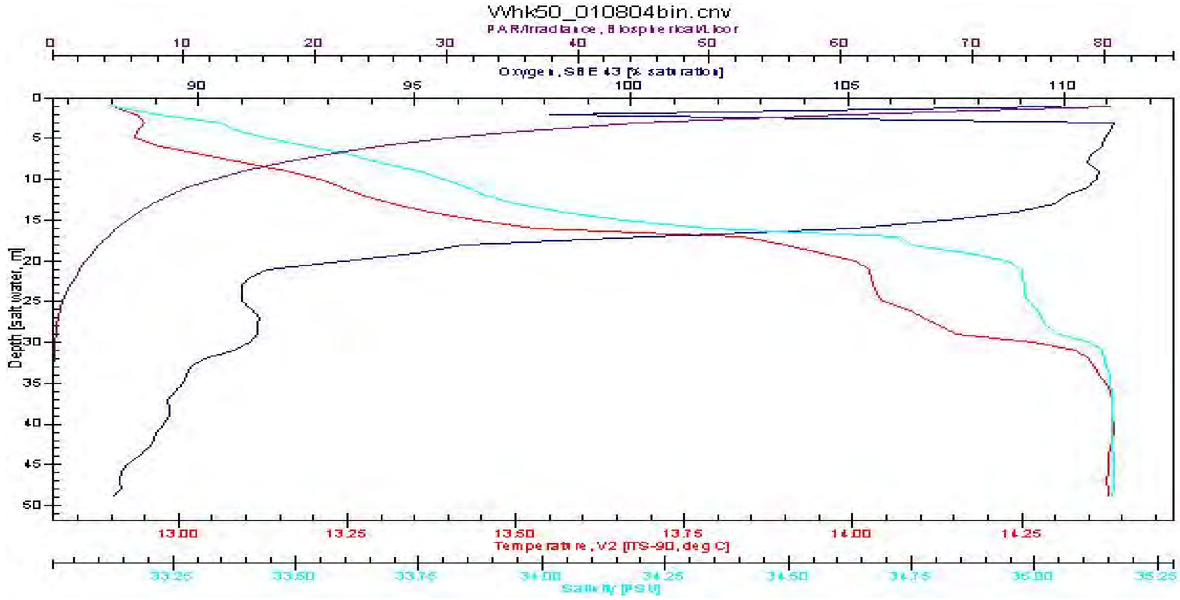

Opo100_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

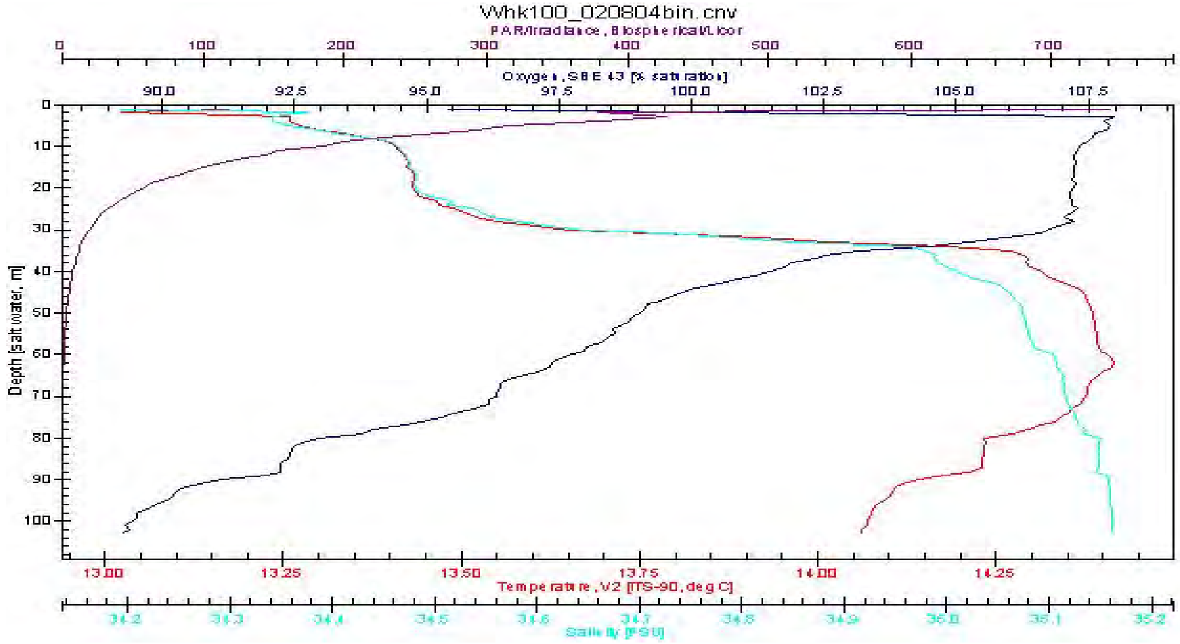

Opo200_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

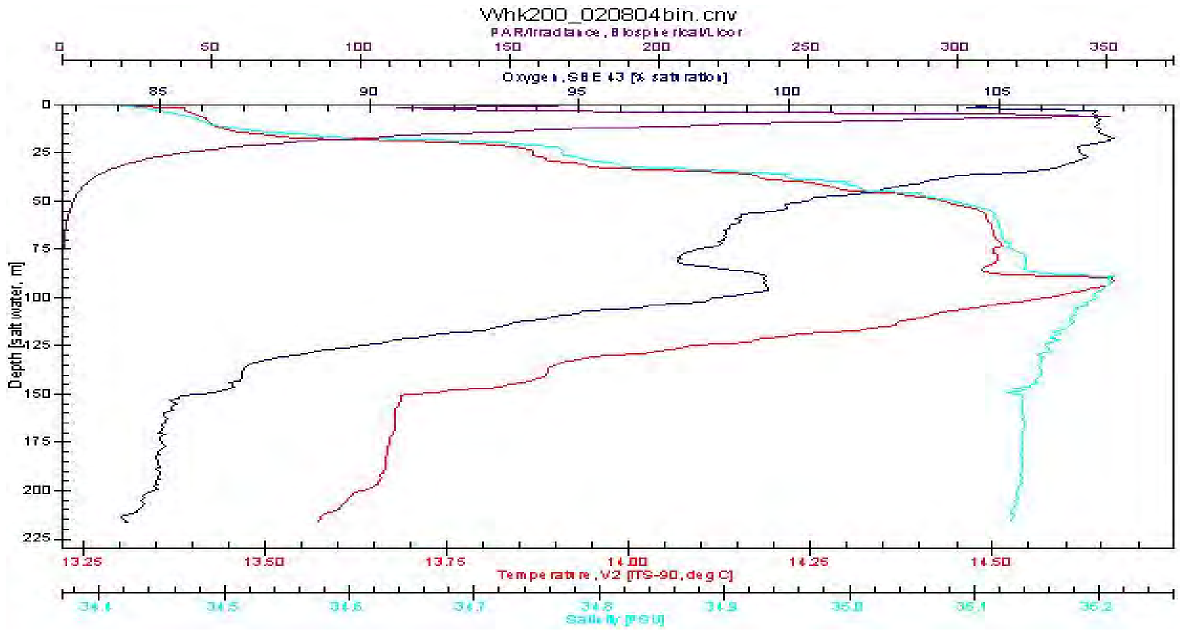

Whk10_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

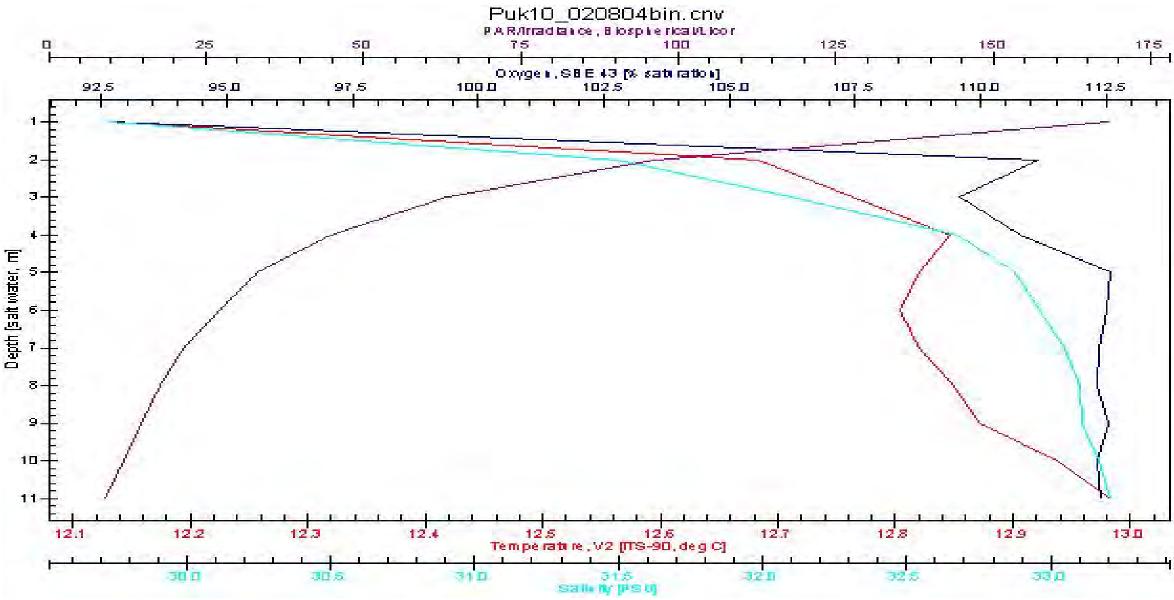

Whk20_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

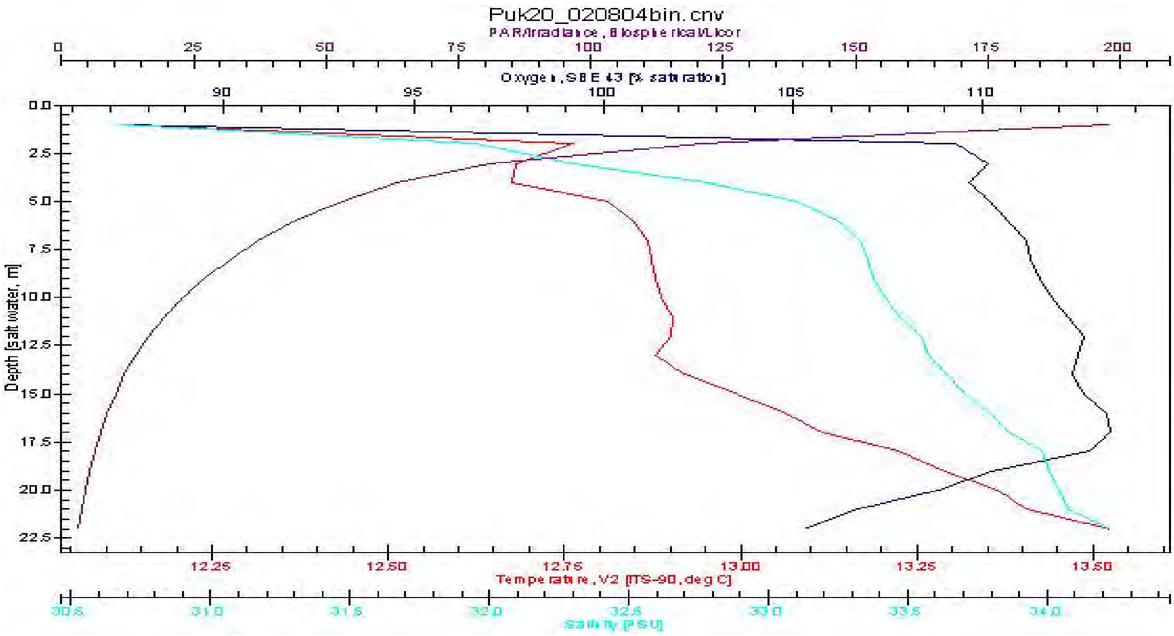

Whk30_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

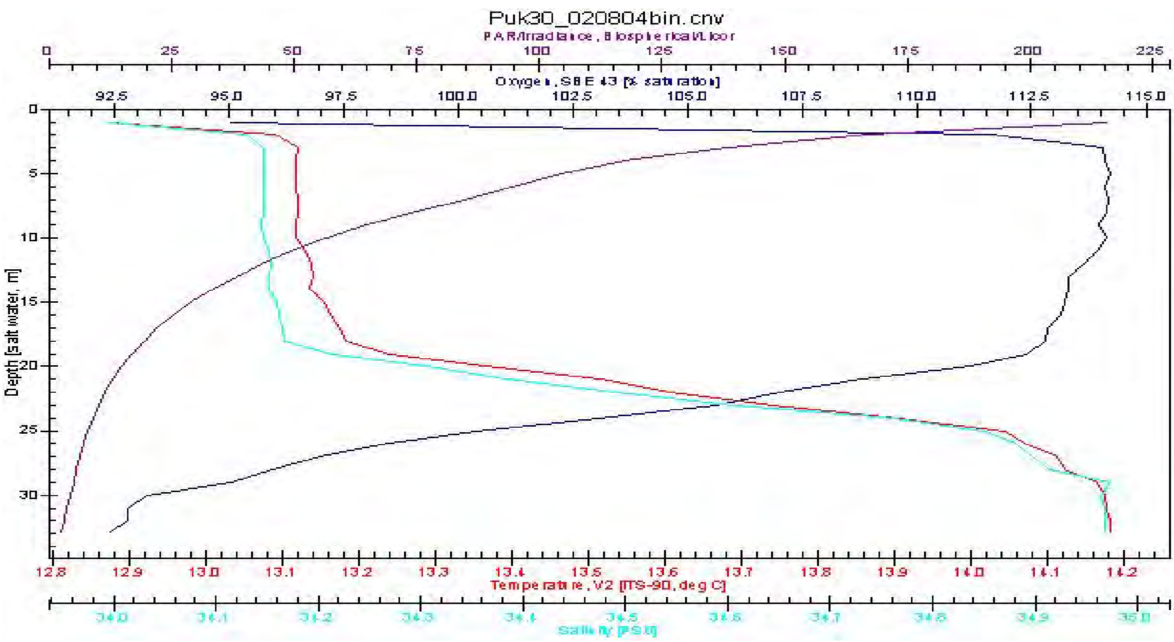

Whk50_010804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

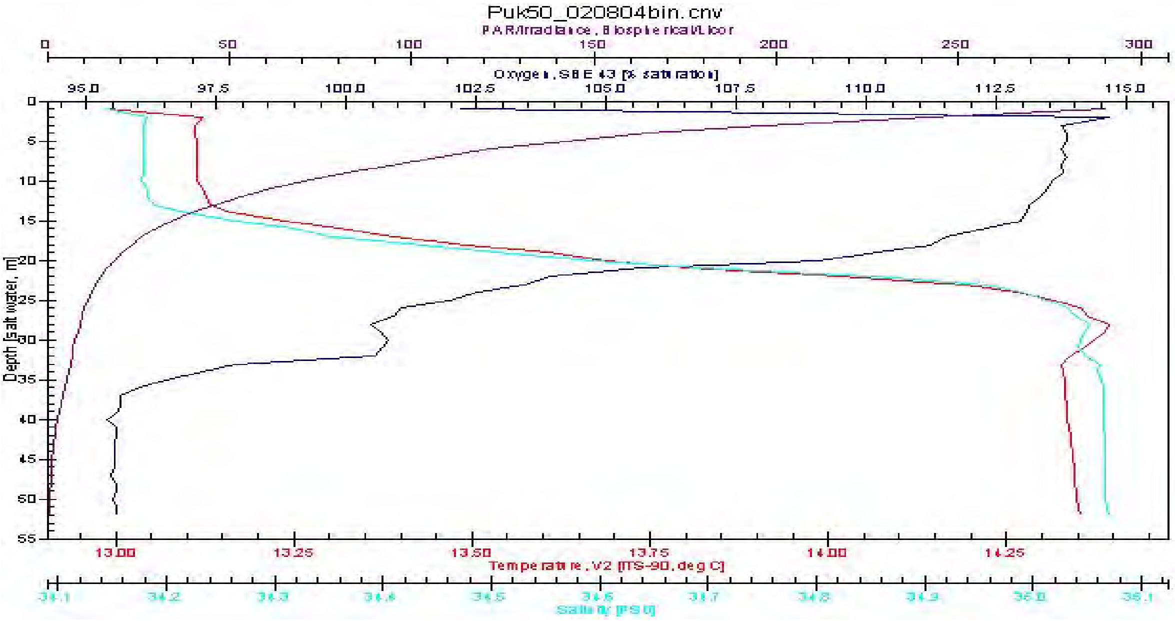

Whk100_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

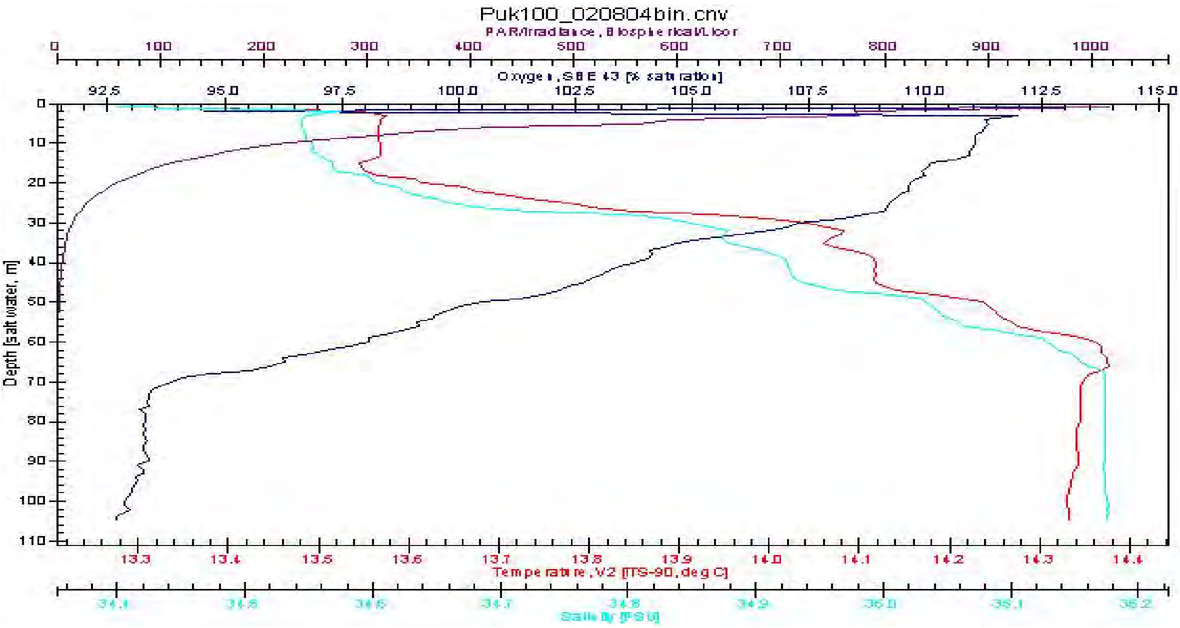

