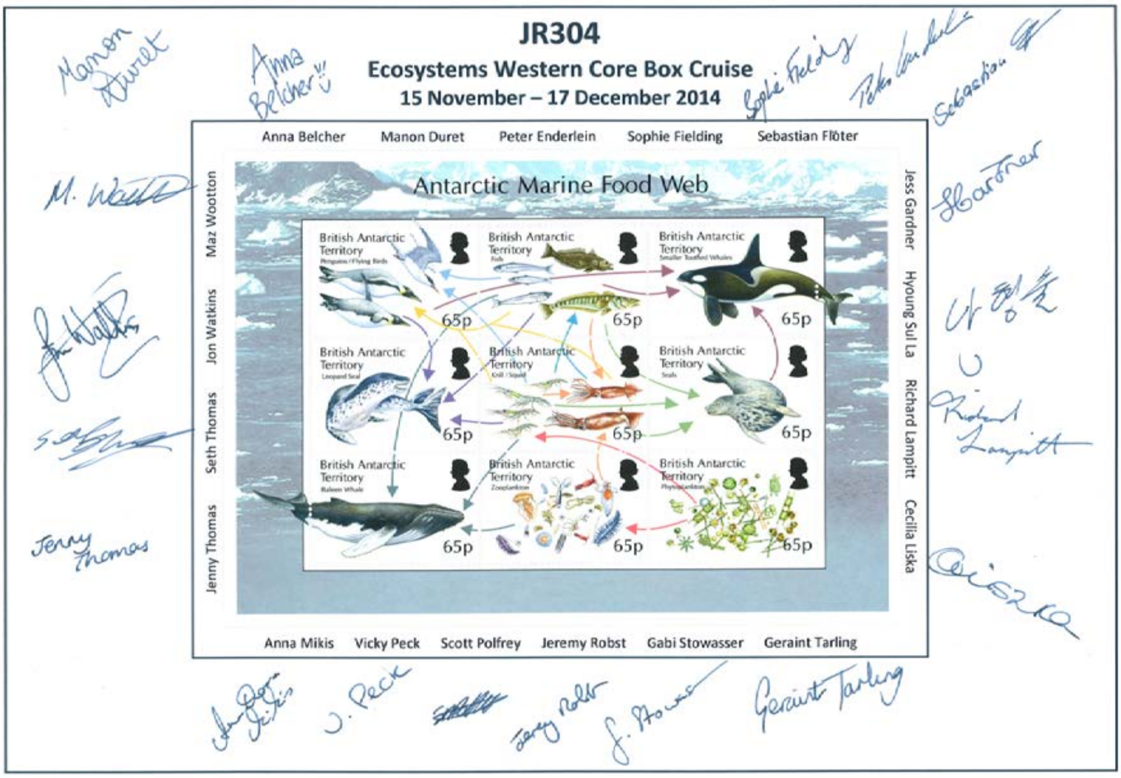
JR304

Ecosystems Western Core Box & Moorings

Incorporating CGS projects 95, 99 and 101

15 November 2014 to 17 December 2014



Version Control – This version produced May 2016, replacing original report

Contents

Report Edit History – Version Control

Report Version	Date completed	Notes
1 original final report	Approx. April 2015	Word doc was named "JR304 cruise report v5.1_final.doc" BODC noted the chapter "Underway Sampling for chlorophyll" Chapter 2.4.1 contained an incorrect table from an earlier cruiser. There was also highlighted text in various sections.
2 (version 2)	March 2016	Ellen Bazeley-White (Polar Data Centre) edited report. Changes: Chapter 2.4.1 table 2-5 replaced with a table provided by Anna Belcher Chapter 6.3 Krill weigh bridge – description of table 6-5 edited Chapter 7.6.2.2 reference error (to another chapter) removed Chapter 11.8 Data Requests – edit provided by Jenny Thomas: *CTD data* – cast 007 – output file name changed Chapter 11.9 Data set summary – edits provided by Jenny Thomas: ADCP & XBT – highlights removed LADCP – calibration information added Marine snow catcher & Bongo – highlights removed Moorings – highlighted text removed Index page numbering updated and version control table added after index
	May 2016	EK60 temp and salinity details added – info provided by Sophie Fielding

1 Introduction

1.1 Rationale

JR304 is a combined science and logistics leg of the 2014-15 voyage of the RRS James Clark Ross to the Antarctic. As part of the logistics element, the ship undertook base reliefs at Bird Island, King Edward Point and Signy. During the science part of the cruise we undertook the Western Core Box survey to determine the distribution and biomass of krill and other plankton to the northwest of South Georgia, refurbished 3 biological moorings in the South Georgia region, undertook a series of time stations across the Scotia Sea which provided a focus for collaborative studies with scientists from UK, Germany and Korea. Included in this cruise were 3 activities funded under the Collaborative Gearing Scheme (CGS).

Unlike many previous combined science and logistic legs, JR304 mixed science and logistics throughout to minimize the revisiting of locations and hence minimize time and total mileage steamed. Thus after leaving Punta the ship undertook the following main blocks of work:

1. CPR and bongo sampling on route to Signy (section 8)
2. Signy base relief
3. Time station sampling at Ice Station (just north of South Orkneys) (section 7)
4. CPR and bongo sampling on route to P2 Southern Mooring Station (section 8)
5. Time station and mooring refurbishment at P2 Southern Mooring Station (sections 4.3 and 7)
6. CPR and bongo sampling en route to Bird Island (section 8)
7. Bird Island passenger call
8. Stromness Acoustic Calibration (section 3.1.4)
9. Cumberland Bay Sampling (section 7.9)
10. KEP base relief
11. Bird Island base relief
12. Western Core Box Survey (section 6)
13. Time station and mooring deployment at P3 Northern Mooring Station (sections 4.44.3 and 7)
14. Time station sampling at Upwelling Station (NW of South Georgia)(section 7)

1.2 West Core Box Summary

Since 1981 BAS have undertaken cruises to determine krill biomass as part of the ongoing assessment of the status of the marine ecosystem in the region of South Georgia. This unique time series, known as the Western Core Box, is part of the Ecosystems Programme contribution to BAS national capability. It comprises an acoustic grid survey of 8 transects each of 80 km in length, together with associated net and oceanographic sampling and the calibration of acoustic instrumentation.

In addition to the acoustic survey, which covers a wide area but has limited temporal coverage, there are three moorings (one on the shelf in the Western Core Box, and two in deep water to the southwest and northwest of South Georgia) to provide a temporal, year-round set of observations. These moorings are recovered during the cruise, refurbished and data downloaded, and then redeployed later in the cruise. The shallow WCB mooring has been in position more or less continuously since 2003.

1.3 Time Station Summary

This year a series of 4 time stations to investigate diel changes in distribution and production of the lower trophic levels of the pelagic food-web were planned and provided a focus for much of the collaborative work being undertaken on this cruise. For each station the overall structure of the sampling was based around a set of 4 oblique zooplankton net hauls centred on the cardinal times of midday, midnight, 06:00 and 18:00 (all with respect to local noon). Other activities such as CTDs, water sampling, vertical netting, snow catcher and snow camera were interspersed between the oblique netting. In addition at stations P2 and P3, the time station incorporated refurbishment of the deep moorings.

1.4 CGS summary

Three CGS projects have been incorporated into cruise JR304:

- Investigating the use of forminiferal stable isotopes for constructing seasonality in the Southern Ocean (cgs- 95)(section 7.8).
- Diel variability in composition of sinking particles (cgs 99)(sections 7.3 and 7.4)
- Early season epipelagic community structure of South Atlantic and Scotia Sea (cgs-101)(section 8).

1.5 Cruise timings – planned v actual

In August 2014 due to problems with the 10 tonne crane in refit the original time allocation for the cruise was reduced by 3 days. Thus the activities to be undertaken had already had to be reduced to fit within the planned itinerary even prior to the start of the cruise. Problems with the crane continued to impact the cruise during initial mobilization in Punta, with the net result that the ship sailed from Punta Arenas around 36 hours later than initially planned. Some of this deficit was recovered during passage to Signy but Signy base relief took substantially longer than planned – essentially 5 days rather than 3 days. After this point it was clear that not all science elements would fit into the remaining time and that a block of around 2.5 – 3 days science time would likely need to be removed. The lowest priority work was the EM2040 multi-beam acoustic study in Cumberland Bay. The next lowest priority was the upwelling time station and it was not clear until almost the end of the cruise as to whether any part of this final station might be completed. While the science element will always be at risk of logistic overruns in these combined cruises it should be appreciated that by combining these two elements re-organizing and interleaving of the science and logistics can be

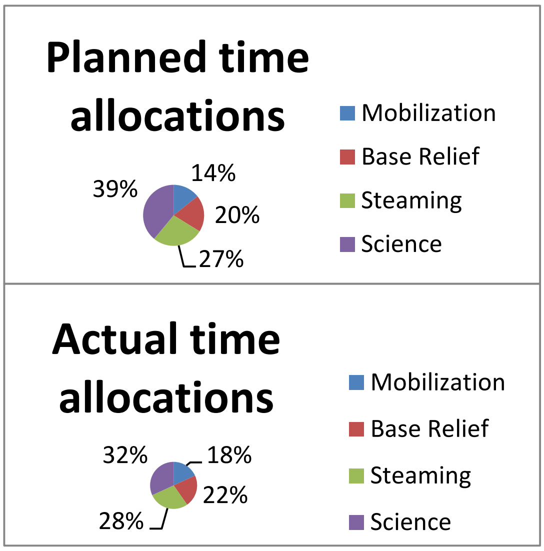


Figure 1-1: Comparison of planned and actual time allocations for the different phases of cruise JR304

continually re-assessed during the cruise to make the most efficient overall use of time.

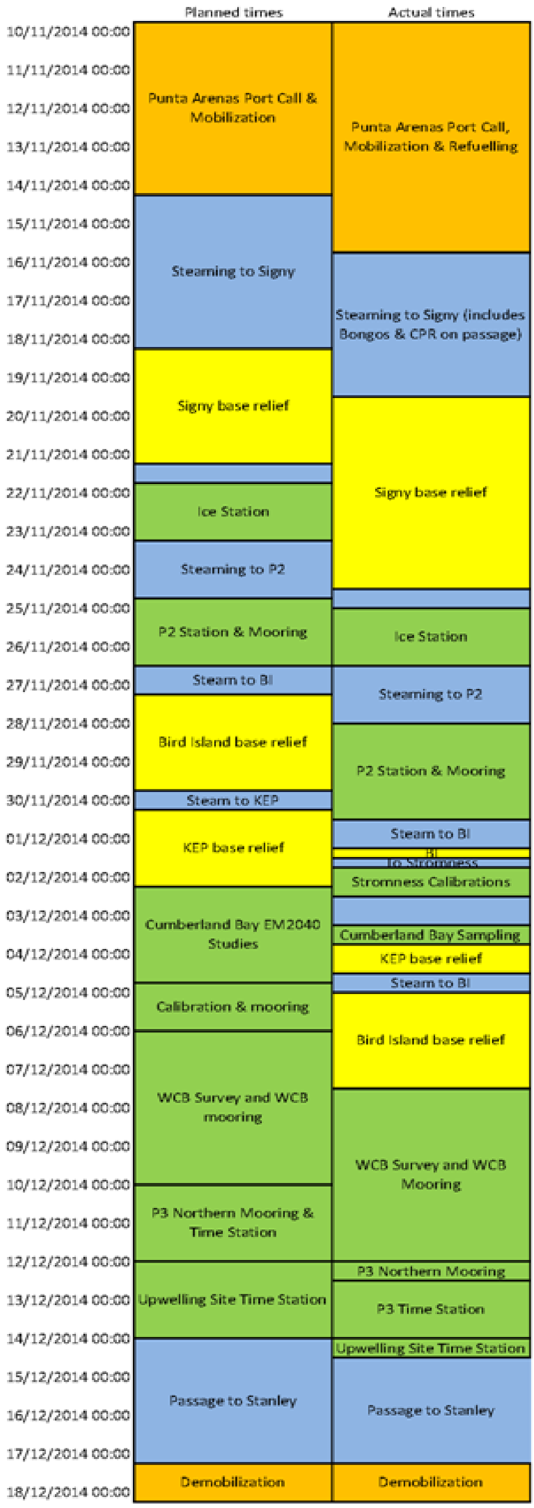


Figure 1-2: Breakdown of planned and actual major activity times and organization during cruise JR304

1.6 Cruise Narrative

Note that all timings in cruise narrative are expressed in local ship's time (GMT -3 hours) unless otherwise stated.

10 November 2014 (Monday)

Science parties from BAS and elsewhere in UK met at Heathrow for the flight via Madrid and Santiago to Punta Arenas. Flight from Madrid left at 23:55.

11 November 2014 (Tuesday)

We arrived in Santiago to find that 8 bags (belonging to 7 people) were missing. All details were taken by LAN agents at airport. We arrive at ship at 20:00 having been picked up by agents from the airport.

12 November 2014 (Wednesday)

The 10 tonne crane still not working so AMT containers still on aft deck, JR304 containers still on hatch cover of forward hold. New scientists were given a brief tour of ship. The second party of scientists and base personnel arrived at the end of day.

13 November 2014 (Thursday)

We have a full safety briefing and boat drill for entire group of scientists and base personnel. Later we have a science meeting to sort use of labs and make final allocates of space. Meanwhile the crane gets load tested and certified. Finally the AMT containers get taken off the aft deck and our containers get put on aft deck by the end of the afternoon. PSO and 2 scientists with Macarena (from the ship's agents Agunsa) visited the airport at 18:00 to follow up with LAN agents about missing luggage but there was still no hard information about where the bags are. The rest of Science team have a late night unpacking containers. Work on the aft deck was complicated by the amount of equipment and cargo on deck, the limited space made it like a life-sized game of solitaire (moving pegs on a board with only 1 free hole).

14 November 2014 (Friday)

Scientists who have lost bags were taken by Agunsa agent to buy clothes, toiletries and other necessary items. The whole process took over 6 hours but the purchases were only delivered to the ship at around 21:00. It was like an early Christmas with the various items to be divided up between the 8 people. We were extremely glad to be able to have a change of clothes as some of us had been having to use the same clothes that we set off from Cambridge in. The remaining science team have been able to mobilize to a large extent.

15 November 2014 (Saturday)

We left the Pratt Pier in Punta Arenas at 07:00 to travel up to the refuelling terminal at Cabo Negro. Two tugs in attendance to ensure no problems coming along side. Strong winds, at times in excess of 30 knots, have meant that the conditions for refuelling have been borderline at best. Deck work has been limited because of the danger of sparks in a gas terminal. We have been able to fit the new brake system to the mooring winch but have not been able to use power tools. Science team met at 14:00 for a general briefing, followed by meeting about underway sampling.

16 November 2014 (Sunday)

First proper day at sea found us steaming at nearly 13-14 knots with a brisk wind 25+ knot wind coming up behind us as we head SE towards the Drake Passage. We left the refuelling terminal at 21:00 last night, taking advantage of a slight lull in the wind to get off the jetty with the attendance of two Chilean tugs. Proceeding overnight up the Straits of Magellan we passed the Pilot Station prior to breakfast. At the present speed we could reach the waypoint off the Inaccessible Islands in 60 hours however our nominal first station, to deploy Bongo and then tow the CPR once we leave Argentine waters, is about 425 nm from the Pilot Station.

17 November 2014 (Monday)

Increasing wind produced a rougher night, with a little more rolling (max 10°). Safety and base briefings take place in the morning, followed by preparations for first bongo event and the launch of the CPR this afternoon. Two bongos started proceedings at 15:45 (L) and then the CPR went in as we got back up to speed, looking to maintain our average speed of around 11.5 knots. We heard at dinner that the 8 missing bags had finally turned up in Punta.

18 November 2014 (Tuesday)

Cracking on to Signy and good conditions enabled us to work in the labs and on deck setting up equipment. After lunch we stopped to undertake a bongo and then re-launch the CPR. Science team met in the afternoon to discuss our plans for the ice station that will take place after the Signy logistics call. We found out that we have left one of our mooring buoys at FIPASS and sent emails to see if we can find a way to get it to South Georgia.

19 November 2014 (Wednesday)

At a waypoint just off the Inaccessible Islands we recovered the CPR at 08:00 (L) and then undertook the final bongo for this Punta to Signy transit. All the worries about sea-ice at Signy proved groundless as we steamed between Coronation Island and Signy encountering just a thin band of brash ice about 100 m wide. We anchored off Borge Bay and sent the reconnaissance party to investigate the situation ashore at 13:40 (L). Unfortunately problems with the cargo tender alternator meant that the engine stopped while looking to put the first work party ashore. The cargo tender was retrieved on a mooring rope taken over by Humber. However there was no more cargo work possible today. We hoped to be able to begin tomorrow at 06:30 (L).

20 November 2014 (Thursday)

Not a productive day as the cargo tender was still not working and by 14:00 (L) the weather put an end to any cargo plans. We upped anchor and steamed out to our night-time safe position beyond Borge Bay. We got the biowire load tested and the water sampler for the P2 mooring tested, however it was too windy to rig the side wires for the RMT8.

Geraint, Sophie, Peter, Gabi and I had a discussion about the ice-station position, and agreed that provided Anna B and Vicky were happy then we should go with position used last year. We will ask Andrew Fleming if they can estimate when that station would have been under permanent sea-ice. We also decided that we will need 12 hours to prepare for the deployment of the mooring once we finish the time station at P2.

21 November 2014 (Friday)

Base opening and cargo team were on standby from 06:30 but first boats got away after 08:00 (L). Decks were covered with a slushy snow. Some cargo went ashore in the Humbers in the morning but the hard work on the cargo tender was rewarded by lunch time and cargo continued using the tender. Pictures of the Humbers leaving the shelter of the ship revealed that everyone must have had a good drenching before they arrived at the base.

22 November 2014 (Saturday)

Signy opening of base continued. We managed to get all science team ashore at some point so at least all the new people have seen the base and the surrounding area.

23 November 2014 (Sunday)

Bird Island staff went off to the penguin colony at Gourlay to retrieve penguin loggers and to layout nest-marking bricks. Some of science team helped with tasks ashore.

24 November 2014 (Monday)

Anchored off Signy again at 07:45 and Engineers and Comms team went ashore. Finally got communication from Signy that all was good to go at 15:00. Once all onboard there was a test of the 3rd Humber engine before we sailed at 16:30 (L). The extensive pack-ice provided many photo opportunities for everyone. Free of the pack south of the Inaccessible Islands we steamed up to the site where we deployed the mooring during JR280. The mooring is pinged a number of times at 23:30 (L) but there is no response, we conclude that there is now no possibility of recovering this mooring.

25 November 2014 (Tuesday)

We finally arrived at the Ice Station and started the first CTD (2000 m) at 06:30. Snow catchers taken at the same time really lived up to their name as it was snowing for much of both the night and the day. The second event, the midday MOCNESS, was started but due to problems with the cable monitoring system had to be abandoned and the net recovered. Pete, Scott, Craig (Deck Engineer) and Steve (ETO) all involved for much of the day in replacing units on the cable monitoring sheeves. The vertical sampling – Bongos, CTDs, plankton cameras and snow catchers proceeded throughout the day. The arrival of an Arnoux's beaked whale with calf provided a special moment for many as they swam around the ship. Winch not ready for evening LHPR but the midnight MOCNESS will go ahead.

26 November 2014 (Wednesday)

At Ice Station, midnight MOCNESS deployed but nets did not open and close on way up from 1000 m, so the first net remained open for the entire haul. After mid-night station work, bongos, snow catcher worked but then CTD winch locked on before instrument went over side. Waited initially to get CTD back into annex so that we could do a net-haul while the winch was fixed. A successful LHPR haul was undertaken and back onboard by 11:0o (L). Repositioned and looking to undertake bongos, plankton camera, CTD and snow catcher before undertaking either another LHPR or MOCNESS (if it can be fixed). Full MOCNESS undertaken as last activity and then CPR deployed after dinner as we head off on passage to P2 for the next time station and mooring refurbishment.

27 November 2014 (Thursday)

In the morning we are on track to P2, and encountering snow showers and icebergs along our course. We recover CPR and then undertake Bongo at 10:00 at the point haflway between the ice station and P2. The CPR is then redeployed and we continue on our wayu to P2.

28 November 2014 (Friday)

We arrived at P2 for 05:00 and found that a large tabular berg, around 1.5 nm long, was only 3 nm away from the mooring site. We recovered the CPR and undertook the CPR calibration bongo before repositioning clear of the mooring. At 05:55 we sent the release signal and at 06:00 (L) the mooring was sighted half way between the ship and the iceberg. In brilliant sunshine with no breeze but a big swell we spent 1.5 hours recovering the deep mooring. With all on board by 07:25 we were able to bring our timetable forward by about 4 hours and at 08:30 we started the time station with a deep CTD to near bottom. Heard during the day that the mooring buoy had been pushed down to 800 m at some point, at this stage we are assuming it was due to the nearby iceberg.

29 November 2014 (Saturday)

P2 station activities continue throughout day although the weather is getting worse. We hope to be able to re-deploy the mooring tomorrow before the weather gets too bad. Afternoon and evening spent preparing the instruments to go on the mooring. There are now 13 separate instruments that need to be checked and programmed before being put on to the mooring tomorrow. Several of these, in particular the water sampler, require significant amounts of discussion, and then substantial prep time. We finish by midnight and look to rest ready for a hard day tomorrow.

30 November 2014 (Sunday)

At 05:00 the wind is only 6 knots but the barometer is falling like a stone, there is a swell but it is reasonable for mooring deployment. We have a weather wind but it is not going to last long. Even as we complete the preparations for the deployment the conditions are worsening. By the time everything is ready (09:00) the sea is building, wind is up around 30 knots but the ship is still stable and we agree to go forward with the deployment. Cold, wet and with gusts up to 45 knots, the mooring is safely deployed by lunch time. All the new equipment has gone over safely with the exception of the new sediment trap which did not respond to programming prior to the deployment and so was excluded.

After lunch, we pinged the mooring and then when deck gear and lab equipment were secure we turned and began to run towards Bird Island. The barometer is now climbing as rapidly as it was falling 6 hours ago. Conditions presently not suitable for Bird Island relief, we will see what tomorrow brings. Most scientist's relaxing after the stress of the time station and mooring deployment.

1 December 2014 (Monday)

We headed into Bird Island this morning and weather was good enough to get Bird Islanders ashore but too windy for cargo work. We then sailed through Willis Strait and then along the north coast of South Georgia to reach Stromness Harbour by late afternoon. We anchored off the whaling station once the tourist ship – Hanseatic – had sailed. Calibration started with the customary CTD to 40 m. Calibration of the 38, 120 and 200 kHz plus the new 70 kHz continued through until 01:00 on the 2 December. Tired but pleased the calibration team plus helpers went to bed with the goal of calibrating the ES853 glider echo sounder tomorrow morning.

2 December 2014 (Tuesday)

Glider ES853 echo-sounder carried out using a calibration mounted on top of the RV Doughnut. Calibration finished by 13:50 (L) and ship upped anchor and sailed for King Edward Point, arriving to find it too windy to go alongside.

3 December 2014 (Wednesday)

In Cumberland Bay undertaking some station work as it is too windy to go alongside or work the cargo tender. Pilot boat came out after breakfast to take tech people ashore and give all ship's personnel a briefing on South Georgia. We work three stations within the Bay:

> A Cumberland Bay Flare Station where a methane seep has previously been detected is studied with the SUCS. Krill are seen on the video camera close to the bottom. A Bongo and Box Core are also undertaken at this site.
> A Bongo station where pteropods have been taken in a previous cruise, however it was too windy for Bongos on this occasion and just a CTD was undertaken.
> A Grytviken Flare Station where another SUCS deployment was undertaken.

After this the ship remains on DP out in Cumberland Bay overnight.

4 December 2014 (Thursday)

Alongside the KEP jetty at 07:00 and science staff who have been to KEP previously worked cargo through day. Opportunities for first time visitors to get ashore to either Penguin River or Maiviken are gratefully taken by all. Ship sails at 17:30 and carries out a Bongo net at yesterday's Bongo Station before proceeding overnight to Bird Island.

5 December 2014 (Friday)

Anchored off Bird Sound by 08:00 but still lumpy and Humbers taking Tech staff ashore delayed for several hours. Too rough for cargo tender but conditions improved during the day and we hope to undertake cargo tomorrow.

6 December 2014 (Saturday)

Early start today, ship anchored off Bird Sound by 06:00. Cargo tender launched and first delivery is the new freezer for the base. A chance for people to get ashore and see the albatrosses is eagerly taken by many of the science party. Remaining scientists help empty container and remove the 45 oil drums that had bee stored in there earlier in the cruise so that we could access the after deck. The containers are then repacked with science gear. Finally the BI cargo and food are removed from the science hold and sent ashore. It is a late finish once again before everything has been transferred ashore.

7 December 2014 (Sunday)

Ship back off Bird Island for 07:30 (L), weather is sunny and no low lying clouds which typically cover Bird Island. Frozen food and Doc sent ashore once we are at anchor. We finally get the alright from the Base in the early afternoon and we steam around to the WCB shallow mooring site, arriving at 15:30 (L). Unfortunately we get no reply from either of the acoustic releases mounted at the base of the mooring. We then undertake a acoustic grid over the mooring position using both the 4 frequency scientific echosounder and the swath bathymetry system. However we do not detect any sign of the mooring. We have had no messages from the Iridium beacon on the mooring to indicate that the mooring has surfaced so its fate remains a mystery.

We have little alternative but to steam away and undertake a test RMT prior to starting the Western Core Box tomorrow. The trial RMT, in the water for only a few minutes, catches krill in good condition so that 3 buckets of live krill can be kept in the cool room.

8 December 2014 (Monday)

Western Core Box started today at 06:00 (L) with ship towing the CPR along transects 1.1 and 1.2. A full suite of RMT, Bongo and CTD were undertaken at each of the 2 stations with a successful target haul undertaken on the shelf-break between the two stations.

9 December 2014 (Tuesday)

Heavy swell and 30 knot plus winds have made the second day of the Western Core Box extremely uncomfortable. Once transects 2.1 and 2.2 were finished we relocated to the southerly station (S2.2S) but it was deemed too rough to carry out the station RMT or Bongo. After carrying out a station CTD we moved up to the shelf break where a krill swarm was found and successfully fished with a target RMT. Relocating to the northerly station (S2.2N) we carried out Bongos to 100 and 200 m before the station CTD to 1000 m.

10 December 2014 (Wednesday)

Third day of Western Core Box and weather has moderated with sun in the morning and swell down so that the night shift have slept well. The CPR was deployed prior to the start of transect 3.1 and the transect itself started at 06:00 (L). All standard core box activities completed today.

11 December 2014 (Thursday)

Final day of Western Core Box and today both transects are run with XBT's at 5 points along the transect. After the transects we target fish for krill and complete the station-based RMT hauls at stations S2.2S and S2.2N (the ones that we could not complete on the evening of the second day due to bad weather). We finish early (01:00) in order to get good rest prior to prepping and deploying the P3 mooring tomorrow.

12 December 2104 (Friday)

Started work on preparing the mooring at 10:00 and all instruments ready by 14:30 (L). A rain squall passed through while we were putting instruments on the main buoy but after that the sun came out and the wind dropped to around 20-25 knots.

Deployment started at 14:38 (L) and proceeded without problem. The weights went over the side at 16:49 (L). We bring forward the start time of the P3 station so that the CTD goes into the water at 18:30 and the last full station is underway.

13 December 2014 (Saturday)

Sun this morning but a big swell is running. The midnight MOCNESS did not function correctly and so there is only one sample from the net. The morning LHPR goes ahead although the winch trips out after the net has descended to ~370 m. There is a delay as everything is reset. We are dropping behind the schedule but still on course to complete this time station and undertake some limited sampling at the Upwelling station. Modifications to the MOCNESS cabling produces a workable solution for the second MOCNESS haul and allow the collection of some depth separated samples.

14 December 2014 (Sunday)

We move over to the Upwelling site, 35 miles to the east of the P3 site. Our final station is underway by 04:00 and we have until 14:00 (L) when we have to leave for Stanley. MOCNESS, CTD, snow camera and catcher, and bongos completed at the final station. We launch an ARGO float for the German Met Office before steaming away and deploying the CPR for our steam towards Stanley.

The main nets are dismantled and washed during the afternoon. The sun is shining and the swell is reasonable allowing us to steam at 11.5 knots. ETA in Stanley is early morning of 17 December.

15 December 2014 (Monday)

On passage and people writing report, packing or finishing experimental incubations. Halfway to Stanley Bongo takes place at 13:00 and then an AVOR (Argo type) float deployed for Germans. We have an excellent cruise dinner in the evening.

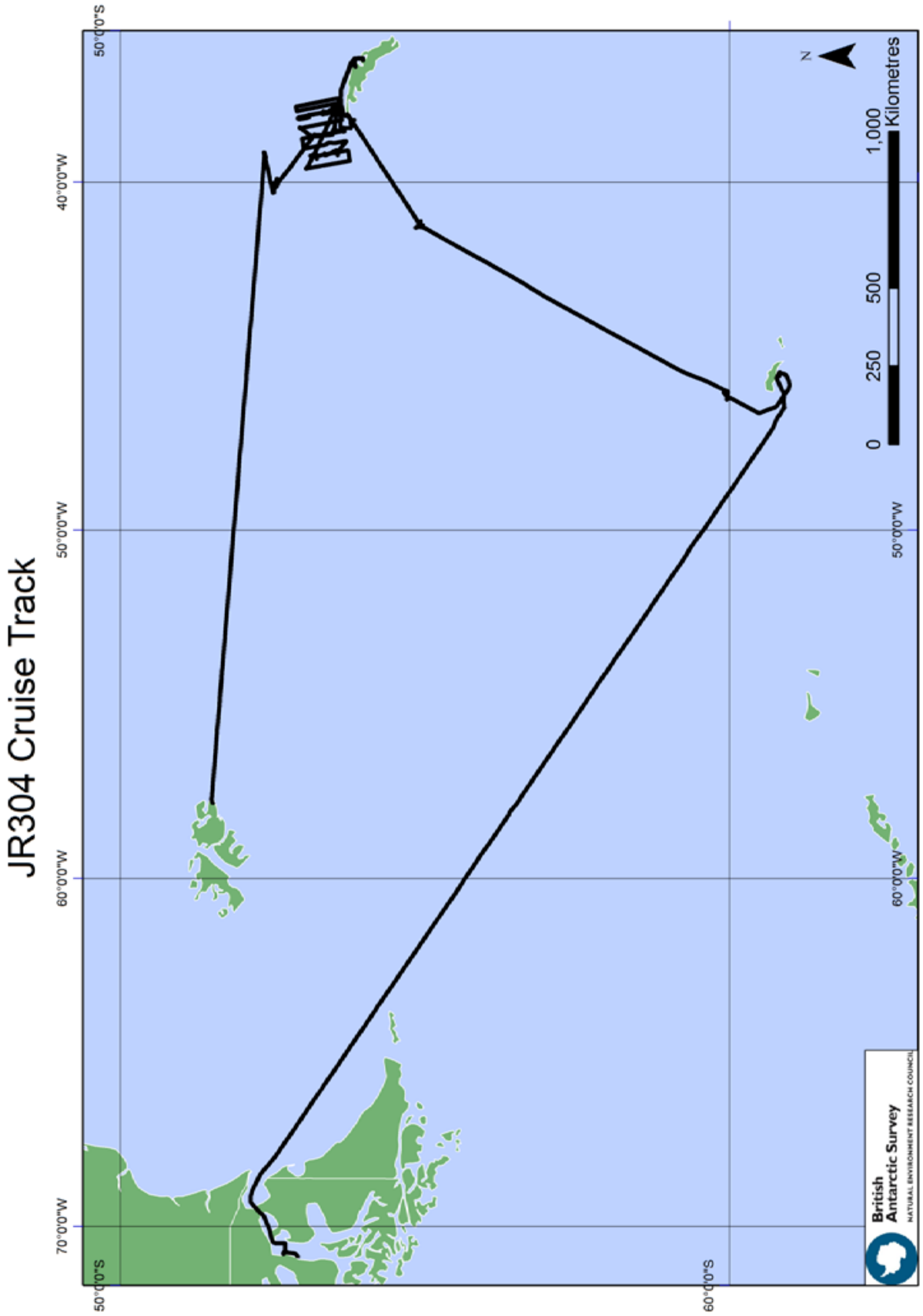
16 December 2014 (Tuesday)

Final full day at sea turns out to be foggy, damp and not the best weather for unpacking the container. CPR recovered for last time at 13:00 followed by last Bongo net. Then resume passage to Stanley.

17 December 2014 (Wednesday)

Arrive FIPASS at 07:50 (L). Demobilization proceeds with container packing, cleaning and tidying throughout day.

1.7 Cruise Track for JR304, Leg 20141112



Figure

1.8 Personnel

Table 1-1: JR304 Scientific and in-transit personnel

JR304 Scientific Personnel		
Jon Watkins	BAS	PSO / Acoustics / Netting
Anna Belcher	NOC/BAS	PhD student / Snow catchers
Manon Duret	NOC	PhD student / CGS
Peter Enderlein	BAS	Equipment Engineer
Sophie Fielding	BAS	Acoustics / Krill
Sebastian Floter	GEOMAR Kiel	PhD student / Biogeochemistry
Jess Gardner	BAS/UEA	PhD student / Pteropod
Hyoung Sul La	KOPRI Korea	Acoustics
Richard Lampitt	NOC	Particle flux / Snow cameras
Cecilia Liszka	BAS/UEA	PhD student /
Anna Mikis	BAS/Cardiff	PhD student / Foraminifera
Vicky Peck	BAS	Geochemistry / Forams /Box corer
Scott Polfrey	BAS	AME
Jeremy Robst	BAS	ITS
Gabi Stowasser	BAS	Deputy PSO / Plankton / Sediment trap
Geraint Tarling	BAS	Plankton / Krill / Nets
Jenny Thomas	BAS	Data management (PDC)
Seth Thomas	BAS	AME
Maz Wootton	SAHFOS	Zooplankton / CPR
Non JR304 staff onboard		
Karen Fowler	BAS	Communications Engineer
Gavin Cook	BAS	Sustainability Engineer
Mariella Giancola	BAS	HR Manager
Terry Lay	BAT	BAT Postal Clerk
Bird Island Staff in transit		
Adam Bradley		Bird Island Station Leader
Jaume Forcada		Seal biologist
Richard Phillips		Albatross & petrel biologist
Lucy Quinn		Zoological Field Assistant
Robbie Scott		Electrical Services Technician
Sian Tarrant		Zoological Field Assistant
Alistair Wilson		Zoological Field Assistant
Robert Fry (BI to Stanley)		Mechanical Services Technician
Signy Staff in transit		
Matt Jobson		Signy Station Leader
Stacey Adlard		Zoological Field Assistant
Jennifer Brown		Marine Ecologist CGS
Hector Kennard		Carpenter / Builder
Robert Mellor		Electrical Services Technician
William Rees		Marine Ecologist CGS
Iain Rudkin		Field Assistant

Table 1-2: JCR Officers and Crew

JCR Officers and Crew	
Jerry Burgan	Master
Timothy Page	Chief Officer
Philippa Bowden	2nd Officer
Greg Johnston	3rd Officer
Mike Gloistein	ETO Comms
Neil MacDonald	Chief Engineer
Gert Behrmann	2nd Engineer
Chris Mannion	3rd Engineer
Marc Laughlan	4th Engineer
Craig Thomas	Deck Engineer
Stephen Amner	ETO
Richard Turner	Purser
Dave Peck	Bosun Scientific Operations
Martin Bowen	Bosun
George Dale	Bosun's Mate
Francisco Hernandez	SG1A
Sheldon Smith	SG1A
Richard Robinson	SG1A
Ian Raper	SG1A
Alan Howard	SG1A
Glyndor Henry	MG1
Jevgenijs Tolks	MG1
John Pratt	Chief Cook
Colin Cockram	2nd Cook
Lee Jones	Senior Steward
Nicholas Greenwood	Steward
Graham Raworth	Steward
Rodney Morton	Steward
Emma Browne	Doctor until KEP
Julie Hunt	Doctor from KEP onwards

1.9 Acknowledgements

This cruise is the 19th year that the Western Core Box Survey has been undertaken and so maintaining this time series has required a major investment of effort over the years; to a large extent this commitment has fallen on a small core of dedicated scientists within the current Ecosystems programme who carry out this cruise year in and year out. The core staff are supported and joined by a willing and enthusiastic group of support staff and collaborators from other polar and marine groups both within the UK and internationally. To all of you thanks for your enthusiasm and hard work which have enabled the cruise objectives to be completed once again.

The cruise also provides logistic support to the bases, all scientists and support staff together with ship staff and base staff worked tirelessly moving cargo and helping across a range of tasks to complete the base reliefs effectively as possible during the often short suitable weather windows.

We are also grateful to the base staff travelling on the ship, particularly those going to Bird Island, for the patience and forbearance shown as we undertook science both on route to Signy and to Bird Island and those extended the time that they had to spend on the ship prior to getting in to start their field-studies.

The officers and crew by now have an in-depth knowledge and awareness of what the West Core Box cruises are likely to entail. We are very grateful for all the help and support that they provide and for the enthusiasm that they still manage to show when subject

Also thank Logistics, South Georgia Government and others involved with ensuring that the mooring buoy was transferred

1.10 Station Summary

Dates	Events	Station	Activities	Notes
17/11/14	1 - 2	1	Bongos	At start of first CPR transect to Signy
18/11/14	4	2	Bongos	Midway along first CPR transect
19/11/14	6	3	Bongos	At end of first CPR transect
25/11/14 – 26/11/14	7 - 36	4	Bongos, CTD, Snow Catcher, Snow Camera, MOCNESS,	Ice station just north of South Orkney Islands
27/11/14	38	5	Bongos	Midway along 2nd CPR transect
28/11/14 – 30/11/14	40 - 69	6	Bongos, CTD, Snow Catcher, Snow Camera, MOCNESS, LHPR	P3 Southern Mooring Station
01/12/14 – 02/12/14	71 - 72	7	CTD, acoustics	Stromness Harbour for calibration
03/12/14	73 - 77	8	SUCS, Bongos, Box Corer	Cumberland Bay, South Georgia
03/12/14	78	9	CTD	East Cumberland Bay
03/12/14	79	10	SUCS	Cumberland Bay
04/12/14	80	11	Bongos	Cumberland Bay
08/12/14 – 09/12/14	88 - 90	1.2N	RMT8, CTD, Bongos	WCB station 1.2N
09/12/14	92 - 94	1.2S	RMT8, CTD, Bongos	WCB station 1.2S
09/12/14	101	2.2S	CTD,	WCB station 2.2S
10/12/14	103	2.2N	Bongo, CTD	WCB station 2.2N
10/12/14	113 - 115	3.2N	RMT, CTD, Bongo	WCB station 3.2N
11/12/14	117 - 119	3.3S	RMT, CTD, Bongo	WCB station 3.2S
11/12/14	131	2.2S	RMT	WCB station 2.2S
11/12/14	132	2.2N	RMT	WCB station 2.2N
12/12/14 – 14/12/14	134 - 157	12	Bongos, CTD, Snow Catcher, Snow Camera, MOCNESS, LHPR	P3 Northern Mooring station
14/12/14	158 - 168	13	Bongos, CTD, Snow Catcher, Snow Camera, MOCNESS	Upwelling station
15/12/14	171	14	Bongo	Midway along final CPR transect
16/12/14	174	15	Bongo	At end of final CPR transect

2 Physical Oceanography

2.1 CTD Operation

2.1.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. 19 casts were carried out in total, as part of the 24-hour time stations at the ice and mooring stations and as part of the Western Core Box. The CTD was operated by Seth Thomas, assisted by Jenny Thomas, Anna Belcher and Sophie Fielding.