Whk200_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

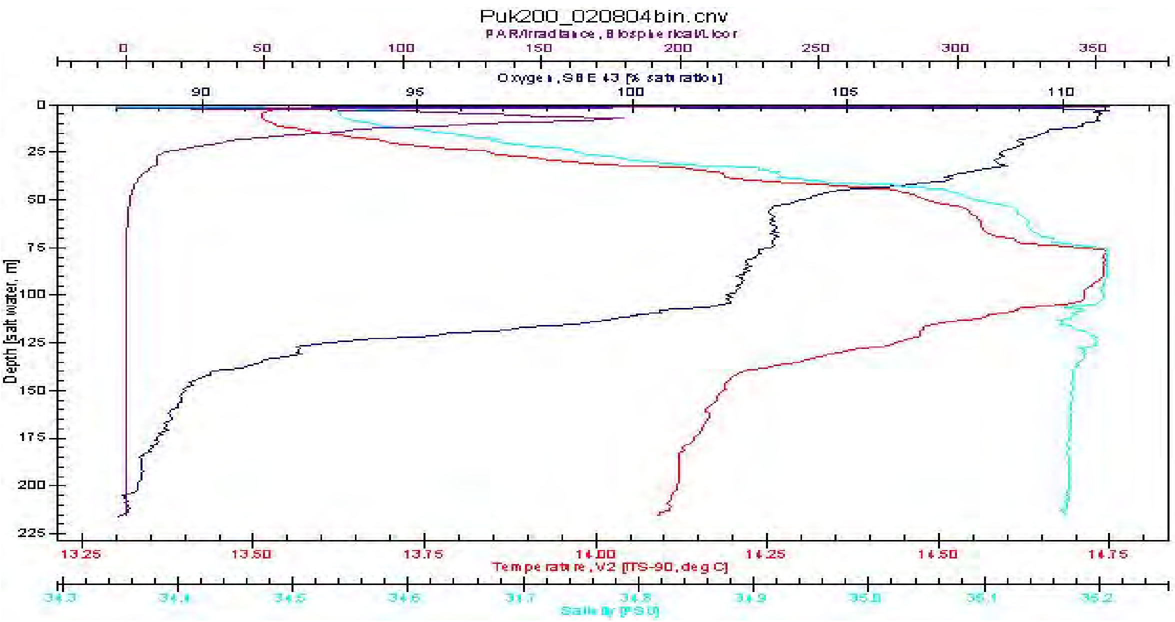

Puk10_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

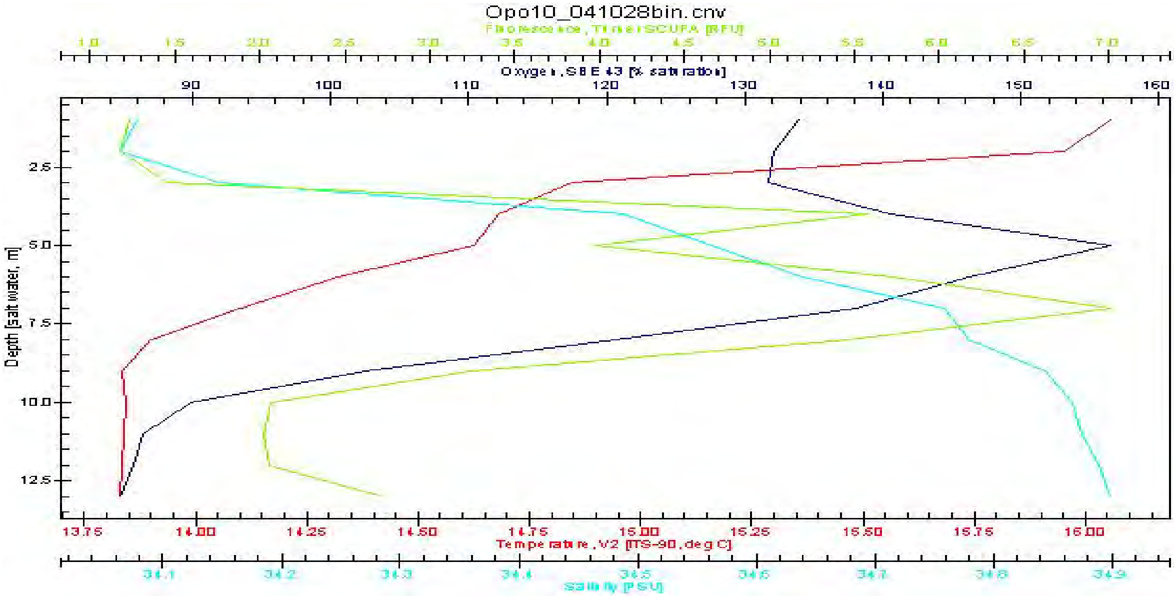

Puk20_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

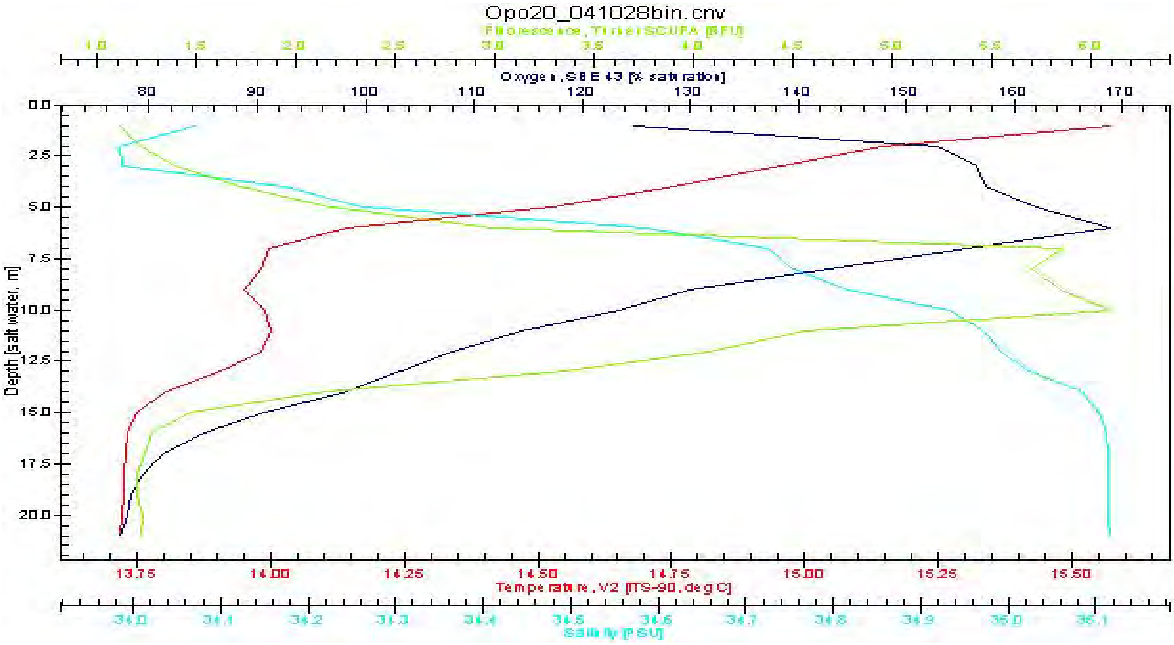

Puk30_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

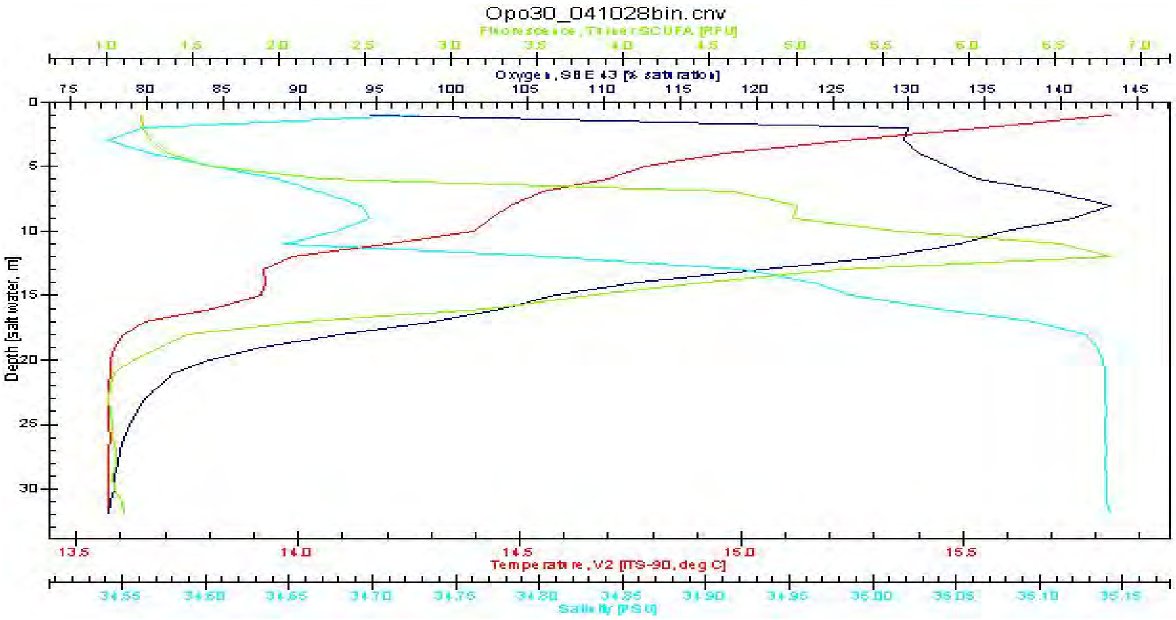

Puk50_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

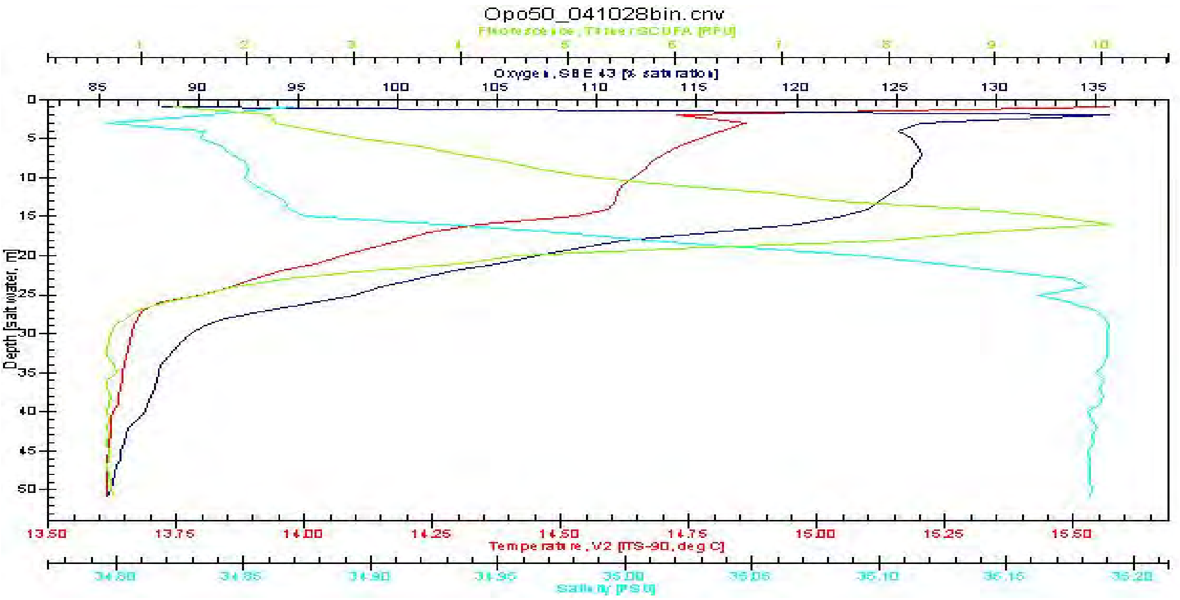

Puk100_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

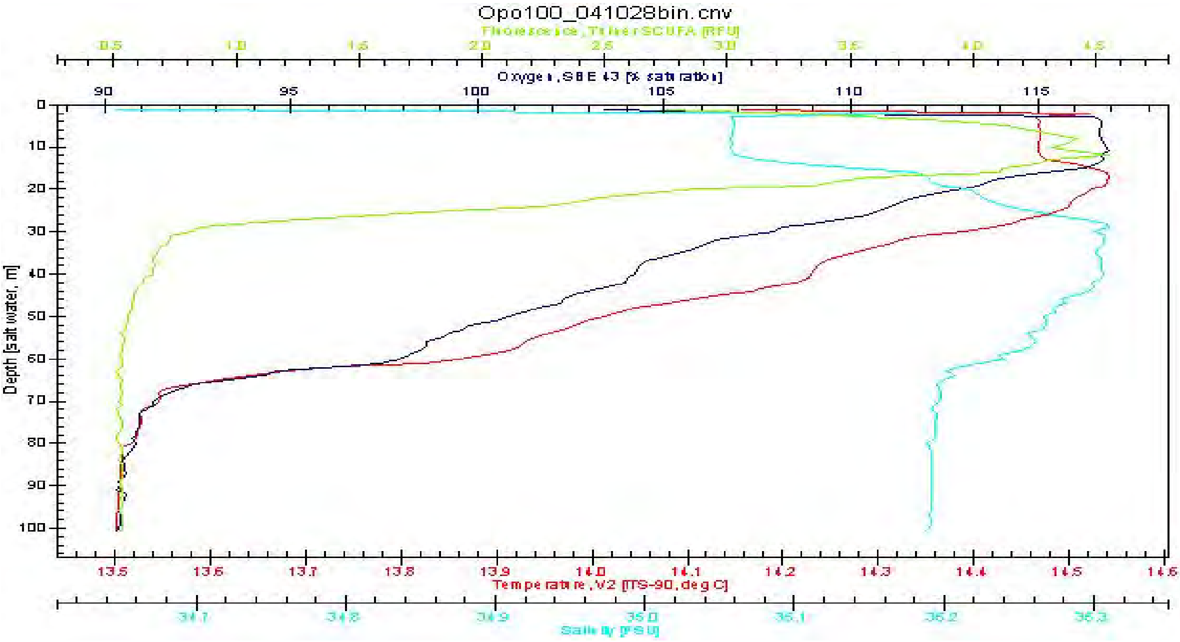

Puk200_020804bin.cnv
PAR/Irradiance, Biospherical/Licor
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

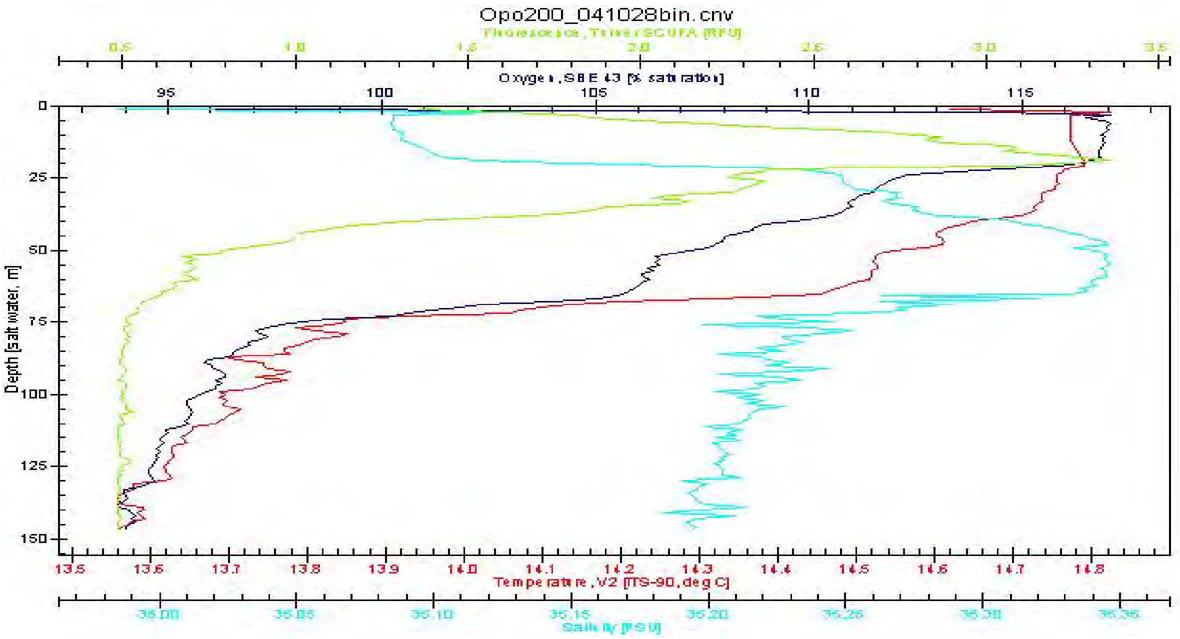

Opo10_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

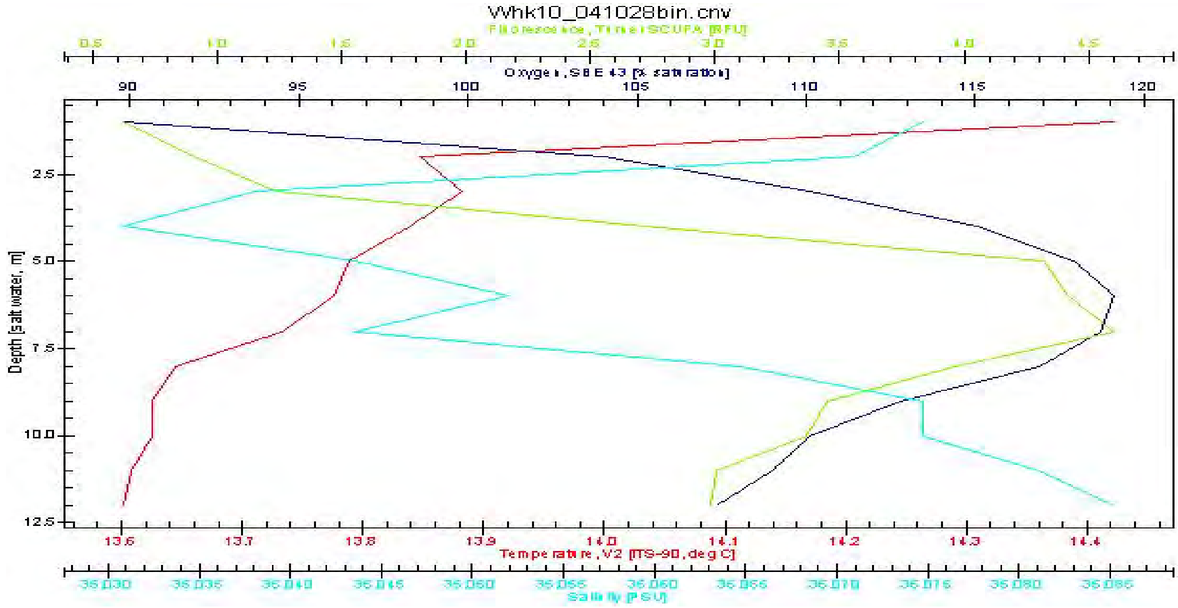

Opo20_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

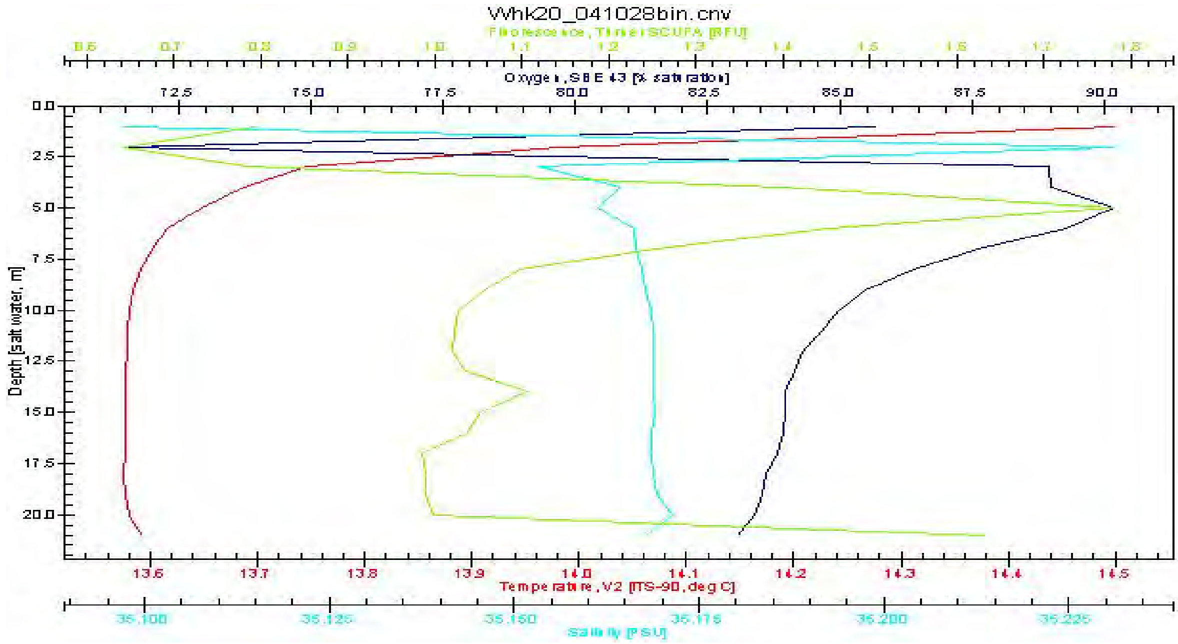

Opo30_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

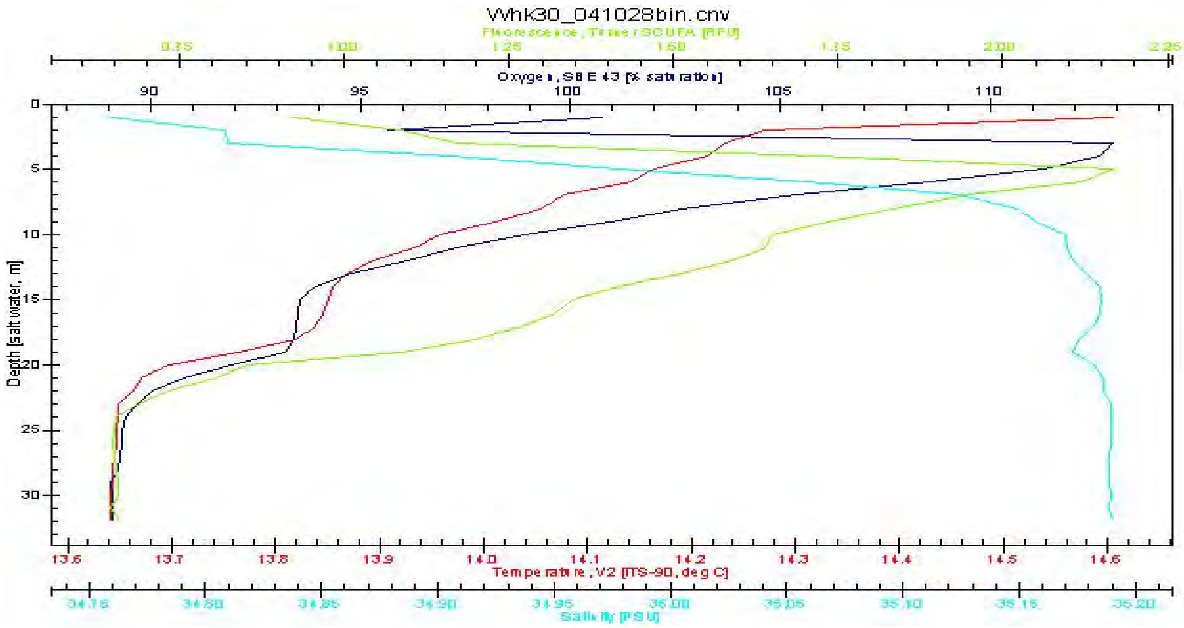

Opo50_041028bin.cnv
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

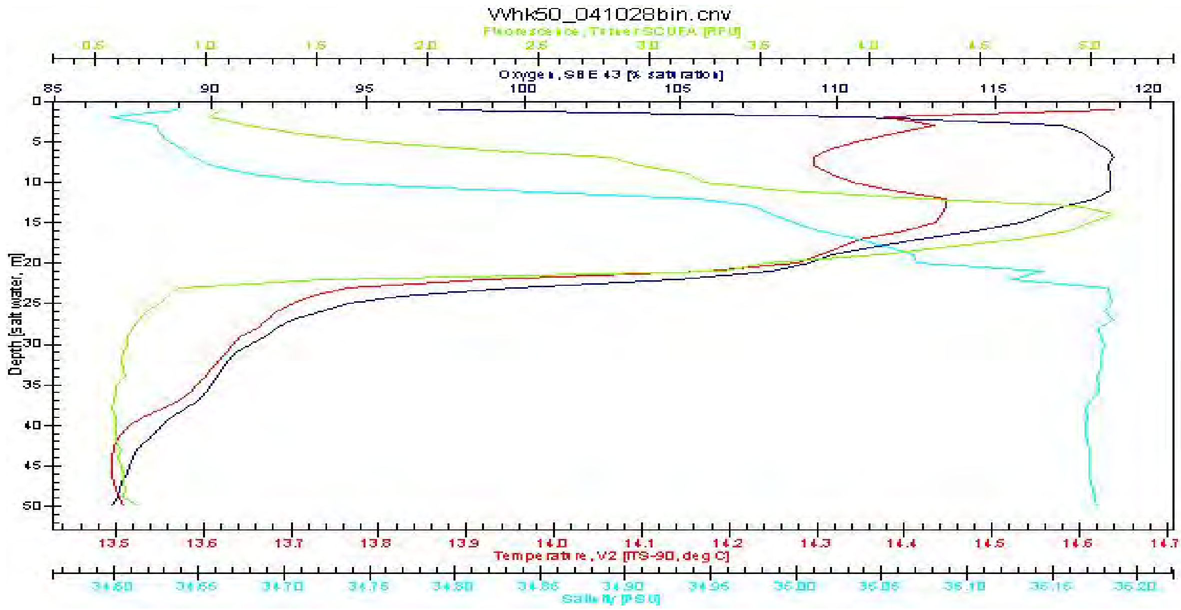

Opo100_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

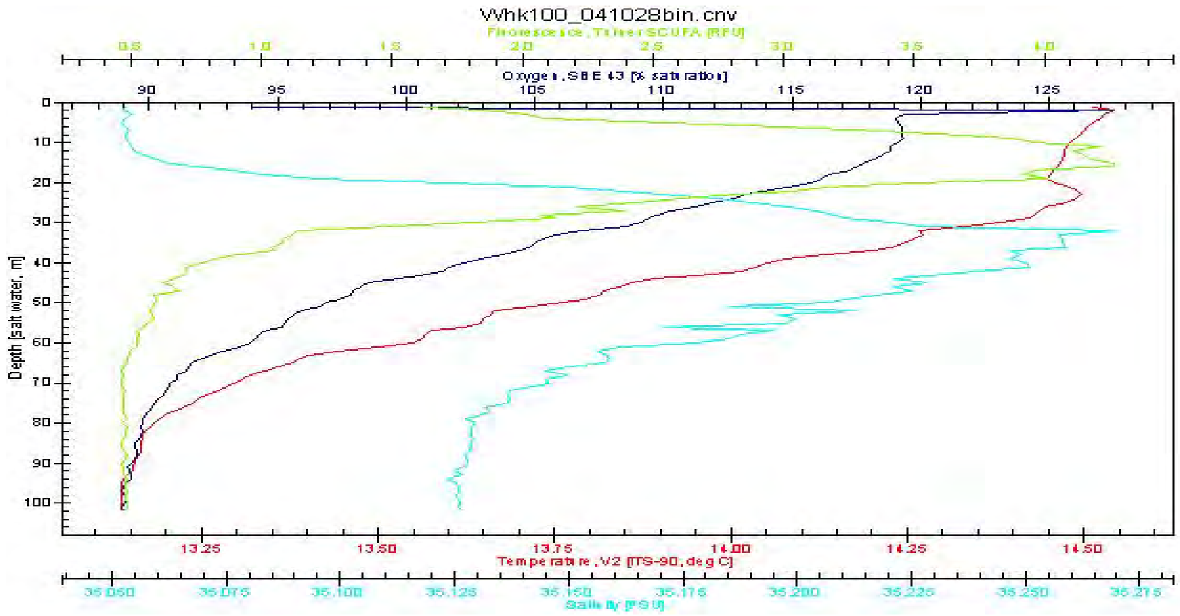

Opo200_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

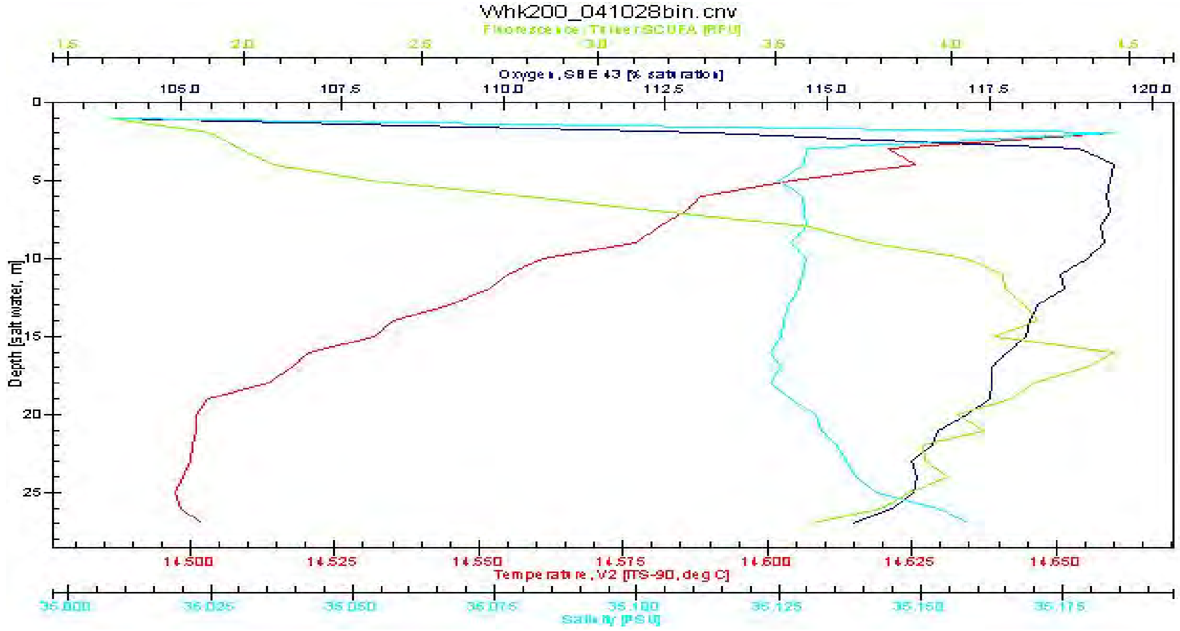

Whk10_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Oxygen, SBE 43 [% saturation]
90
95
100
105
110
115
120
Depth [salt water, m]
2.5
5.0
7.5
10.0
12.5
13.6
13.7
13.8
13.9
14.0
14.1
14.2
14.3
14.4
Temperature, V2 [ITS-90, deg C]
35.030
35.035
35.040
35.045
35.050
35.055
35.060
35.065
35.070
35.075
35.080
35.085
Salinity [PSU]

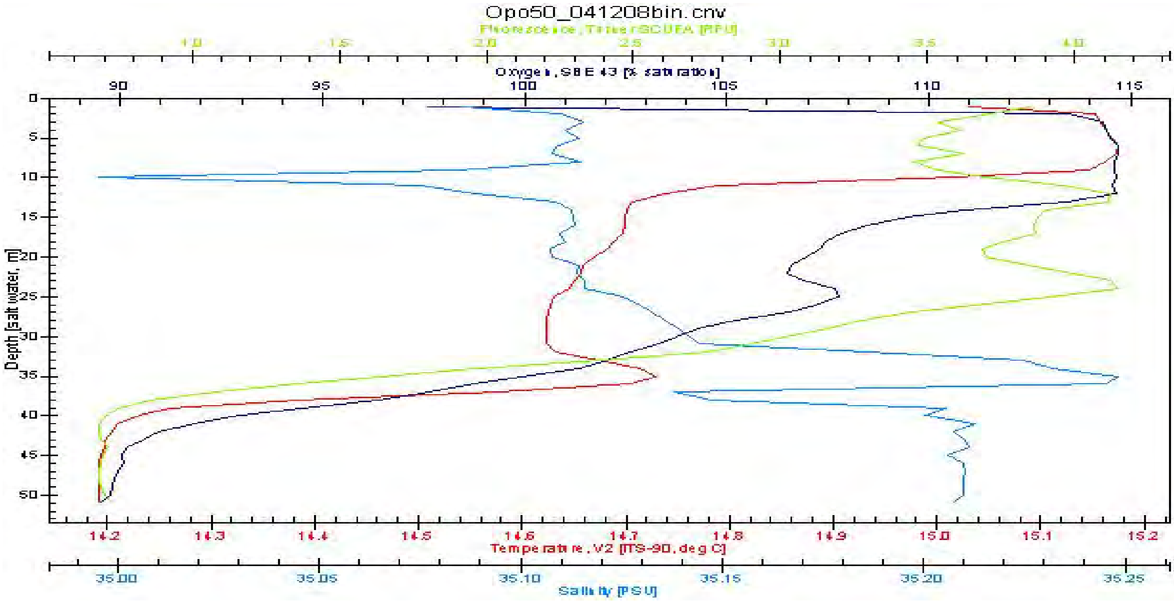

Whk20_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
Oxygen, SBE 43 [% saturation]
72.5
75.0
77.5
80.0
82.5
85.0
87.5
90.0
Depth [salt water, m]
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
13.6
13.7
13.8
13.9
14.0
14.1
14.2
14.3
14.4
14.5
Temperature, V2 [ITS-90, deg C]
35.100
35.125
35.150
35.175
35.200
35.225
Salinity [PSU]