2.1.2 CTD instrumentation and deployment

An SBE32 carousel water sampler, holding 24 12-litre niskin bottles, an SBE9Plus CTD and an SBE11Plus deck unit were used. The SBE9Plus unit held dual SBE3Plus temperature and SBE4C conductivity sensors and dual SBE5T submersible pumps. An SBE35 Deep Ocean Standards Thermometer makes temperature measurements each time a bottle is fired, and time, bottle position and temperature are stored, allowing comparison of the SBE35 readings with the CTD and bottle data. Additional sensors included an altimeter, a fluorometer, two oxygen sensors, a photosynthetically active radiation (PAR) sensor and a transmissometer. A Lowered Acoustic Doppler Current Profiler was also attached and deployed with the CTD.

The altimeter returns real time accurate measurements of height off the seabed within approximately 100m of the bottom. This allows more accurate determination of the position of the CTD with respect to the seabed than is possible with the Simrad EA600 system, which sometimes loses the bottom and, in deep water, often returns depths that are several tens of metres deeper than the true bottom location.

A fin attached to the CTD frame reduced rotation of the package underwater. The CTD package was deployed from the mid-ships gantry on a cable connected to the CTD through a conducting swivel.

CTD data were collected at 24Hz and logged via the deck unit to a PC running Seasave, version 7.22.3 (Sea-Bird Electronics, Inc.), which allows real-time viewing of the data. The procedure was to start data logging, deploy the CTD, then stop the instrument at 10m wireout, where the CTD package was left for at least two minutes to allow the seawater-activated pumps to switch on and the sensors to equilibrate with ambient conditions. The pumps are typically expected to switch on 60 seconds after the instrument is deployed.

After the 10m soak, the CTD was raised to as close to the surface as wave and swell condition allowed and then lowered to within 10m of the seabed. Bottles were fired on the upcast, where the procedure was to stop the CTD winch, hold the package *in situ* for a few seconds to allow sensors to equilibrate, and then fire a bottle. The sensor averages these readings to produce one value for each bottle fire. Short times between firing pairs of bottles sometimes led to no SBE35 readings for the second bottle of the pair.

Bottle firing depths were determined by sampling requirements for ocean acidification and carbon export experiments.

2.1.3 CTD sensor calibrations

Details of the calibrations of sensors on the CTD can be found in section 12.2.

2.1.4 Data acquisition and processing

The CTD data were recorded using Seasave, version 7.22.3, and run through the SVP script. In addition to sending the data to the UK Meteorological Office (as of November 2014, following a note from Tim Smyth (PML) – PSO on JR303), it creates the following four files:

JR304_NNN.hex binary data file

JR304_NNN.XMLCON ascii configuration file with calibration information

JR304_NNN.hdr ascii header file containing sensor information

JR304_NNN.bl ascii file containing bottle fire information

where NNN is the 3-digit CTD cast number (Table 2-2). The *.hex* file was then converted from binary to ascii using the SBE Data Processing software *Data Conversion* module. Three files are output:

JR304_NNNmet.cnv data file with header information

JR304_NNNmet.ros data file associated to bottle firing with header information

JR304_NNNsvp.asc ascii data file

The *Data Conversion* module calculates parameters using the coefficients detailed in the calibration documentation (Section 12.2.) and the raw XMLCON files (stored at the British Antarctic Survey in /data/cruise/jcr/20141112/ctd/JR304) as follows:

Pressure:

$$P = C\left(1-\frac{T_0^2}{T^2}\right)\left(1-D\left(1-\frac{T_0^2}{T^2}\right)\right)$$

where *P* is the pressure (dbar), *T* is the pressure period (µsec), $D = D_1 + D_2U$,

$C = C_1 + C_2U + C_3U$ and $T_0 = T_1 + T_2U + T_3U_2 + T_4U_3 + T_5U_4$ are calculated from the coefficients stored in the raw XMLCON files, where *U* is the temperature in ˚C.

Conductivity:

$$cond = \frac{g + hf^2 + if^3 + jf^4}{1 + \delta t + \varepsilon p}$$

where *cond* is the conductivity (Sm^{-1}), f is instrument frequency (kHz), p is pressure (decibars), *t* is temperature (˚C), the thermal coefficient of expansion, δ = CTcor and the bulk compressibility, ε = CPcor. These and the other coefficients are stored in the raw XMLCON files and in Section 12.2.

Temperature: $temp(ITS90) = \frac{1}{\left\{g + h\left[\ln(f_0/f)\right] + i[\ln^2(f_0/f)] + j[\ln^3(f_0/f)]\right\}} - 273.15$

Where the temperature, *temp*, is measured in ˚C, *g*, *h*, *i* and *j* are coefficients stored in the raw XMLCON files and *f* is the frequency output by the sensor.

Oxygen: $oxy = Soc.(V + Voffset).(1.0 + AT + BT^2 + CT^3).OxSol(T,S).e^{\frac{EP}{K}}$

where *oxy* is dissolved oxygen (ml/l), *V* is the voltage output (V) from the SBE43 sensor, *OxSol* is oxygen saturation (ml/l) which is a function of temperature, *T* (˚C) and salinity, *S* (PSU), K is the temperature (˚K), *P* is the pressure (decibels) and the remaining coefficients are detailed in the raw CTD XMLCON files and Section 12.2.

PAR: $PAR = \left(\frac{multiplier.10^9.10^{(V-B)/M}}{C}\right) + offset$

where *V* is the dark voltage (V), and the coefficients *B*, *M*, *offset*, *multiplier* and *c*, the calibration constant (Cw), are all stored in the raw XMLCON files and can be found in Section 12.2.

Fluorescence: $flsc = \frac{slope(10e^{(V/slope\ factor)} - 10e^{VB})}{10e^{V1} - 10e^{Vacetone}} + offset$

Where *flsc* is measured in µg/l, *V* is the fluorometer output voltage (V) and the remaining coefficients are stored in the raw XMLCON files and Section 12.2.

Transmission: $Light\ transmission = M.output\ voltage + B$

where light transmission is measured in % and *M* and *B* are derived from measured voltages through air and water in light and darkness, and are included in Section 12.2.

The SBE Data Processing *Align CTD* module was then used to align parameter data in time, relative to pressure. This ensures that calculations of salinity, dissolved oxygen concentration, and other parameters are made using measurements from the same parcel of water.

The SBE Data Processing *Wild Edit* module was then used to mark wild points in the data by replacing the data value with *badflag*. The *badflag* value is documented in the input .cnv header. Wild Edit's algorithm requires two passes through the data: the first pass obtains an accurate estimate of the data's true standard deviation, while the second pass replaces the appropriate data with *badflag*.

The SBE Data Processing *Cell thermal mass* module was then used to remove the conductivity cell thermal mass effects from the measured conductivity. This reads in the *JR304_NNN.cnv* file and re-derives the pressure and conductivity, taking into account the temperature of the pressure sensor and the action of pressure on the conductivity cell. The output is another ascii file, named *JR304_NNN_ctm.cnv*. The correction applied to the CTD data is detailed below:

Corrected conductivity = conductivity + ctm

Where

$$ctm = -1 \times \left(\frac{1-5\alpha}{2s\beta+4} \right) \times ctm_0 + \frac{2\alpha}{s\beta+2} \times 0.1(1+0.006[T-20]) \times \Delta T$$

and *s* is the sample interval (secs), *T* is temperature (˚C) , ctm_0 is the uncorrected cell thermal mass, α = 0.03 and β = 7.0.

The following matlab scripts were then used to process the CTD files. Further details on the processing and these scripts can be found in the JR031 and JR200 cruise reports.

ctdread.m	Reads in JR304_NNN_awctm.cnv to matlab. Outputs JR304_ctdNNN.cal.
editctd.m	Reads in JR304_ctdNNN.cal. Manual edit of CTD file to remove start and end data when CTD out of water and any spikes. Outputs JR304_ctdNNN.edt.
Interpol.m	Reads in JR304_ctdNNN.edt. Interpolates any missing data. Outputs JR304_ctdNNN.int.
Salcalapp.m	Reads in JR304_ctdNNN.int. Calculates density (sig0, sig2 sig4). Outputs JR304_ctdNNN.var.
Splitcast.m	Reads in JR304_ctdNNN.var. Splits up cast and down cast. Outputs JR304_ctdNNN.var.up and JR304_ctdNNN.var.dn.
Fallrate.m	Reads in JR304_ctdNNN.var.dn. Removes data from periods where CTD is above a pressure it has already sampled. Outputs JR304_ctdNNN.var.dn.
Gridctd.m	Reads in JR304_ctdNNN.var.dn. Grids data into 2dB depth intervals. Output JR304_ctdNNN.2db.mat. 1dB files were also created on request from Richard Lampitt (JR304_ctdNNN.1db.mat; JR304_ctdNNN.1db.txt).
Fill-to-surf.m	Reads in JR304_ctdNNN.2db.mat. Fills in surface values if CTD doesn't reach surface, user input to determine which ones. Outputs file JR304_ctdNNN.2db.mat.
Ctdplot.m	Reads in JR304_ctdNNN.2db.mat files and creates overview plots saved in /images folder (CTDftopNNN.png; CTDSURFftopNNN.png; CTDSURFtsdNNN.png; CTDtsdNNN.png).
Makebot	Reads in JR304_ctdNNN.2db.mat. Extracts median and standard deviation of variables at the depth/time of each bottle firing. Outputs file JR304_botNNN.1st.

2.1.5 Code and files.

The scripts used for processing can be found under /data/cruise/jcr/20141112/work.scientific_work_areas/ctd/processed_data/Code at the British

Antarctic Survey. This processed data will be transferred to the British Oceanographic Data Centre along with the raw data and cruise report.

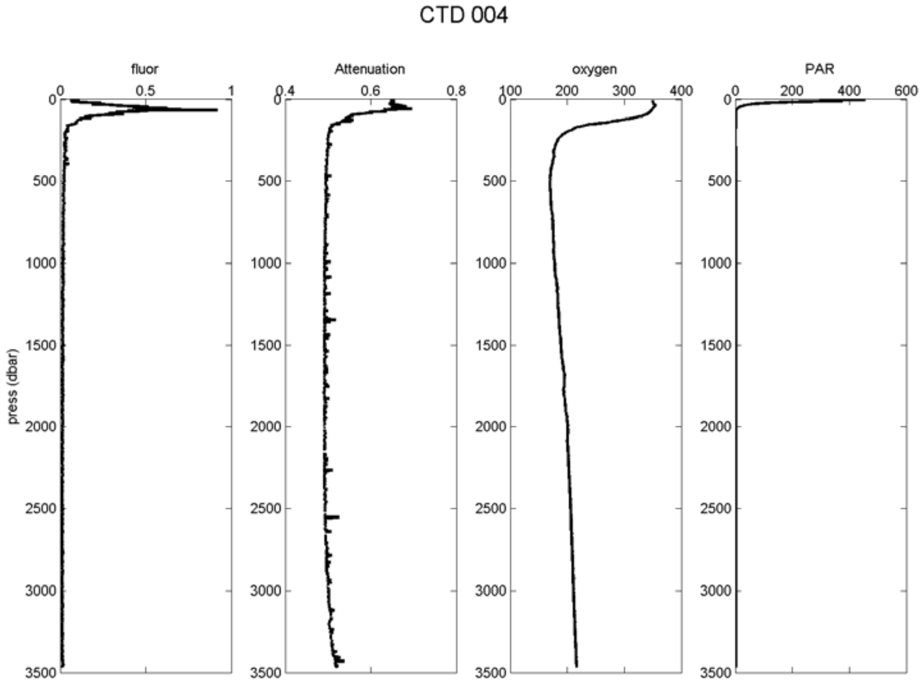


Figure 2-1: CTD Profile for cast 004, Event 42, Station 6 (P2 Southern Mooring Station)

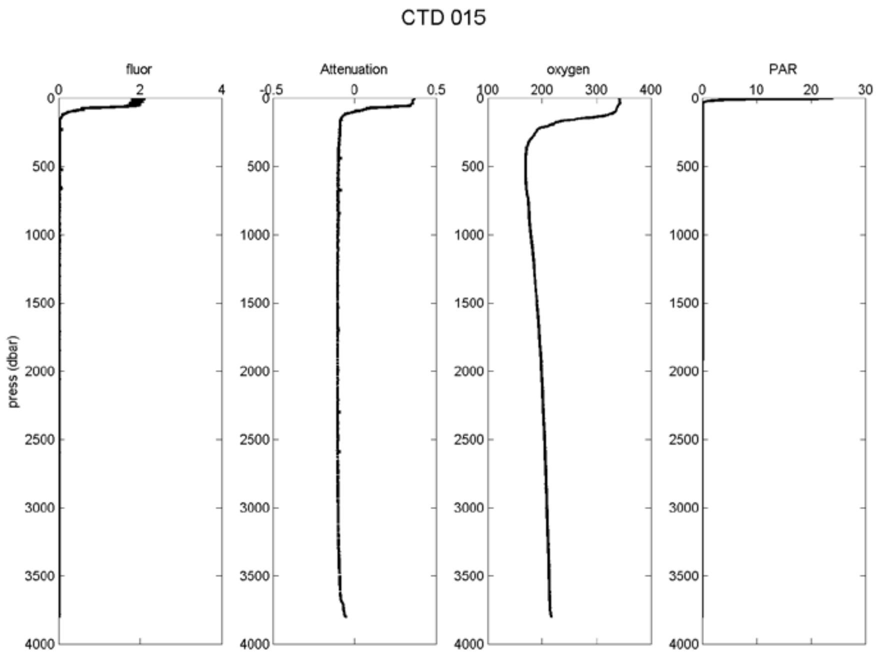


Figure 2-2: CTD Profile for cast 015, Event 134, first CTD at Station 12 (P3 Northern Mooring Station)

2.1.6 CTD casts

19 CTD casts were undertaken.

Table 2-1: Times, event numbers and positions for the 19 CTD casts undertaken during JR304

Date	Event number	Lat	Lon	Station	Bottles fired	Water samples taken?	Comments
25/11/2014 10:21	7	-59.96232	-46.15973	4 (Ice station)	1 to 24	Y	
25/11/2014 19:06	14	-59.96236	-46.1597	4 (Ice station)	1 to 15	Y	
26/11/2014 16:55	32	-59.96291	-46.16022	4 (Ice station)	1 to 18	Y	
28/11/2014 13:44	42	-55.25271	-41.3024	6 (P2)	1 to 24	Y	
29/11/2014 03:04	54	-55.24764	-41.26616	6 (P2)	1 to 16	Y	
29/11/2014 18:11	67	-55.24748	-41.26508	6 (P2)	1 to 15	Y	
01/12/2014 20:21	71	-54.1589	-36.68715	7	1 to 4	N	EK60 calib.
03/12/2014 18:43	78	-54.26656	-36.43325	10	1 to 15	Y	
08/12/2014 23:55	90	-53.49304	-39.25407	WCB 1.2N	1 to 8	Y	
09/12/2014 08:06	94	-53.84768	-39.14336	WCB 1.2S	1 to 13	Y	
09/12/2014 22:19	101	-53.78489	-38.58334	WCB 2.2S	1 to 11	Y	
10/12/2014 06:42	105	-53.43203	-38.69491	WCB 2.2N	1 to 24	Y	
10/12/2014 22:38	115	-53.36126	-38.08294	WCB 3.2N	1 to 12	Y	
11/12/2014 06:36	119	-53.714	-37.96607	WCB 3.2S	1 to 12	Y	
12/12/2014 22:40	134	-52.81159	-39.97267	12 (P3)	1 to 23	Y	
13/12/2014 14:45	147	-52.7623	-40.30386	12 (P3)	1 to 15	Y	
13/12/2014 22:22	154	-52.81183	-39.9726	12 (P3)	1 to 19	Y	
14/12/2014 08:12	158	-52.60006	-39.20002	13 (Upwelling)	1 to 6	Y	
14/12/2014 14:39	163	-52.60039	-39.1996	13 (Upwelling)	1 to 24	Y	

Water samples were taken from all but one CTD cast (cast 7, event 71 when EK60 was being calibrated). A summary of these samples can be found in Table 2-2 but more information can be found in the section 7 (Time station sampling) for the sampling related to each experiment.

Table 2-2: Check list of different water samples taken from water bottles on CTD casts during JR304. MD - Manon Duret, JG - Jess Gardner, SF - Sebastian Floter, AM - Anna Mikis, AB - Anna Belcher, GS - Gabi Stowasser, CL - Cecilia Liszka

Bridge event number	CTD cast number	Nucleic analysis (MD)	Protein assessment (MD)	Cardfish (MD)	TA & DIC (JG SF AM)	Chlorophyll (AB)	Nutrients (AB)	Lugols (AB)	Element analysis (SF)	delta 15 N (SF)	delta 18 O (AM)	delta 13 C DIC (AM)	delta 13 C POC (AM)	Nutrients (AM)	POM (GS)	Active flux (CL)	Nutrients (JG)	Incubation (JG)
7	1	*		*	*	*	*	*	*	*	*	*	*	*			*	*
14	2					*	*	*							*	*		
32	3		*			*	*	*								*		
42	4	*		*	*	*	*	*	*	*	*	*	*	*			*	*
54	5					*	*	*								*		
67	6		*			*	*	*										
71	7																	
78	8				*						*	*	*	*			*	
90	9															*		*
94	10				*						*	*	*	*		*	*	*
101	11				*											*	*	*
105	12															*		
115	13				*											*	*	*
119	14															*		
134	15	*		*	*	*	*	*			*	*	*	*			*	*
147	16					*	*	*	*	*						*		
154	17					*	*	*								*	*	
158	18															*		
163	19	*			*	*	*	*	*	*	*	*	*	*		*	*	*

2.2 Lowered Acoustic Doppler Current Profiler (LADCP)

2.2.1 Introduction

The LADCP creates profiles of the water column using acoustics. It is attached to the CTD frame and was operated at the same time as CTD casts were taken. The LADCP was operated by Seth Thomas and Jenny Thomas.

18 deployments of the LADCP were made, 1 for each CTD cast with one exception: event 071 (CTD deployment) did not have the LADCP running as well. During event 032 (CTD cast 003), the winch did not work, so the LADCP sat pinging on the deck for a long time.

2.2.2 Instrumentation and deployment

The LADCP was connected to a recorder and set charging. Prior to launch, a BBTalk connection was used with commands to test the memory remaining, set up the filename and check the time of the LADCP and recording software were synced to ship time. The battery voltage was tested, pre-deployment tests were run prior to each launch (/data/ladcp/PreDeployTest.rds) and a script was sent to start logging (/data/ladcp/JCR304_ladcp) shortly before the CTD was deployed. The LADCP was then disconnected from the charger and communication leads.

Following deployment, the LADCP was reconnected and logging was stopped. The battery was retested and connected once again to the charger.

2.2.3 Data

Data were downloaded from the LADCP and copied over to the data drive (/data/ladcp) following recovery. Each filename has the format J304MXXX.000 where XXX is the CTD cast number. 'M' here stands for the master LADCP; a slave was not deployed during the cruise.

Paper logs of deployment details were made and these have been scanned (/work/scientific_work_areas/ladcp/scanned_paper_logs). These logs also contain the commands that were sent using BBTalk.

Table 2-3: Details of LADCP deployments on CTD casts during JR304

Time logging started	Time logging stopped	CTD event no.	CTD cast no.	Latitude	Longitude	Filename	Comment
25/11/2014 09:25:50	25/11/2014 11:30:42	7	1	-59.9623	-46.15973	J304M001.000	
25/11/2014 17:09:55	25/11/2014 19:12:40	14	2	-59.96238	-46.15968	J304M002.000	
26/11/2014 07:46:35		32	3	-59.9624	-46.16012		CTD winch failed - deployment aborted.
26/11/2014 16:04:39	26/11/2014 17:37:07	32	32	-59.96294	-46.16023	J304M004.000	CTD cast eventually named as 004. This was an attempt to name the files after the event number but it did not work.
28/11/2014 11:07:49	28/11/2014 13:48:16	42	4	-55.25268	-41.30215	J304M004.000	
29/11/2014 02:24:40	29/11/2014 03:45:40	54	5	-55.24765	-41.26623	J304M005.000	
29/11/2014 15:45:20	29/11/2014 18:18:48	67	6	-55.24752	-41.26502	J304M006.000	Problems deploying CTD, so there will be lots of data from on the deck at the beginning of the file. CTD deployed at 17:17.
03/12/2014 18:12:15	03/12/2014 18:48:50	78	8	-54.26657	-36.43326	J304M008.000	

08/12/2014 23:27:15	09/12/2014 00:52:52	90	9	-53.49302	-39.25401	J304M009.000	
09/12/2014 06:44:35	09/12/2014 08:12:47	94	10	-53.84677	-39.14132	J304M010.000	
09/12/2014 21:50:08	09/12/2014 22:27:01	101	11	-53.78486	-38.58329	J304M011.000	
10/12/2014 05:23:03	10/12/2014 06:46:10	105	12	-53.43206	-38.69489	J304M012.000	
10/12/2014 22:11:45	10/12/2014 23:12:38	115	13	-53.36128	-38.08296	J304M013.000	
11/12/2014 06:05:55	11/12/2014 06:40:28	119	14	-53.71401	-37.9663	J304M014.000	
12/12/2014 21:22:23	13/12/2014 00:20:19	134	15	-52.81117	-39.96982	J304M015.000	Water depth 3787 just before this reading taken - then EA600 went to 0m.
13/12/2014 13:39:00	13/12/2014 14:50:20	147	16	-52.76222	-40.3038	J304M016.000	
13/12/2014 21:56:35	13/12/2014 23:01:50	154	17	-52.81182	-39.97263	J304M017.000	
14/12/2014 06:54:30	14/12/2014 08:17:14	158	18	-52.60394	-39.27932	J304M018.000	
14/12/2014 13:40:30	14/12/2014 14:50:03	163	19	-52.60016	-39.19763	J304M019.000	

2.3 Underway

2.3.1 Underway Navigational Instrumentation

A number of data streams are recorded throughout the cruise, collecting navigational, meteorological data and information on deployments.

Table 2-4: Details of underway instrumentation used on JR304

Data stream	Equipment	Date/time data start (GMT)		Date/time of data end (GMT)	
anemometer	Anemometer	12/11/2014	18:42:21	19/12/2014	02:24:37
ashtech	Ashtec ADU-5 GPS	12/11/2014	18:42:21	19/12/2014	02:24:37
dopplerlog	Sperry SRD 421 Doppler Speed Log	12/11/2014	18:42:21	19/12/2014	02:24:36
ea600	Kongsberg-Simrad EA600	12/11/2014	18:42:21	17/12/2014	13:49:30
em122	Kongsberg-Simrad EM122	17/11/2014	20:36:02	07/12/2014	22:19:59
emlog-vhw	Chernikeeff Aquaprobe Mk V Electromagnetic log	12/11/2014	18:42:21	19/12/2014	02:24:35
emlog-vlw	Chernikeeff Aquaprobe Mk V Electromagnetic log	12/11/2014	18:42:22	19/12/2014	02:24:36
furuno-gga	Furuno GP32	12/11/2014	18:42:21	19/12/2014	02:24:36
furuno-gll	Furuno GP32	12/11/2014	18:42:21	19/12/2014	02:24:36
furuno-rmc	Furuno GP32	12/11/2014	18:42:21	19/12/2014	02:24:36
furuno-vtg	Furuno GP32	12/11/2014	18:42:21	19/12/2014	02:24:36
furuno-zda	Furuno GP32	12/11/2014	18:42:21	19/12/2014	02:24:36
glonass	Ashtec GLONASS	12/11/2014	18:42:21	19/12/2014	02:24:37
gyro	Sperry Mk 37 Model D Gyrocompass	12/11/2014	18:42:21	19/12/2014	02:24:36
netmonitor	Down wire net monitor	26/11/2014	11:28:46	14/12/2014	13:51:41
oceanlogger	BAS oceanlogger (see oceanlogger section below)	12/11/2014	18:42:27	19/12/2014	02:24:34
seatex-gga	Seatex GPS (Seapath 320+)	12/11/2014	18:42:21	19/12/2014	02:24:37
seatex-gll	Seatex GPS (Seapath 320+)	12/11/2014	18:42:21	19/12/2014	02:24:36
seatex-hdt	Seatex GPS (Seapath 320+)	12/11/2014	18:42:21	19/12/2014	02:24:36
seatex-vtg	Seatex GPS (Seapath 320+)	12/11/2014	18:42:21	19/12/2014	02:24:36
seatex-zda	Seatex GPS (Seapath 320+)	12/11/2014	18:42:21	19/12/2014	02:24:36
tsshrp	TSSHRP	12/11/2014	18:42:21	19/12/2014	02:24:36
usbl-gga		17/11/2014	13:29:43	03/12/2014	20:10:07
winch	CLAM winch system	14/11/2014	18:33:34	14/12/2014	14:41:06

2.3.2 Underway Oceanlogger Instrumentation

Surface ocean and meteorological data were logged continuously throughout the cruise. Ocean data were collected from the ship's uncontaminated seawater supply, whilst the meteorological data were measured by instruments on the forward mast. Instruments were as follows:

- Chelsea Technologies 10-AU 005 Fluorometer

- Litre meter F112P Flow meter
- Photosynthetically Active Radiation (PAR) 1, Parlite Quanum Sensor, Kipp & Zonen
- Photosynthetically Active Radiation (PAR) 2, Parlite Quanum Sensor, Kipp & Zonen – not working
- Wetlabs C-star Transmissometer
- Kipp & Zonen SPLite2 (TIR 1)
- Kipp & Zonen SPLite2 (TIR 2)
- Air temperature/humidity 1, Rotronic MP402H-050300
- Air temperature/humidity 2, Rotronic MP402H-050300 19
- Barometer 1
- Barometer 2
- SeaBird Electronics SBE38 seawater temperature 1
- SeaBird Electronics SBE38 seawater temperature 2
- SeaBird Electronics SBE45 thermosalinograph

2.4 Underway water sampling

2.4.1 Underway Sampling for chlorophyll

Anna Belcher and Manon Duret

2.4.1.1 Introduction

The underway (UW) supply brings external surface seawater into the ship's science labs from an inlet in the hull at about 6m below the waterline. Samples from this source allow surface water properties to be measured from a consistent depth whilst the ship is transiting.

2.4.1.2 Objectives

The objective is characterize the different biogeochemical provinces of the Southern Ocean encountered during the cruise in order to provide context to the satellite imaging of chlorophyll-a and particle export measurement (see report Section 7.2 by A. Belcher). These data will also support the work of other scientists on board.

2.4.1.3 Methods

Samples were collected manually from the underway supply in the prep lab whilst the ship was in transit between stations. Samples were collected every 2 hours throughout the day and night (24 hours a day).

Samples were collected for the following at each underway sampling point:

1. 300 mL for chlorophyll-a measurements
2. 14 mL for macro-nutrient concentrations (nitrate+nitrite, phosphate, silicate)

For all the continuously measured datasets the time collected (GMT) is recorded and can be used to extract the data corresponding to the individual underway samples. Likewise precise location can be determined from the ship's GPS logger files. Table 2-5 lists the location and time of samples taken.

Table 2-5: Time and location information for underway samples taken during JR304

Date	Time (GMT)	Latitude (deg N)	Longitude (deg E)	Bottle ID
2014-11-17	17:58	-57.7332	-55.29367	U1
2014-11-17	19:00	-56.66748	-58.17389	U2
2014-11-17	20:59	-56.80299	-57.8287	U3
2014-11-17	23:09	-57.05029	-57.1424	U4
2014-11-18	01:00	-57.26918	-56.55342	U5
2014-11-18	03:04	-57.50775	-55.90937	U6
2014-11-18	05:00	-57.7332	-55.29367	U7
2014-11-18	09:00	-58.20068	-53.99502	U8
2014-11-18	10:55	-58.41272	-53.41395	U9
2014-11-18	13:00	-58.64305	-52.77262	U10
2014-11-18	15:06	-58.87998	-52.10345	U11
2014-11-18	17:21	-59.01748	-51.71296	U12
2014-11-18	19:00	-59.19511	-51.20563	U13
2014-11-18	21:00	-59.41925	-50.52704	U14
2014-11-18	23:17	-59.68952	-49.78724	U15
2014-11-19	01:07	-59.86568	-49.27129	U16
2014-11-19	03:03	-60.05022	-48.7417	U17
2014-11-19	05:00	-60.23178	-48.2017	U18
2014-11-19	06:50	-60.40207	-47.70025	U19
2014-11-19	09:01	-60.60346	-47.0948	U20
2014-11-19	10:55	-60.75172	-46.53433	U21
2014-11-19	12:58	-60.74844	-45.9953	U22
2014-11-25	01:03	-60.71815	-46.28744	U23
2014-11-25	02:32	-60.19709	-46.40826	U24
2014-11-25	05:43	-60.19709	-46.40826	U25
2014-11-25	08:47	-59.96232	-46.15974	U26
2014-11-26	22:08	-59.95304	-46.00255	U27
2014-11-26	22:59	-59.81338	-45.87267	U28
2014-11-27	00:59	-59.48021	-45.58543	U29
2014-11-27	02:55	-59.18907	-45.3259	U30
2014-11-27	06:57	-58.57084	-44.67016	U31
2014-11-27	08:58	-58.24866	-44.33863	U32
2014-11-27	11:00	-57.92327	-44.00109	U33
2014-11-27	14:48	-57.4321	-43.49773	U34
2014-11-27	16:53	-57.1479	-43.19881	U35
2014-11-27	18:58	-56.88232	-42.89734	U36
2014-11-27	20:58	-56.55332	-42.55554	U37
2014-11-27	22:54	-56.32594	-42.32404	U38
2014-11-28	00:55	-56.08494	-42.09177	U39
2014-11-28	03:01	-55.83881	-41.85037	U40
2014-11-28	05:06	-55.5956	-41.60453	U41

2014-11-28	07:00	-55.37142	-41.38279	U42
2014-11-28	09:00	-55.24381	-41.26176	U43
2014-11-30	17:18	-55.1392	-40.98201	U44
2014-11-30	18:54	-54.96117	-40.49905	U45
2014-11-30	21:04	-54.71451	-39.85574	U46
2014-11-30	22:55	-54.5138	-39.32569	U47
2014-12-01	01:01	-54.27615	-38.705	U48
2014-12-01	05:07	-54.13561	-38.22236	U49
2014-12-01	06:56	-54.13553	-38.22221	U50
2014-12-01	09:07	-54.11893	-38.25375	U51
2014-12-01	11:10	-54.08805	-38.31842	U52
2014-12-01	18:58	-54.06578	-36.70318	U53
2014-12-02	18:54	-54.24428	-36.44262	U54
2014-12-07	17:15	-54.0239	-38.06417	U55
2014-12-07	19:05	-53.80063	-37.93957	U56
2014-12-08	08:55	-53.32936	-39.60848	U57
2014-12-08	10:02	-53.49654	-39.55816	U58
2014-12-08	10:52	-53.61822	-39.52205	U59
2014-12-08	12:05	-53.80234	-39.46729	U60
2014-12-08	13:05	-53.95414	-39.42231	U61
2014-12-08	14:02	-54.05693	-39.32466	U62
2014-12-08	15:00	-54.01402	-39.09183	U63
2014-12-08	16:00	-53.85338	-39.1427	U64
2014-12-08	17:00	-53.69278	-39.18942	U65
2014-12-08	18:00	-53.53191	-39.23939	U66
2014-12-09	09:00	-53.92672	-38.98153	U67
2014-12-09	09:55	-53.95892	-38.83025	U68
2014-12-09	11:17	-53.74607	-38.86822	U70
2014-12-09	12:00	-53.64691	-38.92624	U71
2014-12-09	13:08	-53.47451	-38.98039	U72
2014-12-09	14:03	-53.3424	-39.02201	U73
2014-12-09	15:00	-53.26584	-38.90578	U74
2014-12-09	15:59	-53.3166	-38.73162	U75
2014-12-09	17:09	-53.50507	-38.67249	U76
2014-12-09	18:02	-53.64707	-38.62654	U77
2014-12-10	08:53	-53.2101	-38.4514	U78
2014-12-10	09:58	-53.3687	-38.40127	U79
2014-12-10	11:02	-53.53143	-38.3485	U80
2014-12-10	11:59	-53.67447	-38.30298	U81
2014-12-10	13:05	-53.85228	-38.245	U82
2014-12-10	13:57	-53.91771	-38.11205	U83
2014-12-10	15:06	-53.81138	-37.93598	U84
2014-12-10	16:17	-53.60504	-38.00192	U85
2014-12-10	16:59	-53.48933	-38.03974	U86

2014-12-11	08:56	-53.8752	-37.72658	U87
2014-12-11	10:02	-53.70534	-37.78322	U88
2014-12-11	10:52	-53.57856	-37.82576	U89
2014-12-11	13:59	-53.14666	-37.88679	U90
2014-12-11	15:11	-53.28264	-37.78673	U91
2014-12-11	16:01	-53.4073	-37.74499	U92
2014-12-11	17:45	-53.67481	-37.65493	U95
2014-12-11	18:30	-53.79375	-37.6145	U93
2014-12-12	07:10	-53.11438	-39.40806	U94
2014-12-12	09:03	-52.9686	-39.73094	U96
2014-12-12	11:59	-52.80897	-40.04966	U97
2014-12-13	01:58	-52.79864	-39.97119	U98
2014-12-14	03:49	-52.72611	-40.17422	U99
2014-12-14	08:55	-52.60129	-39.19952	U101
2014-12-14	17:28	-52.58589	-39.47085	U100
2014-12-14	19:01	-52.56226	-39.94179	U102
2014-12-14	21:03	-52.53375	-40.56258	U103
2014-12-14	23:43	-52.4901	-41.40579	U111
2014-12-15	01:00	-52.46966	-41.80599	U104
2014-12-15	02:09	-52.42445	-42.71561	U105
2014-12-15	03:05	-52.43811	-42.4435	U106
2014-12-15	04:00	-52.42445	-42.71561	U107
2014-12-15	09:00	-52.34537	-44.20888	U108
2014-12-15	10:59	-52.31998	-44.76039	U109
2014-12-15	14:35	-52.27633	-45.70716	U110
2014-12-15	15:55	-52.2531	-46.09272	U112

2.5 Expendable bathythermographs (XBT)

2.5.1 Introduction

XBTs were used to vertically profile the temperature through the water column on transects in the Western Core Box. The XBT launcher was operated by Jeremy Robst and Jenny Thomas as well as several willing volunteers. 26 deployments were made, of which one failed completely (did not produce a data file). On another occasion the deployment worked but only produced a short trace. On each occasion, the probe was launched at a pre-defined location which has been done on previous surveys in the Western Core Box (see section 1.2 West Core Box Summary).

2.5.2 Instrumentation and operation

The following details have been summarised from the Equipment Guide held on board the JCR (http://wiki.jcr.nerc-bas.ac.uk/Data_and_Instrumentation/XBT). Each deployment was made using a launcher in which the expendable probe was mounted before deployment. When the probe was locked in position, an electrical connection was made between the probe and recorder. An operator then confirmed that the ship-based recording programme was ready for launch. Following the launch of the probe, copper wire de-reeled from inside the launch canister as well as inside the probe to compensate for ship movement. As the probe descended through the water column, depth and temperature data were recorded and displayed in real time (the design of the probe with precision weighting and spin-stabilisation allows a predictable rate of descent and therefore a depth accuracy of 2%). When the probe reached the sea floor (if shallower than the length of the wire), the wire was cut. In deeper water the wire de-reeled to its full length, then dropped into the water column or was cut.

The majority of deployments made were with Lockheed Martin Sippicon T5 probes which have a wire length of 1830 m and need to be operated at a ship speed of 6 knots or less. Two Lockheed Martin Sippicon T7 probes were used (for a second deployment in one case where a probe did not work correctly and for the last deployment when no T5 probes remained) which can be operated at 10 knots, but were still deployed at 6 knots in this case. T7 probes also have a shorter wire length of 700 m.

2.5.3 Data recording

Data were recorded and displayed real-time using Sea-Air Systems software:

- WinMK21 v2.13.1
- MIK21COEF v2.9.1
- MK21AL v2.14.1

Before launch, metadata were entered into the software and K9 was set running to ensure the PC time was synced to ship time. Data were recorded straight into /data/xbt. .EDF (ASCII output of profile data and launch metadata in the header) and .RDF files exist for each deployment (except for event 099 which failed).
A number of deployments showed traces that displayed spikes at unexpected depths so a full profile was not always obtained – on one occasion this was because the wire snapped prematurely.