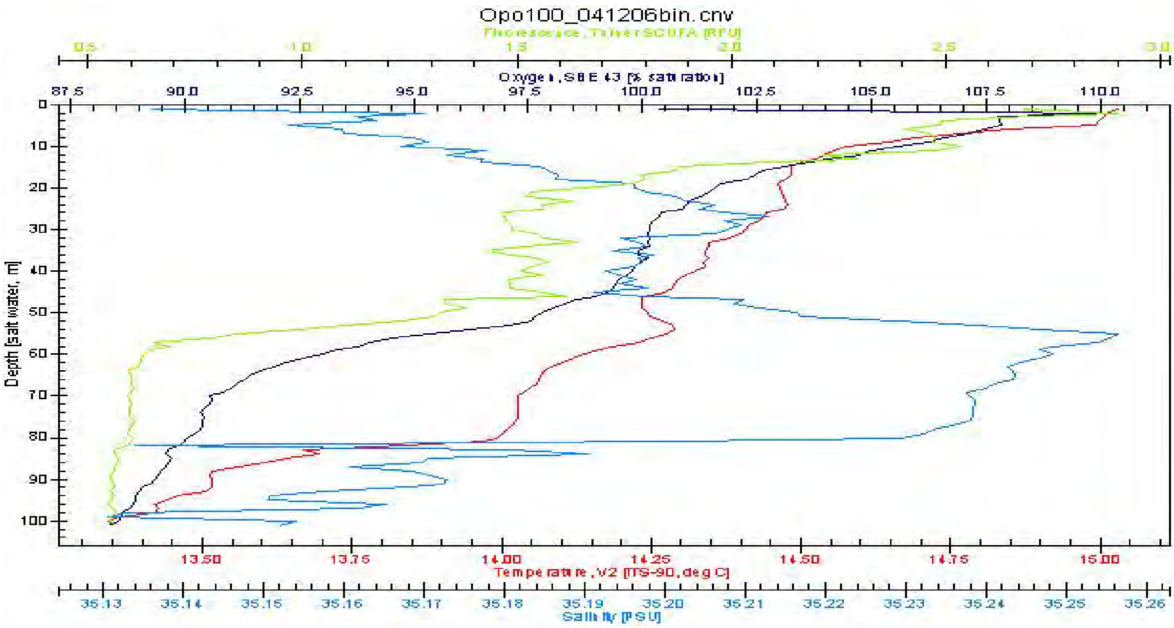

Whk30_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

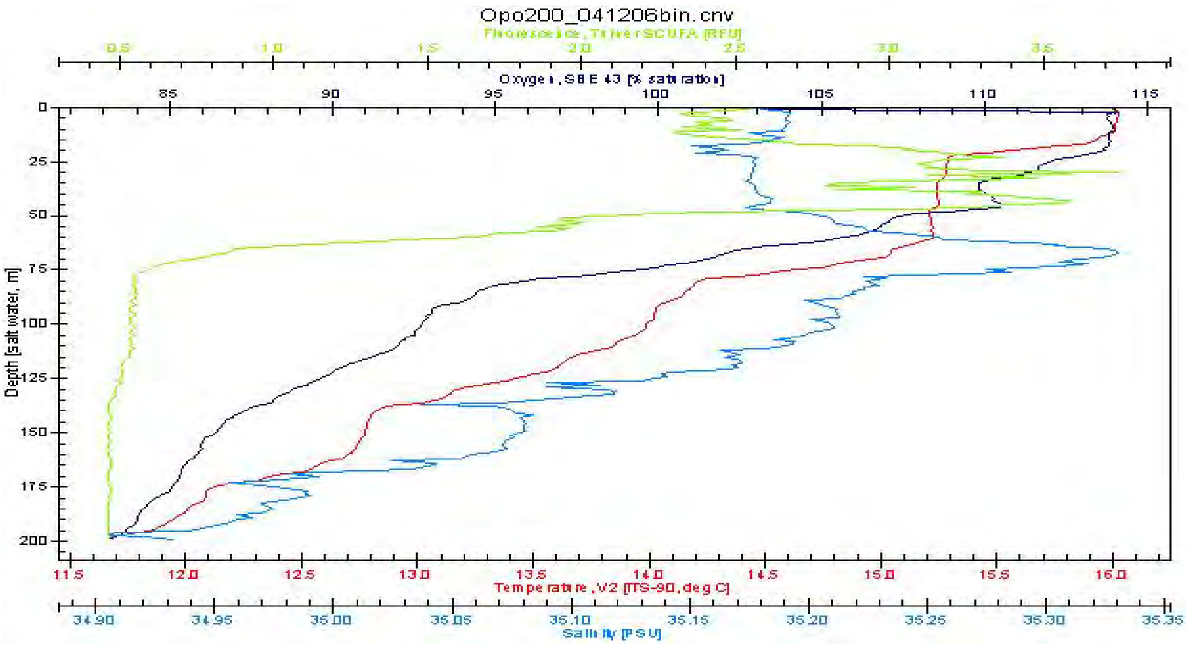

Whk50_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

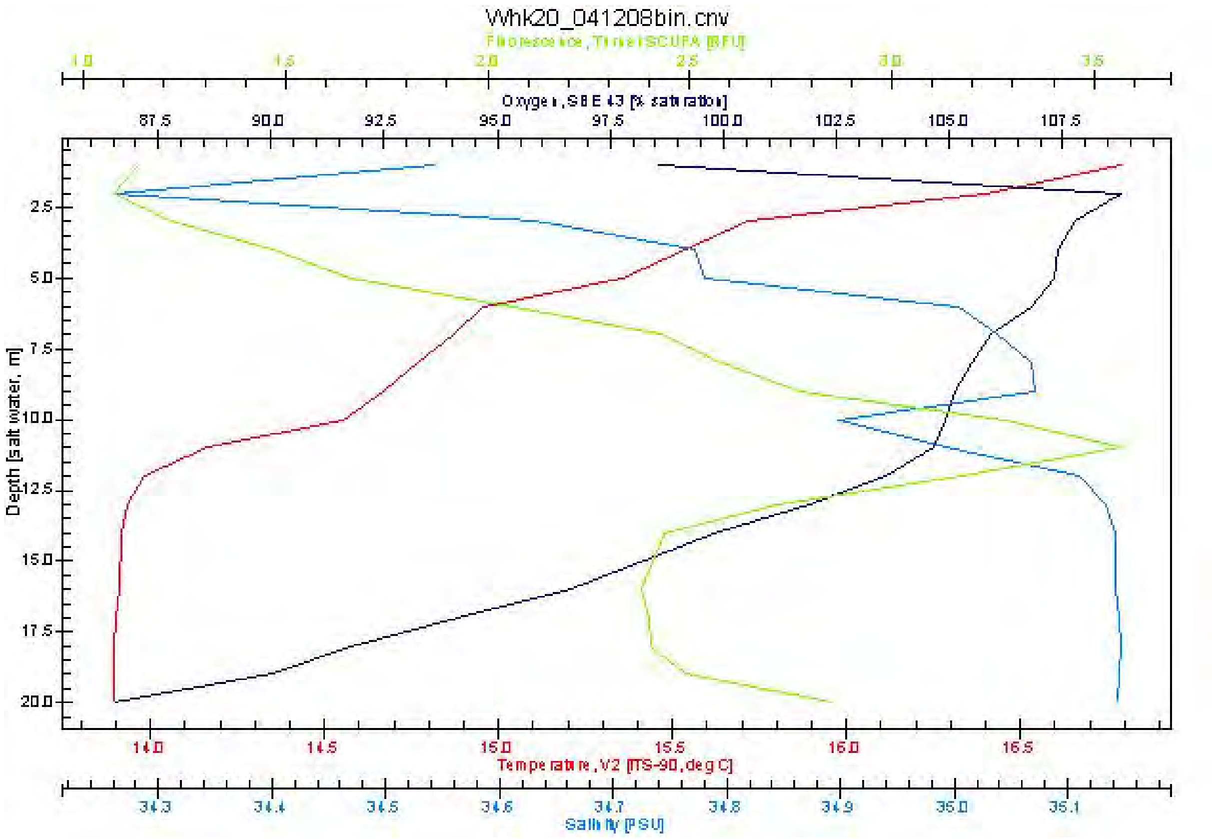

Whk100_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

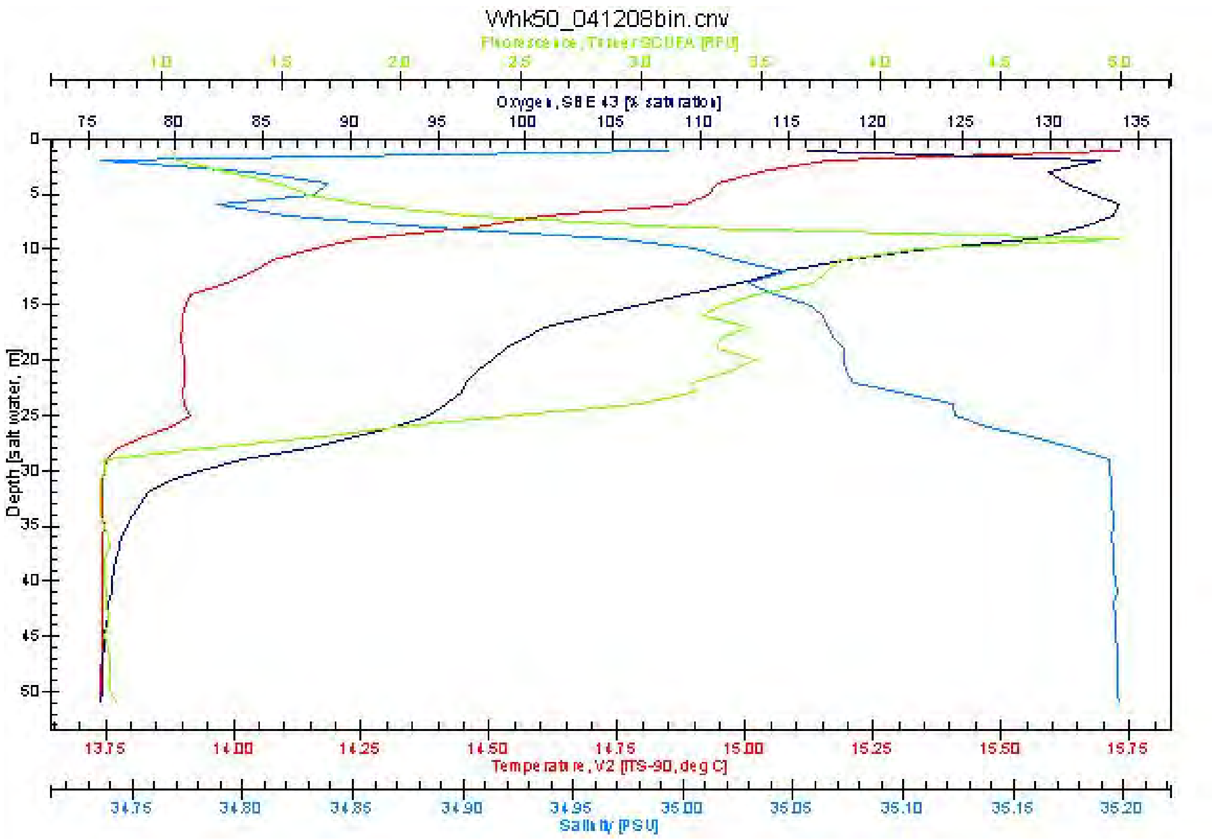

Whk200_041028bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

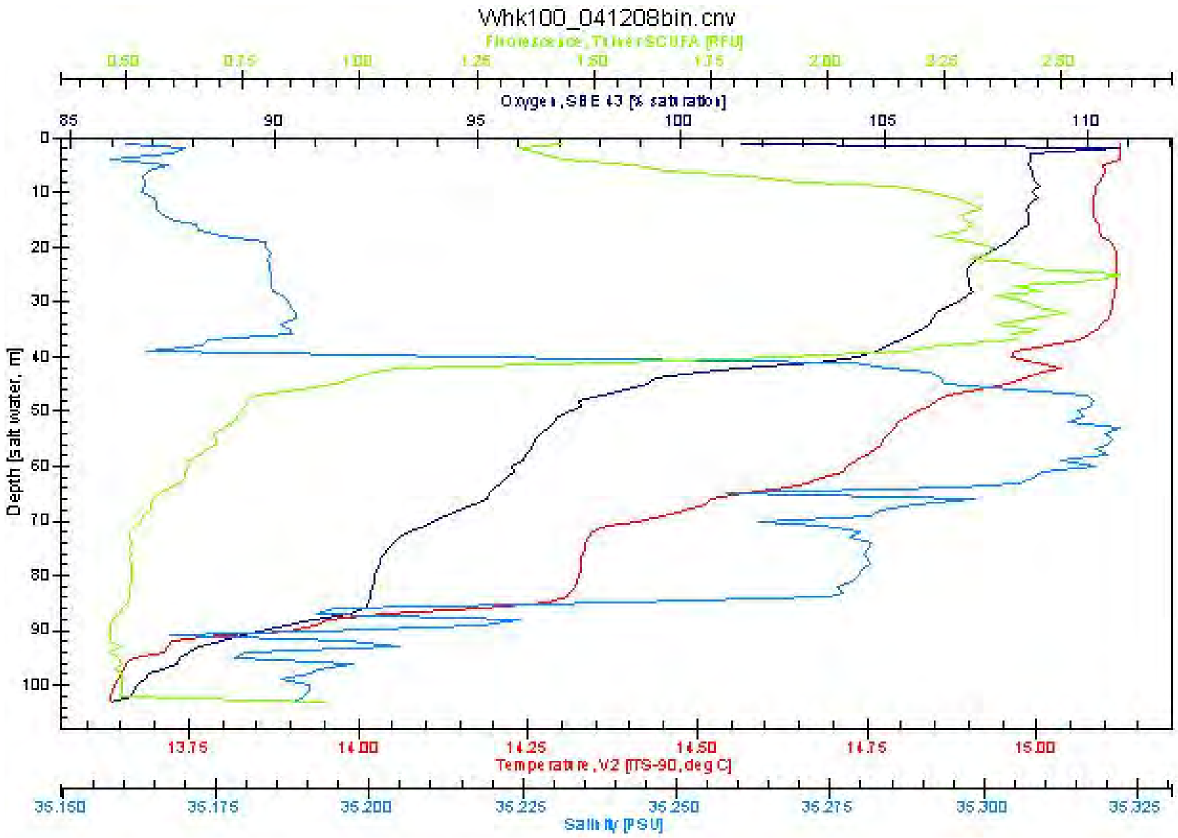

Opo50_041208bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

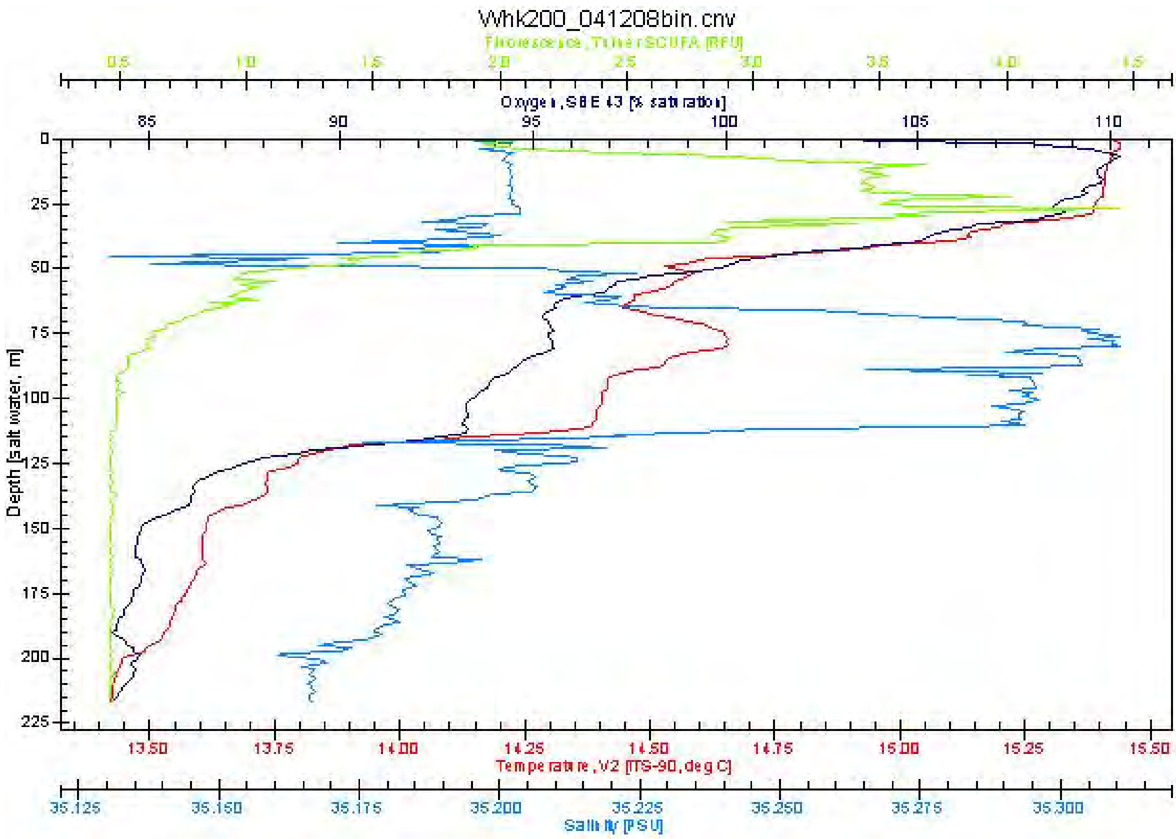

Opo100_041206bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

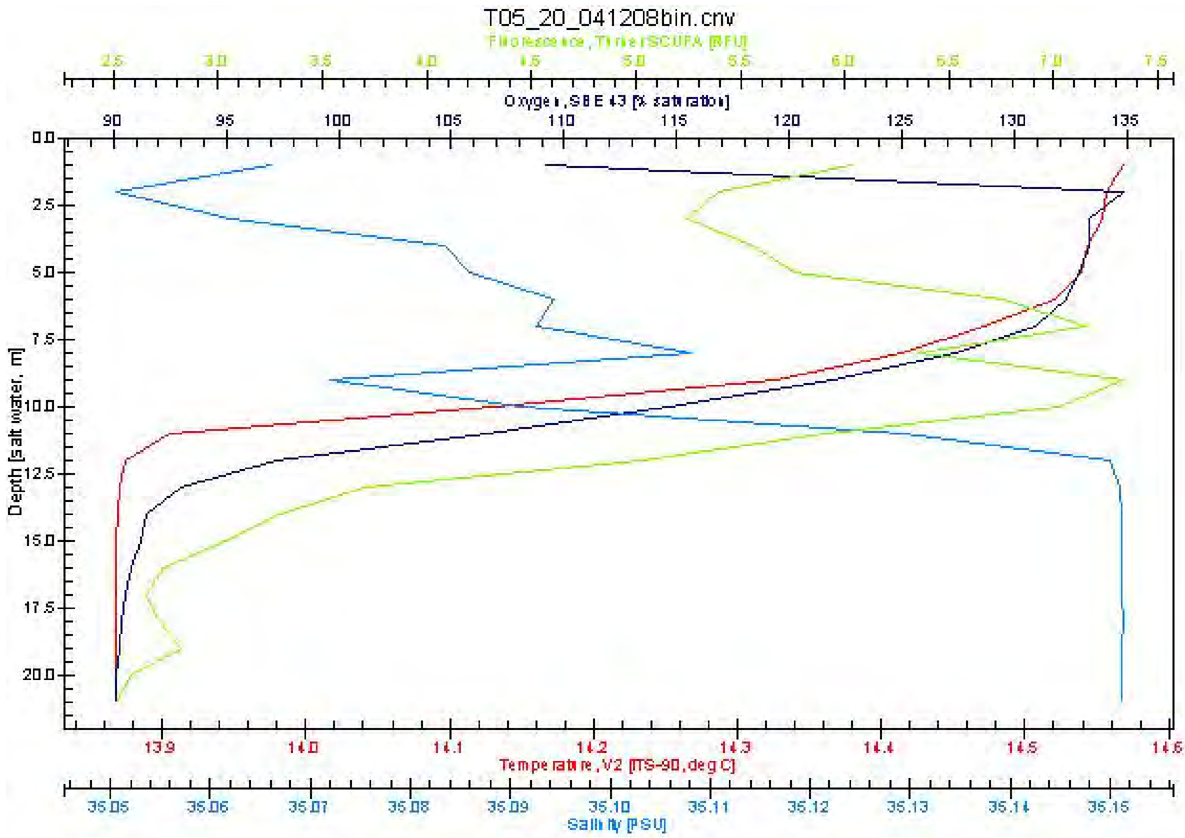

Opo200_041206bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

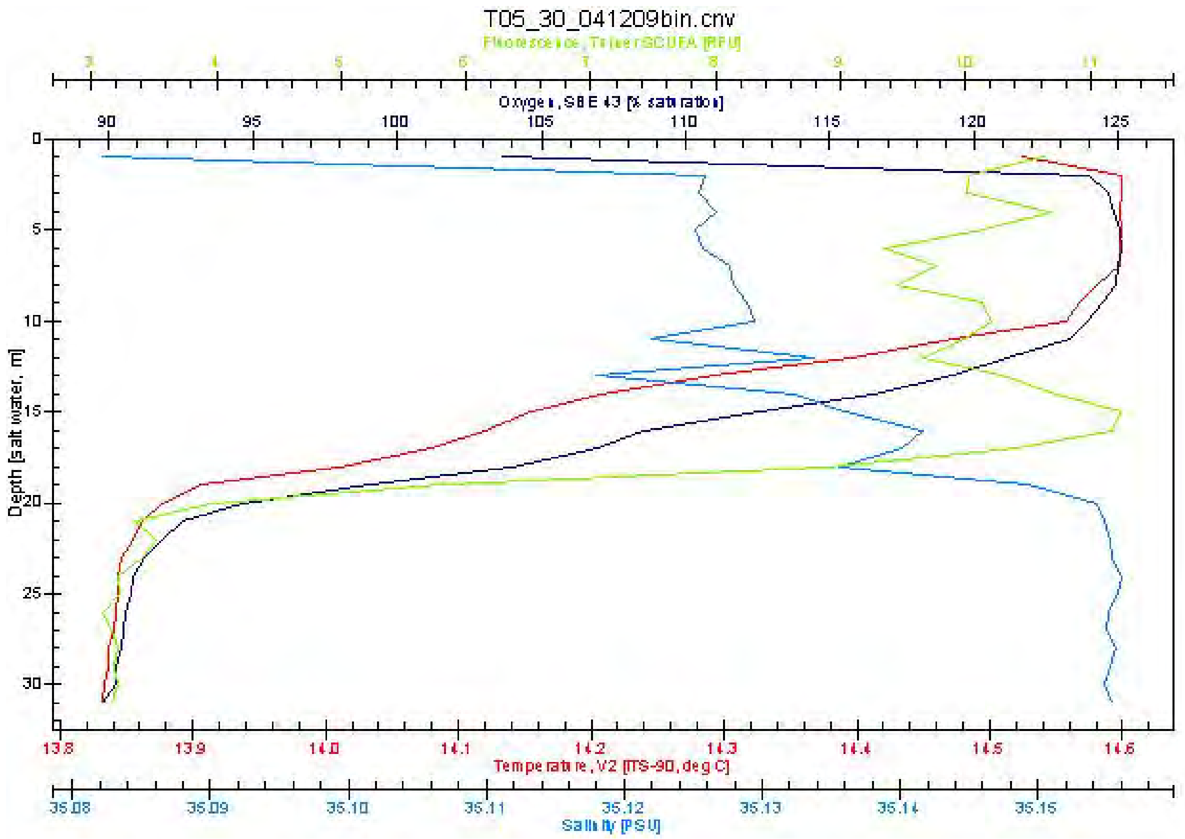

Whk20_041208bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

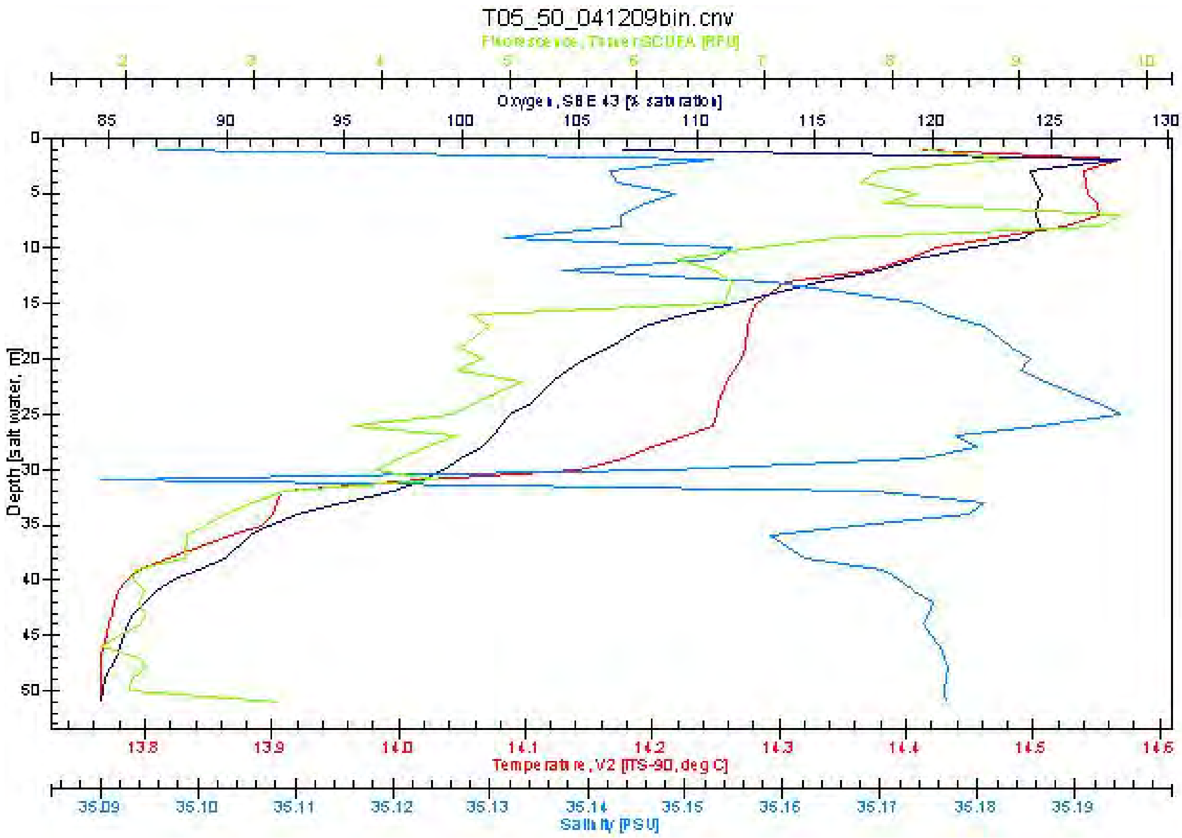