2.5.4 Deployments

XBT deployments are shown below:

Table 2-6: XBT deployment times and positions during JR304

Date	WCB transect	Event number	Data file name	XBT type	Comments
08/12/2014 09:06:00	T1.1	83	T5_00001	T5	
08/12/2014 10:20:00	T1.1	84	T5_00002	T5	
08/12/2014 11:24:00	T1.1	85	T5_00003	T5	
08/12/2014 12:37:00	T1.1	86	T5_00004	T5	
08/12/2014 13:44:00	T1.1	87	T5_00005	T5	
09/12/2014 09:42:00	T2.1	96	T5_00006	T5	
09/12/2014 10:51:00	T2.1	97	T5_00007	T5	
09/12/2014 12:04:00	T2.1	98	T5_00008	T5	
09/12/2014 13:17:00	T2.1	99		T5	Did not write a file.
09/12/2014 14:25:00	T2.1	100	T5_00009	T5	Called XBT9 by operator. Data file XBT 9. Called XBT10 by bridge. Event number correct.
10/12/2014 09:04:00	T3.1	107	T5_00010	T5	Failed.
10/12/2014 09:05:00	T3.1	108	T5_00011	T7	Second attempt in this location.
10/12/2014 10:15:00	T3.1	109	T5_00012	T5	
10/12/2014 11:20:00	T3.1	110	T5_00013	T5	
10/12/2014 12:30:00	T3.1	111	T5_00014	T5	
10/12/2014 13:33:00	T3.1	112	T5_00015	T5	
11/12/2014 09:01:00	T4.1	121	T5_00016	T5	
11/12/2014 10:08:00	T4.1	122	T5_00017	T5	
11/12/2014 11:20:00	T4.1	123	T5_00018	T5	
11/12/2014 12:26:00	T4.1	124	T5_00019	T5	
11/12/2014 13:36:00	T4.1	125	T5_00020	T5	
11/12/2014 14:16:00	T4.2	126	T5_00021	T5	
11/12/2014 15:34:00	T4.2	127	T5_00022	T5	
11/12/2014 16:38:00	T4.2	128	T5_00023	T5	
11/12/2014 17:50:00	T4.2	129	T5_00024	T5	
11/12/2014 18:52:00	T4.2	130	T7_00025	T7	

3 Acoustics

Sophie Fielding, Peter Enderlein, Hyoung Sul La, Jon Watkins

3.1 EK60 Acoustic instrumentation

3.1.1 Introduction

The EK60 was run throughout JR304 to collect information on the horizontal and vertical distribution of krill and to derive estimates of krill biomass for the Western Core Box and to contribute data from transects from the Falklands to South Georgia.

3.1.2 Aim

- Collection of acoustic data to accompany all transects, acoustic surveys, and net tows during the South Georgia survey.
- Backup and process the acoustic data

3.1.3 Methods/System specification

3.1.3.1 Software versions

- Simrad ER60 v. 2.4.3
- Sonardata Echolog 60 v 4.10.1.6230
- Sonardata Echoview v 4.90.81.19054 Live viewing
- Sonardata Echoview v 6.0.89.25446 Processing

HASP Dongle BAS3 licensed for base, bathymetry, analysis export, live viewing, school detection and virtual echogram was used to run the echolog and echoview in live viewing mode. The echosounder pc JCR-EK60-S1 and the EK60 workstation are integrated into the ship's LAN. ER60 .raw data files were logged to a Sun workstation jrua, using a Samba connection, which is backed up at regular intervals. All raw data were collected to 1100 m. Echolog was run on the EK60 workstation and wrote compressed files also directly to the Sun workstation via a Samba connection.

3.1.3.2 Echolog compression settings

Final compression settings used in Echolog for all frequencies were:

- Power data only (angle data is still available from the raw files)
- From 0 - 1100 m (38 kHz), 0 – 1100 (120 kHz) and 0 – 1100 (200 kHz) data only (data from greater depths are available from the raw files)
- Average samples where both Sv below –100 dB and TS below –20 dB
- Maximum number of samples to average: 50
- DO NOT use average samples below echosounder detected bottom unless sure of bottom detection

3.1.3.3 File locations

All raw data were saved in a general folder JR304/raw, all echolog data were saved in the folder JR304/data/echoview. All files were prefixed with JR304. Calibration data were additionally saved to the calibration folder.

3.1.3.4 EK60 (ER60) settings

The EK60 was run initially using default settings (Table 3-1), although the environmental settings were updated at the start of the cruise to a temperature of 1.53° and salinity of 33.7 these resulted in new settings for c and alpha. The transducer settings were reset to default (from the manufacturers tests) and the gain settings reset to the last measured values.

The EK60 was calibrated on the 5th December 2013, and the calibration was NOT applied to the transducers.

Table 3-1: Default settings for EK60 (ER60) during cruise JR304

Variable	38 kHz	70 kHz	120 kHz	200 kHz
Ping interval (per sec)	2	2	2	2
Sound velocity (m/s)	1464	1464	1464	1464
Mode	Active	Active	Active	Active
Transducer type	ES38	ES70-C	ES120-7	ES200-7
Transceiver Serial no.	009072033fa5		00907203422d	009072033f91
Transducer depth (m)	0	0	0	0
Absorption coef. (dB/km)	10.07	19.21	28.17	41.26
Pulse length (ms)	1.024	1.024	1.024	1.024
Max Power (W)	2000	750	500	300
2-way beam angle (dB)	-20.70	-20.70	-20.70	-19.60
Sv transducer gain (dB)	25.09	26.30	24.68	22.10
Sa correction (dB)	-0.51	-0.45	-0.41	-0.29
Angle sensitivity along	22	22	21	23
Angle sensitivity athwart	22	22	21	23
3 dB Beam along	7.16	6.87	7.48	6.51
3 dB Beam athwart	7.02	6.88	7.58	6.36
Along offset	-0.07	0	-0.06	-0.11
Athwart offset	-0.18	0	-0.09	0.18

The EK60 was controlled through the k-sync using variable settings depending on whether the swath was being run opportunistically. A new setting on the k-sync (swath+bio) was used to ping the EK60 as much as possible (on a 2 second ping rate) whilst the swath was pinging once, and then to let the EK60 ping twice on its own. This enables the interference from the swath to be removed from the EK60 data using a spike filter. At other times (when the swath wasn't used) the k-sync was used to synchronise the EA600, ADCP and EK60 all triggering on a 2 second ping rate, with the ADCP and EA600 triggering slower when required. Due to the k-sync switching the EK60 into standby several times after 3 triggers without reply, the reply function was disconnected – which solved the problem.

3.1.4 EK60 Calibration

An acoustic calibration was carried out in Stromness Harbour, South Georgia on 01/12/2014. The ship was anchored, its movement balanced by minimal DP usage, and all over the side water deposits stopped. The EK60 was triggered through the k-sync, the EA600 was still running and ADCP was switched off. Each transducer was calibrated in turn, although all transducers were operating at the time. Standard ER60 calibration procedures were used as documented for previous cruises (the relevant copper sphere was moved through all quadrants of each transducer). In addition the sphere was held on-axis for extra periods of time to enable calibration variables to be determined in Echoview.

A CTD (Event 71) was undertaken on the morning of the calibration. Temperature and salinity were averaged from the surface to 30 m (depth of the calibration sphere) and were 1.06 °C and 33.79 PSU resulting in a speed of sound constant of 1456 m/s (Kongsberg software calculation).

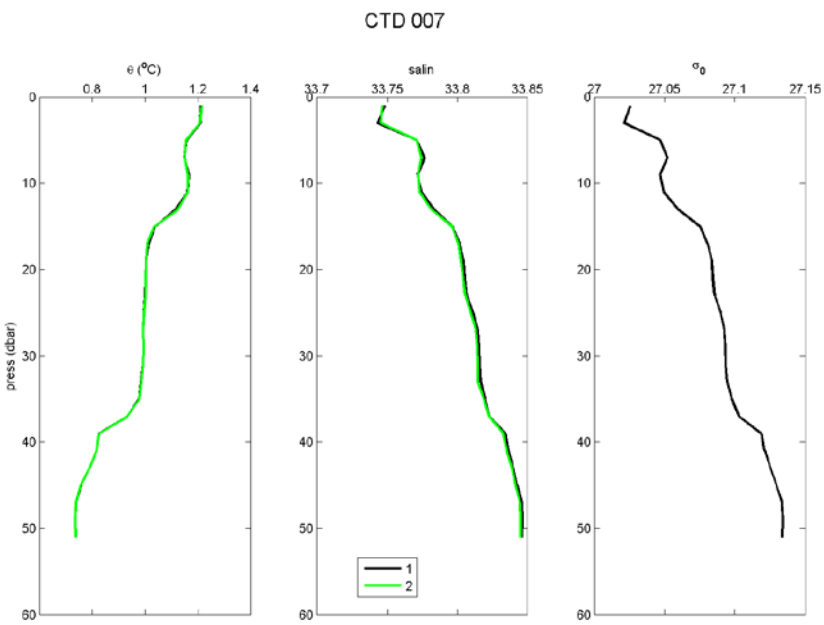


Figure 3-1: Temperature, salinity and density profiles for CTD cast 7, event 71 taken at the acoustic calibration site in Stromness Harbour

Each transducer was calibrated at the settings used throughout the cruise. Parameters from the ER60 lobes calibration were updated onto the ER60 software (Table 3-2), since the last calibration was undertaken in Norway.

The calibration resulted EK60 gain values significantly different (0.5 – 1.5 dB) from those estimated in Norway during sea trials in September 2014. So each calibration was done twice. In each case the results were the same so the parameters were uploaded.

Table 3-2: EK60 settings for calibration at Stromness and new calibrated settings

Date (dd/mm/yyyy)	01/12/2014	02/12/2014	01/12/2014	01/12/2014
Location	Stromness	Stromness	Stromness	Stromness
Time (GMT)	22:22	00:11	13:06	14:15
Frequency (kHz)	38	70	120	200
GPT serial no	009072033fa5	0090720770eb2	00907203422d	9072033191
Comments	EA600 on	EA600 on	EA600 on	EA600 on
Water temperature (°C)	1.06	1.06	1.06	1.06
Salinity (PSU)	33.79	33.79	33.79	33.79
Sound velocity (m/s)	1456	1456	1456	1456
Absorption coeff (dB/km)	9.99	18.06	26.20	39.69
Ping rate (sec^{-1})	1	1	1	1
Transmit Power (W)	2000	750	500	300
Pulse length (ms)	1.024	1.024	1.024	1.024
Bandwidth (kHz)	2.43	2.86	3.03	3.09
Sample Interval (m)	0.186	0.186	0.186	0.186
Original gain (dB)	25.09	26.3	24.68	22.1
Original Sa correction (dB)	-0.51	-0.45	-0.41	-0.29
Theoretical TS of sphere (dB)	-33.72	-39.15	-40.24	-44.87
New gain (dB)	25.6	26.27	23.35	20.66
New Sa correction (dB)	-0.54	-0.38	-0.43	-0.27

3.1.5 Data coverage

3.1.5.1 Acoustic transects

The WCB was run in a west to east direction starting at the Northern end. Weather conditions were bad during the second set of transects and the night time fishing was not undertaken. Instead those samples were undertaken after transects 4 had been completed.

Table 3-3: WCB Transect times, directions and speeds

Transect	Date	Start time (GMT)	End time (GMT)	Comments
WCB1.1	08/12/2014	09:06	13:49	
WCB1.2	08/12/2014	15:00	19:21	
WCB2.1	09/12/2014	09:41	14:28	Iceberg avoided
WCB2.2	09/12/2014	15:32	19:58	
WCB3.1	10/12/2014	09:00	13:36	
WCB3.2	10/12/2014	14:37	18:46	
WCB4.1	11/12/2014	09:00	13:37	
WCB4.2	11/12/2014	14:12	18:56	

3.1.6 Problems encountered

Interference from other acoustic instruments was at a minimum with respect to the other scientific instruments. The k-sync issue of putting instruments into standby if it doesn't receive confirmation from an instrument has created problems by stopping instruments when there is no need to. As a result we disabled the feedback into the k-sync so that it wouldn't trip out.

3.2 Acoustics ES853.

The ES853 echo-sounder was commissioned from Imagenex and is 3.5 inches (88.9 mm) tall with a diameter of 3.25 inches (82.55 mm), operates from a 24V DC power supply with a draw of 0.25 W and communicates with a PC through a serial connection. The ES853 is a single-beam echo-sounder and has an operating frequency of 120 kHz, a pulse length of 100 µs, beam angle of 10°, range of 100 m, configurable gain of either 20 or 40 dB (only the 40 dB gain is considered here) and measures mean volume backscattering (Sv, dB re 1 m-1) per range bin interval of 0.5 m. The ES853 can operate in three modes: real-time logging to a computer with a variable ping rate dependent on serial communication rate (typically ~2 Hz), self-logging with a ping rate of 1 Hz, or self-logging at a rate of 0.25 Hz ('glider mode'). The ES853 records echo intensity counts on a linear scale, which are converted to mean volume backscattering strength using an active version of the SONAR equation (Eq. 1) for distributed targets (Urick, 1983).

$$S_v = RBV + 20log_{10}R + 2\alpha R - (RR + SL) - \left(10\,log_{10}\frac{c\tau}{2}\right) - (10log_{10}EBA) - C - g$$

where R is range (m), RBV is the recorded count (20log10(signal level/1V peak-peak), RR is the transducer receiving response (dB re 1 V/µPa) and SL is the transducer source level (dB re 1 µPa/V at 1m) supplied by the manufacturer, α is the absorption coefficient (dB m-1), c is sound velocity (m s-1), τ is pulse length (s), EBA is the equivalent beam angle (steradians), *C* is a constant calculated during the calibration of the echo-sounder and *g* is the gain (dB). The ES853 has a dynamic range of 120 dB and records signals as integer values, thus the resolution in signal strength is reduced compared with ship-based echo-sounders such as the EK60.

3.2.1 Calibration of the ES853

Calibration of the ES853 was performed in Stromness Bay, South Georgia using an on-axis, standard-target sphere calibration (Foote *et al*., 1987), performed with the ES853, using a 20.008 mm tungsten carbide sphere suspended from a small floating platform next to the ship. Calibrations were performed at gains of 40 and 20 dB and at variable distances from the transducer face. Relevant values of speed of sound and sound absorption were derived from a CTD cast immediately prior to the calibration (see event 71, section 3.1.4 above, EK60 Calibration).

An assembly was constructed such that the echo sounder could be positioned facing downwards while the platform was floating level on the surface of the water. The assembly consisting of a large inflatable ring, cross supports with fishing reel with line at each end and a downright, central pole. A bespoke frame was built over 2013/14 so that the automatic winches from the EK60 calibration rig could be used to control wire out. A battery pack was mounted on one of the cross supports and a 20 mm tungsten carbide sphere attached to the lines from the fishing reels. The target sphere was weighted using a weight separated by 2 m of line. The echo sounder was connected to a laptop by a 50 m serial cable and the assembly lowered into the water by the starboard Effer crane. The tungsten carbide sphere was then lowered to varying depths using the fishing reels first automatically, but since this wasn't quick it was then done by hand bringing the rig in to the edge of the ship.

Table 3-4 lists the files and associated target depths recorded for calibration purposes using the glider echo sounder serial number 5707

Table 3-4: ES853 files recorded during echo sounder calibration

Time (GMT)	Filename	Depth	Gain
14:42	calib_20141202_2	10 m	20 dB
14:48	Calib_20141202_3	10 m	40 dB
Break to fix port aft winch			
15:28	Calib_20141202_4	10 m	40 dB
16:05	Calib_20141202_5	25m	40 dB
16:21	Calib_20141202_6	25 m	20 dB
16:31	Calibr_20141202_7	25 m	20 dB (EK60 on)
16:41	Calib_20141202_8	25	40 db (EK60 on)

3.2.2 Deployments of ES853 on the RMT8 cross

The echo sounder system was mounted on the RMT cross during all net deployments. The cable was strapped in place around the frame and the echo sounder was mounted on a bracket in the space normally occupied by the RMT altimeter. The altimeter was repositioned at the rear of the cross. The echo sounder's transducer was positioned at approximately 45 ° to the crosses orientation, such that it would be facing downwards during towing. Power to the echo sounder was supplied by the newly modified DWNM through a cable and worked well throughout the cruise. Several krill swarms were sampled with the RMT8 and the krill swarms clearly visible on the ES853 data. Each file was saved to a folder with the event number as a title.

3.2.3 Deployment of ES853 on drifter

The new drifting echosounder was deployed tethered to the starboard Effer crane whilst the ship was at anchor off Signy undertaking supply. It was deployed at 18:40 (GMT) 22 November 2014 for a period of approximately 10 minutes in 40 m water depth. The weather conditions were calm, and it is still not clear whether the drifting buoy will tip over in adverse conditions.

4 Mooring cruise report JR 304

Peter Enderlein, Scott Polfrey, Gabi Stohwasser, Sophie Fielding & Geraint Tarling

4.1 General

During JR304 the P2 deep sediment trap mooring was successfully recovered. Also the P2 and P3 moorings were successfully redeployed. Both moorings had a major scientific payload increase and where redesigned. The main buoy got a pH sensor and a CO_2 sensor with an external battery pack added, populating now all holes for instruments. All the ropes where replaced and an additional second sediment trap was added as well as a Seaguard current meter with O_2 sensor. Also a Water sampler was added underneath the top sediment trap.

The Signy mooring was pinged again with little hope to find it this year, and unfortunately, again without any success. The WCB shallow water mooring was not found in its deployment position and despite several attempts was not located at all and therefore could not be recovered.

4.2 Signy mooring of Inaccessible Islands

The Signy mooring was originally deployed on 28.11.2012 at 12:28 in 688 m water depth at location: 60.57537 S and 46.51749 W. The mooring was deployed weight first, ship heading into the approaching ice.

After failing to locate and recover it last year, another attempt was made to ping and find the mooring on this trip. So the mooring was pinged on passage from Signy to the Ice Station on the 25.11.2014. Between 02:25 and 02:35 both releases where pinged 5 times but without any response. Also nothing could be seen on the echo sounders. Having had little hope to find the mooring this year, the decision was made to move off and no further attempts were made to find the mooring.

The following beacon and releases are on the mooring:

- **Iridium satellite beacon:** No: 12091770
- Release 1: Sn: 1357 ARM: 092C Release: 0955 Diagnostics: 0949
- Release 2: Sn: 1358 ARM: 092D Release: 0955 Diagnostics: 0949

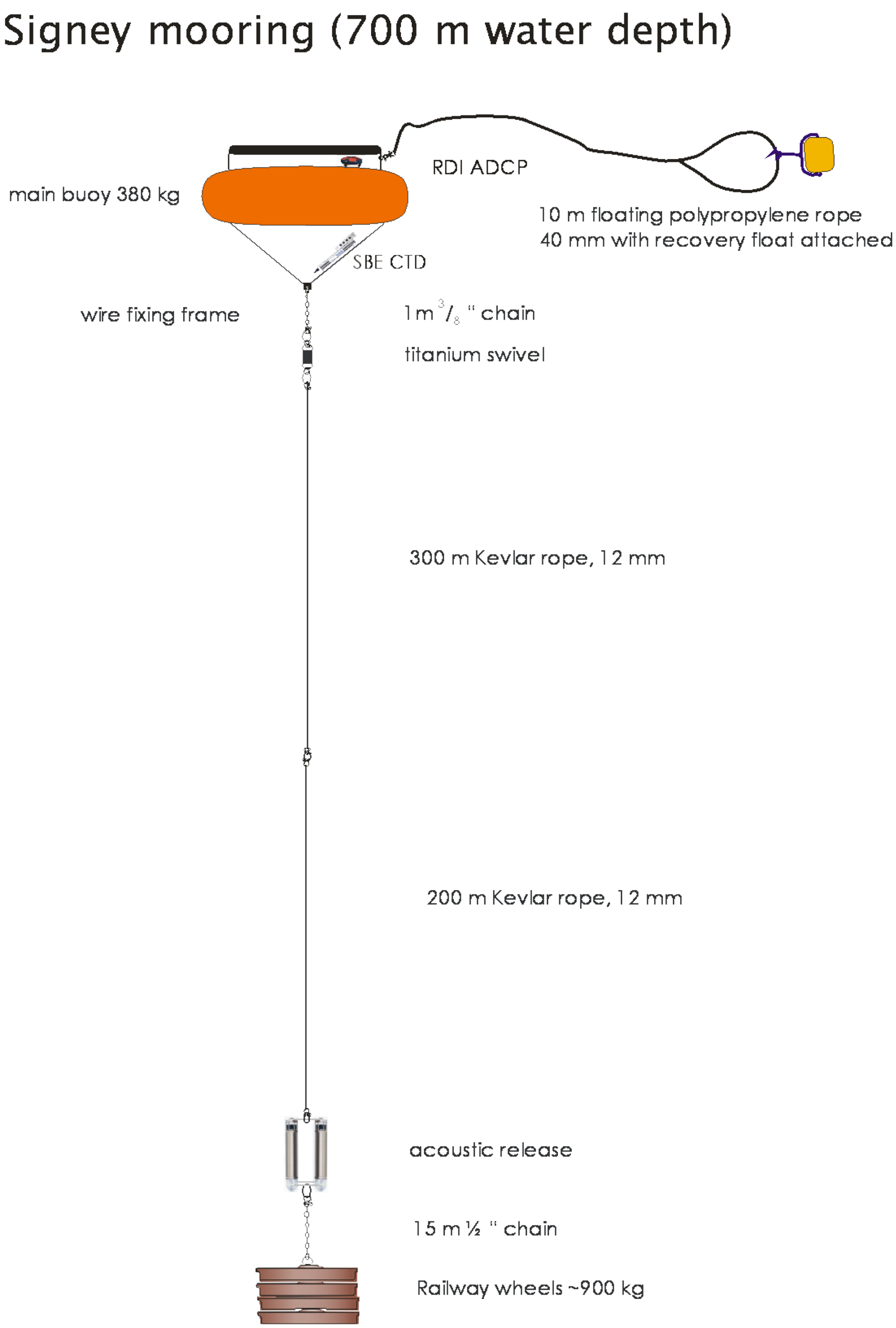


Figure 4-1: Arrangement of the mooring deployed off Signy during JR280 (Dec 2012)

4.3 3200m sediment trap mooring @ P2

4.3.1 Recovery

The recovery took place on 28 of November 2014. The acoustic releases responded straight away and after ranging the mooring successfully a few time, the mooring was released and was within 5min at the surface. The mooring was hooked mid ships and the mooring winch rope attached. The whole rig was recovered by using the mooring winch and a stopper rope on a cleat. This worked very well again and despite the length of the rig, it was a speedy recovery taking about 2 hours.

4.3.2 Performance

The CTD worked and showed that the mooring at one point was pushed down below 1000m thereby destroying the Combobeacon, as it is only rated to 600m water depth. The ADCP worked fine as well as the Current meter. The sediment trap rotations worked according to the timetable set for the P2 sediment trap with 14 planned rotations between deployment and recovery. On recovery 4 of the 21 sample bottles fitted to the sediment trap were missing (bottles 6,8,9,15). All remaining sampled bottles, including 2 blanks, were packed into boxes containing vermiculite and stored until analysis in the laboratory at BAS Cambridge.

4.3.3 Redeployment

The mooring was redeployed on the 30 of November 2014 in less than perfect conditions. The deployment started at 12:14 GMT, buoy first. During the deployment the second sediment trap could not be programmed. Because of time constrains due to the weather conditions, the mooring lay out was changed last minute and the rig was deployed with only one sediment trap. The weight was finally released at **14:50 at 55° 14.5'S, 041° 15.4'W**. After giving the mooring time to settle, it was pinged successful with a range of 3355m.

Table 4-1: Extract from bridge event log showing positions and times of P2 mooring deployment

15:36:00 30/11/2014	070- P2 Mooring Deployment	-55.24280	-41.25749	Mooring pinged, distance of 3355m
14:50:00 30/11/2014	070- P2 Mooring Deployment	-55.24273	-41.25748	Mooring Buoy fully deployed, weight deployed in position 55 14.5 S 041 15.4W

4.3.4 Work carried out:

4.3.4.1 NOVATEC beacon:

- U07-029, Ch A, 154.585 MHz – broken upon recovery!
- Replaced with NOVATECH beacon: CO2-058, Ch A, 160.725 MHz

4.3.4.2 Acoustic Releases:

<u>**Codes**</u>:

Release No: 290

On FR1 FR2 : B637

Release: **B639**

Diagnostic: B640

Pinger: B636 + B694

On new deck unit:

Option 1. RXTX settings

Option 1. Immediate Transmit

RT6XX

Transmit type: command only

Code command: B639 (release), B640 (diagnostic)

Enter

FTO=mono 8kHz

Ranging Distance

Enter

Release No: 1219

ARM, Ranging: 0896

Release code: **0896 + 0855**

Release + Pinger: ARM + 0856

Pinger on: ARM + 0847

Pinger of: ARM + 0848

Diagnostic: ARM + 0849

Acoustic releases: 290 + 1219

- new batteries
- tested

4.3.4.3 *Irmasat beacon 12098770*

- new batteries
- tested

4.3.4.4 *Replaced with ARGOS beacon SN280, ptt 60210*

- Taken of mooring, kept as spares

4.3.4.5 *New NOVATEC Combo beacon: CO2-058*

- new batteries
- tested

4.3.4.6 *CTD 37 SMP 43742: 4852 on main buoy*

- data downloaded
- new batteries
- set-up instrument for re-deployment
    - set real time clock to PC clock (p. 28)
    - check instruments is ok and clock is set properly by using "DS"command (p. 27)
    - set-up instrument for "Autonomous Sampling" following the instructions on page 24
    - samplenum=0 automatically makes entire memory available for recording
    - sample interval: 900 sec
    - starttime=113014 210000
    -

4.3.4.7 *CTD 37 SMP 43742: 4855 not redeployed*

- data downloaded
- new batteries

4.3.4.8 *ADCP WHS300 – I – UG26: 7522*

- data downloaded
- new batteries
- set-up instrument for re-deployment
    - erase data (p.16 WinSC)
    - start WinSC for set up instrument
    - set-up instrument
        - Number of bins: 30 (1-128)
        - Bin size (m): 8 (0.2-16)
        - Pings per Ensemble: 10
        - Interval: 15 min
        - Duration: 550 days
        - Transducer depth: 200 m
    - save deployment settings in prepared folder
    - set up ADCP real time clock to PC clock
    - don't verify the compass (needless on a ship)
    - run pre-deployment tests to check instrument

4.3.4.9 *Sediment trap:* ***Parflux*** *No: ML11966-11*

- new batteries (14x C – Cells + 1x 9V Block battery)
    - o **do not remove both batteries at the same time!**
- **New Motor**
- **Always disconnect the cable on the Sediment trap first, before unplugging the Computer end!!**

The preservative solution for the sediment trap bottles was mixed according to the following instructions and quantities:

1- Buffer 1 L of Formalin with 5g Sodium tetraborate (BORAX) at least 1 day before mixing with filtered seawater. Shake periodically, if possible every 4-6 hours to ensure Borax dissolves completely.
2- Add 100g NaCl to 19 L deepwater at least 1 day before addition of Formalin. Shake periodically, if possible every 4-6 hours to ensure salt dissolves completely.
3- Mix together to produce final volume of 20L preservative solution.
4- The final pH of the solution was 8.2.

4.3.4.10 *Parflux sediment trap deployment settings (21 cups):*

Schedule Verification

- Event 1 of 22 = 12/01/2014 00:00:01
- Event 2 of 22 = 12/15/2014 00:00:01
- Event 3 of 22 = 01/01/2015 00:00:01
- Event 4 of 22 = 01/15/2015 00:00:01
- Event 5 of 22 = 02/01/2015 00:00:01
- Event 6 of 22 = 02/15/2015 00:00:01
- Event 7 of 22 = 03/01/2015 00:00:01
- Event 8 of 22 = 04/01/2015 00:00:01
- Event 9 of 22 = 05/01/2015 00:00:01
- Event 10 of 22 = 06/01/2015 00:00:01
- Event 11 of 22 = 07/01/2015 00:00:01
- Event 12 of 22 = 08/01/2015 00:00:01
- Event 13 of 22 = 09/01/2015 00:00:01
- Event 14 of 22 = 10/01/2015 00:00:01
- Event 15 of 22 = 11/01/2015 00:00:01
- Event 16 of 22 = 12/01/2015 00:00:01
- Event 17 of 22 = 12/15/2015 00:00:01
- Event 18 of 22 = 01/01/2016 00:00:01
- Event 19 of 22 = 01/15/2016 00:00:01
- Event 20 of 22 = 02/01/2016 00:00:01
- Event 21 of 22 = 02/15/2016 00:00:01
- Event 22 of 22 = 03/01/2016 00:00:01

Note header says shollowing, but trap actually deployed deep

P2 shallow trap JR304 deploy

4.3.4.11 *Current meter: Aquadopp No A2L - 1793*

- data downloaded
- new batteries

Aquadopp current meter deployment settings:

- Deployment : Dp_P2
- Current time : 29/11/2014 19:50:22

- Start at : 30/11/2014 21:00:00
- Comment:
- P2 2014 to 2015 deployed JR304
- --
- Measurement interval (s) : 900
- Average interval (s) : 60
- Blanking distance (m) : 0.37
- Diagnostics interval(min) : N/A
- Diagnostics samples : N/A
- Measurement load (%) : 4
- Power level : HIGH
- Compass upd. rate (s) : 900
- Coordinate System : ENU
- Speed of sound (m/s) : MEASURED
- Salinity (ppt) : 34
- File wrapping : OFF
- --
- Assumed duration (days) : 550.0
- Battery utilization (%) : 243.0
- Battery level (V) : 10.7
- Recorder size (MB) : 89
- Recorder free space (MB) : 89.000
- Memory required (MB) : 2.1
- Vertical vel. prec (cm/s) : 1.4
- Horizon. vel. prec (cm/s) : 0.9
- --
- Aquadopp Version 1.28
- Copyright (C) 1997-2004 Nortek AS

4.3.4.12 pH sensor: PO 128

SAMI

deployment settings:

- Set: 29/11/2014 23:22 GMT(29/11/2014 23:22 Local Time(0))
- Wait: 21 Hr. 37 Min. 58 Sec.
- Start: 30/11/2014 20:59 GMT(30/11/2014 20:59 Local Time(0))
- Run: 550 Days 0 Hr. 0 Min.
- Stop: 02/06/2016 20:59 GMT(02/06/2016 20:59 Local Time(0))
- Global
- ---
- Default communications at 57.6K.
- While waiting to start
- Off

- SAMI
- SAMI pH (Vb+)
- Run every 4 Hr. 0 Min.
- Cycles Between Stds=0
- #Samples Averaged=1
- #Flushes=55
- Pump On-Flush=4
- Pump Off-Flush=32
- #Reagent pumps=1
- Valve delay=8
- Pump On ind=8
- P/V Off ind=16
- #Blanks=4
- t_pump_m=8
- Pump off to Meas=16
- Meas to pump on=8
- #Measurements=23
- Salinity Delay=0
-
- Device 1
- Off
- Device 2
- Off
- Device 3
- Off
- P2 deployed JR304 301114:

4.3.4.13 CO2 Sensor: 33-191-75

Remember the battery needs charging for 24 hours before deployment

Deployment settings:

------------- Oceanus Logger Main Menu -------------

FW Version 4.1.0w

Pro Oceanus Inc.

Date: 2014/11/30 Time: 00:37:18

---

1) Record Data Now 5) Auto Start Settings

2) View Logged Data

3) Erase Logged Data 6) Sleep Now

4) Change Clock Time 7) Display SBA Console

Enter Command > Loading User Variables...

Run Mode = 3Sample Num = 4Zero Int = 2Zero Counter = 0Atmosphere Sample = 1Menu Timer = 30

Atmosphere Enabled = 0

------------- Auto Start Menu -------------

Date: 2014/11/30 Time: 00:37:29

Auto Start Program: Three Hour

Number of Samples: 3

Re-Zero Interval: 6

Menu Timeout: 30

Next Start Time: 11:00

____

1) Change Auto Start Program

2) Change Number of Samples

3) Change Re-Zero Interval

4) Toggle ATM Mode

5) Reset Zero Count

6) Change Menu Timer

0) Return to Main Menu

Enter Command >

Go to Main Menu

------------- Oceanus Logger Main Menu -------------

FW Version 4.1.0w

Pro Oceanus Inc.

Date: 2014/11/30 Time: 00:37:51

____

1) Record Data Now 5) Auto Start Settings

2) View Logged Data

3) Erase Logged Data 6) Sleep Now

4) Change Clock Time 7) Display SBA Console

Enter Command >

Press Space-bar to escape Auto-Start (30 Seconds)....

4.3.4.14 *Water sampler:*

The water sampler was deployed using the following two macros. The dialogue between computer and sampler was logged in the L:drive for configuring the water sampler.

Deployment settings:

```
# Macro 0 - Master

# Sampler Owner: BAS Clara Manno, clanno@bas.ac.uk

# Author - Vince Kelly vince@gescience.com

# November 14, 2014

#############################

# Port sampling intervals:

# Example: Alarm (W1) is set to 15/11/2014 12:00:00

# (15 Nov 2014)

# 1 = W1        15/11/2014 12:00:00  (15 Nov)

# 2 = 24 hrs    16/11/2014 12:00:00  (16 Nov)

# 3 = 1hr       16/11/2014 13:00:00  (16 Nov)

# 4 = 15 days   01/12/2014 13:00:00  (01 Dec)

# 5 = 15 days   16/12/2014 13:00:00  (16 Dec)

# 6 = 1hr       16/12/2014 14:00:00  (16 Dec)

# 7 = 15 days   31/12/2014 14:00:00  (31 Dec)

# 8 = 15 days   15/01/2015 14:00:00  (15 Jan)

# 9 = 1hr       15/01/2015 15:00:00  (15 Jan)

#############################
```

Port 1
J1440
P1
M1
Port 2
J60
P2
M1
Port 3
J21600
P3
M1
Port 4
J21600
P4
M1
Port 5
J60
P5
M1
Port 6
J21600
P6
M1
Port 7
J21660
P7
M1
Port 8
J60
P8
M1
Port 9
J21660
P9
M1
Port 10
J21600
P10
M1
Port 11
J60
P11
M1
Port 12
J21600
P12
M1
Port 13
J21660
P13
M1
Port 14
J60
P14
M1
Port 15
J21660
P15
M1
Port 16
J21600
P16
M1
Port 17
J60
P17
M1
Port 18
J21600
P18
M1
Port 19
J21660
P19
M1
Port 20
J60
P20
M1
Port 21
J21660
P21
M1
Port 22
J21600
P22
M1

Port 23
J60
P23
M1
Port 24
J21600
P24
M1
Port 25
J21660
P25
M1
Port 26
J60
P26
M1
Port 27
J21660
P27
M1
Port 28
J21600
P28
M1
Port 29
J60
P29
M1
Port 30
J21600
P30
M1
Port 31
J21660
P31
M1
Port 32
J60
P32
M1
Port 33
J21660
P33
M1
Port 34
J21600
P34
M1
Port 35
J60
P35
M1
Port 36
J21600
P36
M1
Port 37
J21660
P37
M1
Port 38
J60
P38
M1
Port 39
J21660
P39
M1
Port 40
J21600
P40
M1
Port 41
J60
P41
M1
Port 42
J21600
P42
M1
Port 43
J21660
P43
M1
Port 44
J60
P44
M1

```
# Port 45
J21660
P45
M1
# Port 46
J21600
P46
M1
# Port 47
J60
P47
M1
# Port 48
J21600
P48
M1
;0
```

```
#Macro1(200ml Sample)
# Sampler owner: BAS Clara Manno, clanno@bas.ac.uk
# Author - Vince Kelly vince@gescience.com
# Feb. 25, 2014; August 13, 2014
# 50 steps of overdrive
G1
T2
-2500
T2
+2500
T2
-2500
T2
+2525
T2
-22500
T2
P0
T2
+22525
;0
```

4.3.4.15 Seaguard current meter with O_2 sensor:

Seaguard current meter serial number: ??

Current meter sensor: 851

Optode: 1561

The seaguard current meter with O_2 sensor does not output a setup file.

Deployment settings:

The sampling interval was set to 2 hrs, as this resulted in a deployment time of 560 days. All other settings were left at the manufacturers settings. It was checked that the current meter was set in burst mode (optimal for long term battery use). It is assumed a deployment file will be logged on the memory card for download on retrieval

4.3.5 Planned mooring rig to be deployed:

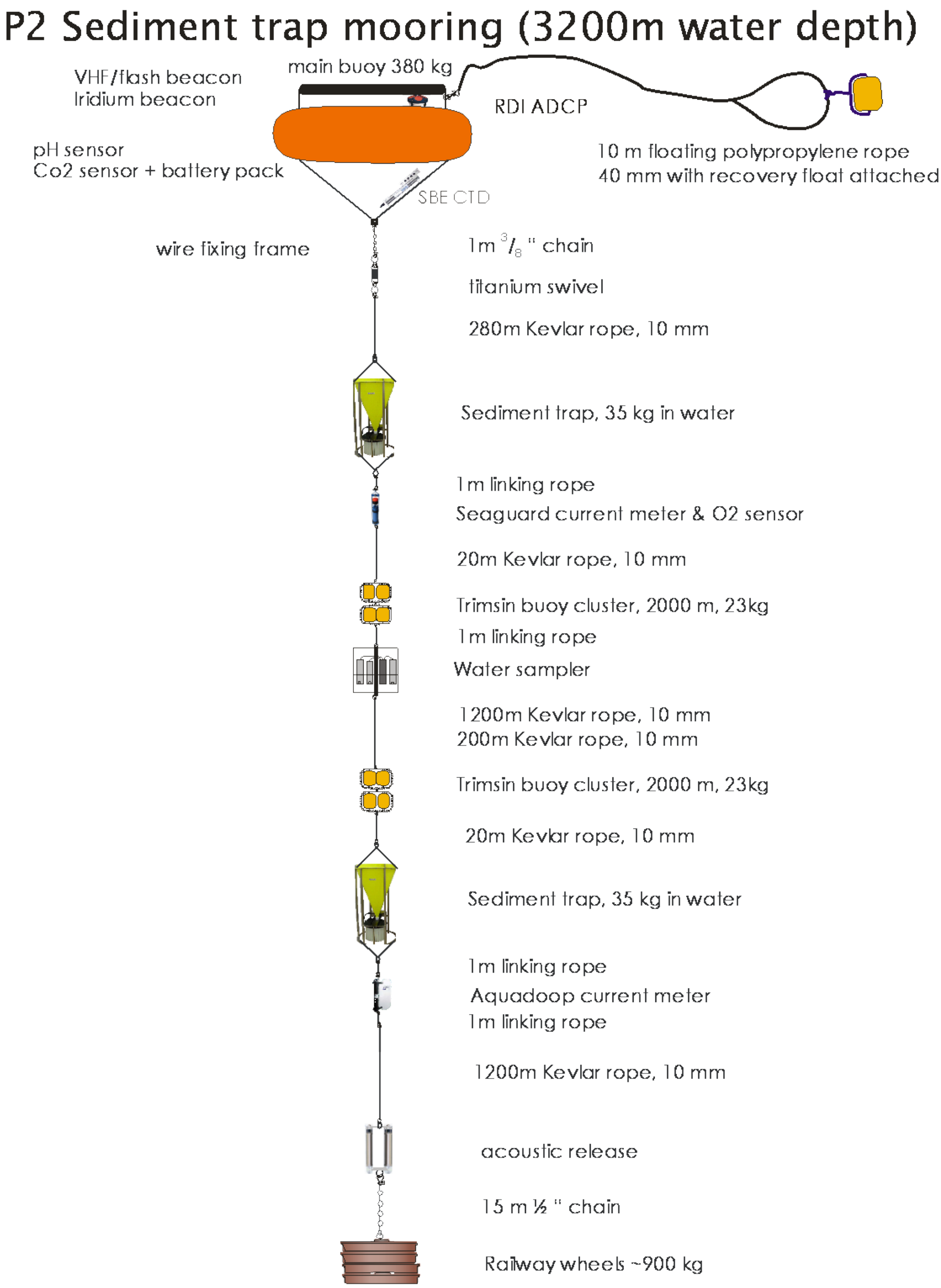


Figure 4-2: Original planned arrangement of instruments on mooring rig to be deployed at P2 Southern Mooring Station

4.3.6 Mooring rig actually deployed:

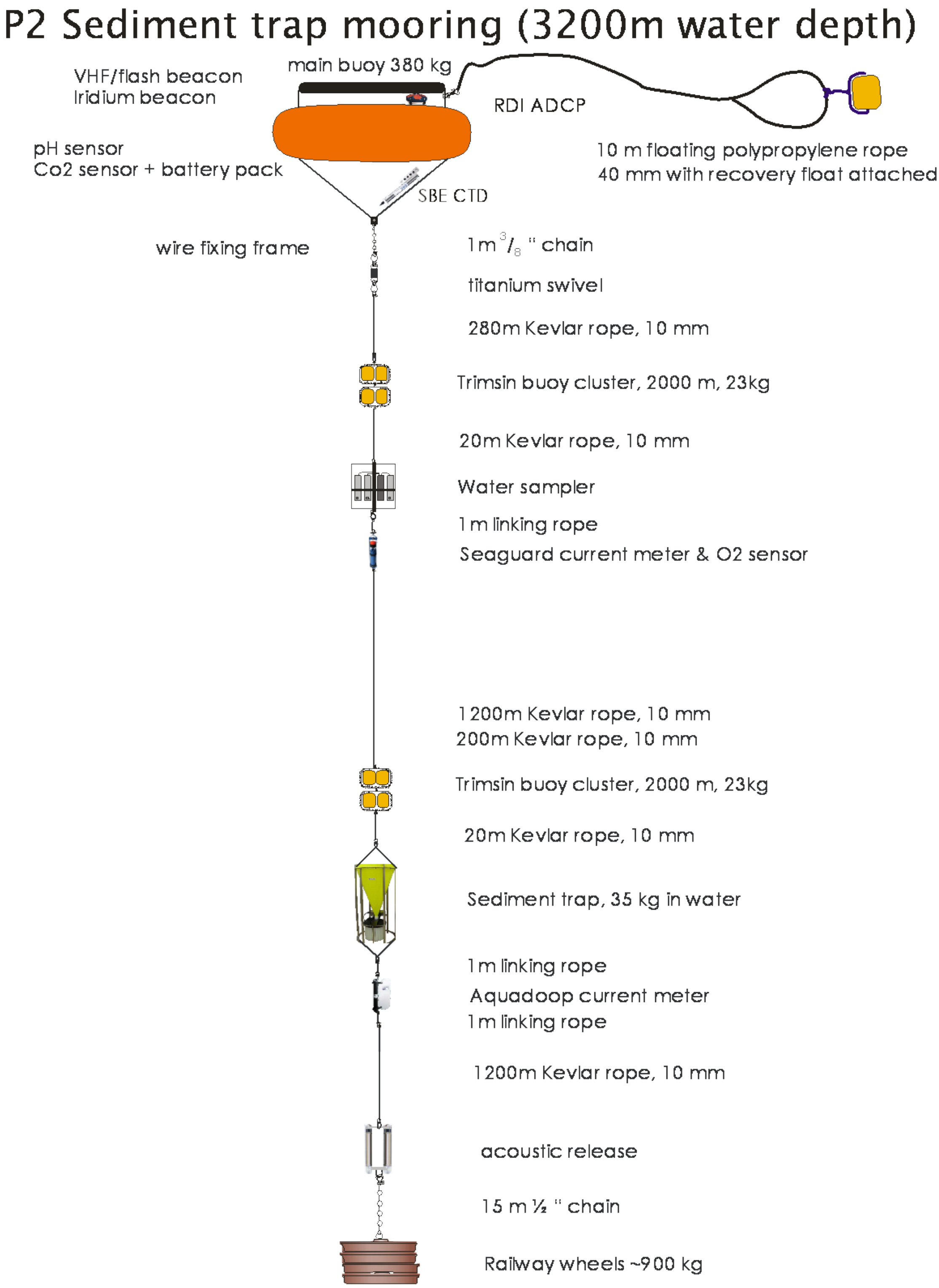


Figure 4-3: Actual arrangement of instruments on P2 Southern Mooring Station as deployed in November 2014

4.4 3700m sediment trap mooring @ P3

4.4.1 Redeployment

As the mooring was not redeployed last year, all equipment was on board prior to the deployment. The whole rig was deployed as per its new configuration with all the new instruments attached. The mooring was redeployed on the 12.12.2014 in good weather conditions. The mooring was deployed buoy first at 17:38. After streaming out all the rope and attaching all the instruments, the weight was finally released at 19:49 in 3787 m water depth at 52° 48.7'S 040° 06.7'W.

Table 4-2: Extract from bridge event log of time and final positions of P3 Northern Mooring Station as deployed in December 2014

19:57:00 12/12/2014	P3 Northern Mooring	-52.81493	-40.12140	Vessel stopped in DP to range mooring. Approx position 52° 48.7'S 040° 06.7'W
19:49:00 12/12/2014	P3 Northern Mooring	-52.81401	-40.11891	Weight deployed. Water depth 3787m

4.4.2 Work carried out:

4.4.2.1 NOVATEC beacon:

R090-020, Ch B, 159.48 MHz

4.4.2.2 Acoustic Releases:

Codes:

Release No: 93 release code: **0484 + 0455**

Release No: 573 release code: **15E1 + 1555**

- new batteries
- tested

4.4.2.3 *Irmasat beacon*

13901110

- new batteries
- tested

4.4.2.4 Argos beacon

SN 280, ID: 60210

- new batteries
- tested

4.4.2.5 *NOVATEC Combo beacon*

R09-020

- new batteries
- tested
- batteries taken out and in biscuit box

4.4.2.6 *CTD 37 SMP 29579: 2462 on main buoy*

- new batteries

deployment settings:

- set-up instrument for re-deployment
    - set real time clock to PC clock (p. 28)
    - check instruments is ok and clock is set properly by using "DS"command (p. 27)
    - set-up instrument for "Autonomous Sampling" following the instructions on page 24
    - samplenum=0 automatically makes entire memory available for recording
    - sample interval: 900 sec
    - starttime= 121314 000001

4.4.2.7 *CTD 37 4584 to go below Water sampler*

- new batteries

deployment settings:

set-up instrument for re-deployment

- set real time clock to PC clock (p. 28)
- check instruments is ok and clock is set properly by using "DS"command (p. 27)
- set-up instrument for "Autonomous Sampling" following the instructions on page 24
- samplenum=0 automatically makes entire memory available for recording
- sample interval: 900 sec
- starttime= 121314 000001

4.4.2.8 *ADCP WHS300 : 2967*

- new batteries
- set-up instrument for re-deployment
    - erase data (p.16 WinSC)
    - start WinSC for set up instrument
    - set-up instrument
        - Number of bins: 30 (1-128)
        - Bin size (m): 8 (0.2-16)
        - Pings per Ensemble: 10
        - Interval: 15 min
        - Duration: 550 days
        - Transducer depth: 200 m
    - save deployment settings in prepared folder
    - set up ADCP real time clock to PC clock
    - don't verify the compass (needless on a ship)
    - run pre-deployment tests to check instrument

4.4.2.9 *Sediment trap:* ***Parflux*** *No: top one*

- batteries connected (main), back up batteries inserted

    - **do not remove both batteries at the same time!**
- **Always disconnect the cable on the Sediment trap first, before unplugging the Computer end!!**

Two sediment traps were deployed at Station P3. The preservative solution was the same used for the sediment trap at P2 (see above). The pH of the prepared solution was again 8.2.

Parflux sediment trap deployment settings (21 cups)

PS3 Sediment Trap Deployment

Schedule Verification

- Event 1 of 22 at 12/15/14 00:00:01
- Event 2 of 22 at 01/01/15 00:00:01
- Event 3 of 22 at 01/15/15 00:00:01
- Event 4 of 22 at 02/01/15 00:00:01
- Event 5 of 22 at 02/15/15 00:00:01
- Event 6 of 22 at 03/01/15 00:00:01
- Event 7 of 22 at 04/01/15 00:00:01
- Event 8 of 22 at 05/01/15 00:00:01
- Event 9 of 22 at 06/01/15 00:00:01
- Event 10 of 22 at 07/01/15 00:00:01
- Event 11 of 22 at 08/01/15 00:00:01
- Event 12 of 22 at 09/01/15 00:00:01
- Event 13 of 22 at 10/01/15 00:00:01
- Event 14 of 22 at 11/01/15 00:00:01
- Event 15 of 22 at 11/15/15 00:00:01
- Event 16 of 22 at 12/01/15 00:00:01
- Event 17 of 22 at 12/15/15 00:00:01
- Event 18 of 22 at 01/01/16 00:00:01
- Event 19 of 22 at 01/15/16 00:00:01
- Event 20 of 22 at 02/01/16 00:00:01
- Event 21 of 22 at 02/15/16 00:00:01
- Event 22 of 22 at 03/01/16 00:00:01

The current header reads:

1: "P3 deployed JR304 12/12/14"

*4.4.2.10 Sediment trap: **Parflux** No: bottom one*

- batteries connected (main), back up batteries inserted
    - **do not remove both batteries at the same time!**
- **Always disconnect the cable on the Sediment trap first, before unplugging the Computer end!!**

Parflux sediment trap deployment settings (21 cups)

PS3 Sediment Trap Deployment

Schedule Verification

- Event 1 of 22 at 12/15/14 00:00:01
- Event 2 of 22 at 01/01/15 00:00:01
- Event 3 of 22 at 01/15/15 00:00:01
- Event 4 of 22 at 02/01/15 00:00:01
- Event 5 of 22 at 02/15/15 00:00:01
- Event 6 of 22 at 03/01/15 00:00:01
- Event 7 of 22 at 04/01/15 00:00:01
- Event 8 of 22 at 05/01/15 00:00:01
- Event 9 of 22 at 06/01/15 00:00:01
- Event 10 of 22 at 07/01/15 00:00:01
- Event 11 of 22 at 08/01/15 00:00:01
- Event 12 of 22 at 09/01/15 00:00:01
- Event 13 of 22 at 10/01/15 00:00:01
- Event 14 of 22 at 11/01/15 00:00:01
- Event 15 of 22 at 11/15/15 00:00:01
- Event 16 of 22 at 12/01/15 00:00:01
- Event 17 of 22 at 12/15/15 00:00:01
- Event 18 of 22 at 01/01/16 00:00:01
- Event 19 of 22 at 01/15/16 00:00:01
- Event 20 of 22 at 02/01/16 00:00:01
- Event 21 of 22 at 02/15/16 00:00:01
- Event 22 of 22 at 03/01/16 00:00:01

1: "P3 JR304 deep sediment trap"

3: "12/12/14"

4.4.2.11 *Current meter: Aquadopp No A2L - 1793*

- data downloaded
- new batteries

Aquadopp current meter deployment settings:

==

Deployment   : P3_304

Current time : 12/12/2014 14:20:08

Start at   : 13/12/2014 00:00:01

Comment:

P3 mooring deployed JR304

Measurement interval (s) : 900

Average interval   (s) : 60

Blanking distance   (m) : 0.37

Diagnostics interval(min) : N/A

Diagnostics samples   : N/A

Measurement load (%) : 4
Power level : HIGH
Compass upd. rate (s) : 900
Coordinate System : ENU
Speed of sound (m/s) : MEASURED
Salinity (ppt) : 34
File wrapping : OFF

Assumed duration (days) : 550.0
Battery utilization (%) : 243.0
Battery level (V) : 10.5
Recorder size (MB) : 89
Recorder free space (MB) : 89.000
Memory required (MB) : 2.1
Vertical vel. prec (cm/s) : 1.4
Horizon. vel. prec (cm/s) : 0.9

Aquadopp Version 1.28

===

4.4.2.12 pH sensor: PO 129

Set: 12/12/2014 15:54 GMT(12/12/2014 15:54 Local Time(0))
Wait: 8 Hr. 5 Min. 24 Sec.
Start: 12/12/2014 23:59 GMT(12/12/2014 23:59 Local Time(0))
Run: 550 Days 0 Hr. 0 Min.
Stop: 14/06/2016 23:59 GMT(14/06/2016 23:59 Local Time(0))
Global

Default communications at 57.6K.

While waiting to start
Off

SAMI
SAMI pH (Vb+)
Run every 4 Hr. 0 Min.
Cycles Between Stds=0
#Samples Averaged=1
#Flushes=55
Pump On-Flush=4
Pump Off-Flush=32
#Reagent pumps=1
Valve delay=8

Pump On ind=8
P/V Off ind=16
#Blanks=4
t_pump_m=8
Pump off to Meas=16
Meas to pump on=8
#Measurements=23
Salinity Delay=0

Device 1
Off

Device 2
Off

Device 3
Off

4.4.2.13 CO2 Sensor:

****Remember to charge the battery (through firmware USB port) for 24 hours before deployment

------------- Auto Start Menu -------------

Date: 2014/12/12 Time: 17:17:35

Auto Start Program: Three Hour

Number of Samples: 3

Re-Zero Interval: 6

Menu Timeout: 5

Next Start Time: 20:00

____

1) Change Auto Start Program

2) Change Number of Samples

3) Change Re-Zero Interval

4) Toggle ATM Mode

5) Reset Zero Count

6) Change Menu Timer

0) Return to Main Menu

Enter Command >

Go to Main Menu

4.4.2.14 Water sampler:

The same macros were used for the P3 mooring as the P2 mooring. A log of communications with the sampling unit is on the L:drive. These macros can be copied and pasted for the future – although the 2 columns will need to be removed.

deployment settings:

```
# Macro 0 - Master
# Sampler Owner: BAS Clara Manno, clanno@bas.ac.uk
# Author - Vince Kelly vince@gescience.com
# November 14, 2014
##############################
# Port sampling intervals:
# Example: Alarm (W1) is set to 15/11/2014 12:00:00
# (15 Nov 2014)
# 1 = W1          15/11/2014 12:00:00  (15 Nov)
# 2 = 24 hrs      16/11/2014 12:00:00  (16 Nov)
# 3 = 1hr         16/11/2014 13:00:00  (16 Nov)
# 4 = 15 days     01/12/2014 13:00:00  (01 Dec)
# 5 = 15 days     16/12/2014 13:00:00  (16 Dec)
# 6 = 1hr         16/12/2014 14:00:00  (16 Dec)
# 7 = 15 days     31/12/2014 14:00:00  (31 Dec)
# 8 = 15 days     15/01/2015 14:00:00  (15 Jan)
# 9 = 1hr         15/01/2015 15:00:00  (15 Jan)
##############################

# Port 1
J1440
P1
M1
# Port 2
J60
P2
M1
# Port 3
J21600
P3
M1
# Port 4
J21600
P4
M1
# Port 5
J60
P5
M1
# Port 6
J21600
P6
M1
```

Port 7
J21660
P7
M1
Port 8
J60
P8
M1
Port 9
J21660
P9
M1
Port 10
J21600
P10
M1
Port 11
J60
P11
M1
Port 12
J21600
P12
M1
Port 13
J21660
P13
M1
Port 14
J60
P14
M1
Port 15
J21660
P15
M1
Port 16
J21600
P16
M1
Port 17
J60
P17
M1
Port 18
J21600
P18
M1
Port 19
J21660
P19
M1
Port 20
J60
P20
M1
Port 21
J21660
P21
M1
Port 22
J21600
P22
M1
Port 23
J60
P23
M1
Port 24
J21600
P24
M1
Port 25
J21660
P25
M1
Port 26
J60
P26
M1
Port 27
J21660
P27
M1
Port 28
J21600
P28
M1

```
# Port 29
J60
P29
M1
# Port 30
J21600
P30
M1
# Port 31
J21660
P31
M1
# Port 32
J60
P32
M1
# Port 33
J21660
P33
M1
# Port 34
J21600
P34
M1
# Port 35
J60
P35
M1
# Port 36
J21600
P36
M1
# Port 37
J21660
P37
M1
# Port 38
J60
P38
M1
# Port 39
J21660
P39
M1
# Port 40
J21600
P40
M1
# Port 41
J60
P41
M1
# Port 42
J21600
P42
M1
# Port 43
J21660
P43
M1
# Port 44
J60
P44
M1
# Port 45
J21660
P45
M1
# Port 46
J21600
P46
M1
# Port 47
J60
P47
M1
# Port 48
J21600
P48
M1
;0
```

```
#Macro1(200ml Sample)
# Sampler owner: BAS Clara Manno, clanno@bas.ac.uk
# Author - Vince Kelly vince@gescience.com
# Feb. 25, 2014; August 13, 2014
# 50 steps of overdrive
G1
T2
-2500
T2
+2500
T2
-2500
T2
+2525
T2
-22500
T2
P0
T2
+22525
;0
```

4.4.2.15 Seaguard current meter with O_2 sensor:

deployment settings:

Seaguard current meter serial number: ??

Current meter sensor: 851

Optode: 1561

The seaguard current meter with O_2 sensor does not output a setup file.

deployment settings:

The sampling interval was set to 2 hrs, as this resulted in a deployment time of 560 days. All other settings were left at the manufacturers settings. It was checked that the current meter was set in burst mode (optimal for long term battery use). It is assumed a deployment file will be logged on the memory card for download on retrieval.

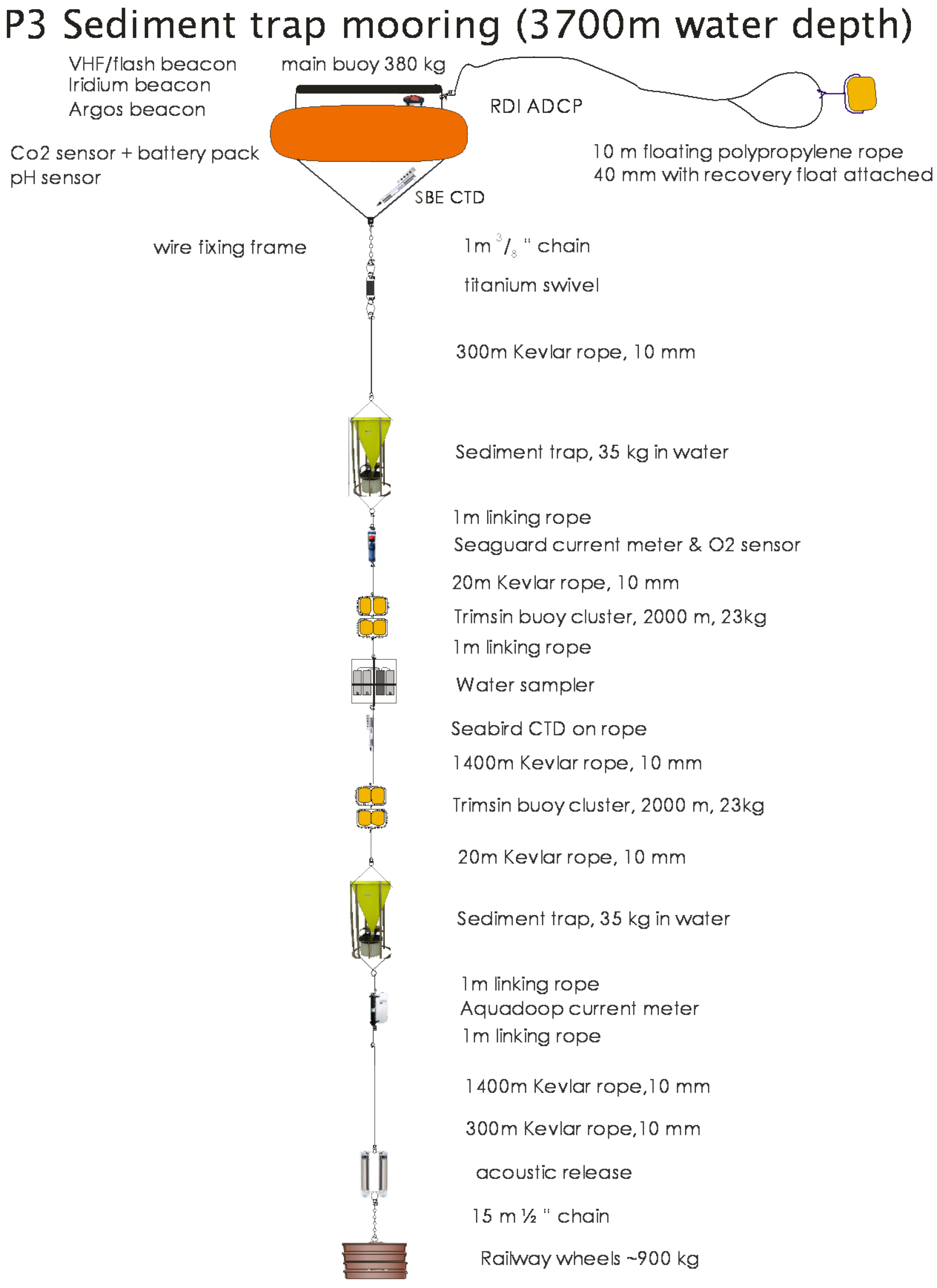


Figure 4-4: Arrangement of instruments on P3 Northern Mooring Station as deployed in December 2014

4.5 shallow water WCB mooring:

4.5.1 Recovery:

The western core box mooring was pinged on the 07.12.2014 and both releases did not respond. Therefore the vessel moved closer to the mooring position and finally over the mooring position. During this time the mooring was pinged both with the ships build in transducer and with a Hydrophon deployed over the side. Apart from a couple of false reading from the ships echosounders, we got no answers from either release. So finally the vessel stopped over the deployment position to try to find the mooring with the ships echosounders. Nothing was found on the echosounders so the decision was made to move of for the time being and to come back later to do an acousitic search gird, with the hope to find the mooring if it has been dragged away slightly by a fishing vessel or ice berg.

Table 4-3: Extract from bridge event log recording attempts to locate Western Core Box Shallow Mooring

19:37:00 07/12/2014	WCB Shallow Mooring	-53.80171	-37.93783	Vessel off DP and moving clear for RMT 8 test deployment
19:21:00 07/12/2014	WCB Shallow Mooring	-53.80170	-37.93792	Vessel stopped over deployment position
19:16:00 07/12/2014	WCB Shallow Mooring	-53.80063	-37.93958	Vessel moving back over deployment position
19:15:00 07/12/2014	WCB Shallow Mooring	-53.80065	-37.93959	Hydrophone recovered.
19:08:00 07/12/2014	WCB Shallow Mooring	-53.80063	-37.93957	Vessel stopped 170m NW of deployment position. Hydrophone deployed.
18:56:00 07/12/2014	WCB Shallow Mooring	-53.80313	-37.93559	No clear readings, v/l moving ahead in DP hdg 325
18:50:00 07/12/2014	WCB Shallow Mooring	-53.80307	-37.93554	V/l stopped on DP
18:36:00 07/12/2014	WCB Shallow Mooring	-53.80472	-37.93223	V/l off DP moving towards mooring location hdg 320
18:33:00 07/12/2014	WCB Shallow Mooring	-53.80476	-37.93237	V/l stopped on DP, 500m downwind of WCB shallow mooring site

After an RMT8 deployment, the vessel moved back to the mooring position for the acoustic search grid, running all acoustic instruments: EM122, EK60 and EA500:

Table 4-4: Extract from bridge event log recording acoustic search grid used to try and locate WCB Shallow Mooring

22:20:00 07/12/2014	WCB Shallow Mooring	-53.80150	-37.94405	Completed acoustic search for mooring. Vessel departing for start of the Core Box
21:22:00 07/12/2014	WCB Shallow Mooring	-53.80129	-37.94408	Commenced acoustic search pattern for mooring
20:53:00 07/12/2014	081	-53.76580	-37.98216	Deck secure. Vessel repositioning for WCB Mooring acoustic search

Unfortunately the acoustic search was neither successful, so after a final attempt pinging the mooring unsuccessfully the decision was made to stop the search for the WCB mooring and to move off and to carry on.

4.5.2 Instrument settings

4.5.2.1 NOVATEC beacon

R09-021: Ch. C.: 160.725 MHz

4.5.2.2 Acoustic Releases:

Code shallow water mooring:

release:No: 1022 release code: **1890 + 1855**

release:No: 1218 release code: **0895 + 0855**

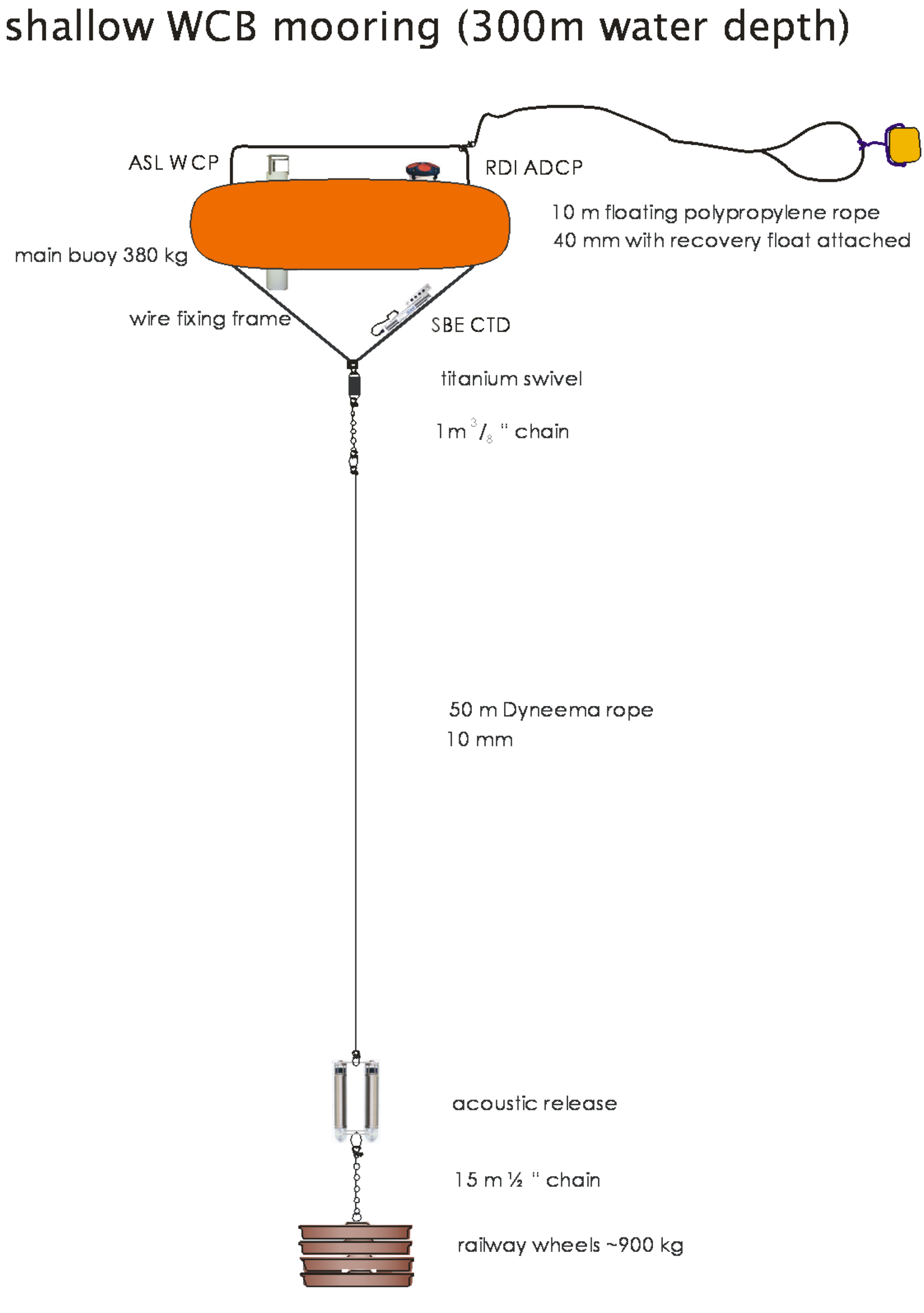


Figure 4-5: Arrangement of instruments on Western Core Box Shallow Mooring as deployed during JR291 (December 2013)

4.6 Aquamonitor deployments on P2 and P3 moorings

Geraint Tarling, Sophie Fielding, Gabi Stowasser, Peter Enderlein, Scott Palfrey, Jon Watkins

The Aquamonitor is a system that autonomously collects water via a syringe mechanism and pumps it into consecutive collection bags. The instrument consists of three separate parts – the control module, the syringe module and a battery pack. A stainless steel frame was custom made by BAS to house these components as well as 2 plastic boxes containing the water collection bags (Figure 4-6).

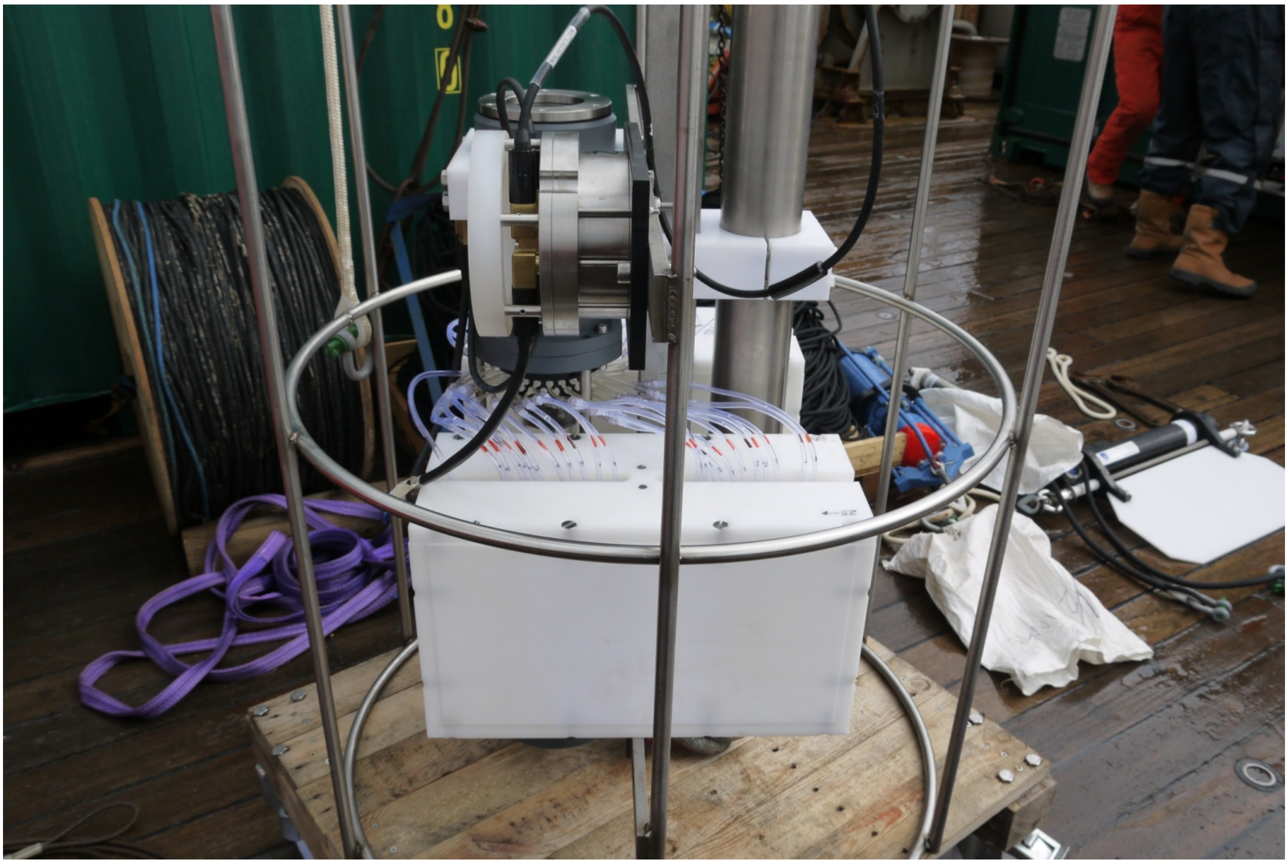


Figure 4-6: Aquamonitor just prior to deployment on deep water mooring

The system was deployed on both moorings at a depth of 500 m (280 m below depth of the sub-surface buoy). The system was set up through the uploading of Macros via a Terraterm interface - the first Macro (Macro 0) instructed the instrument on when to wake up and operate the syringe mechanism and which port (2 of 48) to pump the collected water through. The intake of water into the syringe vessel was via port 1. Macro 0 called a second Macro (Macro 1) which detailed a sampling procedure i.e. consecutive flushing of the syringe mechanism and then collection of 200 ml of water to be pumped into the awaiting collection bag. An internal carousel moved the outlet to the appropriate port (as instructed by Macro 0).

A number of trial runs were performed during the early part of the cruise to ensure that the Macro loading procedure was being correctly enacted by the instrument. Communication to the instrument was via a cable containing a RS232 port and plugs to insert into a power supply (which was set to 12V and 3 amps). Terraterm should register communication with the instrument as soon as power is supplied via this cable. On putting the instrument into autonomous mode, this cable was removed and the instrument was connected to the battery pack.

With regards the Aquamonitor deployed at P3, it was also necessary to upload new firmware (sub-gen-2040.hex ; this had already been carried out on the instrument deployed at P2).

Before deployment, sampling device ports 2 to 47 were connected to the 47 collection bags via 4 mm tubes, cut to length. The bags were prefilled with either 10 ml of buffed formalin (followed by 35 ml of MilliQ water) or 50 ul of saturated mercuric chloride solution (followed by 15 ml of MilliQ water). The formalin solution was prepared by adding 5 g Borax to 1 L of formalin (37 % formaldehyde) at least 24 h prior to use. The formalin (F) and mercuric chloride (M) solutions were added to the bags in a quasi-alternate order as detailed in Table 4-5.

During deployment, a series of instructions were transferred to the instrument via Terraterm, culminating in the command to enact Macro 0. The power supply/comms cable was removed and replaced by the battery pack lead. As a means of double checking that the instrument is in sampling mode, it runs immediately through a mock sampling procedure where water is both sucked in and pumped out of port 1. This was performed successfully in both instances.

Table 4-5: Sequence of ports, bags and preservative (F – buffered formalin and M – mercuric chloride). The last columns indicates the number of minutes the system waits before enacting the command to fill the bag. The above sequence is such that a formalin preserved sample is collected once every 2 weeks, a mercuric chloride preserved sample , once a month.

Port	Bag label	Preservative	Wait time (mins)
2	1	F	1440
3	2	M	60
4	3	F	21600
5	4	F	21600
6	5	M	60
7	6	F	21600
8	7	F	21660
9	8	M	60
10	9	F	21660
11	10	F	21600
12	11	M	60
13	12	F	21600
14	13	F	21660
15	14	M	60
16	15	F	21660
17	16	F	21600
18	17	M	60
19	18	F	21600
20	19	F	21660
21	20	M	60
22	21	F	21660
23	22	F	21600
24	23	M	60

25	24	F	21600
26	25	F	21660
27	26	M	60
28	27	F	21660
29	28	F	21600
30	29	M	60
31	30	F	21600
32	31	F	21660
33	32	M	60
34	33	F	21660
35	34	F	21600
36	35	M	60
37	36	F	21600
38	37	F	21660
39	38	M	60
40	39	F	21660
41	40	F	21600
42	41	M	60
43	42	F	21600
44	43	F	21660
45	44	M	60
46	45	F	21660
47	46	F	21600
48	47	M	60

5 Scientific Equipment Cruise Report JR304

Scott Polfrey & Peter Enderlein

5.1 Down Wire Net Monitor system (DWNM)

The DWNM was used with the Biological Wire and had a new mechanical and electrical termination at the very beginning of the cruise. It was tested to 3.5 tonne. 3 of the 4 units were used this time with various sensors attached to them. There was one on the RMT8, MOCNESS and the LHPR which all work as expected. A new bend restrictor replaced the very old, very worn out one and worked very well.

5.2 Mooring Winch

Since the winch failed earlier on in the year 2 replacement break units have been fitted to it. There was an underling problem with a contactor which the ships ETO managed to replace. The winch was then tested for long and short periods of time to make sure it worked correctly. It performed perfectly for each of the mooring recoveries and deployments. It was looking a bit tired when we first arrived so it had a small service which involved an oil change and greasing the necessary parts. Each year the winch should have the oils and lubrication checked and replaced if necessary. It will also have a new contactor every year along with an electrical test to ensure its reliability in the future.

For the 2015 season the winch will require a new o-ring between the motor and the break as the existing one is a little damaged. A new junction box is needed to replace the broken one on the motor to breaker. A 415v heater will need to be fitted to the main control panel as both of the 2 underrated existing ones are overheating and failing. A new housing is needed for the electronics to replace the existing plastic one (Dimensions: W:495 * D:425 * H:750). Next year while the JCR is in refit the intention is to have the winch drum modified. This will involve adding a separation section to the drum to take the shackles and joining rings away from the rope/ wire when spooling on and off.

5.3 EM 2040

After the disappearance of the old EM 2040 container a new one was needed. When JCR was at Stanley a new one was located and loaded on board along with a new 19’ computer rack and a desk. Some clear rubber curtain was purchased in Punta Arenas which was needed to be fitted on the inside of the container doors much the same as the previous EM 2040 container. A few days into the cruise we fitted the container out with the necessary modifications. This included, fitting of the curtain, a board along the length of the doors which is attached to the floor to help prevent water from getting in. The desk was extended along the far wall of the container to give us maximum desk space. The 19’ rack had the back cut out to allow for somewhere cables to run and for better ventilation. A small hole was cut from the side of the container to allow cables to pass through to the outside. A small piece of curtain was attached to the outside of the hole covering it. This is to help prevent water from getting in. The container is to be kept in Fipass along with all of the EM 2040 parts which are to be kept inside it. It has been consign now to Stanley office with all the relevant paper work. The EM 2040 was not used on the cruise as there was not time after all the delays we had.

5.4 LHPR

The LHPR performed fine with no real issues and was used 4 times. A longer sea cable was made as part of the DWNM integration. A small modification needs to be made to the second spooling box to fit the open and closing mechanism.

5.5 Bongo net

This net was used 40 times and had no problems at all. Before the use of it next season some modifications need to be made. These include the design of new cod ends, fixtures, fittings and fasteners for the whole structure. The cod ends have to be easily removable and non-filtering.

5.6 MOCNESS net

The MOCNESS was deployed 8 times during the cruise. 3 of the new DWNM integration cables failed over the period of the cruise. Each of the cables failed due to water ingress. This is probably due to the cables compressing when the MOCNESS is taken to large depths and allowing the water to penetrate down between the cables and potting into the small internal PCB. The potting that has been used does not seem to have bonded to the cables. A single cable was made to drive the motor so it could be operated without it failing. New integration cables will be made before its used next season but without the feedback cable. The feedback switch is no longer going to be uses in the future as it is unnecessary.