Whk50_041208bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

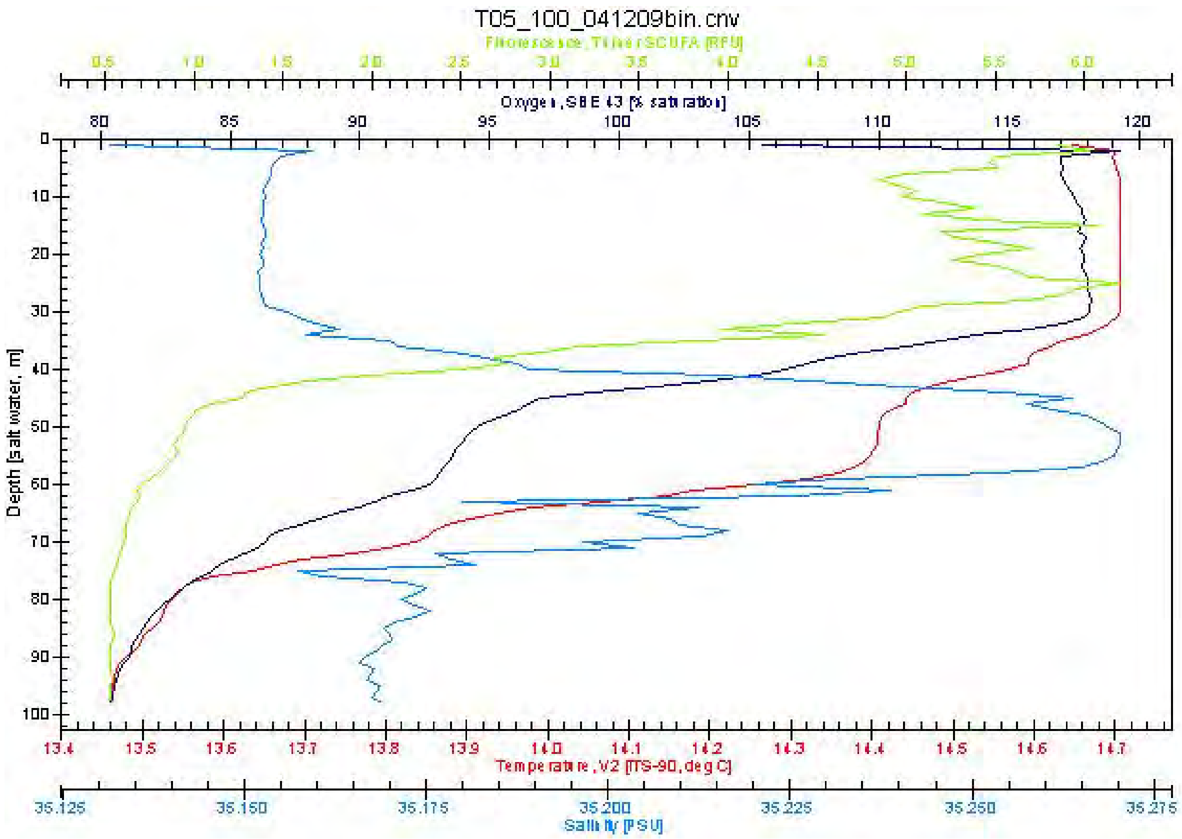

Whk100_041208bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

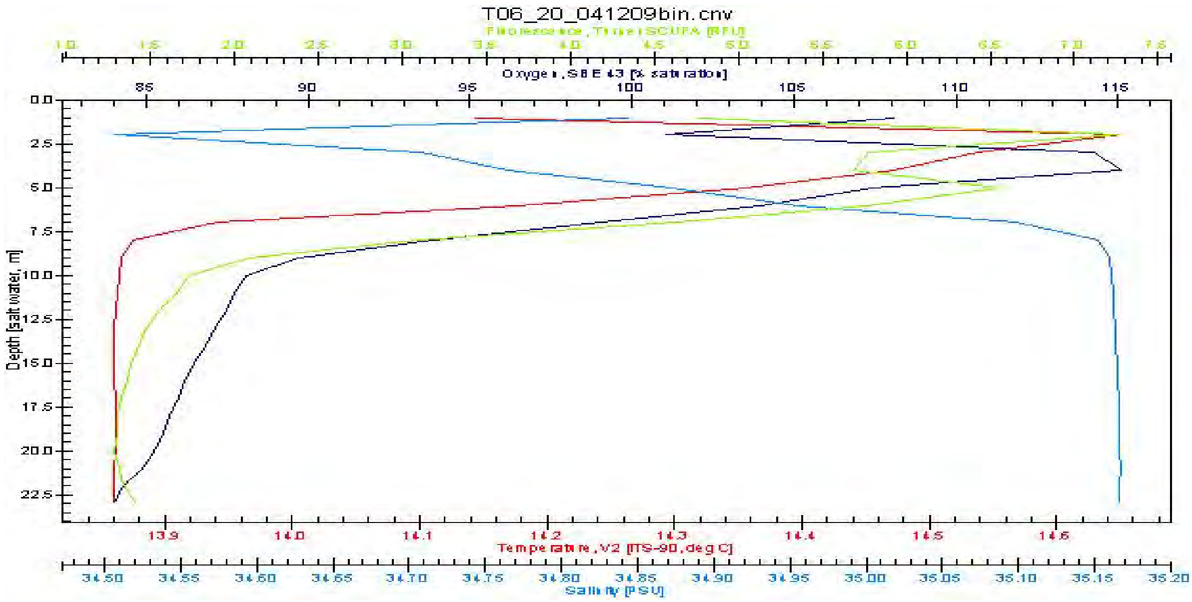

Whk200_041208bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

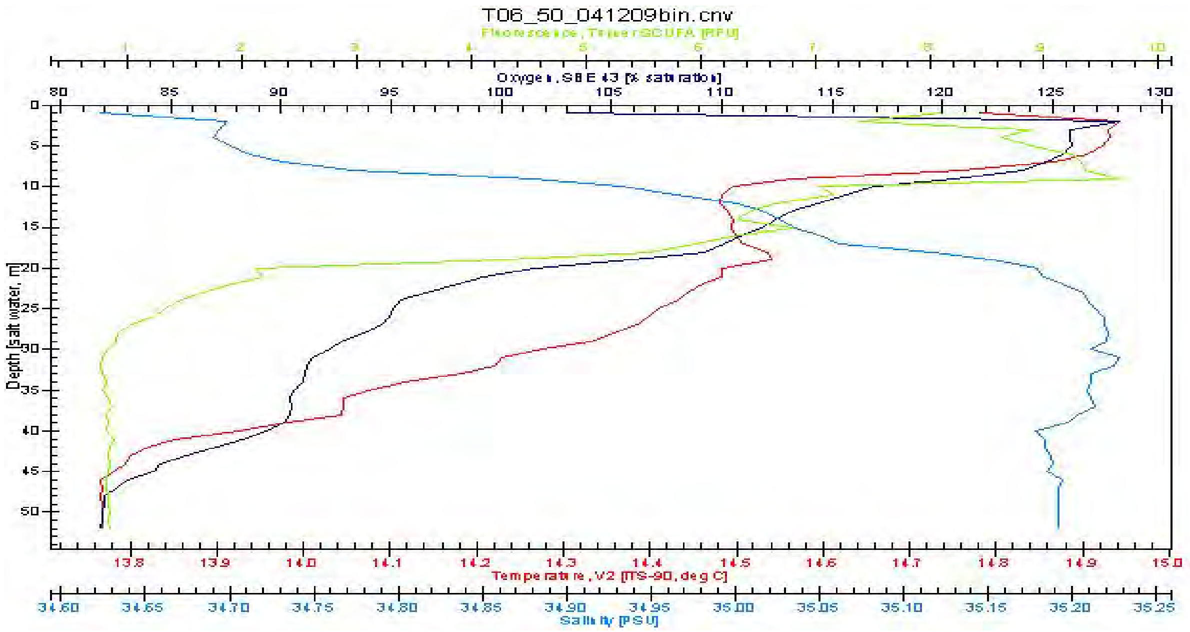

T05_20_041208bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

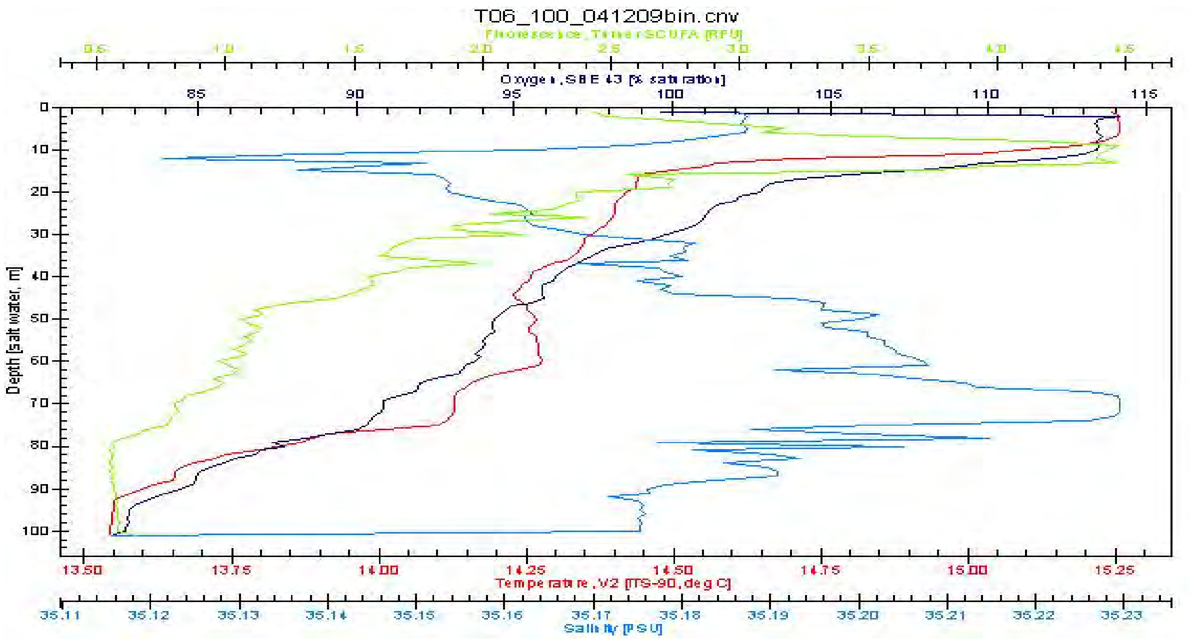

T05_30_041209bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

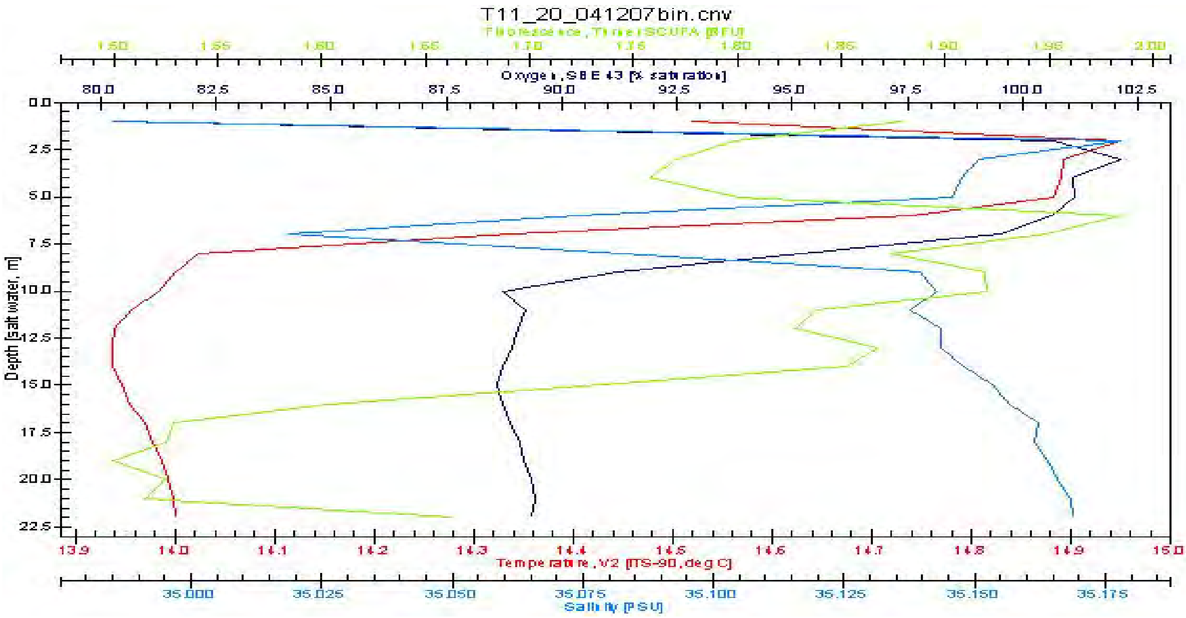

T05_50_041209bin.cnv
Fluorescence, Turner SCUFA [RFU]
2
3
4
5
6
7
8
9
10
Oxygen, SBE 43 [% saturation]
85
90
95
100
105
110
115
120
125
130
Depth [salt water, m]
0
5
10
15
20
25
30
35
40
45
50
13.8
13.9
14.0
14.1
14.2
14.3
14.4
14.5
14.6
Temperature, V2 [ITS-90, deg C]
35.09
35.10
35.11
35.12
35.13
35.14
35.15
35.16
35.17
35.18
35.19
Salinity [PSU]