New buckets are to be designed for use with the MOCNESS for next season. New spring washers are needed for the stainless steel tie bars along with some spare bridles with bullet heads. Some maintenance needs to be done to the existing release motor when it's back at Cambridge. This includes a top up of oil and possibly a new more reliable type of connector fitted to it. A new motor and release mechanism is to be made as there are currently no spares for it.

5.7 RMT 8

The RMT 8 worked as expected and the new quick release clips on the cod ends seemed to work very well. It was deployed 11 times throughout the cruise. A few new parts are to be made for next season including a Go Pro and light bracket to be fitted to the cross, along with a way of turning the light on and off when the nets are in use. Cables will need to be made using the power out of the ES853 port to support the light.

5.8 SUCS

The SUCS system was on board to set it up and to work on it after the initial trials during the summer. The fibre optic bulk head was replaced as well as the 2pin power bulk head. The monitor bracket needs modification to prevent any rattling during long stays on the winch. In the moment the system is working fine and stable at low resolution. The high resolution is currently unstable but a new graphics card is coming with the new team and once installed, hopefully will improve the stability of the system.

5.9 Sediment trap

The Sediment trap bottles seems to be very fragile and we seem to lose a few every deployment. So we will look into a new design/material to replace the existing once with once which are sturdier.

Table 5-1: Summary of number of deployments for the main gear deployed over the side during cruise JR304

Equipment	Number of deployments
XBT	26
CTD	19
LADCP	18
MOCNESS	8
RMT8	11
Bongo	40
LHPR	4
CPR	10
Snow catcher	30
Snow camera	10
Box corer	1
SUCS	2

6 Western Core Box

6.1 Macrozooplankton

Gabriele Stowasser, Sophie Fielding, Peter Enderlein, Scott Polfrey, Geraint Tarling, Hyoung Sul La, Cecilia Liszka, Maz Wootton, and Jon Watkins

6.1.1 Gear

The RMT8 was used to characterise the macrozooplankton community in the Western Corebox in 200m oblique trawls and target trawls (Table 6-1). Target trawls were undertaken on krill swarms identified from the EK60. In oblique trawls net 1 was opened at the surface and the net deployed to 200m (where water depth was sufficient) before closing and net 2 opened at 200m depth and closed at the surface. The choice of deployment type depended on the task. Target hauls were made to supply the WCB team with krill for length frequency measurements and Cecilia Liszka (PhD student at BAS) with *Euphausia superba* (Antarctic krill) for live incubations. Krill was furthermore sampled for individual weight measurements, preservation for genetic studies (Will Goodall-Copestake, BAS) in Cambridge and total lipid analysis at SAMS, Oban. Oblique trawls were only undertaken at the Western Core Box CTD positions.

6.1.2 Catch sorting and processing

6.1.2.1 *Oblique hauls*

For the oblique hauls the total catch of net 2 (200m – surface) was sorted and quantified. Numbers caught and total weight was obtained for each species. For some groups specific identification was not possible and identification will be verified through re-examination in the laboratory. All material collected in net 1 (surface – 200m) was preserved in 4% formalin. Specimens of fish species were collected for a population study on fish in the Scotia Sea (Ryan Saunders, BAS) and preserved at -80°C. Various invertebrate species were collected as reference specimens for species identification by Maz Wootton (SAHFOS, Plymouth). All data were recorded in an Excel database.

6.1.2.2 *Targeted hauls*

The catch of targeted hauls was sorted and quantified. A summary of samples preserved is given in Table 6-2: Invertebrate and fish species sampled in the Western Core Box area during cruise JR304. Where live *E. superba* were caught samples were taken for live incubations (Cecilia Liszka and Geraint Tarling , BAS) and individual weight measurements (Sophie Fielding, BAS). Further subsamples were frozen at -80 for genetic studies (Will Goodall-Copestake, BAS) and total lipid analysis (David Pond, SAMS). In hauls where sufficient numbers of *E. superba* were caught, length-frequency data were collected (section 6.2, Krill length frequency). Krill total length was measured on 100 fresh krill, using the standard BAS measurement from the anterior edge of the eye to the tip of the telson, with measurements rounded down to the nearest mm (Morris et al. 1988). Maturity stage was assessed using the scale of Makarov and Denys with the nomenclature described my Morris et al. (1988).

Table 6-1: Summary of RMT8 net hauls undertaken during cruise JR304

Event No	Time and Date (GMT)	Net depth (m)	Action	Comment
81	**07/12/2014 20:11**	**0.6**	**Net deployed**	**Target haul**
81	07/12/2014 20:12	12.6	Net 1 opened	
81	07/12/2014 20:14	21.8	Net 1 closed	
81	07/12/2014 20:15	24.7	Net 2 opened	
81	07/12/2014 20:17	28.8	Net 2 closed	
81	07/12/2014 20:21	0.3	Net recovered	
88	**07/12/2014 21:17**	**0**	**Net deployed**	**Stratified haul**
88	08/12/2014 21:19	12.1	Net 1 opened	
88	08/12/2014 21:52	199.9	Net 1 closed	
88	08/12/2014 21:53	211.7	Net 2 opened	
88	08/12/2014 22:24	18.6	Net 2 closed	
88	08/12/2014 22:30	0.3	Net recovered	
91	**09/12/2014 02:52**	**0.3**	**Net deployed**	**Target haul**
91	09/12/2014 02:59	27.4	Net 1 opened	
91	09/12/2014 03:00	21.8	Net 1 closed	
91	09/12/2014 03:01	22.3	Net 2 opened	
91	09/12/2014 03:02	28.8	Net 2 closed	
91	09/12/2014 03:07	0.3	Net recovered	
92	**09/12/2014 04:49**	**15.6**	**Net deployed**	**Stratified haul**
92	09/12/2014 04:50	15.6	Net 1 opened	
92	09/12/2014 05:22	197.2	Net 1 closed	
92	09/12/2014 05:23	203.9	Net 2 opened	
92	09/12/2014 05:51	8.3	Net 2 closed	
92	09/12/2014 05:54	0	Net recovered	
102	**10/12/2014 01:25**	**0.6**	**Net deployed**	**Target haul**
102	10/12/2014 01:29	28.8	Net 1 opened	
102	10/12/2014 01:31	27.2	Net 1 closed	
102	10/12/2014 01:31	36	Net 2 opened	
102	10/12/2014 01:33	41.4	Net 2 closed	
102	10/12/2014 01:42	0.6	Net recovered	
113	**10/12/2014 20:18**	**0.6**	**Net deployed**	**Stratified haul**
113	10/12/2014 20:20	10.8	Net 1 opened	
113	10/12/2014 20:47	199.6	Net 1 closed	
113	10/12/2014 20:52	202.6	Net 2 opened	
113	10/12/2014 21:15	14.5	Net 2 closed	
113	10/12/2014 21:17	0.6	Net recovered	
131	**11/12/2014 20:49**	**0.6**	**Net deployed**	**Target haul**
131	11/12/2014 20:51	31.5	Net 1 opened	
131	11/12/2014 20:52	39.3	Net 1 closed	
131	11/12/2014 20:53	33.6	Net 2 opened	
131	11/12/2014 20:55	20.7	Net 2 closed	
131	11/12/2014 20:58	0.6	Net recovered	
132	**11/12/2014 22:57**	**0.6**	**Net deployed**	**Stratified haul**
132	11/12/2014 22:59	13.2	Net 1 opened	
132	11/12/2014 23:20	170.1	Net 1 closed	
132	11/12/2014 23:21	173.6	Net 2 opened	

132	11/12/2014 23:42	16.7	Net 2 closed	
132	11/12/2014 23:46	0.6	Net recovered	
133	**12/12/2014 02:00**	**0.6**	**Net deployed**	**Stratified haul**
133	12/12/2014 02:03	12.9	Net 1 opened	
133	12/12/2014 02:34	200.4	Net 1 closed	
133	12/12/2014 02:34	205.5	Net 2 opened	
133	12/12/2014 03:04	21.5	Net 2 closed	
133	12/12/2014 03:10	0.3	Net recovered	

Table 6-2: Invertebrate and fish species sampled in the Western Core Box area during cruise JR304

Project	Species	Event-Net	Number sampled	Storage
Genetics	*Euphausia superba*	81-2	150	-80°C
	Salpa spp.	88-1	1	-80°C
	Euphausia triacantha	88-2	64	-80°C
	Salpa spp.	88-2	10	-80°C
	Salpa spp.	91-1	50	-80°C
	Euphausia superba	91-1	150	-80°C
	Euphausia superba	102-2	150	-80°C
	Euphausia superba	131-2	150	-80°C
Lipids	*Euphausia superba*	91-1	300	-80°C
	Euphausia superba	102-1	100	-80°C
	Euphausia superba	102-2	100	-80°C
	Euphausia superba	131-2	200	-80°C
Reference specimens	*Themisto gaudichaudii*	92-2	2	Formalin
	Euphausia triacantha	92-2	2	Formalin
	Gymnoscopelus spp.	92-2	2	Formalin
	Thysanoessa spp.	92-2	2	Formalin
	Euphausia vallentini	92-2	2	Formalin
	Euphausia frigida	92-2	2	Formalin
	Clione sp.	92-2	2	Formalin
	Spongiobranchia sp.	92-2	2	Formalin
	Diphyes spp.	113-1	1	Formalin
	Diphyes spp.	113-1	2	Formalin
Fish population studies	*Bathylagus spp.*	133-1	1	-80°C
	Electrona antarctica	133-1	6	-80°C
	Protomyctophum choriodon	133-1	4	-80°C
	Gymnoscopelus braueri	133-1	6	-80°C
	Gymnoscopelus fraseri	133-1	13	-80°C
	Gymnoscopelus fraseri	133-2	15	-80°C
	Gymnoscopelus nicholsi	133-2	4	-80°C
	Gymnoscopelus braueri	133-2	13	-80°C
	Protomyctophum bolini	133-2	5	-80°C
	Electrona antarctica	133-2	8	-80°C

6.2 Krill length frequency

Sophie Fielding, Hyoung Sul La, Jon Watkins

6.2.1 Introduction

Antarctic krill (*Euphausia superba*) were sampled to determine the variation in the structure of the population around South Georgia and to provide parameters required in the target strength model for krill biomass estimation.

6.2.2 Methods

Krill samples were taken from RMT8 samples where there were sufficient numbers of krill to select 100 decent state specimens for length frequency, maturity and krill shape photographs. Krill were laid out on blue plastic boards (in pre-drilled grooves) and photographed using a Nikon DX3 with two flash guns on a stand (Photograph). The same krill were then measured for length and staged. Krill total length was measured, using the standard BAS measurement from the anterior edge of the eye to the tip of the telson, with measurements rounded down to the nearest millimetre (Morris et al. 1988). Maturity stage was assessed using the scale of Makarov and Denys with the nomenclature described by Morris et al. (1988).

6.2.3 Data

Krill length frequency data were input into a spreadsheet on the L drive “Krill_length_JR304.xls”. The Net event numbers from which krill were measured and whether they were photographed is identified in Table 6-3 with the mean length of those events. The krill length frequency pdf for the whole cruise are shown in Figure 6-1.

Table 6-3: Krill length frequency mean length per station and photograph file names

Event Number	Photo	Mean Length (mm)
81_2	N	37.56
91_1	287-9456.jpg – 287-9464.jpg	37.3
91_2	287-9442.jpg – 287-9442.jpg	39.37
102_1	287-9489.jpg – 287-9497.jpg	34.10
102_2	287-9476.jpg – 287-9488.jpg	33.67
131_1	287-9521.jpg – 287-9538.jpg	50.45
131_2	287-9503.jpg – 287.9520.jpg	47.38

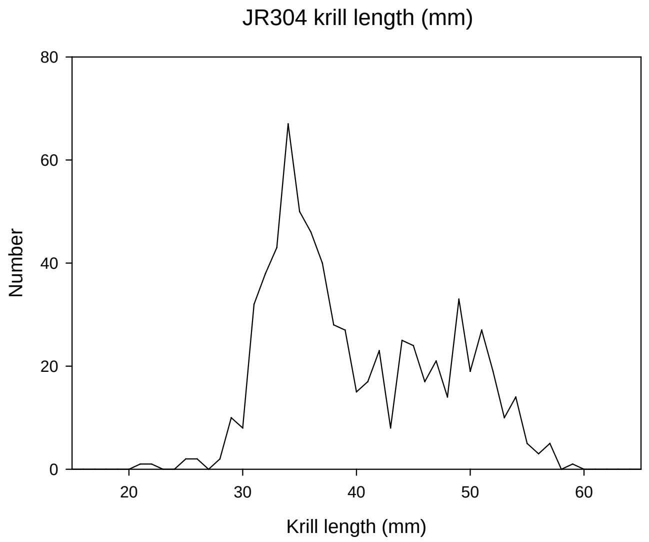


Figure 6-1: Krill length frequency plot for all krill measured during cruise JR304

6.3 Krill weigh bridge JR304

The weight and density of krill was measured during JR304 using the krill weigh bridge designed and built by Sevi Afanasyev. Krill were kept in the cold room and used when weather conditions permitted. Prior to each set of weight measurements the krill weigh bridge was set up and left connected to the battery for a minimum of an hour with the reference weight and an 80g calibration weight to establish the baseline measurements made by the load cells. After each measurement the krill was put into a single eppendorf tube and frozen at -80 °C.

Measurement protocol: The process requires an accurate measurement (on land) of the reference weight, the density bottle (and lid) and the volume of water the bottle can hold. In this case bottle 3 was used Table 6-4.

Table 6-4: Vital statistics for density bottle reference weights

Bottle ID	Bottle num	Bottle wt (g)	Lid wt (g)	Both wt (g)	Both + water (g)
K67	1	26.63	5.17	31.80	83.99
K68	2	27.2318	5.2069	32.4338	84.6291
K58	3	26.9584	5.1882	32.1462	84.4319
K57	4	27.2745	5.1808	32.4552	84.5491
Old	1	28.9882	7.8093	36.7976	77.4895
Old	2	28.4704	8.5621	37.0323	76.5787

The following constants are required before use (with weights measured on land):

W_{rw} Weight of the reference weight (g) = 80 g

W_b Weight of empty bottle and lid (hereafter just referred to as bottle) (g) = 32.1462 g

V_b Volume of bottle (ml) = 52.595 ml

Step by step procedure

1. Fill bottle to brim with water and weigh (W_1)

2. Remove ~2ml of water using a syringe and weigh (W_2)

3. Add krill to bottle and weigh (W_3)

4. Fill bottle to brim with water (same water and temperature as during 1) and weigh (W_4)

Specific gravity of the water (σ_w) used is calculated as:

$$\sigma_w = \frac{(W_1 - W_b)}{V_b}$$

Weight of krill (W_k) is calculated as:

$$W_k = W_3 - W_2$$

Weight of liquid (W_l) added is calculated as:

$$W_l = W_4 - W_k - W_b$$

Volume of liquid (V_l) in bottle is calculated as:

$$V_l = \frac{W_l}{\sigma_w}$$

Volume of krill (V_k) is calculated as:

$$V_k = V_b - V_l$$

Specific gravity of krill (σ_k) is calculated as:

$$\sigma_k = \frac{W_k}{V_k}$$

Table 6-5 contains all the measurements of krill weight, the actual measurements recorded from the krill weigh bridge are contained within the file JR304 Krill weights.xls. The relationship between krill length and weight is given in Figure 6-2.

Table 6-5: Krill length, maturity stage and weight of krill measured using krill weigh bridge

Krill id	Krill Length (mm)	Krill stage	Krill wt (g)
1	43	MS2	0.6
2	49	FA1	0.95
3	32	MS2	0.25
4	36	MS1	0.35
5	36	J	0.345
6	38	J	0.41
7	31	J	0.23
8	35	J	0.37

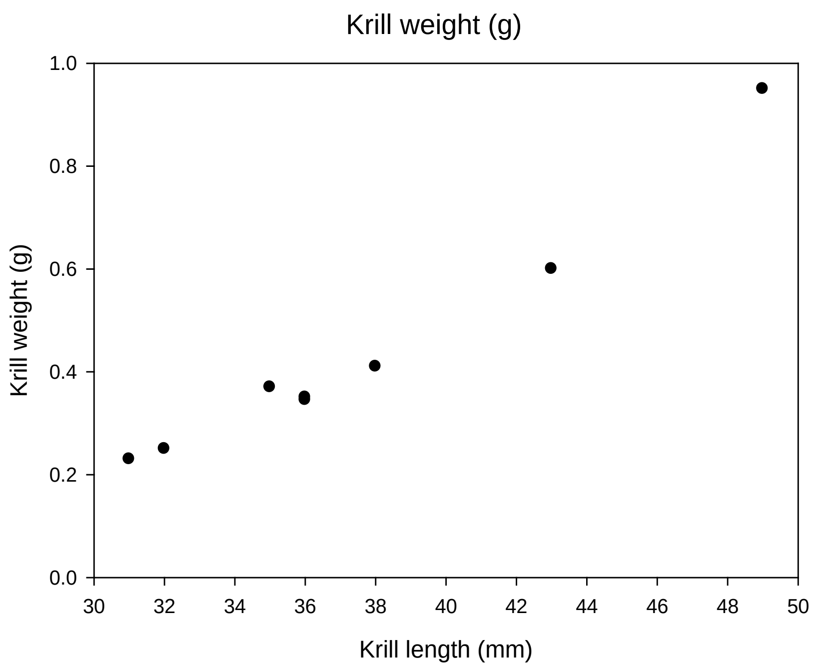


Figure 6-2: Relationship between krill length and weight for animals measured with krill weigh bridge

6.4 Analysis of Shallow WCB mooring

Hyoung Sul La

6.4.1 Introduction

The pelagic ecosystem at South Georgia has experienced apparent temporal variation in krill abundance. The shallow WCB mooring has been operated with the water column profiler (WCP; ASL Environmental 125 kHz) and acoustic Doppler current profiler (ADCP; RDI Workhorse 300 kHz) to determine the abundance and distribution of zooplankton including krill and understand the causes and consequences of their temporal variability. The high temporal resolution of mooring acoustic instruments could provide insights into the possible causes of variation, which might be unachievable with conventional ship-based method.

6.4.2 Aim

Preliminary analysis to observe the variability of diel vertical migration based on acoustic backscatter as a proxy for abundance of krill and other zooplankton species in the South Georgia region.

6.4.3 Methods/System specification

The WCB mooring was deployed on the shelf (approximately 300 m water depth) near the northwest of South Georgia (Figure 6-3). The design of the mooring is shown in Figure 6-3, and the detail regarding the mooring design and instrument configuration are explained in the JR291 cruise report. In this report, acoustic data collected between December 6 2012 and May 31 2013 were analyzed to compare the temporal variability of diel vertical migration.

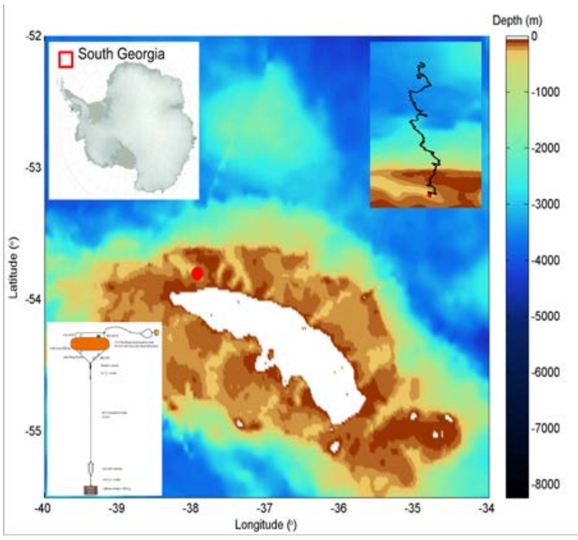


Figure 6-3: Map of study area. The red circles indicates the mooring location (53°48.10S, 37°56.26W). The left bottom figure indicates the design of mooring system and the progressive vector plots is shown in the right top figure.

The WCP and ADCP were deployed in an upward-looking configuration at a depth of 222 m with a standard deviation of 20 cm. Both instruments covered the water column from surface to 220-m depth. The configuration of each transducer during deployment is given in Table 6-6. WCP relative echo intensity was converted to volume backscattering strength (S_v dB re 1m^{-1}) using AzfpLink v. 1.0.09 with calibration coefficients, supplied by ASL Environmental Sciences. The ADCP has 4 beams, each with a 3.9° 3-dB beam width at a slant 20° off vertical. The ADCP recorded vertical velocity (w), and relative echo intensity on a 0 to 255 automatic gain control (AGC). The 4-beam averaged w and AGC value were used to improve signal-to-noise ratio and AGC was converted to S_v using the SONAR equation presented by Deines (1999). The converted S_v from both ADCP and WCP were imported into the Myriax Echoview software (v. 6.0) and the bad regions from surface, pinging on deck and blank after transmit were marked and excluded from further process. A cConvolution kernel operator (3 × 3) and time-varied gain threshold (TVT) function were applied to remove the periodic noise of interference and background noise, respectively. (Myriax, 2012). For the direct comparison of two echo sounders, WCP data was resampled into equivalent bins of 8 m (vertical) by 15-min. (horizontal) between 20 and 210-m depth.

Table 6-6: Instrument configurations for the water column profiler (WCP) and acoustic Doppler current profiler (ADCP)

Instrument	WCP	ADCP
Frequency	125 kHz	307 kHz
3-dB Beam width	18°	4 beams with 3.9°
Sampling rate	1 ping every 6 sec.	10 pings ensemble every 15 min.
Range bin	1.0 m	8.0 m
Blank after transmit	0 m	1.76 m
Instrument depth	222 m	222 m

6.4.4 Preliminary results and discussion

The time series of S_v and w represent the temporal variability of vertical distribution of macrozooplankton (Figure 6-4). Both echo sounders show a similar pattern of temporal variability, with S_v gradually increasing in intensity from December to March and sharply decreasing from then to May. During May, relatively low S_v was observed, with little temporal variability. The mean integrated S_v from 20 to 200 m varied between – 75 dB and – 55 dB, with the maximum Sv observed during February and minimum S_v recorded during May. The ADCP S_v was approximately 5 ‐ 10 dB higher than WCP S_v. The difference was approximately 5 dB between December and March and increased to 10 dB by May. It is possible that this temporal difference of delta S_v between the two frequencies represents larger zooplankton present between December and March, compared with the size of zooplankton between April and May.

Figure 6-4: Time series of acoustic backscatter and vertical velocity from December 6 2012 to May 31 2013: volume backscattering strength (S¬v) from (a) water column profiler (WCP) and (b) acoustic Doppler current meter (ADCP) and (c) represents the vertical velocity (w)

There were clear signatures of diel vertical migration within the data, with high backscatter in the surface 50m at night descending down to depths of 200 m and below the mooring during the daytime (Figure 6-5). On January 16th, downward movement began from 20-m depth at 05:00 around sunrise (05:27 GMT), and took about 1-h to reach 200-m depth; ascent occurred at 21:40 around sunset (21:55 GMT). This timing of vertical variation is linked to the length of daytime. w is also clear visible in daily migration of zooplankton. The downward migration begins about 30 min after sunrise, whilst highest negative w of 6.6 cm s^{-1} was found 30 min later. The highest upward w of 5.9 cm s^{-1} appeared 1-h after sunset.

Figure 6-5: Diel cycle of volume backscattering strength (Sv) and vertical velocity (w) from (a) water column profiler (WCP) and (b-c) acoustic Doppler current profiler

ADCP S_v and w were averaged (per ensemble) during each month to compare the monthly variability of diel cycle (Figure 6-6and Table 6-7).

Figure 6-6: Monthly averaged diel cycle of volume backscattering strength (Sv) and vertical velocity (w) recorded by acoustic Doppler current meter (ADCP)

There was a clear diel signal in the acoustic data, observed for the months December to March and May. Downward motion occurred with the maximum negative w between –0.9 and –5.2 cm s^{-1}

around sunrise and upward movement showed with the maximum positive w between 0.8 and 3.6 cm s^{-1} around sunset. However, the timing of ascent and descent and w exhibited monthly variability. w was relatively higher during the phase of increasing migration duration (December-February) than those observed during the phase of decreasing day length (March-May). Higher w and longer periods at the surface were observed during December, whilst lower w and shorter periods at the surface were observed during May.

Total water column S_v did not change much from December to May but it decreased from December to May.

Table 6-7: Timing of the vertical migration with the maximum migration speed and migration period

Month	Migration time (HH:MM, GMT)		Maximum migration speed (cm s^{-1})		Migration duration (HH, GMT)	Sunrise/sunset** (HH:MM, GMT)
	Downward	Upward	Downward	Upward		
December	04:46	22:45	-5.2	3.6	18.0	04:55/22:00
January	05:02	22:30	-3.3	2.5	17.5	05:27/21:55
February	06:44	19:22	-2.9	2.2	12.6	06:29/21:02
March	08:23	18:43	-1.5	1.2	10.3	07:24/19:56
April*	08:42	17:05	-1.1	0.9	8.4	08:21/18:42
May	09:38	16:38	-0.9	0.8	7.0	09:15/17:41

* Daily data (April 2) was used for April migration time as diel cycle was not clear in the ensemble averaged data during April

** Sunrise/sunset time was calculated at 16th each month with Ephemeris 2.0 software.

7 Time station sampling

7.1 Net sampling for zooplankton

Geraint Tarling, Sophie Fielding, Cecelia Liszka, Jeremy Robst

7.1.1 MOCNESS

The MOCNESS had a mouth opening area of 1 m^2 and contained 9 x 330 µm meshed nets. It was nominally trawled at between 2 and 3 knots. The angle of the net in the water was logged throughout the deployment to determine the effective mouth opening area. The device also contained a flow meter (to measure effective distance travelled through the water), temperature and salinity probes.

The MOCNESS was deployed at each of the 36 h diel-period stations (Ice-station, P2, P3 and the upwelling station, Table 7-1). It was set up with the new Down Wire Net Monitor system operating system, which had yet been untried. There were some problems with this system throughout each of these stations, which resulted in some deployments being unsuccessful (the problem was ultimately traced to the potting of custom made cables). However, there was 1 successful deployment at the Ice station, 2 successful deployments at P2 and P3 and one partially successful deployment at the upwelling station (the maximum depth sampled discretely being 625 m – the problem arising from the release mechanism not being set to the ready position). Buckets 4, 5 and 9 were lost on Event 150.

Summary statistics from data generated by the down-wire net monitor during deployments were logged in the following Excel file :

L:\scientific_work_areas\MOCNESS\jr304-MOCNESS-stats.xls

Figure 7-1: MOCNESS net being recovered

On recovery, Net 1 was not considered for analysis and was not retained (although Maz Wootton did preserve net 1 from Events 24 and 137 for type specimens). In certain instances, organisms of interest were extracted and preserved individually from Net 1 samples. Nets 2 to 9 were picked for a number of different purposes :(1) Vicky Peck (VLP), Sebastian Flotter (SF) and Jessie Gardner (JG) picked out pteropods either for incubations or (mainly) for drying (2) Cecelia Liszka (CL) picked out live euphausiids (*Thysanoessa* sp. or *Euphausia triacantha*) (3) Geraint Tarling picked out *Calanoides acutus* CV (or sometimes CIVs or females) for CHN analysis. Logs of all organisms extracted were kept (Table 7-2). The remainder of the sample was preserved in buffered ethanol.

7.1.2 LHPR

The LHPR had an effective mouth diameter of 38 cm and a 200 µm meshed-net funneling down to the spooling mechanism. It contained a flow meter, and temperature and salinity probes.

The LHPR was deployed in 3 out of the 4 diel-period stations (Ice-station, P2 and P3, Table 7-3). All deployments were successful. In each deployment, the device was sent to 1000 m with the mouth-mechanism in the closed position. The mechanism was opened at the maximum haul-depth and the spooling mechanism enabled. Hauling rate was approximately 10 to 30 m/min such that the upward trajectory took approximately 90 minutes. This resulted in between 40 to 45 separate patches of plankton being collected.

Once recovered, each of these patches were cut into separate segments and layered between sheets of polythene within a plastic box, the respective patch number label accompanying each patch. The box was placed in the -20°C freezer. [Note that the order of the number labels may have been reversed in certain instances – during analysis, take care to note that the label 'Mouth' represents the last patch i.e. the one closest to the surface and still open on recovery. This patch is the bottom-most patch in every box, and all subsequent labels should be referenced to this].

Summary statistics from data generated by the down-wire net monitor during deployments were logged in the following Excel file:

L:\scientific_work_areas\ LHPR\ jr304-lhpr-stats.xls

7.1.3 Motion-compensated Bongo

The Bongo net was deployed successfully 39 times over the cruise (Table 7-4). The net was deployed either to 100 m, 200 m or to within 20 m of the bottom in shelf environments. The diameter of each of the net rings was 57 cm. One net contained a 100 µm net-mesh, the other, 200 µm net-mesh. Plastic bags were placed in the cod-ends in the majority of instances and these bags were extracted, having loosened the jubilee clip connecting the net-mesh to the cod-end. The contents of the bags were gently poured into buckets (already partially filled with seawater from the non-contaminated sea-water supply) for further processing.

Bongo net deployments were made in four different phases of the cruise:

- During transit phases - to accompany Continuous Plankton Recorder (CPR) tows. These tows were 0-200 m or to within 20 m of the bottom. The 200 µm mesh sample was preserved immediately (10% formalin), the 100 µm was picked mainly for pteropods (and sometimes copepods) and then either dried or preserved in 10% buffered formalin.

- During the 36 h diel-stations - to sample the community over a diel cycle. Where weather conditions allowed, two tows were performed, one to 100 m, the other to 200 m. The 200 µm sample in both instances was filtered onto precut 200 µm filter mesh, folded and frozen at -80°C as quickly as practicable (the purpose being to halt digestion in copepods to be later analysed for gut fluorescence) . The 100 µm was picked for pteropods and copepods and either dried or preserved in 10% buffered formalin. In certain instances, large pteropods were quickly removed from the 200 µm sample before filter and freezing, records being kept of all extracted material.
- During our visit to Cumberland Bay - to sample the surface community for pteropods. These tows were made to within 20 m of the bottom for the main purpose to survey the Bay for local populations of pteropods and foraminifera.
- During the Western Core Box (WCB) – a single 0-200 m Bongo net deployment was made at each of the net sampling stations in the WCB to characterize the mesozooplankton community composition and to provide samples from which to pick pteropods and foraminifera.

Table 7-4 details all organisms that were extracted from Bongo net samples and the ultimate fate of the sample (dried, frozen to -80°C, or preserved in 10% buffered formalin).

Figure 7-2: Bongo net deployment

Table 7-1: MOCNESS deployment log

Time	Latitude	Longitude	Water depth	Event No.	Net number	Open depth	Close depth	Comment
UPWELLING STATION								
14/12/2014 13:07	-52.61696	-39.28492	3753.98	162	6	125	5	Time net closed
14/12/2014 12:59	-52.61479	-39.27678	3753.22	162	5	250	125	Time net closed
14/12/2014 12:52	-52.61351	-39.26901	3757.06	162	4	375	250	Time net closed
14/12/2014 12:45	-52.61212	-39.26181	3752.45	162	3	500	375	Time net closed
14/12/2014 12:36	-52.60896	-39.24577	3751.68	162	2	625	500	Time net closed
14/12/2014 12:29	-52.60896	-39.24577	3751.68	162	1	0	1000 then to 625	Time net closed - changed depths because of cogging error (not placed in ready position)
14/12/2014 10:54	-52.5885	-39.1512	3002.88	162	1	0	1000 then to 625	Deployed- changed depths because of cogging error (not placed in ready position)
P3								
14/12/2014 02:39	-52.74735	-40.26299	3787.78	157	9	125	20	Time net closed
14/12/2014 02:32	-52.74758	-40.25594	3787.78	157	8	250	125	Time net closed
14/12/2014 02:23	-52.74763	-40.2461	3784.7	157	7	375	250	Time net closed
14/12/2014 02:13	-52.74769	-40.2351	3787.01	157	6	500	375	Time net closed
14/12/2014 02:05	-52.74819	-40.22526	3394.945	157	5	625	500	Time net closed
14/12/2014 01:51	-52.7508	-40.21135	3002.88	157	4	750	625	Time net closed
14/12/2014 01:44	-52.75221	-40.20292	3002.88	157	3	875	750	Time net closed. Winch tripped so delay in hauling
14/12/2014 01:19	-52.75619	-40.17498	4509.7	157	2	1000	875	Time net closed
14/12/2014 01:08	-52.7577	-40.16257	4146.05	157	1	0	1000	Time net closed
13/12/2014 23:46	-52.76247	-40.0631	3782.4	157				Net deployed
P3								
13/12/2014 19:05	-52.75598	-40.25841	3779.33	150	9	125	20	Time net closed (bucket lost)
13/12/2014 18:57	-52.75697	-40.24682	3779.33	150	8	250	125	Time net closed

13/12/2014 18:48	-52.75824	-40.23482	3777.79	150	7	375	250	Time net closed
13/12/2014 18:38	-52.7597	-40.22211	3780.86	150	6	500	375	Time net closed
13/12/2014 18:29	-52.76079	-40.21016	3780.1	150	5	625	500	Time net closed (bucket lost)
13/12/2014 18:20	-52.76176	-40.19838	3780.1	150	4	750	625	Time net closed (bucket lost)
13/12/2014 18:13	-52.76257	-40.18843	3780.1	150	3	875	750	Time net closed
13/12/2014 18:05	-52.76346	-40.1775	3780.1	150	2	1000	875	Time of net closing
13/12/2014 17:51	-52.76461	-40.16156	3785.47	150	1	0	1000	Time net closed
13/12/2014 16:25	-52.76928	-40.04897	3781.63	150				Net deployed
P3								
13/12/2014 03:46	-52.76918	-40.0861	3791.62	137				Net recovered, no nets triggered. Cod-end 8 lost
13/12/2014 01:05	-52.81092	-39.91899	3791.62	137	1	0	1000	Net deployed. No flow
P2								
29/11/2014 07:23	-55.1655	-41.31074	3265.54	57	9	125	5	No feedback. 4 commands sent, didn't close last net. Time command send to close net.
29/11/2014 07:13	-55.17049	-41.30769	3262.46	57	8	250	125	Time net closed.
29/11/2014 07:04	-55.17479	-41.3059	3262.46	57	7	375	250	Time net closed.
29/11/2014 06:56	-55.17861	-41.30382	3262.46	57	6	500	375	Time net closed.
29/11/2014 06:45	-55.18298	-41.30231	3265.54	57	5	625	500	Time net closed. Feedback renewed.
29/11/2014 06:39	-55.1655	-41.31074	3265.54	57	4	750	625	Time net closed. Feedback not working.
29/11/2014 06:29	-55.18996	-41.29848	3268.61	57	3	875	750	Time net closed.
29/11/2014 06:16	-55.19532	-41.29595	3274.75	57	2	1000	875	Time net closed.
29/11/2014 06:02	-55.20113	-41.29351	3283.97	57	1	0	1000	Time net closed.
29/11/2014 04:36	-55.2437	-41.26896	3376.13	57				Time in water.
P2								
28/11/2014 17:48	-55.2419	-41.13365	3158.02	45	9	125	5	Time net closed.
28/11/2014 17:35	-55.24052	-41.1496	3167.23	45	8	250	125	Time net closed.
28/11/2014 17:23	-55.23929	-41.16503	3182.59	45	7	375	125	Time net closed.

28/11/2014 17:11	-55.23819	-41.17915	3194.88	45	6	500	375	Time net closed.
28/11/2014 16:55	-55.23686	-41.19888	3213.31	45	5	625	500	Time net closed.
28/11/2014 16:49	-55.23639	-41.20748	3225.6	45	4	749	625	Time net closed.
28/11/2014 16:45	-55.23606	-41.21321	3234.82	45	3	875	749	Time net closed.
28/11/2014 16:40	-55.23568	-41.2197	3253.25	45	2	1001	875	Time net closed.
28/11/2014 16:23	-55.23653	-41.23346	3305.47	45	1	0	1001	Time net closed.
28/11/2014 14:53	-55.26895	-41.31022	3499.01	45				Time in water.
Ice station								
26/11/2014 21:22	-59.97028	-46.09907	4945.15	36				Time on deck.
26/11/2014 21:20	-59.97004	-46.10086	4943.62	36	9	125	5	Time net closed.
26/11/2014 21:12	-59.96862	-46.11391	4948.99	36	8	250	125	Time net closed.
26/11/2014 21:04	-59.96862	-46.11391	4948.99	36	7	375	248	Time net closed.
26/11/2014 20:56	-59.96788	-46.12033	4922.11	36	6	500	375	Time net closed.
26/11/2014 20:43	-59.96628	-46.13737	4502.78	36	5	625	500	Time net closed.
26/11/2014 20:35	-59.96473	-46.14548	4847.62	36	4	750	625	Time net closed. Feedback fine.
26/11/2014 20:25	-59.96325	-46.1541	4843.78	36	3	875	750	Time net closed. No feedback.
26/11/2014 20:15	-59.96325	-46.1541	4843.78	36	2	1000	875	Net closed
26/11/2014 20:04	-59.96205	-46.16348	4849.15	36	1	0	1000	Time net closed.
26/11/2014 18:48	-59.96205	-46.16348	4849.15	36				MOCNESS in water
Ice-station (Trial)								
26/11/2014 18:11	-59.96542	-46.12541	4923.65	35				Net on deck, all worked well
26/11/2014 18:05	-59.91628	-46.06079	4670.21	35	5	43	1	Nets were originally attached incorrectly: nets 5 and 6 were the wrong way around. this has now been corrected in this log, so this net number is correct.
26/11/2014 18:04	-59.96476	-46.13375	4913.66	35	6	43	43	Nets were originally attached incorrectly: nets 5 and 6 were the wrong way around. this has now been corrected in this log, so this net number is correct.
26/11/2014 18:03	-59.96464	-46.13495	4915.2	35	4	43	43	

26/11/2014 17:58	-59.96413	-46.14098	4896	35	2	1	45	
26/11/2014 17:57	-59.96401	-46.14225	4856.06	35	1	1	1	Testing feedback mechanism with clear view of net.
26/11/2014 17:56	-59.96391	-46.14352	4854.53	35				Net in water
Ice station (Malfunction)								
26/11/2014 05:12	-59.91628	-46.06079	4670.21	24				MOCNESS recovered - no nets triggered
26/11/2014 02:10	-59.98965	-46.21374	4502.78	24				MOCNESS deployed
Ice station (malfunction)								
25/11/2014 13:56	-59.98504	-46.20639	4560.38	10				Time recovered following aborted deployment due to winch problem.
25/11/2014 13:43	-59.99077	-46.21851	4381.44	10				Time deployed. Winch problem - deployment aborted.