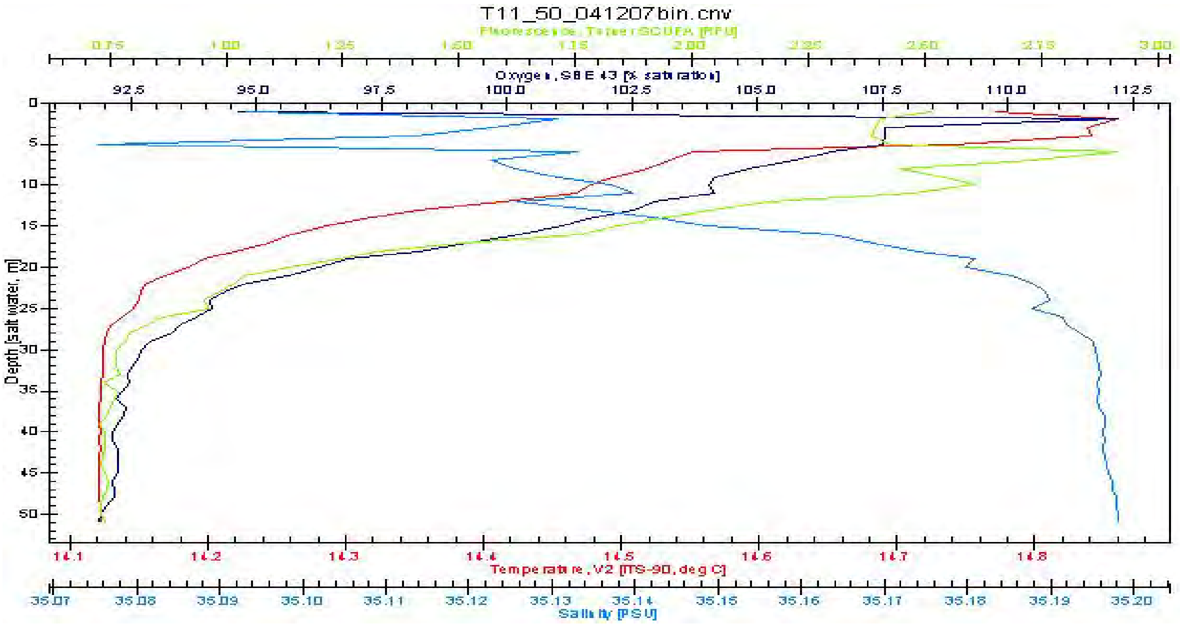

T05_100_041209bin.cnv
Fluorescence, Turner SCUFA [RFU]
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Oxygen, SBE 43 [% saturation]
80
85
90
95
100
105
110
115
120
Depth [salt water, m]
0
10
20
30
40
50
60
70
80
90
100
13.4
13.5
13.6
13.7
13.8
13.9
14.0
14.1
14.2
14.3
14.4
14.5
14.6
14.7
Temperature, V2 [ITS-90, deg C]
35.125
35.150
35.175
35.200
35.225
35.250
35.275
Salinity [PSU]

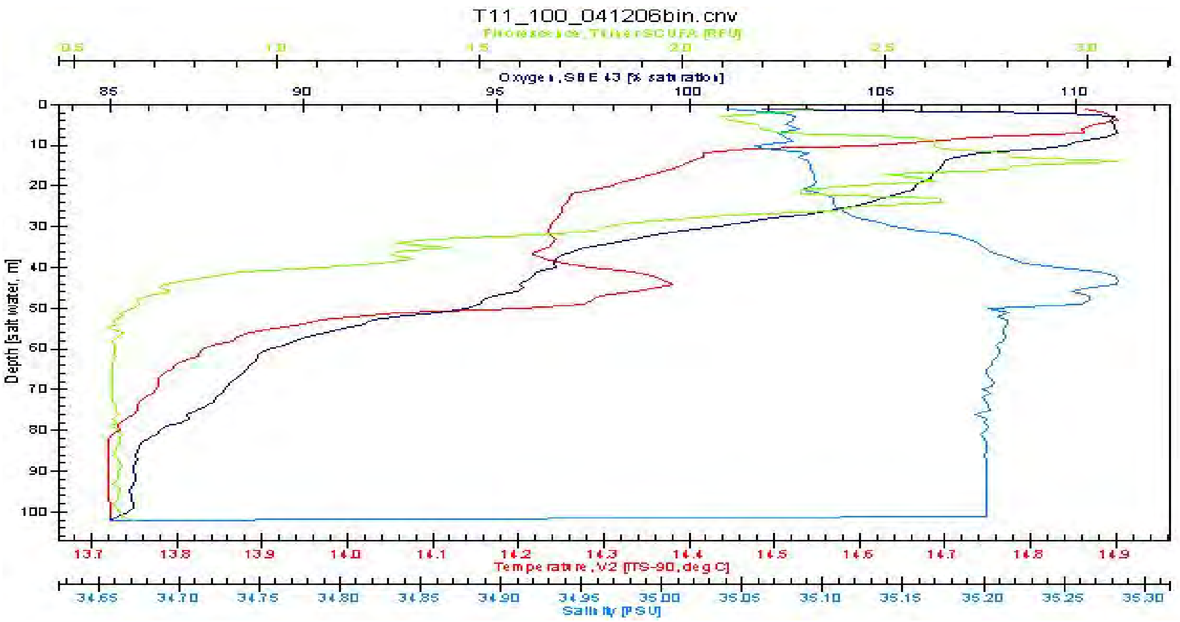

T06_20_041209bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

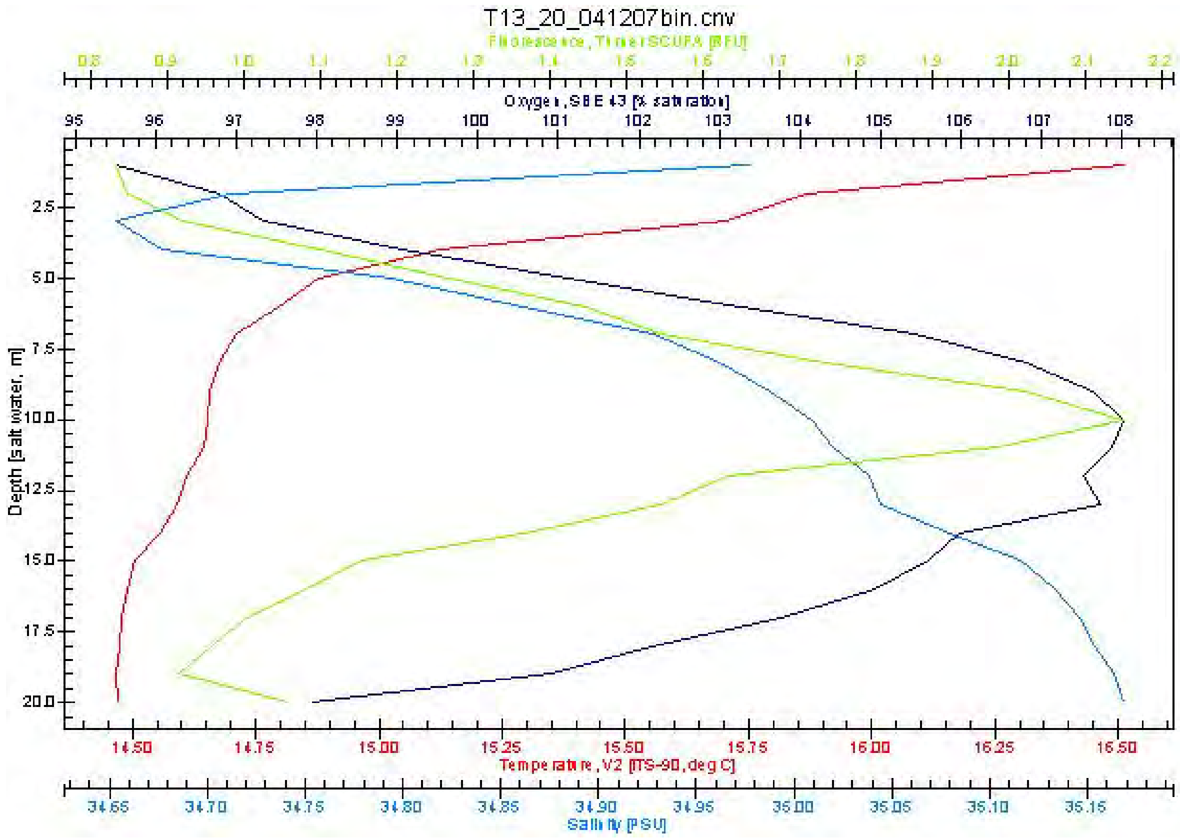

T06_50_041209bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

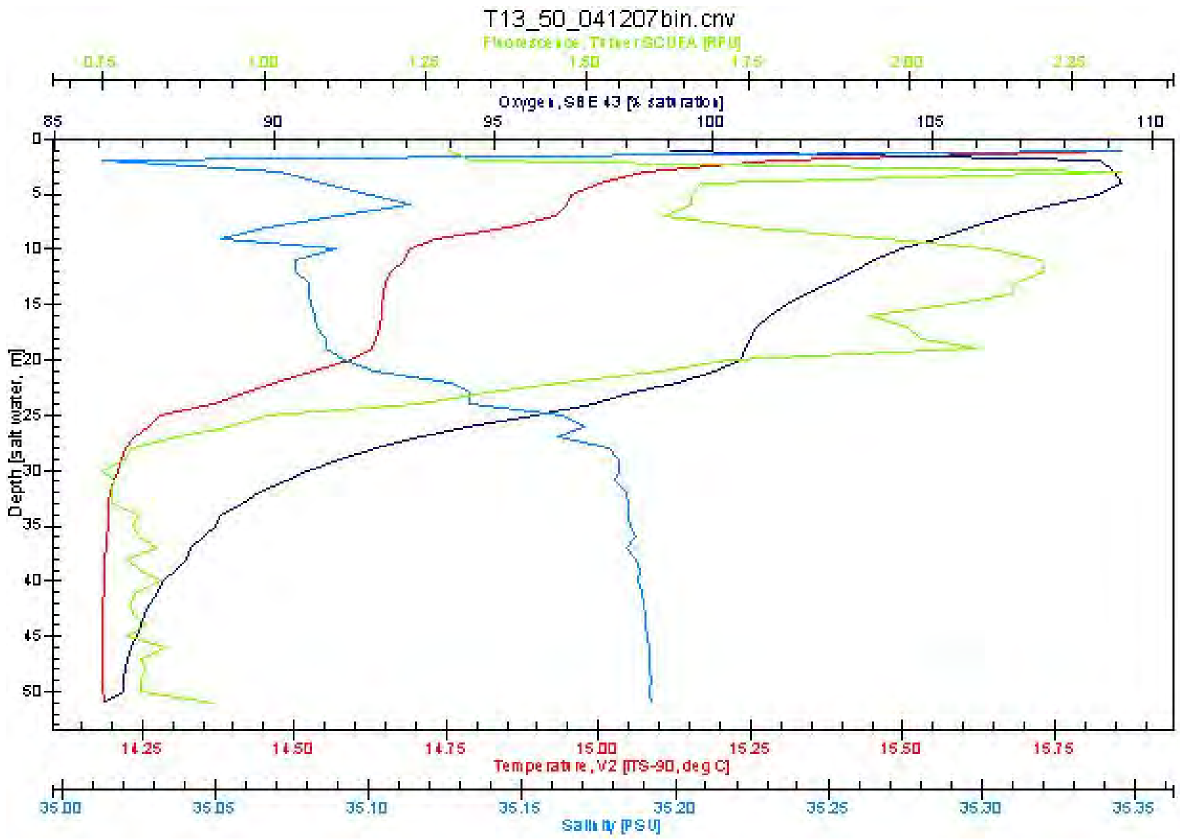

T06_100_041209bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

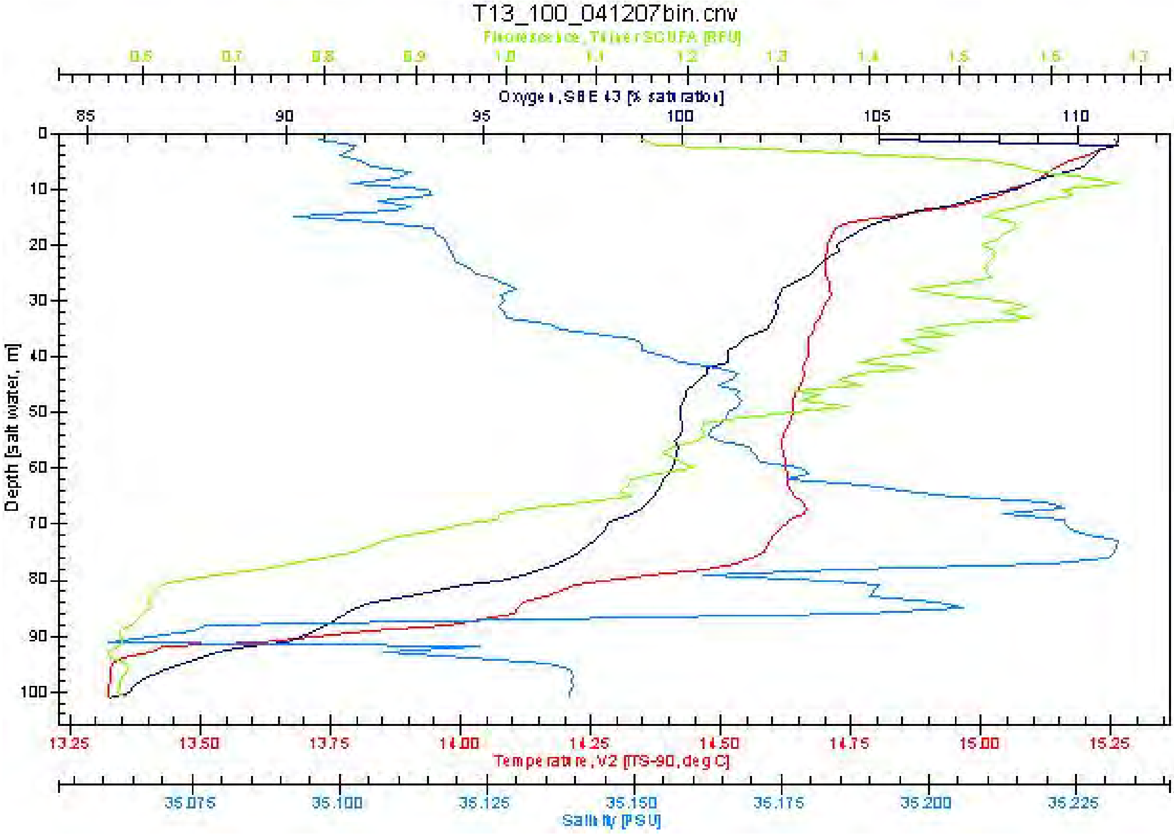

T11_20_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

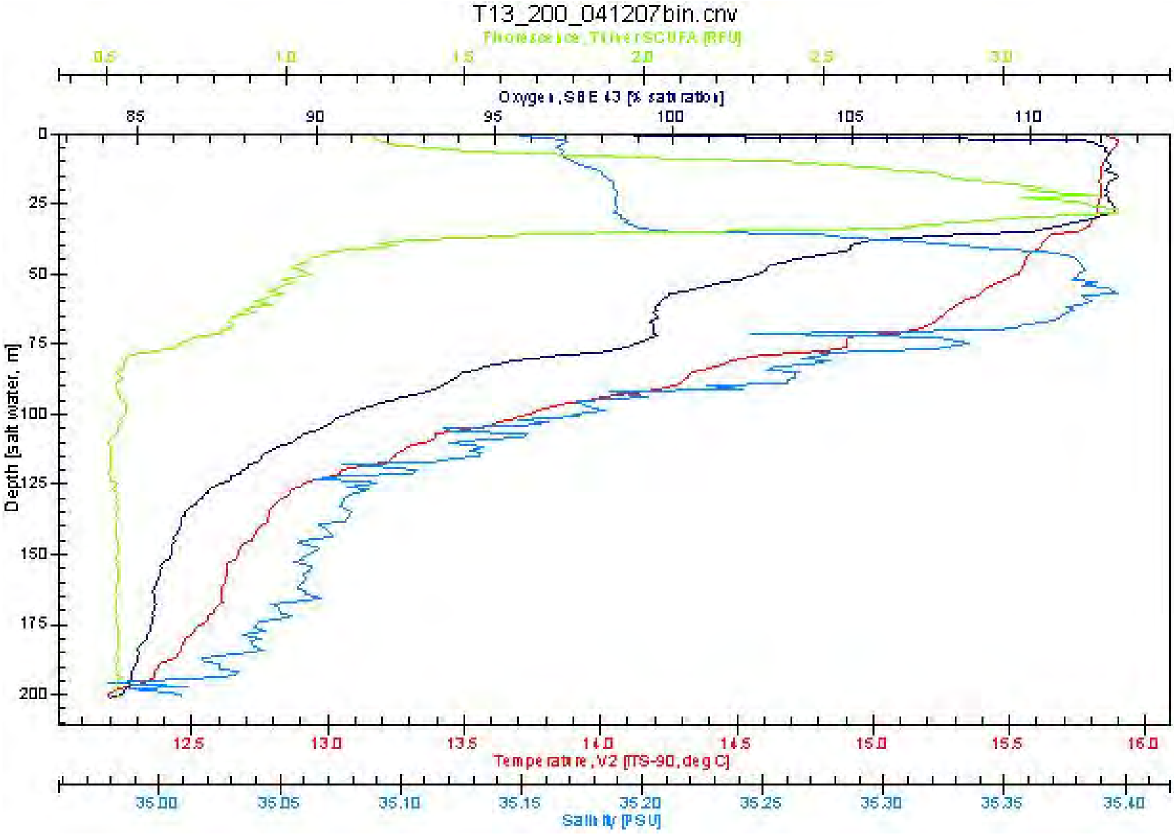

T11_50_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

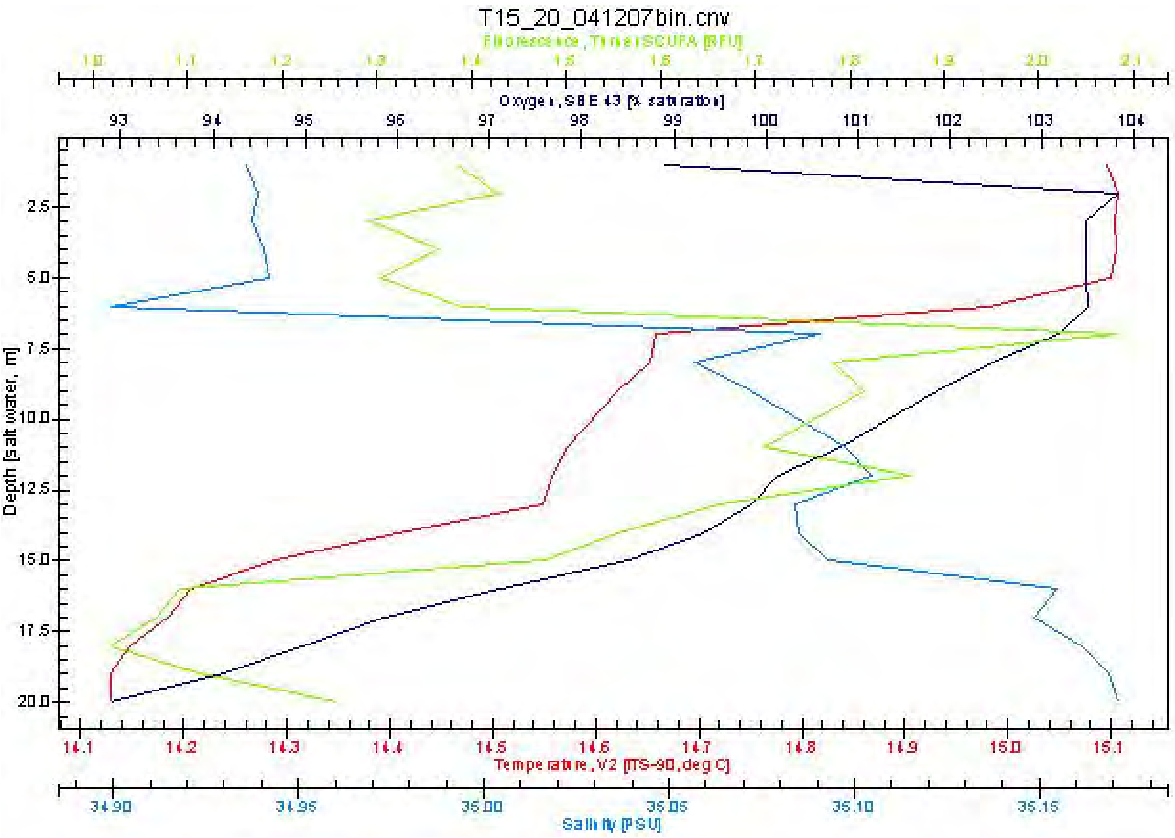

T11_100_041206bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

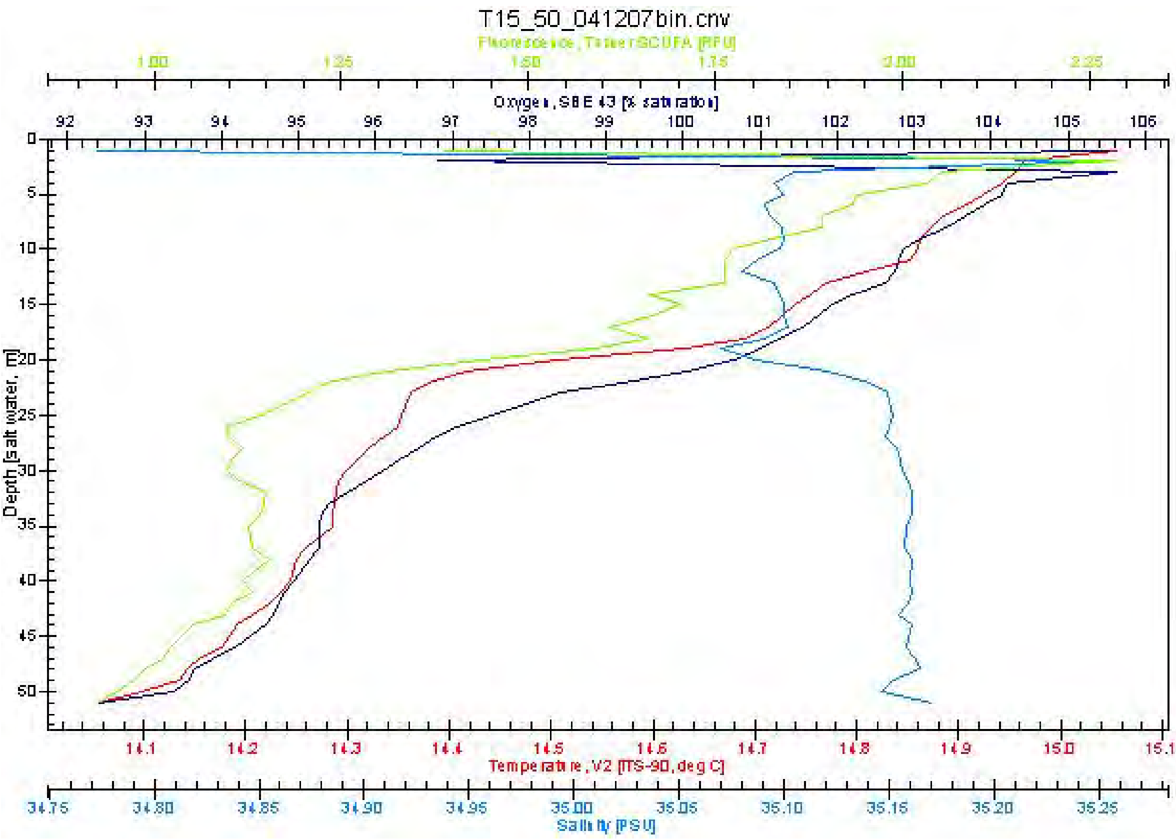