Table 7-2: MOCNESS log of specimens extracted before preservation

Event 36							
Net2	Net 3	Net 4	Net 5	Net 6	Net 7	Net 8	Net 9
C. acutus CV x3 (GT)	Thysanoessa x 1 (CL)	Thysanoessa x 1 (CL)	Thysanoessa x 4 (CL)	C. acutus CV x 2 (GT)	C. acutus x 20 (GS)	Pteropods x 3 (VLP)	Pteropods x 12 (JG)
C. acutus Fem x 2 (GT)	C. acutus CV x 6 (GT)	C. acutus CV x 6 (GT)	C. acutus CV x 5 (GT)	C. acutus Fem x 5 (GT)	C. acutus CV x 10 (GT)	Thysanoessa x 4 (CL)	Thysanoessa x 8 (CL)
	C. acutus Fem x 5 (GT)	C. acutus Fem x 5 (GT)	C. acutus Fem x 5 (GT)	C. acutus CIV x 5 (GT)	C. acutus Fem x 5 (GT)	C. acutus x 20 (GS)	C. acutus CV x 10 (GT)
		C. acutus CIV x 5 (GT)	C. acutus CIV x 5 (GT)			C. acutus CV x 10 (GT)	C. acutus Fem x 5 (GT)
						C. acutus Fem x 5 (GT)	
Event 45							
Net2	Net 3	Net 4	Net 5	Net 6	Net 7	Net 8	Net 9
Thysanoessa x 1 (CL)	Limacina helicina veligers x 4 (VLP)	Limacina helicina veliger x 4 (VLP)	E. triacantha x 5 (CL)	E. triacantha x 3 (CL)	E. triacantha x 13 (CL)	L. helicina juv and veliger x 122 (VLP)	L. helicina adukt x 159 (VLP)
C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	L. helicina juv x 6 (VLP)	C. acutus x 5 (GT)	C. acutus CV x 10 (GT)	Thysanoessa x 3 (C)	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)
		C. acutus CV x 10 (GT)			L. helicina veligers x 5 (VLP)		
					C. acutus CV x 10 (GT)		
Event 57							
Net2	Net 3	Net 4	Net 5	Net 6	Net 7	Net 8	Net 9
Pteropod eggs	L. helicina small juv x 9 (VLP)	L. helicina small juv x 18 (VLP)	L. helicina small juv x 1 (VLP)	L. helicina small juv x 15 (VLP)	E. triacantha x 5 (CL)	L. helicina small juv x 21 (VLP)	L. helicina adults x 17 (VLP)
L. helicina juv x 3 (2 small, 1 med) VLP				E. triacantha x 7 (CL)		L. retroversa x 2 (VLP)	
						E. triacantha x 5 (CL)	
Event 150							

Net2	Net 3	Net 4	Net 5	Net 6	Net 7	Net 8	Net 9
C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	Net bucket lost	Net bucket lost	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	Net bucket lost
L. helicina juv x 2 (VLP)				L. retroversa juv x 1 (VLP)	C. acutus Fem x 4 (GT)		
					E. triacantha x 25 (CL)		
Event 157							
Net2	Net 3	Net 4	Net 5	Net 6	Net 7	Net 8	Net 9
Poromitra crassiceps x 1 (GS)	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	L. helicina small juv x 1 (VLP)	L. helicina small juv x 4 (VLP)	E. triacantha x 4 (CL)	E. triacantha x 9 (CL)	Candacia sp (mal) x 3 (MW)
C. acutus CV x 10 (GT)			C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	L. retroversa small juv x 1 (VLP)	C. acutus CV x 10 (GT)
						L. helicina small juv x 1 (VLP)	
						Candacia sp (fem) x 1 (MW)	
						C. acutus CV x 10 (GT)	
Event 162							
Net2	Net 3	Net 4	Net 5	Net 6	Net 7	Net 8	Net 9
E. triacantha x 2 (CL)	E. triacantha x 5 (CL)	E. triacantha x 10 (CL)	C. acutus CV x 8 (GT)	C. acutus CV x 10 (GT)	Not sampled	Not sampled	Not sampled
L. helicina small juv x 2 (VLP)	L. helicina small juv x 1 (VLP)	L. helicina small juv x 2 (VLP)	L. helicina small juv x 2 (VLP)	L. helicina small juv x 1 (VLP)	L. helicina small juv x 2 (VLP)	L. helicina small juv x 2 (VLP)	L. helicina small juv x 1 (VLP)
C. acutus CV x 10 (GT)	C. acutus CV x 11 (GT)	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	C. acutus CV x 11 (GT)	C. acutus CV x 10 (GT)	C. acutus CV x 10 (GT)	C. acutus CV x 11 (GT)

Table 7-3: LHPR deployment log

Time	Latitude	Longitude	Water depth (m)	Event	Net depth (m)	No. increments	Comments
P3							
13/12/2014 12:08	-52.7623	-40.2976	3782.4	144	10.5	44	Final number of patches
13/12/2014 12:02	-52.7624	-40.2897	3784.7	144	113.1	41	Hauled in at 50 m/min until winch tripped out at net depth of 370m. Resumed hauling at 40 m/min
13/12/2014 11:56	-52.7624	-40.2822	3780.86	144	194.5	38	
13/12/2014 11:48	-52.7628	-40.2726	3792.38	144	306	34	
13/12/2014 11:26	-52.7629	-40.2461	3779.33	144	411.4	24	Wire stopped at 842 m wire out for technical issues
13/12/2014 11:17	-52.7626	-40.2348	3781.63	144	509	19	
13/12/2014 11:10	-52.7623	-40.2253	3790.08	144	608.2	15	
13/12/2014 11:03	-52.7622	-40.216	3790.08	144	690.5	12	
13/12/2014 10:54	-52.7618	-40.2037	3780.1	144	799.8	7	
13/12/2014 10:46	-52.7619	-40.1928	3780.1	144	919.1	4	
13/12/2014 10:40	-52.762	-40.1846	3780.1	144	989	2	Net at 1000 m
13/12/2014 09:17	-52.7622	-40.0716	3790.85	144	2.2		LHPR deployed
P2							
29/11/2014 13:49	-55.1824	-41.3037	3262.46	63	0.8	45	Final number of patches
29/11/2014 13:42	-55.1871	-41.3002	3268.61	63	103.2	42	
29/11/2014 13:33	-55.1919	-41.2969	3271.68	63	201.2	38	
29/11/2014 13:24	-55.197	-41.2936	3274.75	63	307.8	33	
29/11/2014 13:16	-55.2015	-41.2907	3283.97	63	403.4	29	
29/11/2014 13:02	-55.2092	-41.2855	3305.47	63	509.6	22	

29/11/2014 12:55	-55.2135	-41.2825	3317.76	63	605.3	19	
29/11/2014 12:48	-55.2178	-41.2795	3317.76	63	702.8	15	
29/11/2014 12:35	-55.2251	-41.2762	3330.05	63	805.6	9	
29/11/2014 12:26	-55.2307	-41.2735	3351.55	63	913	5	
29/11/2014 12:18	-55.2354	-41.2715	3373.06	63	984.4	2	Net at 1000 m
29/11/2014 11:04	-55.2846	-41.2448	3394.56	63	0.8		Net in water
P2							
29/11/2014 00:14	-55.2055	-41.1697	3161.09	51	0.8	44	Final number of patches
29/11/2014 00:10	-55.2044	-41.1758	3176.45	51	12.1	44	
28/11/2014 23:59	-55.2025	-41.1928	3207.17	51	104.3	39	
28/11/2014 23:46	-55.202	-41.2137	3222.53	51	206.1	32	
28/11/2014 23:36	-55.2041	-41.2292	3225.6	51	308.1	27	
28/11/2014 23:30	-55.2063	-41.2374	3234.82	51	406.6	24	
28/11/2014 23:24	-55.2089	-41.244	3247.1	51	503.1	21	
28/11/2014 23:15	-55.214	-41.2487	3268.61	51	604.5	17	
28/11/2014 23:06	-55.2193	-41.2518	3287.04	51	709.8	12	
28/11/2014 22:58	-55.2239	-41.2545	3296.26	51	803.2	8	
28/11/2014 22:50	-55.2286	-41.2569	3317.76	51	902.8	4	
28/11/2014 22:42	-55.2332	-41.259	3339.26	51	997	1	
28/11/2014 21:10	-55.2864	-41.2797	3528.32	51	2.7	1	Net deployed
Ice station							
26/11/2014 13:36	-59.9488	-46.0331	4503.55	28	5.7	41	Final number of patches
26/11/2014 13:26	-59.9506	-46.0471	4503.55	28	105.4	37	
26/11/2014 13:15	-59.9527	-46.0641	4928.26	28	208	31	
26/11/2014 13:04	-59.9546	-46.0808	4892.93	28	301.9	26	
26/11/2014 12:54	-59.9565	-46.0961	4886.02	28	408.7	21	
26/11/2014 12:50	-59.9572	-46.1024	4901.38	28	501.3	19	

26/11/2014 12:46	-59.958	-46.1087	4910.59	28	609	17	
26/11/2014 12:35	-59.9591	-46.1194	4922.11	28	702	11	
26/11/2014 12:29	-59.9599	-46.1268	4925.95	28	806.4	8	
26/11/2014 12:24	-59.9607	-46.1331	4915.97	28	912.2	6	
26/11/2014 12:12	-59.9623	-46.1431	4896	28	988.4	0	Net at 1000 m
26/11/2014 10:51	-59.9684	-46.2273	4625.66	28	0	0	Net in water

Table 7-4: Bongo deployment log and sample fate

	Time	Event	Mesh size	Depth	Picked	Taxa	Number picked	Picked by	Fate of pickings	Sample residue preserved	Comment
42	16/12/2014 16:15	174	200	0-200	Yes	L. retroversa	~40	JG, SF	Air dried	Formalin	Adults only
42	16/12/2014 16:15	174	100	0-200	Yes	L. retroversa	~150	JG, SF	Air dried		Adults and juveniles Sample lost through wrong filter
41	15/12/2014 16:16	171	200	0-200	Yes	L. retroversa	~120	JG, SF	Air dried	Formalin	
41	15/12/2014 16:16	171	100	0-200	Yes	L. retroversa	~20	JG, SF	Air dried	Formalin	
40	14/12/2014 15:57	168	200	0-200	No				Frozen at -80 C for gut content analysis	Frozen	
40	14/12/2014 15:57	168	100	0-200	Yes	L. helicina Forams	~20 ~100	SF AM	Air dried	Formalin	
39	14/12/2014 15:44	167	200	0-100	Yes	L. helicina	>20	JG, SF	Pteropods air dried Frozen at -80 C for gut content analysis	Frozen	Pteropods picked as sample was filtered for freezing
39	14/12/2014 15:44	167	100	0-100	No					Formalin	
38	14/12/2014 08:46	160	200	0-200	No			CL	Frozen at -80 C for gut	Frozen	

									content analysis		
38	14/12/2014 08:46	160	100	0-200	Yes	Forams	>100	AM	Air dried	70% buffered ethanol	
37	14/12/2014 08:27	159	200	0-100	No			CL	Frozen at -80 C for gut content analysis	Frozen	
37	14/12/2014 08:27	159	100	0-100	Yes	Forams	<100	AM	Air dried	70% buffered ethanol	
36	13/12/2014 21:39	153	200	0-100	No			CL	Frozen at -80 C for gut content analysis	Frozen	
36	13/12/2014 21:39	153	100	0-100	??					Formalin	
35	13/12/2014 21:17	152	200	0-200	No			CL	Frozen at -80 C for gut content analysis	Frozen	
35	13/12/2014 21:17	152	100	0-200						Formalin	
34	13/12/2014 13:14	146	100	0-200	Yes	L. retroversa	_10	JG	Incubated	Formalin	Juveniles
34	13/12/2014 13:14	146	200	0-200	Yes	L. retroversa	~30	JG	Incubated	Frozen	Juveniles
34									Remnants frozen at -80 C for gut content analysis		
33	13/12/2014 06:26	139	200	0-200	No			CL	Frozen at -80 C for gut	Frozen	

									content analysis		
33	13/12/2014 06:26	139	100	0-200	Yes	Pteropods	>100	JG		Formalin	
						Forams	>100	AM			
32		118	200	0-100						Formalin	
32	11/12/2014 05:40	118	100								
31		114	200	0-200						Formalin	
31	10/12/2014 21:43	114	100								
30	10/12/2014 04:54	104	200	0-200	Yes	Forams	<20	VLP			Dense diatom bloom.
30						Pteropods	<20	VLP			Dense diatom bloom. Veliger and juvenile pteropods; few nps.
30	10/12/2014 04:54	104	100	0-200	Yes	Pteropods	<20	VLP			Dense diatom bloom. Veliger and juvenile pteropods; few nps.
30					Yes	Forams	<20	VLP			Dense diatom bloom.
30	10/12/2014 04:54	104	?		Yes	Pteropods	5	SF			Dense diatom bloom.
29	10/12/2014 04:35	103	200	0-100	??						
29	10/12/2014 04:35	103	100	0-100	??						

29	10/12/2014 04:35	103	100+200		Yes	Pteropods	4	SF			
28	09/12/2014 06:59	93	200	0-200	Yes	Drepanopus	15	MW	Formalin	Formalin	
28	09/12/2014 06:59	93	100	0-200	??					Formalin	
27	08/12/2014 23:12	89	200	0-200	Yes	Pteropods	25	JG	Air dried	Formalin	
27	08/12/2014 23:12	89	100	0-200	Yes	Forams	31	AM		Formalin	
26	04/12/2014 21:56	80	200	0-200	Yes	R. gigas	29	CL, MW	Incubated	Formalin	18 x CV incubated for respiration experiments 9 x CV incubated for faecal pellet production experiment 1 x CIV discarded 1 x CV lost
26	04/12/2014 21:56	80	100	0-200	Yes	L. helicina	1	JG	Air dried	Formalin	Juvenile
26						Forams	8	AM/ VLP	Air dried		
25	03/12/2014 15:54	76	100+200	0-200	Yes	Forams	>50	VLP	Air dried		
25	03/12/2014 15:54	76	200	0-200	Yes	Euphausiid faecal pellets		CL, GT	Incubated and fixed with formalin	Formalin	Fixed over 5 days with 1 ml 10% formalin for degradation analysis
25	03/12/2014 15:54	76	100	0-200	??					Formalin	
24	03/12/2014 15:38	75	100+200	0-100	Yes	L. helicina	1	SF	Air dried	See	Adult

24	03/12/2014 15:38	75	100+200	0-100	Yes	L. helicina	9	VLP	Air dried	below	Juveniles
24	03/12/2014 15:38	75	100+200	0-100	Yes	Forams	>50	AM	Air dried		
24	03/12/2014 15:38	75	200	0-100						Formalin	
24	03/12/2014 15:38	75	100	0-100						Formalin	
23	29/11/2014 15:29	66	200	0-200							
23	29/11/2014 15:29	66	100	0-200	Yes	Foraminifera	>100	AM		Formalin	
23						L. helicina	3	JG	Air dried		Adults
22	29/11/2014 15:17	65	100	0-100	Yes	L. helicina	4	JG	Air dried	Formalin	Adults
22					Yes	Foraminifera	>100	AM			
22	29/11/2014 15:17	65	200	0-100	Yes	L. helicina	7	JG	Air dried		Adults (for Sebastian). Relates to sample frozen for gut contents analysis.
21	29/11/2014 09:20	60	200	0-200							
21	29/11/2014 09:20	60	100	0-200	Yes	Foraminifera		VLP		Formalin	
20	29/11/2014 09:05	59	200	0-100	Yes	L. helicina	7	VLP			(Adult pteropods). Relates to sample frozen for gut content analysis.
20									Frozen at -80 C for gut	Frozen	Relates to sample picked for

									content analysis		pteropods.
20	29/11/2014 09:05	59	100	0-100	Yes	Foraminifera		VLP		Formalin	
19	29/11/2014 01:54	53	100	0-100	Yes	Foraminifera		Anna M			
19						L. helicina	24	Jessie G	Air dried		5 x veligers, 1 x adult, 18 x juvenile (For Sebastian)
19	29/11/2014 01:54	53	200	0-100	Yes	Pteropods	3	Jessie G	Air dried		Adults (For Sebastian). Relates to sample frozen for gut content analysis.
19									Frozen at -80 C for gut content analysis	Frozen	Relates to samples picked for pteropods.
18	28/11/2014 19:44	48	100	0-200	Yes	Foraminifera		Anna M			
18						L. helicina	6	Jessie G	Air dried		Adult (For Sebastian)
18	28/11/2014 19:44	48	200	0-200	Yes	L. helicina	12	Jessie G	Air dried		Adult (For Sebastian). Relates to sample frozen for gut content analysis.
18									Frozen at -80 C for gut content analysis	Frozen	Relates to samples picked for pteropods and forams.
17	28/11/2014 19:29	47	100	0-100	Yes	Foraminifera		Anna M		Formalin	

17						L. helicina	5	Jessie G	Air dried		4 x juvenile 1 x adult (For Sebastian)
17	28/11/2014 19:29	47	200	0-100				CL	Frozen at -80 C for gut content analysis	Frozen	Relates to records of pteropod and foram samples picked from net before freezing
17					Yes	L. helicina	14	Jessie G	Air dried		Adult (For Sebastian).Relates to sample frozen for gut content analysis.
16	28/11/2014 08:23	40	200	0-200	Yes	L. helicina	20	VLP	Preserved in formalin	Formalin	Adults
16	28/11/2014 08:23	40	100	0-200	Yes	Diatoms	Residue	VLP	Stored at -80 C	Frozen	
16						Foraminifera	>100	VLP			
16						L. helicina	5	VLP			Adults (4 good, 1 damaged)
15	27/11/2014 13:10	38	200	0-200	No				Preserved in formalin	Formalin	
15	27/11/2014 13:10	38	100	0-200	Yes	L. helicina	20	Vicky	3 crushed, others incubation		Adults. Respiration incubations (Jess)and shell analysis (crushed for Sebastian).
15						Foraminifera		Anna M			

15						Diatoms		Vicky			For Gabi.
14	26/11/2014 14:52	30	200	0-200	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and frozen for gut content analysis.
14	26/11/2014 14:52	30	100	0-200	Yes	Foraminifera		Anna M	Dried	Formalin	Remnants sieved and dried for classifying zooplankton.
13	26/11/2014 14:40	29	200	0-100	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and frozen for gut content analysis.
13	26/11/2014 14:40	29	100	0-100	Yes	Foraminifera		Anna M	Dried	Formalin	Remnants sieved and dried for classifying zooplankton.
12	26/11/2014 07:20	27	200	0-200	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and mesh frozen for gut content analysis.
12	26/11/2014 07:20	27	100	0-200	Yes			Vicky	Dried		Remnants sieved and dried for classifying zooplankton.
11	26/11/2014 07:05	26	200	0-100	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and frozen for gut content analysis.
11	26/11/2014 07:05	26	100	0-100	Yes			Vicky	Preserved in formalin		Remnants preserved in 4 % formaldehyde.
10	25/11/2014 21:18	21	200	0-200	No				Frozen at -80 deg C	Frozen	No paper log. Put through

											200 um mesh and frozen for gut analysis.
10	25/11/2014 21:18	21	100	0-200	Yes						No paper log. Remnants preserved in 4 % formaldehyde.
9	25/11/2014 20:58	20	200	0-100	No				Frozen at -80 deg C	Frozen	No paper log.Put through 200 um mesh and frozen for gut content analysis.
9	25/11/2014 20:58	20	100	0-100	Yes						No paper log. Remnants preserved in 4 % formaldehyde.
8	25/11/2014 19:28	18	200	0-200	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and mesh frozen for gut content analysis.
8	25/11/2014 19:28	18	100	0-200	Yes	Foraminifera	~ 3	Anna M			Remnants preserved in 4 % formaldehyde.
7	25/11/2014 19:13	17	200	0-100	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and frozen for gut content analysis.
7	25/11/2014 19:13	17	100	0-100	Yes	Foraminifera	~25	Anna M			Remnants preserved in 4 % formaldehyde.
6	25/11/2014 15:53	12	100	0-200	Yes	Foraminifera	~ 6	Anna M			Remnants preserved in 70

											% buffered ethanol.
6	25/11/2014 15:53	12	200	0-200	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and frozen for gut content analysis.
5	25/11/2014 15:49	11	200	0-100	No				Frozen at -80 deg C	Frozen	Put through 200 um mesh and mesh frozen for gut content analysis.
5	25/11/2014 15:49	11	100	0-100	Yes	Foraminifera	~ 40	Anna M	Dried on net		Lots of krill fecal pellets found.Remnants preserved in 70 % buffered ethanol.
4	19/11/2014 11:24	6	100	0-115	Yes	Pteropods	~ 30	Sebastian	Dried		
4						Foraminifera	~ 50	Anna M	Not preserved.		No organisms left in sample.
4	19/11/2014 11:24	6	200	0-115	No				Preserved in buffered 4 % formaldehyde.	Formalin	
3	18/11/2014 16:21	4	200	0-200	No				Preserved in buffered 4 % formaldehyde	Formalin	
3	18/11/2014 16:21	4	100	0-200	Yes	Foraminifera	~ 100	Anna M	Not preserved		None left in sample.
2	17/11/2014 19:07	2	200	0-200	No				Preserved in 4 % formaldehyde	Formalin	
2	17/11/2014 19:07	2	100	0-200	Yes	Pteropods			Preserved in ethanol	Formalin	

1	17/11/2014 18:38	1	200	0-200	Yes	Pteropods	300	Jess	Incubation		In incubation experiment for respiration.
1						Pteropods	150	Sebastian	Dried		3 cohorts of Limacina retroversa found.
1						Foraminifera		Anna M			Some organisms left in sample.
1	17/11/2014 18:38	1	100	0-200							

7.2 Marine Snow Catcher

Anna Belcher, National Oceanography Centre, UK (A.Belcher@noc.soton.ac.uk)

7.2.1 Objectives and Aims

The aim of the cruise was to investigate the controls on export and remineralisation processes in three contrasting regions (different ecosystem structure but of similar temperature) in the Scotia Sea. The marine snow catcher (MSC) was utilised to collect marine snow particles from the water column and examine the size, composition and abundance of marine snow material at different depths and make estimates of particle flux and investigate diel variability. As such it was aimed to use the MSC to:

- Measure any variation in the particle flux (in terms of magnitude, particle size and composition) with depth
- Investigate diel variability in particle flux and composition through multiple snow catcher deployments at each site during the day
- Measure the sinking rates of particles to investigate any relationship with particle size
- Collect water from the MSC to measure the particulate organic carbon (POC), particulate inorganic carbon (PIC), biogenic silica (BSi), and chlorophyll (Chl) in the slow sinking carbon pool
- Investigate the influence of community structure on export through samples taken for Scanning Electron Microscope (SEM) analysis and size fractionated Chl, as well as data from plankton net tows carried out on board
- Investigate degradation of sinking particles through measurement of oxygen gradients and calculation of respiration rates

7.2.2 Methods

95 litres of water were collected in each of two marine snow catchers (a PVC closing water bottle designed to minimise turbulence) at 10m and 110m below the chlorophyll maximum at base of the mixed layer (determined from the most recent CTD profile). The two MSC's were deployed one after the other to provide a depth comparison for a particular station, with deployments carried out four times daily at stations P2, P3 and ICE stations. As soon as the MSCs were on deck, an initial two litre sample was taken from the bottom tap on the MSC. The MSCs were then left upright for two hours to allow the marine snow particles to sink to the bottom. One litre of the initial sample (Time zero - T_0 sample) was filtered immediately for POC and represents the homogenous water column. The remaining litre was left to stand for two hours before also being filtered for POC (T_2 sample).

After standing for two hours the top section of the snow catcher was drained. The bottom section of the MSC containing 7 litres of water and settled particles was then removed. A four litre sample was siphoned out of the base section (representing the slow sinking pool), before removing the particle collector tray from the base and storing in a 2°C temperature controlled laboratory. Water samples collected from the base sections of the MSC were filtered for analysis of POC, PIC, POC, BSi, Chl (size fractionated) and SEM analysis.

Particles that had settled to the base of the bottom chamber were removed using a wide-bore pipette and photographed using an Olympus SZX16 microscope with Canon EOS 70D camera and Olympus BX-SZX Micro Cam. These particles represent the fast sinking pool. In addition, sinking rate experiments using a flow chamber (Ploug and Jørgensen, 1999; Ploug et al., 2010) were carried out on 5-15 particles from each MSC. Each particle was carefully placed in a 10cm high Plexiglas tube (5cm diameter), on a net extended across middle of the tube. Flow is supplied from below the net, adjusted using a needle valve, resulting in a uniform flow field across the upper chamber. The flow is adjusted so that the particle is suspended one particle diameter above the net. At this point the sinking velocity is balanced by the upward flow velocity (Ploug et al., 2010), and can be calculated by dividing the flow rate by the area of the flow chamber. Three measurements of the sinking velocity were made for each particle and the x, y, and z dimensions measured using a horizontal dissection microscope with a calibrated ocular.

For a number of fast sinking particles, the oxygen gradients at the particle-water interface were measured using a Clark-type oxygen microelectrode with a guard cathode (Revsbach, 1989) mounted in a micromanipulator. Sensors were calibrated at 0% and 100% oxygen. The microsensor had a tip diameter of 10 µm, with a 90% response time of <1s and stirring sensitivity of < 0.3%. The electrode current was read by a picoammeter (Unisense). Particles were placed on the net of the flow chamber, and after measuring the sinking velocity, the flow rate was reduced slightly so the particle was stable. The microsensor was then slowly brought down towards the particle surface in steps of 10-100 µm. Measured oxygen gradients will be analysed using a diffusion-reaction model to calculate oxygen uptake rates and calculate respiration rates (Iversen and Ploug, 2010b).

7.2.3 Filter Sample Preparation, Preservation and Analysis:

POC: Each sample was filtered through a 25mm diameter, ashed GF/F filter, rinsed with milliQ water, placed in a Petri dish, air dried and stored at room temperature for later analysis.

PIC: Each sample was filtered through a 0.8µm pore size, 25mm diameter, nucleopore polycarbonate membrane filter, rinsed with pH adjusted milliQ water, stored in a centrifuge tube, air dried and stored at room temperature for later analysis.

BSi: Each sample was filtered through a 0.8µm pore size, 25mm diameter, nucleopore polycarbonate membrane filter, rinsed with pH adjusted milliQ water, stored in a centrifuge tube, air dried and stored at room temperature for later analysis.

Total Chlorophyll: Each sample was filtered through a 0.8µm pore size, 25mm diameter, MPF300 filter, rinsed with milliQ water, placed in an eppendorf tube and stored at -20°C for later analysis.

Chl >10 µm: Each sample was filtered through a 10µm pore size, 25mm diameter nucleopore polycarbonate membrane filter, rinsed with milliQ water, placed in an eppendorf tube and stored at -20°C for later analysis.

SEM: Each sample was filtered through a 0.8µm pore size, 25mm diameter, nucleopore polycarbonate membrane filter, rinsed with pH adjusted milliQ water, placed in a Petri dish, air dried and stored at room temperature for later analysis.

7.2.4 Preliminary Results

During the cruise a total of 27 successful snow catcher deployments were made (Table 7-5) with three misfires.

Table 7-6 details the water samples taken from each MSC deployment.

Table 7-5: Details of MSC deployments during JR 304 (Positions given in decimal degrees)

Date	Time (GMT)	Event Number	Station	Latitude	Longitude	MSC	Depth (m)
25/11/2014	10:16 10:38	008 009	ICE	-59.9623 -59.9623	-46.1598 -46.1598	A B	60 160
25/11/2014	18:18 18:39	015 016	ICE	-59.9623 -59.9623	-46.1597 -46.1597	A B	70 170
26/11/2014	00:55 01:19	022 023	ICE	-59.9623 -59.9623	-46.1597 -46.1597	A B	70 170
26/11/2014	16:44 17:12	033 034	ICE	-59.9629 -59.9629	-46.1603 -46.1603	A B	60 160
28/11/2014	11:33 11:51	043 044	P2	-55.2527 -55.2527	-41.3022 -41.3022	A B	55 155
28/11/2014	20:14 20:30	049 050	P2	-55.2484 -55.2484	-41.264 -41.264	A B	35 135
29/11/2014	03:16 03:53	055 056	P2	-55.2477 -55.2477	-41.2649 -41.2661	A B	35 135
29/11/2014	09:54 10:07	061 062	P2	-55.2477 -55.2477	-41.2649 -41.2649	A B	35 135
29/11/2014	17:32 17:47	068 069	P2	-55.2475 -55.2475	-41.2651 -41.2651	A B	45 450
12/12/2014	22:14 22:40	135 136	P3	-52.8116 -52.8116	-39.9727 -39.9727	A B	70 170
13/12/2014	 07:53 08:24	140 141 142 143	P3	 -52.812 -52.812	 -39.9725 -39.9725	A A A B	Misfire Misfire 70 170m
13/12/2014	14:11 14:33	148 149	P3	-52.7623 -52.7623	-40.3038 -40.3038	A B	70 misfire
13/12/2014	22:25 22:47	155 156	P3	-52.8118 -52.8118	-39.9727 -39.9726	A B	80 180
14/12/2014	14:07 14:39	164 165	Upwelling	-52.6004 -52.6004	-39.1996 -39.1996	A B	70 170

Table 7-6: Summary of water samples and volumes taken from MSC

		Initial (T_0, T_2) (volume ml)	Slow Sinking (SS) (volume ml)					
Event	MSC	POC	POC	PIC	BSi	Chl >10 µm	Chl Total µm	SEM
008	A	990 (T_2=1000)	1000	500	500	250	250	500
009	B	900 (T_2=1000)	1000	500	500	250	250	500
015	A	1000	1000	500	500	300	300	500
016	B	1000	1000	500	500	300	300	500
022	A	1000	1000	500	500	300	300	500
023	B	1000	1000	500	500	300	300	500
033	A	1000	1000	500	500	300	300	500
034	B	1000	1000	500	500	300	300	500
043	A	1000	1000	500	500	300	300	500
044	B	1000	1000	500	500	300	300	500
049	A	1000	990	500	500	300	300	500
050	B	1000	1000	500	500	300	300	500
055	A	820 (T_2=1000)	1000	500	500	300	300	500
056	B	1000	1000	500	500	300	300	500
061	A	1000	1000	500	500	300	300	500
062	B	990 (T_2=1000)	1000	500	500	300	300	500
068	A	1000	1000	500	500	300	300	500
069	B	990 (T_2=1000)	1000	500	500	300	300	500
135	A	1000	1000	500	500	250	250	500
136	B	1000 (T_2=960)	1000	500	500	250	250	500
142	A	1000	1000	500	500	250	250	500
143	B	1000	1000	500	500	250	250	500
148	A	1000	1000	500	500	250	250	500
155	A	1000	1000	500	500	250	250	500
156	B	1000	1000	500	500	250	250	500
164	A	1000	1000	500	500	250	250	500
165	B	1000	1000	490	500	250	250	500

MSC's were deployed in pairs at different depths to investigate changes in sinking material with depth. It was noted for all stations that much less material was recorded in the deep MSC (110 m below the base of the mixed layer) when compared to the shallow MSC (10 m below the base of the mixed layer), as expected considering remineralisation and bacterial degradation processes. A range of particles were observed in the base of the MSC's, with a high abundance of faecal pellets and phytoplankton cells such as *acantharia sp*. and *thalassiosira sp*. (Figure 7-3). Marine snow aggregates and 'faecal fluff' were also observed, as well as unidentifiable detrital material. Preliminary assessment of sinking material suggests that krill faecal pellets made up the bulk of sinking material at the ICE station. At P2, P3 and the upwelling site faecal pellets were typically smaller, paler and many are believed to be of copepod origin. High quantities of sinking phytoplankton cells were also observed at P2, P3 and upwelling stations.

Figure 7-3: Examples of particles recovered in marine snow catcher, A: Krill faecal pellet, B: Paler faecal pellets, C: Acantharia. Scale bar = 1mm

Sinking rate experiments were carried out on those particles large enough to see by eye, with the range of measured velocities reflecting the variation in particle composition, size and density. Average sinking velocities measured were; 152, 145, 88, and 168 m/day at ICE, P2, P3, and upwelling stations respectively. Sinking rates ranged from to 2 m/day for a degraded faecal pellet at the ICE station, to 1022 m/day for a foraminifera cell at the upwelling station. Later analysis of microscope data will enable any relationship with sinking speed and particle size to be determined.

Further results will be worked up following laboratory analysis of sample filters (POC, PIC, BSi, Chl and SEM). It will then be possible to calculate the sinking rates and export of slow sinking material, and allow a more in depth analysis of the composition of sinking material and any variation across stations. An estimate of the fast sinking POC flux will be made based on microscope photographs and volume calculations of particles (Alldredge et al., 1998). In addition to this, for each snow catcher 2-3 splits of fast sinking material were collected on GF/F filters for analysis of POC content, providing further means to estimate the fast sinking POC flux.

Data from the MSC will be compared with other data collected from the cruise, such as CTD data, and information on biological community structure from plankton net tows, to explain any variations and trends in particle size, composition and export at the stations sampled.

7.2.5 References

Alldredge, A.L., U. Passow, and S.H.D. Haddock, 1998, The characteristics and transparent exopolymer particle (TEP) content of marine snow formed from thecae dinoflagellates, *J.Plankton Res*., 20 (3), 393-406.

Ploug, H. and B.B. Jørgensen, 1999, A net-jet flow system for mass transfer and microsensor studies of sinking aggregates, *Mar. Ecol. Prog. Ser*., 176, 279–290.

Ploug, H., A. Terbrüggen, A. Kaufmann, D. Wolf-Gladrow, and U. Passow, 2010, A novel method to measure particle sinking velocity *in vitro*, and its comparison to three other *in vitro* methods, *Limnol. Oceanogr.* Methods, 8, 386–393.

Iversen, M. H. and Ploug, H., 2010b, Ballast minerals and the sinking carbon flux in the ocean: carbon-specific respiration rates and sinking velocity of marine snow aggregates, *Biogeosciences*, 7, 2613–2624, doi:10.5194/bg-7-2613-2010.

Revsbech, N. P., 1989, An oxygen microsensor with a guard cathode, *Limnol. Oceanogr.,* 34, 474–478.

7.3 The Marine Snow Camera (part of cgs 99)

Richard Lampitt, NOC

7.3.1 Introduction

The principle vehicles for downward particle flux have long been considered to be “marine snow particles” loosely defined as inanimate particles greater than 0.5mm in diameter. Due to their high sinking rates (100’s meters per day) they are certainly responsible for the mass flux events which characterise temperate and boreal zones but there is increasing evidence that the finer fractions may in certain regions or at certain times of the year may contribute significantly to downward flux.

There are several methods to determine downward flux all of which have strengths and weaknesses. Sediment traps provide long term quantitative samples of the settling material but do not provide information on the vehicles for this flux; the sizes and characteristics of the particles settling into the traps. Optical techniques have been used for many years to characterise these particles but the assumptions required to convert these data to fluxes are very large (size to mass; size to sinking rate). Simultaneous use of different approaches offers the best approach to a description of both the fluxes and the characteristics of the particles responsible for this flux.

In addition to this, collection of particles with the Marine Snow Catcher facilitates characterisation of individual particles in a way which has very rarely been done; sinking rates and chemical gradients across the particle.

During this cruise optical techniques were used at four contrasting locations to characterise the particles in the upper 250m of the water column, data which would be used in conjunction with data obtained on collected particles using the Marine Snow Catcher and also as a temporal snap shot of water column characteristic during sediment trap deployments at two of the sites (P2 and P3).

7.3.2 Methods

The Marine Snow Camera comprises three independent self-recording sensors; A standard camera system (P-Cam) photographing under dark ground illumination 7 litres of water every 5 seconds, a Holographic system (LISST-HOLO) imaging 1.8mls of water every 5 seconds and a CTD (Idronaut) sampling once per second.

Figure 7-4: Marine snow camera being deployed

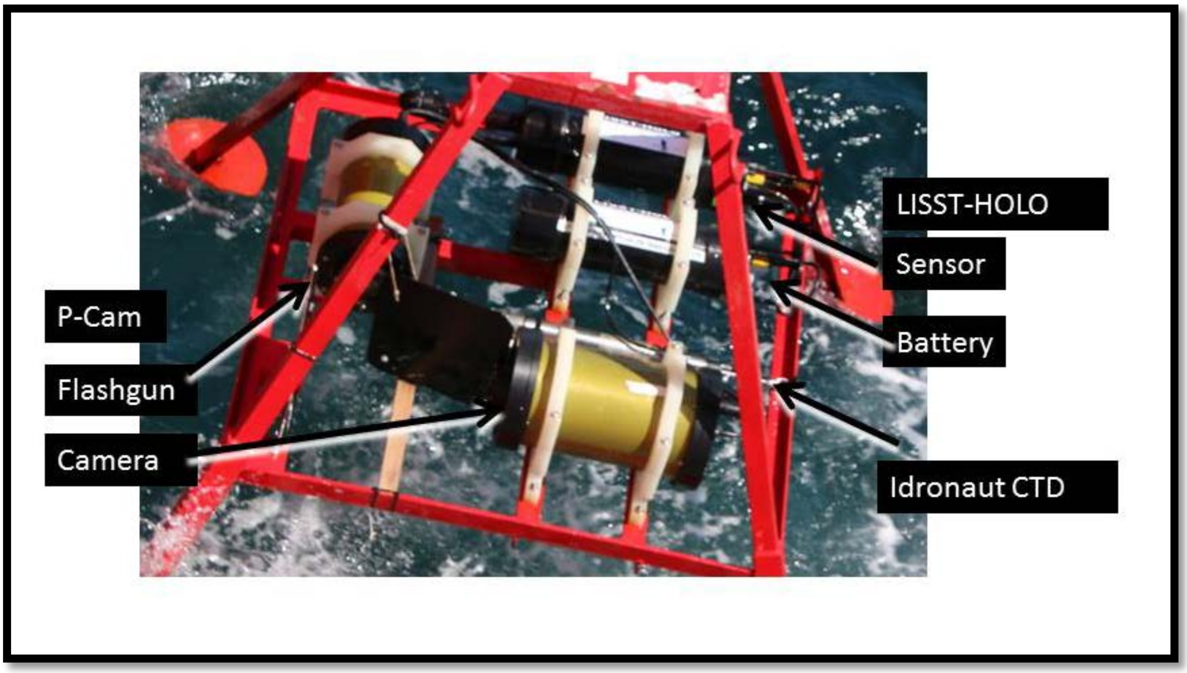


Figure 7-5: Component parts of marine snow camera system as deployed during JR304

The system was lowered to 250m depth and raised at approximately 0.2m/sec giving one exposure of P-Cam and LISST-HOLO every meter.