T13_20_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

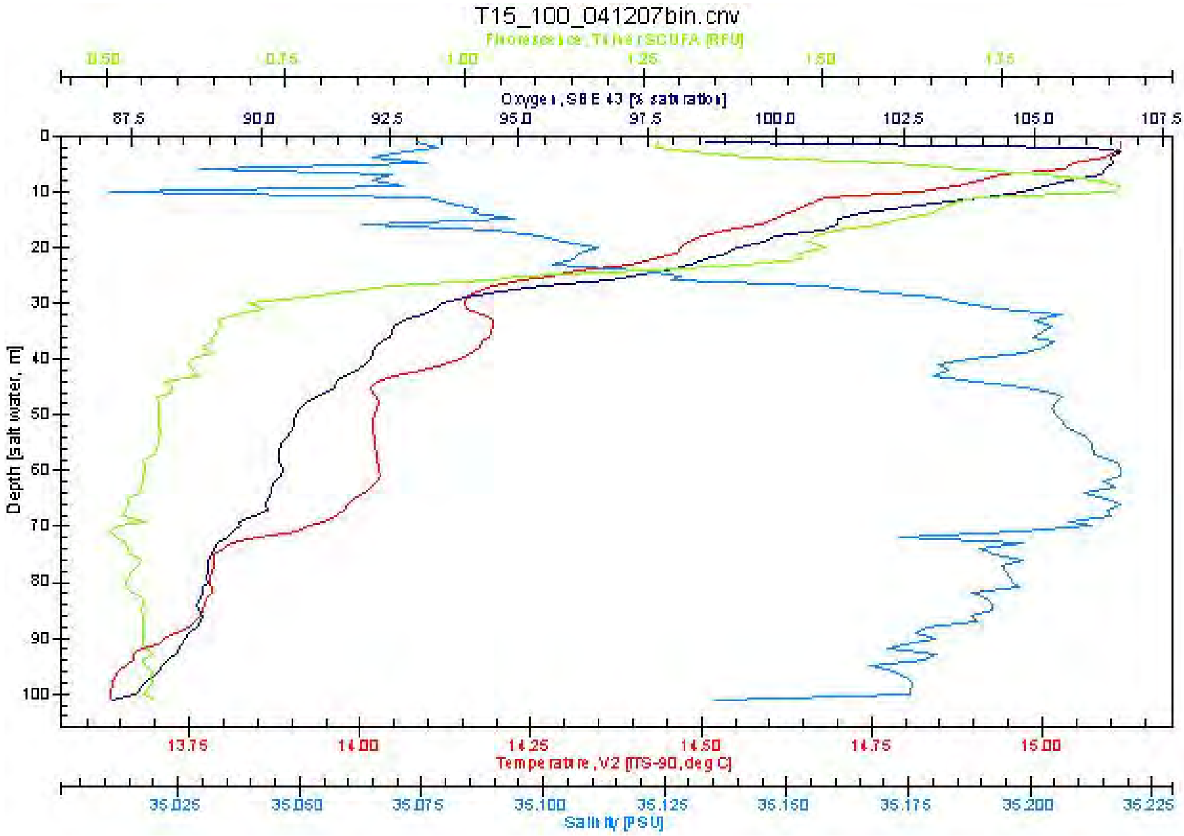

T13_50_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]

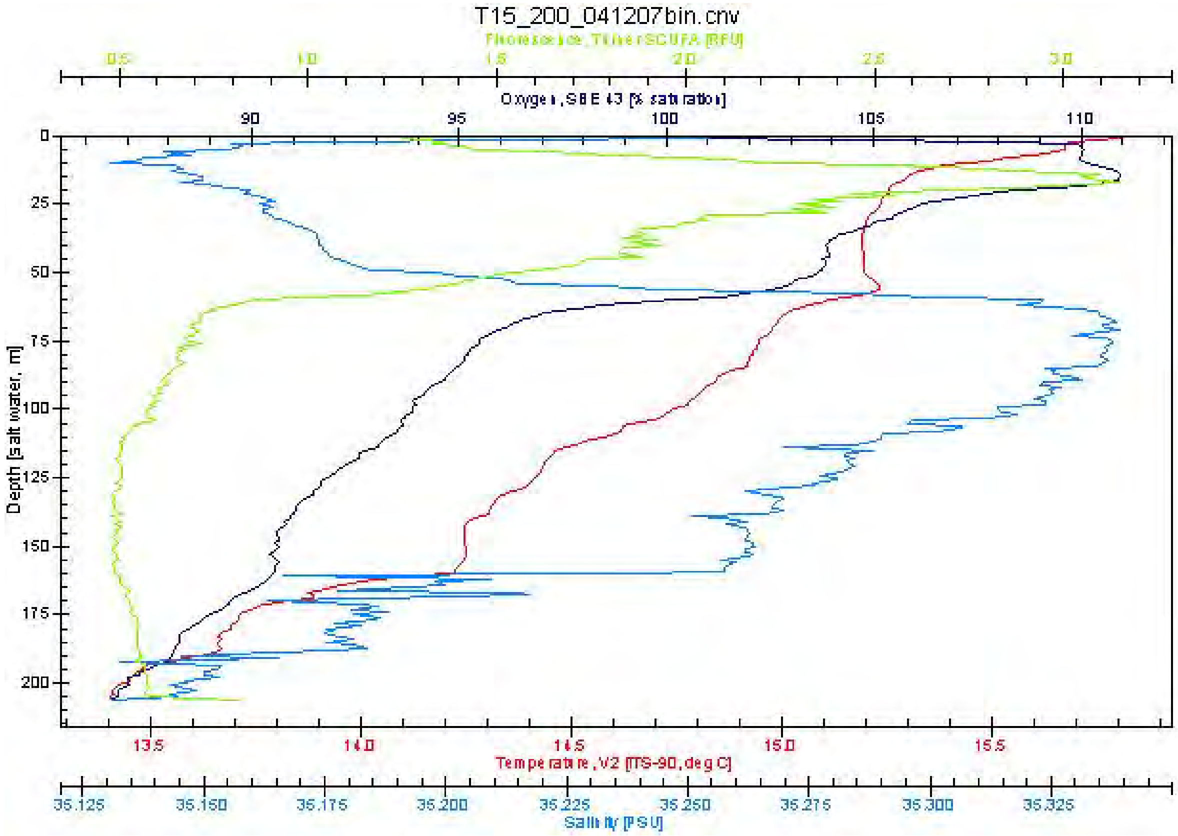

T13_100_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


T13_200_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


T15_20_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


T15_50_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


T15_100_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]


T15_200_041207bin.cnv
Fluorescence, Turner SCUFA [RFU]
Oxygen, SBE 43 [% saturation]
Depth [salt water, m]
Temperature, V2 [ITS-90, deg C]
Salinity [PSU]