7.3.2.1 P-Cam description

This comprised:

Canon EOS 6D digital SLR camera

Canon Speedlite 600EX-RT flash gun

Quantum Turbo 3 battery pack

Hahnel Giga T Pro II remote timer

Lens: 50mm

Due to the absence of a covered work space, the camera was started in the Main Lab with a 15 minute delay in order to install the camera in the pressure case and fix it to the frame on deck.

The camera settings were:

Frame interval: 5 sec

Aperture: f32

ISO: 10,000

Shutter speed: 1/180 sec

Flash energy: 35mm focal length

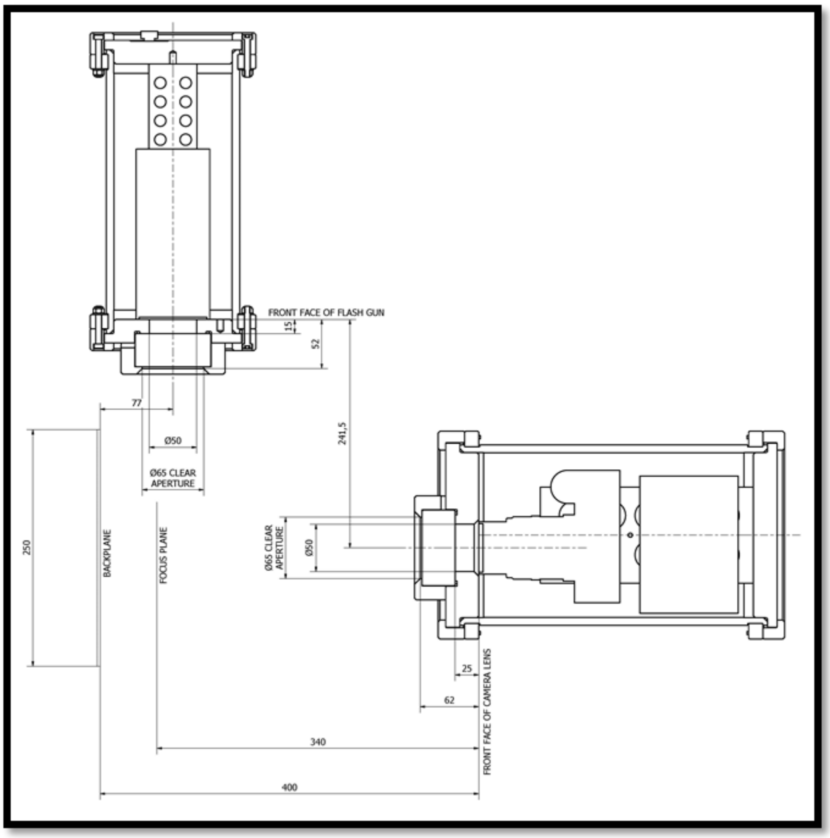


Figure 7-6: Diagram of P-Cam system

7.3.2.2 P-Cam data processing

Images were batch processed using “Image J” software after increasing the Virtual memory of the laptop to 20GB. Processing lasted about 1 hour. The processing sequence used was:

1- File/Import/Image Sequence
2- Image/ Type/ 8 bit
3- Image / Adjust/ Threshold............... Set to 35
4- Process / Binary / Make Binary
5- Analyse / Set Scale .... 32.15 pixels/mm
6- Analyse / Analyse particles

Summary data were immediately exported to Excel for visualisation. The full data set with characteristics of each particle will be carried out after the cruise.

7.3.2.3 LISST-HOLO description

The LISST-HOLO is a submersible digital holographic camera, during the present cruise it was operated in a self-contained mode powered from an external battery pack. The instrument records in-line holographic images that are stored in internal flash memory or an ‘external memory module’ (EMM). These .PGM (portable grey map) images also code supporting data, date, time, temperature, depth, and instrument details in the file structure (see Sequoia manual section 12, p65 for details). This supporting data can be read in plain text at the end of the file using the ‘HEXview’ option in Irfanview (convenient software for opening and viewing the .PGM files). This is a useful feature where the file’s original timestamp may have been lost on copying of file transfer (occurs, though can be prevented, when using FileZilla to download images from the camera’s internal memory).

The notional capability of the instrument is the detection and volume measuring of particles in the size range 25-2500µm equivalent spherical diameter, through a path length of 50mm, having a sampled volume of 1.86cm^3. Optical sections of the recorded image are reconstructed mathematically from the interference fringes produced by the interaction of particles with the laser illumination. Summary statistics are provided in terms of total particle volume concentration and volume concentration in size bins (note that four different bin size scales are offered –

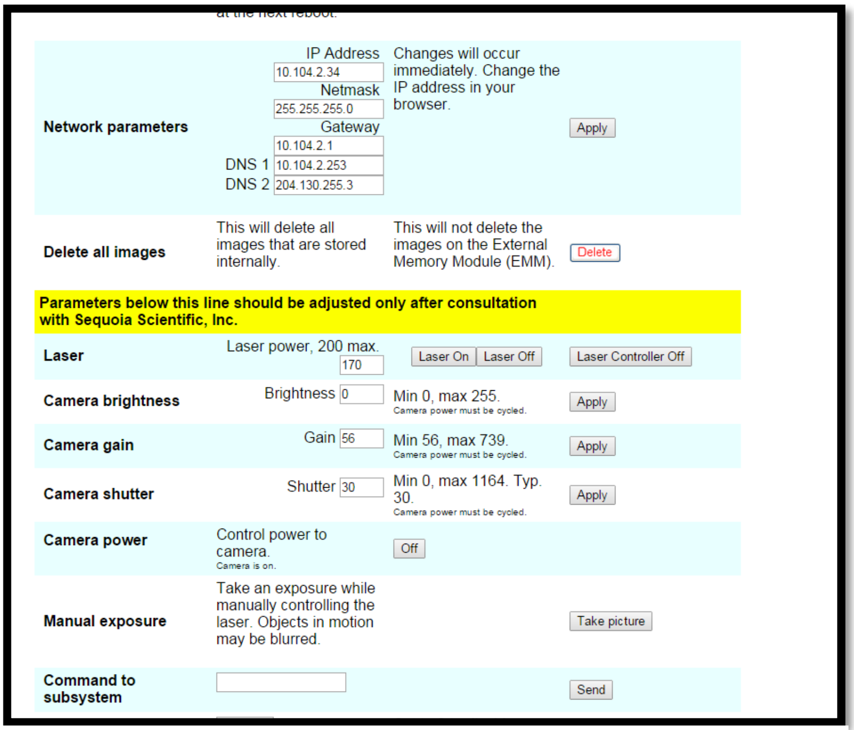


Figure 7-7: Sequoia manual extract showing setup for LISST-HOLO

for processing onboard this cruise, the 'LISST-100X RANDOM type C' was uniformly employed).

7.3.2.4 LISST-HOLO Data processing

Image reconstruction and data generation requires use of Sequoia supplied software:
HOLO_Batch for batch processing and data generation

Other software is also required:
1: An image viewer that can read .PGM files, "Irfanview" was employed.
2: An FTP utility for mass downloading of images from the instrument's internal memory. "FileZilla" was used but it is much easier to use the External Memory Module (EMM) instead of the internal memory. EMM can be treated as any normal memory stick to transfer data but taking extreme care every time only to remove it from the LISST-HOLO after it has entered "sleep mode" and to "eject the hardware" before removing it from the laptop connection. Failure to do this would have damaged the EMM.

Although the output from HOLO_Batch provides, as stated in the manual, data in 50 size bins logarithmically placed from 1.25 -4923 micron, the effective resolution of the instrument is only about 25 micron rendering the first 18 bins completely useless.

7.3.3 Data Coverage

13 deployments of the Marine Snow Camera system were made during the cruise to 250m depth covering 4 stations: Ice Edge, P2, P3 and Upwelling. All three instruments on the device (P-Cam, LISST-HOLO and Idronaut CTD) functioned according to specification during all deployments due in large part to the diligent preparation carried out by Kev Saw at NOC prior to the cruise.

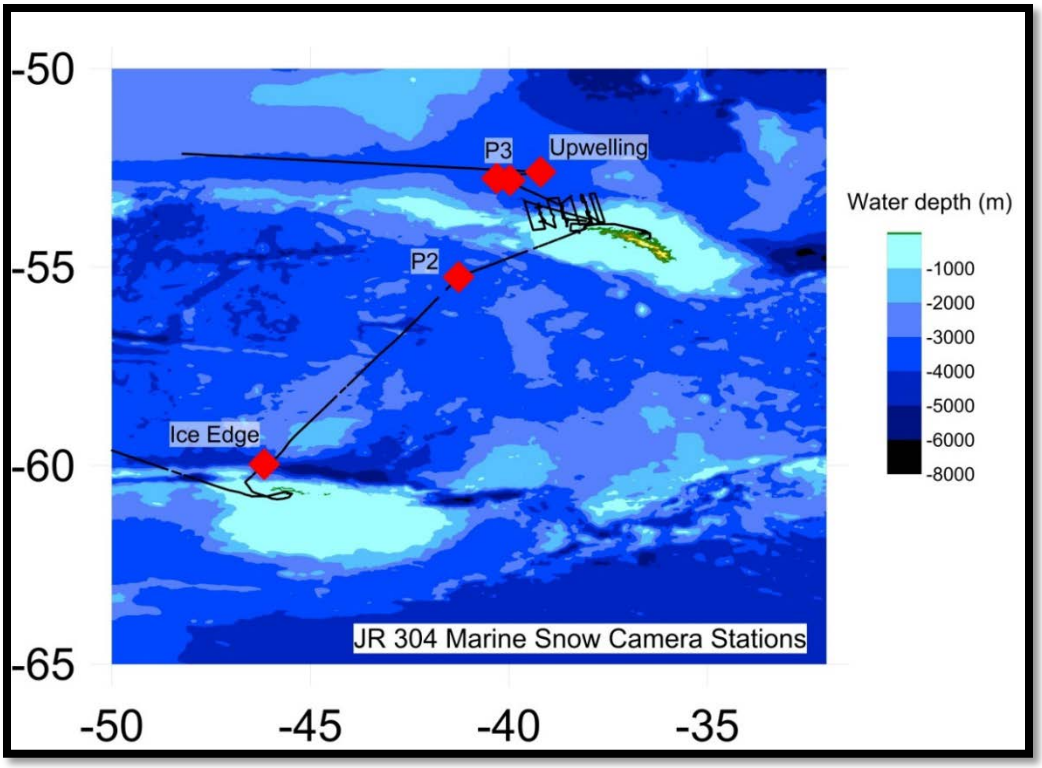


Figure 7-8: Location of Marine Snow Camera stations during JR304

Table 7-7: Event numbers, times and locations of Marine Snow Camera deployments during JR304

Event	Station	Start positions		Times	
		Lat	Lon	Start	End
13	Ice edge	-59.9624	-46.1597	25/11/2014 16:39	25/11/2014 17:33
19	Ice edge	-59.9623	-46.1598	25/11/2014 22:59	25/11/2014 23:43
25	Ice edge	-59.9627	-46.1633	26/11/2014 06:10	26/11/2014 06:51
31	Ice edge	-59.9629	-46.1602	26/11/2014 15:28	26/11/2014 16:11
46	P2	-55.2484	-41.264	28/11/2014 18:43	28/11/2014 19:25
52	P2	-55.2477	-41.2662	29/11/2014 01:02	29/11/2014 01:40
58	P2	-55.2477	-41.2648	29/11/2014 08:16	29/11/2014 08:57
64	P2	-55.2475	-41.265	29/11/2014 14:32	29/11/2014 15:13
138	P3	-52.8121	-39.9724	13/12/2014 05:30	13/12/2014 06:15
145	P3	-52.7622	-40.3038	13/12/2014 12:30	13/12/2014 13:10
151	P3	-52.8118	-39.9726	13/12/2014 20:33	13/12/2014 21:14
161	Upwelling	-52.6018	-39.1994	14/12/2014 09:26	14/12/2014 10:20
166	Upwelling	-52.6004	-39.1997	14/12/2014 14:59	14/12/2014 15:40

7.3.4 Preliminary results

As can be seen from the examples of data collected, there are substantial differences in the physical and biological setting as determined by the CTD rosette sampler at P2 (Fe-) and P3 (Fe+) which are also very different from the Ice-edge station. The methodological conclusion from these data sets is that the LISST-HOLO analyses an insufficient volume of water and hence there is massive scatter in the data which will make it hard to make significant conclusions. The P-Cam however suffers from the disadvantage of an insufficiently well proscribed optical system but data which although in absolute terms have some uncertainty, (perhaps 50% uncertainty), the data clearly are extremely robust in a comparative sense.

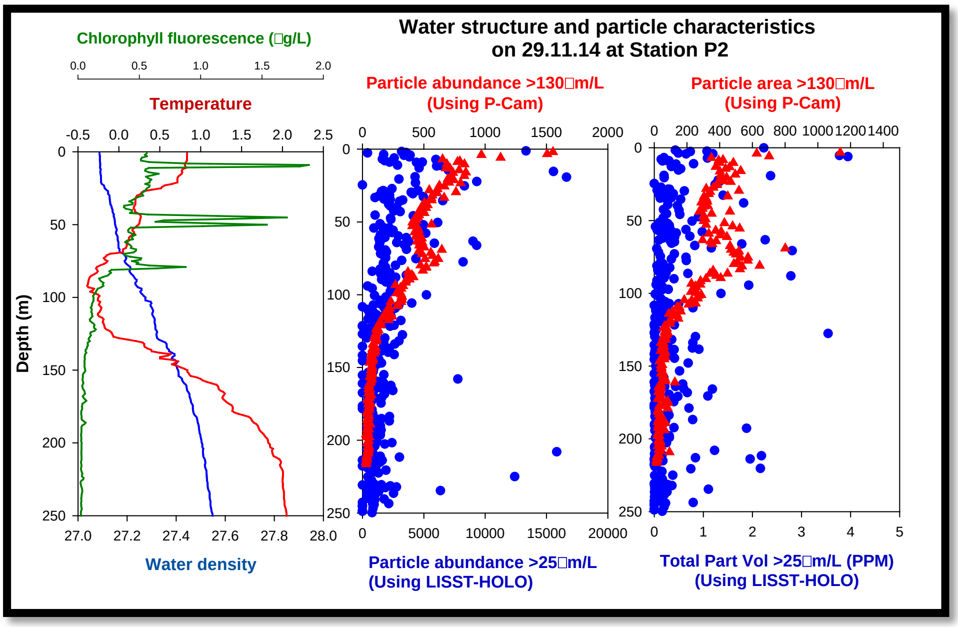


Figure 7-9: Plots of water column structure and particle characteristics captured with marine snow camera system at Station P2

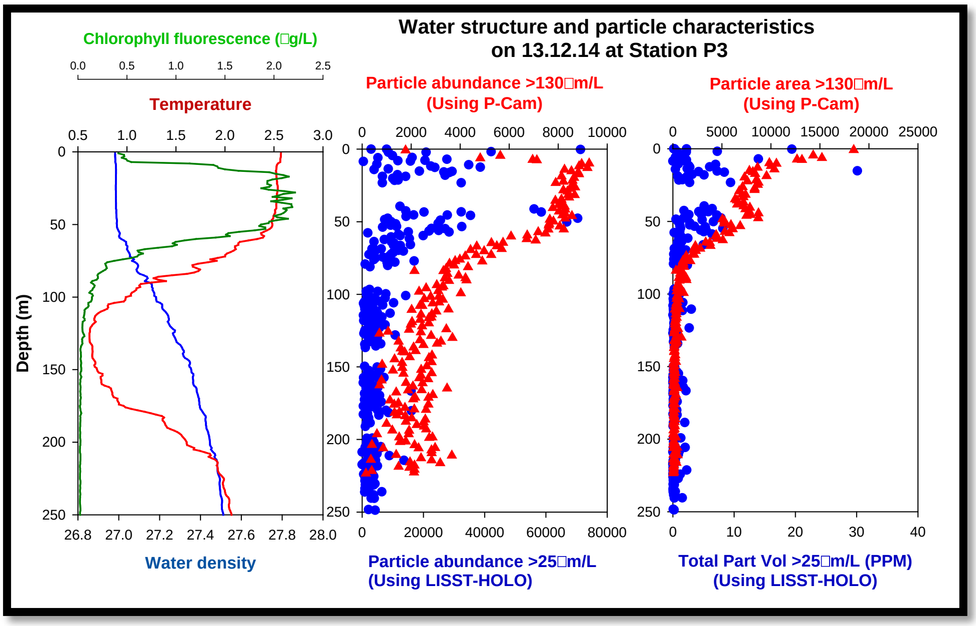


Figure 7-10: Plots of water column structure and particle characteristics captured with marine snow camera system at Station P3

7.4 Composition of free-living and particle-associated microbial communities in contrasting Antarctic marine environments (part of cgs 99)

Manon T. Duret, National Oceanography Centre, UK

7.4.1 Objectives and Aims

The aim of the cruise was to investigate the composition of microbial communities in contrasting Antarctic environments in the Scotia Sea, as well as the differences between free-living and particle-associated microbial communities (i.e. in/on particles). This study aims to provide insights in the remineralisation processes carried out on sinking particulate organic matter in the twilight zone of the water column. Seawater from the Conductivity-Temperature-Depth (CTD) rosette unit was sampled in order to collect total microbial communities, and from the Marine Snow Catcher (MSC) in order to collect particle-attached and free-living communities. The collected samples will be analysed *via* four different molecular methods:

- Metagenomics or DNA analysis, which will provide insights in the taxonomical diversity of the different targeted microbial communities;
- Metatranscriptomics or RNA analysis, which will provide insights in:
    - The active taxonomical groups within these communities,
    - The functional diversity of these active groups;
- CARD-FISH analysis, which will provide insights in:
    - The structuration of communities in/on particles,
    - A quantitative estimation of the taxonomical groups forming these communities;

- Phytoplankton protein assessment, which will provide insights in the phytoplanktonic composition of the water column.

7.4.2 Sample collection:

7.4.2.1 DNA/RNA:

From the CTD:

The depth targeted for DNA/RNA samples were the following:

Mixed layer (20m);
10m below the deep chlorophyll maximum (i.e. depth matching with the MSC A);
110m below the deep chlorophyll maximum (i.e. depth matching with the MSC B);
Oxygen minimum zone;
Mid-mesopelagic (~500m);
Deep mesopelagic (~1,000m).

~10L of seawater were filtered through an in-line filtration system equipped with a peristaltic pump (Figure 7-11) using three different pore size filters (100, 10 and 0.22µm) in order to collect the total microbial communities at each studied depth. Filters were incubated with RNA later for ~12h at 4°C then stored at -80°C until later analysis.

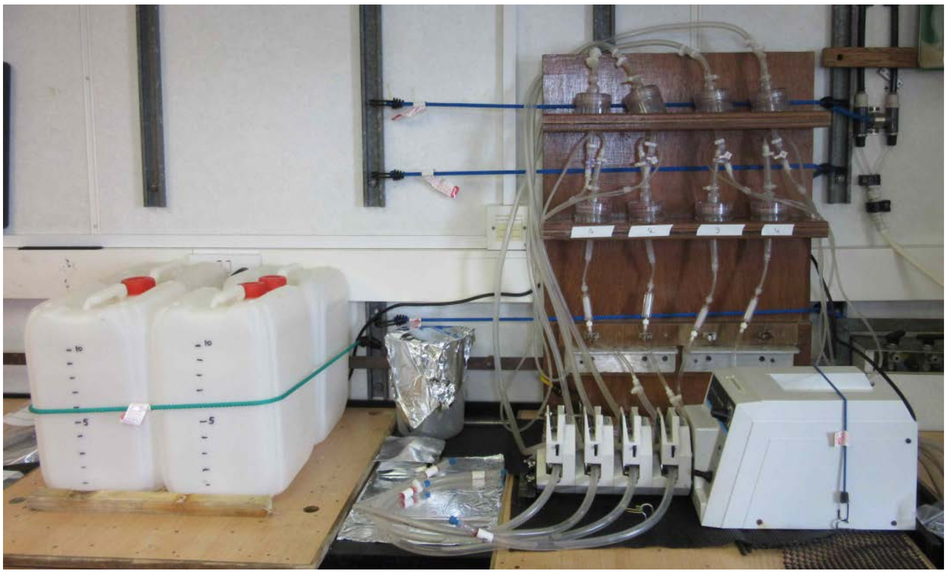


Figure 7-11: In-line filtration system.

From the Marine Snow Catcher:

The depths targeted were the following:

10m below the deep chlorophyll maximum (i.e. MSC A);
110m below the deep chlorophyll maximum (i.e. MSC B).

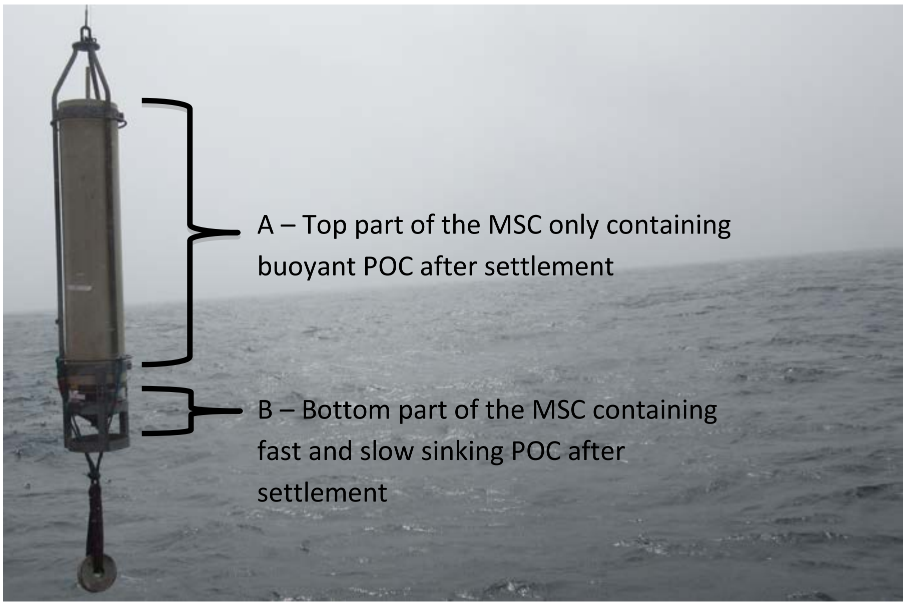


Figure 7-12. Marine snow catcher functional parts.

The MSC was resting for two hours after recovery in order to let the fast and slow sinking particles to settle down on the bottom part.

In order to collect free-living microbial communities, ~10L of seawater were collected from the top part MSC after the settlement of the sinking marine particles pool in the bottom of the MSC (Figure 7-12-A). The collected marine snow-free seawater was filtered through an in-line filtration system equipped with a peristaltic pump using three different pore size filters (100, 10 and 0.22µm). Filters were incubated with RNA later for ~12h at 4°C then stored at -80°C until later analysis.

In order to collect particle-attached, ~1.5L of seawater were collected from the bottom part MSC, which includes sinking marine particles pools (Figure 7-12-B). Particles were collected on a 10µm pore size filter. Filters were incubated with RNA later for ~12h at 4°C then stored at -80°C until later analysis.

7.4.2.2 CARD-FISH:

The depth targeted were the following:

Mixed layer (20m);
10m below the deep chlorophyll maximum (i.e. depth matching with the MSC A);
10m below the deep chlorophyll maximum (i.e. MSC A);
110m below the deep chlorophyll maximum (i.e. depth matching with the MSC B);
110m below the deep chlorophyll maximum (i.e. MSC B);
Oxygen minimum zone;
Mid-mesopelagic (~500m);
Deep mesopelagic (~1,000m).

~100mL of seawater from the CTD and the top part of the MSC were fixed with 1% paraformaldehyde for ~12h at 4°C. After being fixed, the seawater samples were filtered through three different pore size filters (10, 3, 0.2µm) and rinsed with MilliQ water in order to get rid of the remaining paraformaldehyde. Filters were then stored at -80°C until later analysis.

7.4.2.3 Protein assessment:

The depth targeted were the following:

10m below the deep chlorophyll maximum (i.e. depth matching with the MSC A);
110m below the deep chlorophyll maximum (i.e. depth matching with the MSC B);
Deep mesopelagic (~1,000m).

~1L of seawater from the CTD were filtrated onto a burned GF/F filter. Filters were incubated with RNA later for ~12h at 4°C then stored at -80°C until later analysis.

Table 7-8: Summary of samples taken for the 4 different types of processing

Sample ID	Depth (m)	Event n°	Filter size (µm)	Volume (L)	Type
ICE-CTD-20-100µm	20	7	100	8	DNA-RNA
ICE-CTD-60-100µm	60	7	100	10.5	DNA-RNA
ICE-CTD-160-100µm	160	7	100	10.5	DNA-RNA
ICE-CTD-300-100µm	300	7	100	9	DNA-RNA
ICE-CTD-500-100µm	500	7	100	10.5	DNA-RNA
ICE-CTD-1000-100µm	1000	7	100	9	DNA-RNA
ICE-CTD-20-10µm	20	7	10	8	DNA-RNA
ICE-CTD-60-10µm	60	7	10	10.5	DNA-RNA
ICE-CTD-160-10µm	160	7	10	10.5	DNA-RNA
ICE-CTD-300-10µm	300	7	10	9	DNA-RNA
ICE-CTD-500-10µm	500	7	10	10.5	DNA-RNA
ICE-CTD-1000-10µm	1000	7	10	9	DNA-RNA
ICE-CTD-20-0.22µm	20	7	0.22	8	DNA-RNA
ICE-CTD-60-0.22µm	60	7	0.22	10.5	DNA-RNA
ICE-CTD-160-0.22µm	160	7	0.22	10.5	DNA-RNA
ICE-CTD-300-0.22µm	300	7	0.22	9	DNA-RNA
ICE-CTD-500-0.22µm	500	7	0.22	10.5	DNA-RNA
ICE-CTD-1000-0.22µm	1000	7	0.22	9	DNA-RNA
ICE-CTD-20	20	7	10-3	0.1	CARD-FISH
ICE-CTD-60	60	7	10	0.1	CARD-FISH
ICE-CTD-160	160	7	10-3-0.2	0.1	CARD-FISH
ICE-CTD-300	300	7	10- 3-0.2	0.1	CARD-FISH
ICE-CTD-500	500	7	10-3-0.2	0.1	CARD-FISH
ICE-CTD-1000	1000	7	10	0.1	CARD-FISH
ICE-MSC-60-100µm	60	8	100	9.5	DNA-RNA
ICE-MSC-p-60	60	8	N/A	N/A	DNA-RNA
ICE-MSC-60-10µm	60	8	10	9.5	DNA-RNA
ICE-MSC-60-0.22µm	60	8	0.22	9.5	DNA-RNA
ICE-MSC-60	60	8	10-3	0.1	CARD-FISH
ICE-MSC-p-60	60	8	N/A	0.1	CARD-FISH
ICE-MSC-160-100µm	160	9	100	10	DNA-RNA
ICE-MSC-p-160	160	9	N/A	N/A	DNA-RNA

ICE-MSC-160-10µm	160	9	10	10	DNA-RNA
ICE-MSC-160-0.22µm	160	9	0.22	10	DNA-RNA
ICE-MSC-160	160	9	10-3-0.2	0.1	CARD-FISH
ICE-MSC-p-160	160	9	N/A	0.1	CARD-FISH
ICE-MSC-bottom-70-10µm	70	15	10	1.5	DNA-RNA
ICE-MSC-bottom-170-10µm	170	16	10	1.5	DNA-RNA
ICE-CTD-PA-20	20	32	GF/F	1	Prot Ass
ICE-CTD-PA-60	60	32	GF/F	1	Prot Ass
ICE-CTD-PA-160	160	32	GF/F	1	Prot Ass
ICE-CTD-PA-300	300	32	GF/F	1	Prot Ass
ICE-CTD-PA-500	500	32	GF/F	1	Prot Ass
ICE-CTD-PA-1000	1000	32	GF/F	1	Prot Ass
P2-CTD-20-100µm	20	42	100	9	DNA-RNA
P2-CTD-55-100µm	55	42	100	9	DNA-RNA
P2-CTD-155-100µm	155	42	100	9	DNA-RNA
P2-CTD-300-100µm	300	42	100	10.5	DNA-RNA
P2-CTD-500-100µm	500	42	100	10.5	DNA-RNA
P2-CTD-1000-100µm	1000	42	100	10.5	DNA-RNA
P2-CTD-20-10µm	20	42	10	9	DNA-RNA
P2-CTD-55-10µm	55	42	10	9	DNA-RNA
P2-CTD-155-10µm	155	42	10	9	DNA-RNA
P2-CTD-300-10µm	300	42	10	10.5	DNA-RNA
P2-CTD-500-10µm	500	42	10	10.5	DNA-RNA
P2-CTD-1000-10µm	1000	42	10	10.5	DNA-RNA
P2-CTD-20-0.22µm	20	42	0.22	9	DNA-RNA
P2-CTD-55-0.22µm	55	42	0.22	9	DNA-RNA
P2-CTD-155-0.22µm	155	42	0.22	9	DNA-RNA
P2-CTD-300-0.22µm	300	42	0.22	10.5	DNA-RNA
P2-CTD-500-0.22µm	500	42	0.22	10.5	DNA-RNA
P2-CTD-1000-0.22µm	1000	42	0.22	10.5	DNA-RNA
P2-MSC-55-100µm	55	43	100	10.5	DNA-RNA
P2-MSC-55-10µm	55	43	10	10.5	DNA-RNA
P2-MSC-55-0.22µm	55	43	0.22	10.5	DNA-RNA
P2-MSC-55-bottom-10µm	55	43	10	1.5	DNA-RNA
P2-MSC-155-100µm	155	44	100	10	DNA-RNA
P2-MSC-155-10µm	155	44	10	10	DNA-RNA
P2-MSC-155-0.22µm	155	44	0.22	10	DNA-RNA
P2-MSC-155-bottom-10µm	155	44	10	1.5	DNA-RNA
P2-CTD-20	20	42	10-3-0.2	0.1	CARD-FISH
P2-CTD-55	55	42	10-3-0.2	0.1	CARD-FISH
P2-CTD-155	155	42	10-3-0.2	0.1	CARD-FISH

P2-CTD-300	300	42	10-3-0.2	0.1	CARD-FISH
P2-CTD-500	500	42	10-3-0.2	0.1	CARD-FISH
P2-CTD-1000	1000	42	10-3-0.2	0.1	CARD-FISH
P2-MSC-55	55	43	10-3-0.2	0.1	CARD-FISH
P2-MSC-155	155	44	10-3-0.2	0.1	CARD-FISH
ICE-CTD-PA-45	45	67	GF/F	1	Prot Ass
ICE-CTD-PA-450	450	67	GF/F	1	Prot Ass
ICE-CTD-PA-1000	1000	67	GF/F	1	Prot Ass
P3-CTD-20-100µm	20	134	100	8.5	DNA-RNA
P3-CTD-70-100µm	70	134	100	10	DNA-RNA
P3-CTD-170-100µm	170	134	100	10	DNA-RNA
P3-CTD-300-100µm	300	134	100	10	DNA-RNA
P3-CTD-500-100µm	500	134	100	10	DNA-RNA
P3-CTD-1000-100µm	1000	134	100	9	DNA-RNA
P3-MSC-70-100µm	70	135	100	8.5	DNA-RNA
P3-MSC-170-100µm	170	136	100	10	DNA-RNA
P3-CTD-20-10µm	20	134	10	8.5	DNA-RNA
P3-CTD-70-10µm	70	134	10	10	DNA-RNA
P3-CTD-170-10µm	170	134	10	10	DNA-RNA
P3-CTD-300-10µm	300	134	10	10	DNA-RNA
P3-CTD-500-10µm	500	134	10	10	DNA-RNA
P3-CTD-1000-10µm	1000	134	10	9	DNA-RNA
P3-MSC-70-10µm	70	135	10	8.5	DNA-RNA
P3-MSC-170-10µm	170	136	10	10	DNA-RNA
P3-CTD-20-0.22µm	20	134	0.22	8.5	DNA-RNA
P3-CTD-70-0.22µm	70	134	0.22	10	DNA-RNA
P3-CTD-170-0.22µm	170	134	0.22	10	DNA-RNA
P3-CTD-300-0.22µm	300	134	0.22	10	DNA-RNA
P3-CTD-500-0.22µm	500	134	0.22	10	DNA-RNA
P3-CTD-1000-0.22µm	1000	134	0.22	9	DNA-RNA
P3-MSC-70-0.22µm	70	135	0.22	8.5	DNA-RNA
P3-MSC-170-0.22µm	170	136	0.22	10	DNA-RNA
P3-MSC-70-bottom-10µm	70	135	10	1.5	DNA-RNA
P3-MSC-170-bottom-10µm	170	136	10	1.5	DNA-RNA
P3-CTD-20	20	134	10-3-0.2	0.1	CARD-FISH
P3-CTD-70	70	134	10-3-0.2	0.1	CARD-FISH
P3-CTD-170	170	134	10-3	0.1	CARD-FISH
P3-CTD-300	300	134	10-3-0.2	0.1	CARD-FISH
P3-CTD-500	500	134	10-3-0.2	0.1	CARD-FISH
P3-CTD-1000	1000	134	10-3-0.2	0.1	CARD-FISH
P3-MSC-70	70	135	10-3-0.2	0.1	CARD-FISH
P3-MSC-170	170	136	10-3-0.2	0.1	CARD-FISH
UP-CTD-20-100µm	20	163	100	8	DNA-RNA

UP-CTD-70-100µm	70	163	100	9	DNA-RNA
UP-CTD-170-100µm	170	163	100	10	DNA-RNA
UP-CTD-300-100µm	300	163	100	10	DNA-RNA
UP-CTD-500-100µm	500	163	100	10	DNA-RNA
UP-CTD-1000-100µm	1000	163	100	10	DNA-RNA
UP-MSC-70-100µm	70	164	100	9	DNA-RNA
UP-MSC-170-100µm	170	165	100	10	DNA-RNA
UP-CTD-20-10µm	20	163	10	8	DNA-RNA
UP-CTD-70-10µm	70	163	10	9	DNA-RNA
UP-CTD-170-10µm	170	163	10	10	DNA-RNA
UP-CTD-300-10µm	300	163	10	10	DNA-RNA
UP-CTD-500-10µm	500	163	10	10	DNA-RNA
UP-CTD-1000-10µm	1000	163	10	10	DNA-RNA
UP-MSC-70-10µm	70	164	10	9	DNA-RNA
UP-MSC-170-10µm	170	165	10	10	DNA-RNA
UP-CTD-20-0.22µm	20	163	0.22	8	DNA-RNA
UP-CTD-70-0.22µm	70	163	0.22	9	DNA-RNA
UP-CTD-170-0.22µm	170	163	0.22	10	DNA-RNA
UP-CTD-300-0.22µm	300	163	0.22	10	DNA-RNA
UP-CTD-500-0.22µm	500	163	0.22	10	DNA-RNA
UP-CTD-1000-0.22µm	1000	163	0.22	10	DNA-RNA
UP-MSC-70-0.22µm	70	164	0.22	9	DNA-RNA
UP-MSC-170-0.22µm	170	165	0.22	10	DNA-RNA
UP-MSC-70-bottom-10µm	70	164	10	1.5	DNA-RNA
UP-MSC-170-bottom-10µm	170	165	10	1.5	DNA-RNA

7.5 Pteropod studies

Jess Gardner (BAS/UEA studentship)

7.5.1 Water sampling

A full depth CTD was utilised to investigate the total alkalinity, dissolved inorganic carbon and nutrient analysis to determine the carbonate chemistry of the water column. Water samples were decanted through Tygon tubing into acid washed borosilicate bottles. These were fixed with 50 µL saturated mercuric chloride solution to be analysed post cruise. Using the CO2SYS software the carbonate saturation states of aragonite was indirectly calculated. Nutrient samples were then collected in Nalgene bottles to be frozen (-20 C) and stored in the dark to be analysed post cruise.

Table 7-9: CTD water samples taken for pteropod studies

Date	Event Number	Niskin Bottle	Station	Sample Depth	TA/DIC	Nutrients
25/11/2014	7	23	Ice Station	10 m	X	
25/11/2014	7	15	Ice Station	100 m	X	X
25/11/2014	7	5	Ice Station	1000 m	X	
25/11/2014	7	4	Ice Station	1400 m	X	X

25/11/2014	7	14	Ice Station	150 m	X	X
25/11/2014	7	13	Ice Station	160 m	X	X
25/11/2014	7	3	Ice Station	1603 m	X	X
25/11/2014	7	2	Ice Station	1802 m	X	X
25/11/2014	7	12	Ice Station	200 m	X	X
25/11/2014	7	1	Ice Station	2002 m	X	X
25/11/2014	7	10	Ice Station	23 m	X	X
25/11/2014	7	11	Ice Station	300 m	X	
25/11/2014	7	21	Ice Station	40 m		X
25/11/2014	7	10	Ice Station	400 m	X	X
25/11/2014	7	18	Ice Station	60 m		X
25/11/2014	7	7	Ice Station	600 m	X	X
25/11/2014	7	16	Ice Station	80 m	X	X
25/11/2014	7	6	Ice Station	800 m	X	X
25/11/2014	7	21	Ice Station	40 m	X	
25/11/2014	7	24	Ice Station	5 m	X	
25/11/2014	7	20	Ice Station	50 m	X	
25/11/2014	7	8	Ice Station	500 m	X	
25/11/2014	7	18	Ice Station	60 m	X	
28/11/2014	42	23	P2	10 m	X	X
28/11/2014	42	16	P2	100 m	X	X
28/11/2014	42	4	P2	1000 m	X	X
28/11/2014	42	3	P2	1400 m	X	X
28/11/2014	42	15	P2	150 m	X	X
28/11/2014	42	2	P2	1600 m	X	X
28/11/2014	42	21	P2	20 m	X	X
28/11/2014	42	13	P2	200 m	X	X
28/11/2014	42	1	P2	2000 m	X	X
28/11/2014	42	12	P2	300 m	X	X
28/11/2014	42	20	P2	40 m	X	X
28/11/2014	42	10	P2	400 m	X	X
28/11/2014	42	24	P2	5 m	X	X
28/11/2014	42	9	P2	500 m	X	X
28/11/2014	42	18	P2	60 m	X	X
28/11/2014	42	7	P2	600 m	X	X
28/11/2014	42	17	P2	80 m	X	X
28/11/2014	42	6	P2	800 m	X	X
03/12/2014	78	8	Cumberland bay	105 m	X	X
03/12/2014	78	14	Cumberland bay	12 m	X	X
03/12/2014	78	13	Cumberland bay	14 m	X	X
03/12/2014	78	6	Cumberland bay	145 m	X	X
03/12/2014	78	3	Cumberland bay	205m	X	X
03/12/2014	78	12	Cumberland bay	25m	X	X
03/12/2014	78	15	Cumberland bay	4 m	X	X

03/12/2014	78	11	Cumberland bay	45 m	X	X
03/12/2014	78	10	Cumberland bay	65 m	X	X
09/12/2014	94	5	Western Core Box	100 m	X	X
09/12/2014	94	2	Western Core Box	150 m	X	X
09/12/2014	94	10	Western Core Box	20 m	X	X
09/12/2014	94	1	Western Core Box	200 m	X	X
09/12/2014	94	9	Western Core Box	40 m	X	X
09/12/2014	94	13	Western Core Box	5 m	X	X
09/12/2014	94	6	Western Core Box	60 m	X	X
12/12/2014	134	15	P3	100 m	X	X
12/12/2014	134	5	P3	1000 m	X	X
12/12/2014	134	14	P3	125 m	X	X
12/12/2014	134	4	P3	1400 m	X	X
14/12/2014	134	13	P3	150m	X	X
12/12/2014	134	11	P3	175 m	X	
12/12/2014	134	21	P3	20 m	X	X
12/12/2014	134	10	P3	200 m	X	X
12/12/2014	134	2	P3	2000 m	X	X
12/12/2014	134	9	P3	300 m	X	X
12/12/2014	134	20	P3	40 m		X
14/12/2014	134	20	P3	40m	X	
12/12/2014	134	23	P3	5 m	X	X
12/12/2014	134	19	P3	50 m	X	X
12/12/2014	134	18	P3	60 m	X	X
12/12/2014	134	6	P3	600 m	X	X
14/12/2014	163	12	Upwelling station	100 m	X	
14/12/2014	163	12	Upwelling station	100m		X
14/12/2014	163	22	Upwelling station	10m	X	X
14/12/2014	163	11	Upwelling station	125 m	X	X
14/12/2014	163	9	Upwelling station	200 m	X	
14/12/2014	163	9	Upwelling station	200m		X
14/12/2014	163	21	Upwelling station	20m	X	X
14/12/2014	163	7	Upwelling station	300m	X	X
14/12/2014	163	19	Upwelling station	40 m	X	
14/12/2014	163	19	Upwelling station	40m		X
14/12/2014	163	24	Upwelling station	5 m	X	
14/12/2014	163	5	Upwelling station	500 m	X	X
14/12/2014	163	24	Upwelling station	5m		X
14/12/2014	163	16	Upwelling station	60 m	X	
14/12/2014	163	3	Upwelling station	600m	X	X
14/12/2014	163	16	Upwelling station	60m		X
14/12/2014	163	2	Upwelling station	800m	X	X
14/12/2014	163	14	Upwelling station	80m	X	X

7.5.2 Incubation of pteropods to observe calcification and physiological responses to ocean acidification

Where sufficient numbers of pteropods were collected within Bongo or MOCNESS sample specimens were collected immediately and transferred into unfiltered seawater and left for acclimatisation. After 2 hours those which were actively swimming and with a good condition shell were transferred either into a calcein solution for one hour or fresh seawater. These were then rinsed three times with filtered sea water. Non-active specimens were air dried and transferred to a specimen slide as control specimens. Were sufficient numbers permitted some pteropods were frozen in -80 °C freezer after being rinsed in mill-Q water for lipid analysis post cruise. All pteropods collected were photographed immediately.

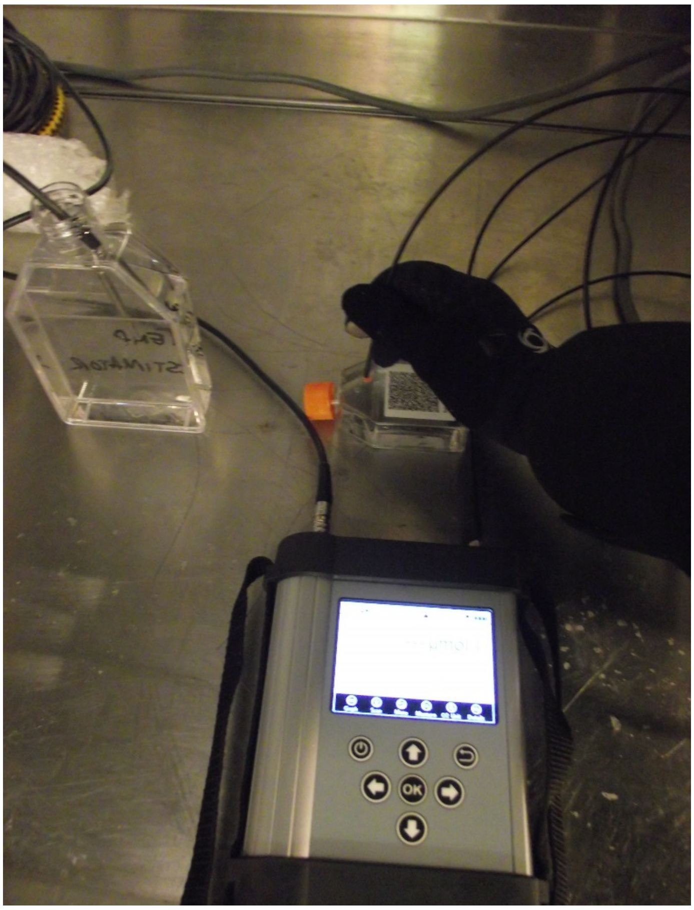


Figure 7-13: Measuring temperature and oxygen concentration using Presans octode sensor

Seawater collected from CTD casts at 60m was filtered using a 0.22um filter system. Prior to each incubation a TA/DIC sample was also taken to determine the initial carbonate chemistry of the incubation to be analysed post cruise. This was prepared as described in section X1. Incubations were either under two temperatures (1.5° and 3.5°C) at ambient Ph (~400 ppm), or at two temperatures (1.5° and 3.5°C) and three pH conditions (~400 ppm, 750 ppm and 1100 ppm). The quantities of HCL and NaCO3 required to achieve the target pH conditions was calculated using the relationship between the ambient seawater pH, temperature, salinity with TA and DIC established on JR274. All treatments were run as at least triplicates. In addition an incubation was established with no seawater treatment and ambient seawater temperature (1.5°) using 500ml bottles to investigate bottle effects of food deprivation and pteropod numbers. During some of the incubations the respiration rate of the pteropods was measured every four hours along with temperature and visual observations of behavioural activity.

On termination of the incubation each of the pteropods were recovered and assessed on shell condition and activity levels. Subsequently they were rinsed in milli-Q water and photographed. A subsample was taken and stored in -80°C for lipid analysis post cruise. The remaining pteropods were air dried for growth analysis post cruse using fluorescence microscopy. Where eggs were laid these were incubated further and allowed to hatch. The subsequently offspring were also incubated in two pH and two temperatures with 4 being removed and preserved from the incubation each day on filter paper and in 70% buffered ethanol.

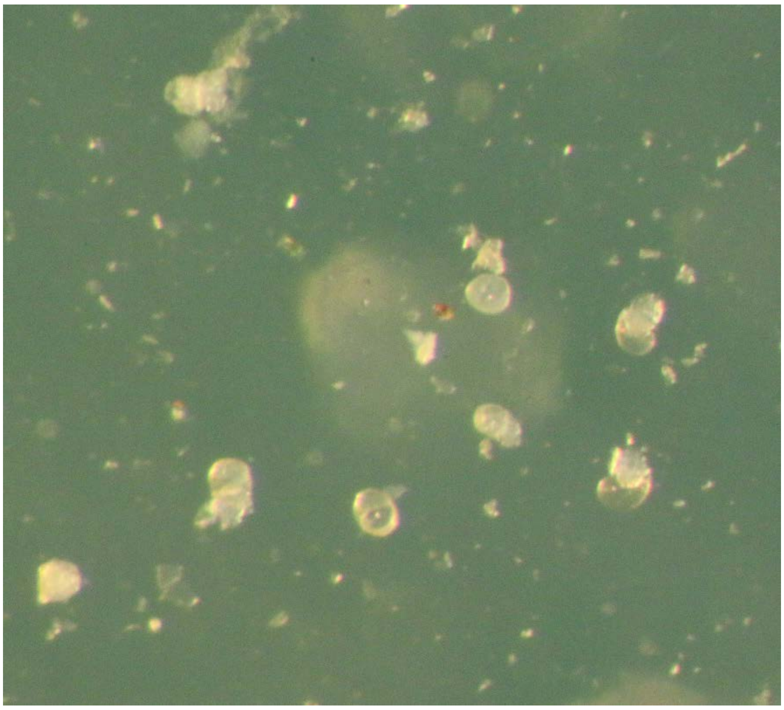


Figure 7-14: 5 day old *L. helicina*

Table 7-10: Pteropod incubation summary

Exp. #	Start date	Origin event number	Treatment description	Bottle volume	Species	Calcein staining method	Number of individuals	Respiration measureme	Lipids	Incubation Length
1	18/11/14	001	Bottle effects: Pteropod numbers	65ml	L. Retroversa Juveniles	None	Varied	Yes	Yes	4
2	26/11/14	38	Two temperatures	65ml	L. Helicina adults	25 mg/l in incubation bottles	1	Yes	No	18
3	28/11/14	045	Bottle effects: Food deprivation	500 ml	L. Helicina	None	2	No	No	9
4	8/12/14		Juveniles 2 temperatures		L. Retraversa	25 mg/l in incubation bottles	1	Yes	Yes	8
5	9/12/14	N/A	Juvenile hatched from Exp. 2 Two temperatures, two pH	65ml	L.Helicina	Staining 1 day	12	No	No	7
6	13/12/14	152	Veliger 2 temperatures and 3 pH	500 ml	L. Helicina	Staining 2 hours	4	Yes	Yes	3

7.6 Vertical migration as a mediator of active flux of carbon and nitrogen

Cecilia Liszka (BAS/UEA studentship)

7.6.1 Introduction

Samples were collected to contribute first year field data to my PhD investigating the active flux of carbon and nitrogen, mediated by the vertical migration of zooplankton (Primary Supervisor: Geraint Tarling). Data was sought from a number of samples and experiments set up with specimens collected from the equipment described in the following sections, in addition to samples from the Longhurst Hardy Plankton Recorder (LHPR) which will be analysed for zooplankton community composition and diel variability at BAS labs.

The purpose of samples collected and experiments undertaken during the cruise was to gather data on respiration rates of prominent diel vertical migrators (notably euphasiids and abundant species of copepod) at temperatures broadly reflective of above and below the mixed layer depth, the degradation of euphausiid faecal material over time within the water column, and the fate of faecal material within the water column. The following sections describe the equipment deployed, and what samples or experimental data they contributed.

7.6.2 Bongo net samples

7.6.2.1 Scientific purpose

Bongo net samples were primarily used to determine zooplankton community composition and gut fullness of zooplankters (in particular, known or putative copepod and Euphausiid diel vertical migrators) at 0 – 100 m and 0 – 200 m depths, bongo nets fitted with 200 µm mesh nets were deployed to 100 m and 200 m at time stations and opportunistically.

Samples were taken from day- and night-time hauls, to analyse differences in community composition and gut contents throughout the diel cycle and evidence of diel vertical migration of zooplankters. They will be analysed using gut fluorometry once back at BAS labs to infer feeding activity of zooplankters and to obtain information regarding vertical migration and gut evacuation.

In addition, one bongo net haul was used to harvest Euphausiid faecal pellets (FPs) so as to determine FP degradation over time (E076) (see description in CTD section) and one was used to harvest *Rhincalanus gigas* copepods (E080) for incubations (see description for incubations in MOCNESS section).

The full list of bongo net samples taken and their use is detailed in Table 7-11.

Table 7-11: Bongo net samples taken, and use and fate of samples

Date/ time (GMT)	Event ID	Station	Latitude	Longitude	Net mesh size microns	Fate of sample
14/12/201415:57:00	168	13 (Upwelling)	-52.60035	-39.19966	200	Frozen at -80 C for gut content analysis
14/12/201415:57:00	167	13 (Upwelling)	-52.60037	-39.19963	200	Frozen at -80 C for gut content analysis

14/12/201415:44:00	160	13 (Upwelling)	-52.60078	-39.1997	200	Frozen at -80 C for gut content analysis
14/12/201408:46:00	159	13 (Upwelling)	-52.60006	-39.19993	200	Frozen at -80 C for gut content analysis
14/12/201408:27:00	153	12 (P3)	-52.81177	-39.97263	200	Frozen at -80 C for gut content analysis
13/12/201421:17:05	152	12 (P3)	-52.81178	-39.97261	200	Frozen at -80 C for gut content analysis
13/12/201413:14:00	146	12 (P3)	-52.76215	-40.30367	200	Frozen at -80 C for gut content analysis
13/12/201406:26:00	139	12 (P3)	-52.81209	-39.97237	200	Frozen at -80 C for gut content analysis
04/12/2014 21:56:00	80	11	-54.26662	-36.43319	200	*R. gigas* harvested and incubated: - 18 x CV incubated for respiration experiments - 9 x CV incubated for faecal pellet production experiment (lost) - 1 x CIV discarded - 1 x CV lost
03/12/201415:54:00	76	8 (Cumberland)	-54.20243	-36.45429	200	Euphausiid FPs incubated and fixed with 1 ml 10% formalin over 5 days for degradation analysis
29/11/201409:05:00	59	6 (P2)	-55.24777	-41.26484	200	Frozen at -80 C for gut content analysis
29/11/201401:54:00	53	6 (P2)	-55.24766	-41.26622	200	Frozen at -80 C for gut content analysis
28/11/201419:44:00	48	6 (P2)	-55.24843	-41.26397	200	Frozen at -80 C for gut content analysis
28/11/201419:29:00	47	6 (P2)	-55.24845	-41.26395	200	Frozen at -80 C for gut content analysis
26/11/201414:52:05	30	4 (Ice station)	-59.96292	-46.16023	200	Frozen at -80 C for gut content analysis
26/11/201414:40:26	29	4 (Ice station)	-59.96291	-46.16025	200	Frozen at -80 C for gut content analysis
26/11/201407:20:32	27	4 (Ice station)	-59.9624	-46.16011	200	Frozen at -80 C for gut content analysis
26/11/201407:05:03	26	4 (Ice station)	-59.96238	-46.16011	200	Frozen at -80 C for gut content analysis
25/11/201421:18:10	21	4 (Ice station)	-59.96231	-46.15973	200	Frozen at -80 C for gut content analysis
25/11/201420:58:26	20	4 (Ice station)	-59.96231	-46.15973	200	Frozen at -80 C for gut content analysis
25/11/201419:28:46	18	4 (Ice station)	-59.9624	-46.16011	200	Frozen at -80 C for gut content analysis
25/11/201419:13:50	17	4 (Ice station)	-59.96238	-46.15968	200	Frozen at -80 C for gut content analysis

25/11/201415:53:32	12	4 (Ice station)	-59.96238	-46.15968	200	Frozen at -80 C for gut content analysis
25/11/201415:49:10	11	4 (Ice station)	-59.96238	-46.15968	200	Frozen at -80 C for gut content analysis

7.6.2.2 Materials and methods

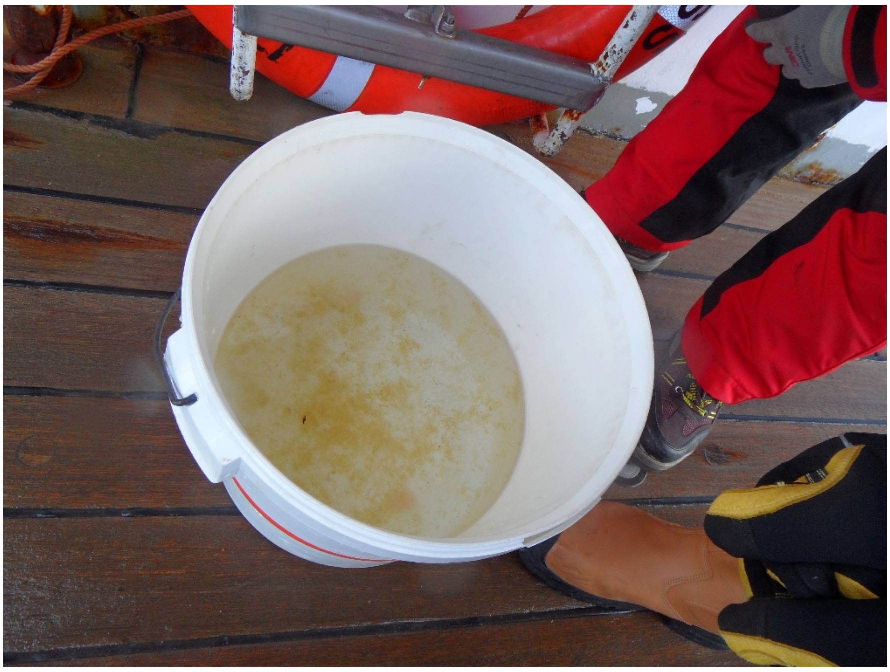


Figure 7-15: Contents of bongo cod-end in bucket ready for filtering

Catches from the 200 µm mesh cod end were decanted into a bucket with a small quantity of filtered seawater.

Once inside the wet lab, buckets were immediately filtered onto a 200 µm mesh filter (see example in Figure 2) which was folded into quarters, stapled closed and stored in a labelled plastic bag in the -80°C freezer for later analysis of gut fluorescence.

If being picked for pteropods or forams, this was done concurrently to filtering the contents of the bucket through the mesh.

Figure 7-16: 200 µm mesh being prepared for filtering

7.6.2.3 Sample preservation and storage

Individual bagged samples were collectively stored in labelled plastic boxes in the -80°C for transport back to Cambridge. Boxes were labelled for 0 – 100 m depth or 0 – 200 m depth respectively.

Records of samples were stored on paper logs (stored in L:\scientific_work_areas\bongo\scanned_paper_logs) and copied to the JCR logsheets (intranet) under JR304_bongo_sampling.

7.6.3 MOCNESS net samples

7.6.3.1 Scientific purpose

MOCNESS net samples from time station deployments (see Figure 7-17 for retrieval of MOCNESS cod-ends) were used for three purposes:

- Buckets from MOCNESS deployments at time stations inspected for euphausiids (specifically *Euphausia triacantha* and *Thysanoessa* spp.) for incubations to determine temperature-dependent respiration rates over a period of up to 48 hours.
- Depth-stratified samples taken from midnight and midday deployments, giving the zooplankton community distribution from 0 – 1,000 m and insight into diel variability in depth-integrated community structure.
- *Euphausia superba* specimens collected in the first MOCNESS deployment (E024) incubated for faecal pellet production. Faecal material harvested for subsequent elemental analysis and production per individual.

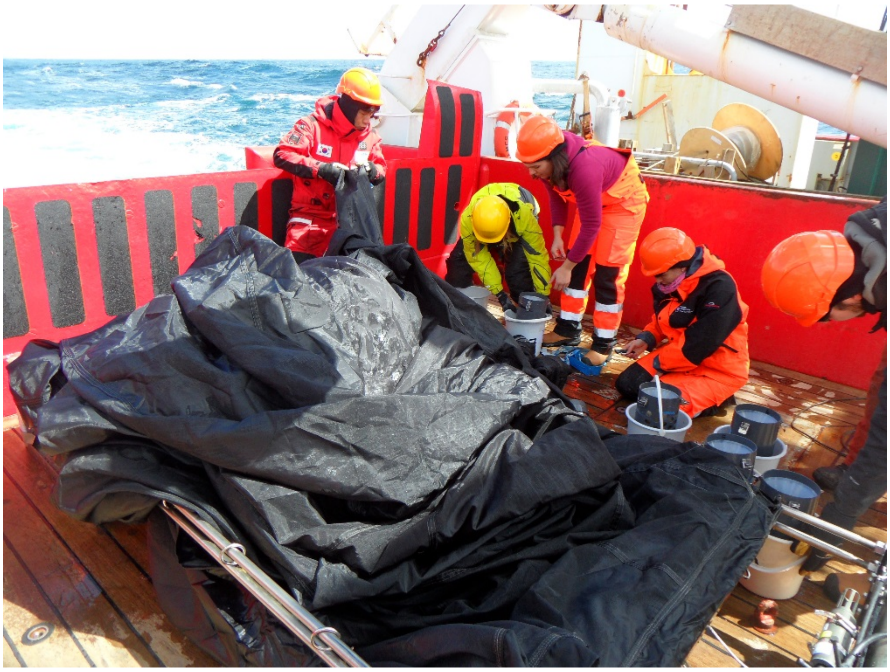


Figure 7-17: Retrieval of MOCNESS net and transfer into buckets

A summary of MOCNESS net hauls used for the above experiments (excluding standard net preservation for depth-stratified sampling – detailed in MOCNESS section of report) is documented in Table 7-12.

Table 7-12: MOCNESS net samples (not including regular preservation of samples for depth-stratified sampling) taken for experiments

Date/ time (GMT)	Event ID	Station	Latitude	Longitude	Summary	Experiment/ activity description	Sample preservation and storage description
26/11/2014 03:46	24	Ice	-59.94961	-46.13489	**FP production (*E. superba*)**	13 *E. superba* in large plastic container with weighted grille on bottom of box Sample taken from (failed) MOCNESS 1, Event 24, bucket 1 (depth unknown)	Specimens frozen in plastic bag at -20 C (dead at end of experiment) Pellets pipetted into 5 x 15 mL vials for fixation to compare laboratory produced pellets with ocean pellets
26/11/2014 03:46	24	Ice	-59.94961	-46.13489	**FP fixation**	Preservation of FPs from laboratory production experiment FPs pipetted gently into 15 ml centrifuge tubes, excess water removed, topped up to 13 ml with FSW First sample fixed 29.11.14 with 1 mL 10% formalin; subsequent samples fixed on consecutive days	1 mL 10% formalin in each vial Stored in chemical store on LHS on exit from wet lab
28/11/2014 16:24	45	6	-55.23642	-41.23273	**Incubation CL_INC2a (*E. triacantha*)**	Incubation set up with *E. triacantha* from MOCNESS (E045) O2 concentrations measured at experiment start 19:15 GMT, to continue every 4 hours	All dead; nothing preserved. Respiration measurements only data stored.
28/11/2014 16:24	45	6	-55.23642	-41.23273	**Incubation CL_INC2b (*E. triacantha*)**	Incubated at same time as above but terminated early to free up bottles for midnight MOCNESS Terminated bottles (Z1-Z4 and CL5-CL8) determined by death, size of animal, slowdown in decrease in O2 Terminated 09:30 GMT	Water poured off each sample into 3 x 15 mL blue capped vials for NH4 analysis, taped together and labelled, frozen at -80 C Individuals frozen in individual Eppendorfs for elemental analysis, stored at -80 C
29/11/2014 06:07	57	6	-55.19892	-41.29452	**Incubation CL_INC3 (*E. triacantha*)**	Incubation of 1 *E. triacantha* per bottle: Z1-Z4 and CL5-CL8 to run alongside ongoing CL_INC2a First measurements taken 10:00 GMT	Remaining living specimens preserved: Z1, Z2, Z3, CL7 (latter compromised by air bubble). - Animals frozen in single Eppendorfs at -80 C for elemental analysis - Water frozen in sets of 3 15 mL test tubes for NH4 analysis, stored at -80 C
29/11/2014 06:07	57	6	-55.19892	-41.29452	**FP filtration**	Filtration of FPs from bottles containing residual samples from MOCNESS buckets (01.12.14)	Faecal material from *E. triacantha* individuals picked from MOCNESS nets and stored in FSW for FP production: - Individuals frozen in Eppendorfs at -80 C - FP material filtered onto 47 mm ashed GF/F filter and stored at -20 C

13/12/2014 19:05	150	12 (P3)	-52.75598	-40.25841	**E. triacantha incubation: CL_INC7**	1 triacantha per bottle (P1-3, Z2-4, CL1-3, CL5-7) plus controls (P4, Z1, CL4, CL8) Taking respiration readings as often as possible for 3-4 hours before termination.	Experiment terminated after 6 hours immediately after final reading): - 3 15 ml vials filled with 12 ml water for NH4 analysis - remaining water filtered down over 47 mm ashed GF/F filter, catching animal in slotted spoon - animals frozen in individual Eppendorfs - faecal matter retained on filter and left to air dry in fume hood for 24 hours before storage for CHN analysis
14/12/2014 02:39	157	12 (P3)	-52.74735	-40.26299	**E. triacantha incubation: CL_INC8**	1 triacantha per bottle (P1-3, Z1-3, CL1-3, CL5-7) plus controls (P4, Z4, CL4, CL8) Taking respiration readings as often as possible for 3-4 hours before termination.	Experiment terminated after 4 hours (immediately after final reading): - 3 15 ml vials filled with 12 ml water for NH4 analysis - remaining water filtered down over 47 mm ashed GF/F filter, catching animal in slotted spoon - animals frozen in individual Eppendorfs - faecal matter retained on filter and left to air dry in fume hood for 24 hours before storage for CHN analysis
14/12/2014 13:07	162	13 (Upwelling)	-52.61696	-39.28492	**E. triacantha incubation: CL_INC9**	1 triacantha per bottle (P1-3, Z1-3, CL1-3, CL5-7) plus controls (P4, Z4, CL4, CL8) Taking respiration readings as often as possible for 3-4 hours before termination.	Experiment terminated after 5.45 hours immediately after final reading): - 3 15 ml vials filled with 12 ml water for NH4 analysis - remaining water filtered down over 47 mm ashed GF/F filter, catching animal in slotted spoon - animals frozen in individual Eppendorfs - faecal matter retained on filter and left to air dry in fume hood for 24 hours before storage for CHN analysis

NB: technical faults resulted in a number of failed deployments and prevented the planned suite of hauls being deployed.

7.6.3.2 Materials and methods

7.6.3.2.1 Respiration incubations

For the incubations, two temperatures were selected to simulate the temperature of above the thermocline (~3 °C) and the temperature below (~1 °C). Temperatures were maintained using, respectively, the ambient temperature of the cold room (generally set at 4 °C to maintain the water bath at a temperature of 3.3 °C) and a purpose-built incubator (Spartel Temperature Gradient Incubator, with a C-400 circulator unit at one end and FC-500 in-line cooler at the other end.

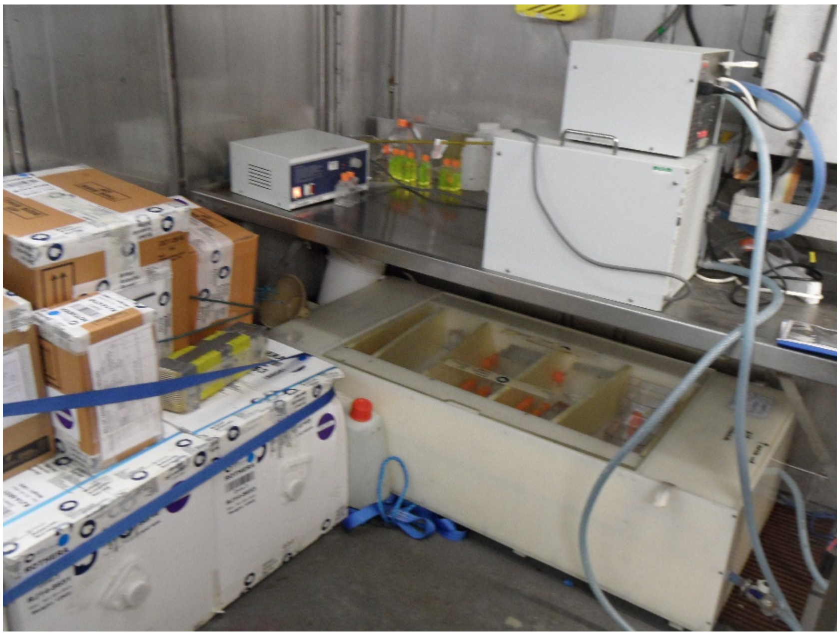


Figure 7-18: Setup of incubator in cool specimen room

Temperature controls at each end were set at ~-2.5 °C to achieve an internal temperature of ~1.1 °C[1] (see Figure 7-18).

Respiration rates were determined by oxygen (O_2) consumption as measured using a Fibox 4 Fiber optic oxygen transmitter with temperature sensor Pt100 (PreSens, Precision Sensing GmbH, Germany). A full description of the equipment, and operating instructions, can be found at L:\X_other_work_areas\Geraint\FIBOX manual\IM_FB4-FB4trace_dv1.pdf. Briefly, O_2 concentrations were determined by holding a polymer optical fiber against a sensor spot, previously adhered to the inside of the sample bottle using silicone adhesive, whilst the Pt100 temperature sensor was immersed in a temperature control bottle (see Figure 7-19). Each sensor spot was pre-calibrated by the manufacturers, and calibration details were loaded onto the Fibox 4 device by scanning a complimentary barcode. Once scanned, sensor spots were given a unique ID and stored in the device. When taking measurements, sensor spots could either be selected by re-scanning the relevant barcode, or by selecting the unique ID. For this series of experiments, the latter was deemed to be the quickest and most convenient method.

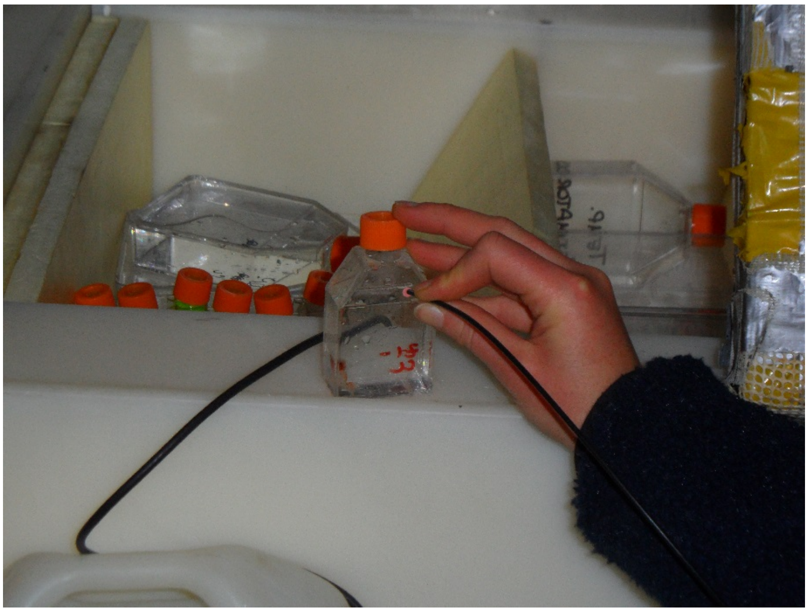


Figure 7-19: Sensor spot being scanned by fiber optic optode

60 ml polystyrene bottles were filled with filtered seawater (FSW) and placed in the water bath or incubator to acclimate to the required incubation temperature at least one hour, preferably longer, before each incubation. A top-up bottle of FSW was also acclimated to each temperature to

[1] Throughout the cruise, problems occurred with the temperature of both the cold room and the incubator, resulting in significant fluctuations in temperature during the course of incubations. The source of the fluctuations is unknown; however, it is possible that problems with the cold room may be arising due to only one of the two cooling units in the cold room being operational. For subsequent years, the possibility of using fridges with set temperatures is being investigated.

top bottles up to eliminate air bubbles once individuals had been incubated. Finally, a 60 ml temperature control bottle was filled with FSW and placed at its respective temperature.

To set up incubations, specimens were gently transferred from the MOCNESS bucket to a separate container of FSW, for washing prior to incubating. Healthy looking individuals were subsequently transferred to incubations bottles: one per bottle in the case of euphausiids; a mixture of one and two per bottle for *R. gigas* (see Figure 7-20). Bottles were topped up, replaced in their respective temperatures and a T0 O_2 concentration was taken. Subsequent readings were taken approximately every four hours.

Figure 7-20: Transfer of specimens from washing jug to incubation bottles

Upon termination of the incubations, samples containing dead animals were discarded. From samples containing live animals, water from each bottle was decanted into 15 ml tubes for later ammonia analysis and frozen at -80 °C. Specimens were transferred to individual Eppendorf vials and frozen at -80 °C.

With the exceptions of CL_INC1, CL_INC2a and b and CL_INC3, the remaining water was filtered onto to an ashed GF/F filter over a slotted spoon in which to collect the specimen, to collect faecal material from the sample bottle (see Figure 7). The spoon and bottle were rinsed with MilliQ, as was the filtration cup. Once filtered, the filters were left in the fume cupboard to air dry for 24 hours before being boxed up and stored at -20 °C before transport home.

Data from each incubation experiment was initially collected under an individual on the Fibox 4 device. It was then exported from the device to the accompanying PreSens Data Manager software in a .csv file which was converted to .xlsx for subsequent analysis. Data was also backed up onto external hard drive and USB storage.

7.6.3.2.2 Depth-stratified zooplankton distribution

Samples were preserved in 10 % borax buffered formalin once pickers had finished with the buckets and removed organisms had been recorded. Sub-samples will be analysed for zooplankton composition once preserved cargo returns to BAS labs.

7.6.3.2.3 Faecal pellet production experiment

13 *E. superba* were harvested from MOCNESS Bucket 1 (E024) and placed in a large plastic container filled with FSW and a large air pocket (see Figure 7-22). It was attempted to separate the specimens from the faecal material accumulating at the bottom via a weighted grille at the bottom of the container; however, the animals still managed to get underneath.

Upon termination of the experiment, the animals were preserved in individual Eppendorfs and frozen at -80 °C for future analysis at BAS labs. Faecal pellets were pipetted into 15 ml centrifuge tubes, topped up with FSW and fixed with 1 ml 10 % formalin over five consecutive days. Samples were then stored in the chemical store for future analysis at BAS labs.

Figure 7-21: Filtering down residual sample water and collection of specimen for freezing

7.6.3.3 Sample preservation and storage

7.6.3.3.1 Respiration incubations

Samples were labelled and stored in the -80 °C freezer until arrival back at BAS labs.

7.6.3.3.2 Depth-stratified zooplankton distribution

Formalin-preserved samples were labelled and stored in the chemical cupboard until arrival back at BAS labs.

7.6.3.3.3 Faecal pellet production experiment

Animals were labelled and stored in the -80 °C freezer and formalin-fixed samples of faecal material were labelled and stored in the chemical cupboard until arrival back at BAS labs.

Figure 7-22: E. superba faecal pellet production experiment

7.6.4 RMT 8 net samples

7.6.4.1 Scientific purpose

Samples from RMT 8 deployments during the Western Core Box (WCB) survey (see Figure 7-23) were used for two purposes:

- To collect *E. superba* FPs from target fishing deployments for incubation and degradation experiments in water samples from CTD bottles fired at 300 m and 1,000 m, to capture differences in FP degradation over time under different water and bacterial characteristics

NB: Allied to this is the collection of sub-samples of the same CTD water for bacterial analysis (detailed in CTD section below).

- To collect *E. triacantha* specimens for respiration incubations from station deployments, from day- and night-time hauls, to gather more respiration data and to capture any variability in diel respiration rates or production of faecal matter, thus providing insight into feeding activity during the diel cycle.

Figure 7-23: Helping deploy the RMT 8 net during the Western Core Box Survey

Details of samples taken from each RMT 8 net and storage information are summarised in Table 7-13 below.

Table 7-13: RMT 8 net samples taken for respiration and FP incubation experiments

Date/ time (GMT)	Event ID(s)	Station	Latitude	Longitude	Summary	Experiment/ activity description	Sample preservation and storage description	Other notes
20:06:00 07/12/2014 23:55:00 08/12/2014	81 90	WCB Shallow Mooring WCB/1.2N	-53.78999 -53.49304	-37.95018 -39.25407	**FP fixation**	7.12.14: *E. superba* FPs taken from RMT 8 sample. Prepared for 1,000 m CTD water for degradation analysis by storage in FSW and incubation in cold room. 8.12.14: FSW decanted and topped up with 1,000 m CTD water. 9.12.14 (GMT): First day fixed with 1 ml 10 % formalin.	Taped together and stored in chemical store 1	CTD sub-sample stored in -80 C freezer.
20:06:00 07/12/2014 23:55:00 08/12/2014	81 90	WCB Shallow Mooring WCB/1.2N	-53.78999 -53.49304	-37.95018 -39.25407	**FP fixation**	7.12.14: *E. superba* FPs taken from RMT 8 sample. Prepared for 300 m CTD water for degradation analysis by storage in FSW and incubation in cold room. 8.12.14: FSW decanted and topped up with 300 m CTD water. 9.12.14 (GMT): First day fixed with 1 ml 10 % formalin.	Taped together and stored in chemical store 1	CTD sub-sample stored in -80 C freezer.
08/12/2014	88	WCB/ T1.2S	-53.48811	-39.20270	**E. triacantha incubation: CL_INC4**	1 *E. triacantha* per bottle (P1-3, Z1-3, CL1-3, CL5-7) plus controls (P4, Z4, CL4, CL8) Taking respiration readings as often as possible for 3-4 hours before termination and repeat with remaining samples from same net following gut evacuation for 24 hours.	Experiment terminated after 4 hours (half an hour after final reading): - 3 15 ml vials filled with 12 ml water for NH4 analysis (frozen at -80 °C) - remaining water filtered down over 47 mm ashed GF/F filter, catching animal in slotted spoon - animals frozen in individual Eppendorfs (-80 °C) - faecal matter retained on filter and left to air dry in fume hood for 24	Intention to repeat experiment with remaining specimens after 24 hr gut evacuation failed as animals died (same for following incubations)

							hours; storage at -20 C until transport home for CHN analysis	
01:23:00 10/12/2014 05:34:00 10/12/2014	102 105	WCB 2.2S WCB/ 2.2N	-53.76466 -53.43204	-38.58835 -38.69492	**FP fixation**	10.12.14: *E. superba* FPs taken from RMT 8 sample (ID 102). Topped up with 1,000 m CTD water (ID 105). First day fixed with 1 ml 10 % formalin.	Taped together and stored in chemical store 1	CTD sub-sample stored in -80 C freezer.
01:23:00 10/12/2014 05:34:00 10/12/2014	102 105	WCB 2.2S WCB/ 2.2N	-53.76466 -53.43204	-38.58835 -38.69492	**FP fixation**	10.12.14: *E. superba* FPs taken from RMT 8 sample (ID 102). Topped up with 1,000 m CTD water (ID 105). First day fixed with 1 ml 10 % formalin.	Taped together and stored in chemical store 1	CTD sub-sample stored in -80 C freezer.
10/12/2014	113	WCB 3.2	-53.36688	-38.13716	**E. triacantha incubation: CL_INC5**	1 *E. triacantha* per bottle (P1-3, Z1-3, CL1-3, CL5-7) plus controls (P4, Z4, CL4, CL8) Taking respiration readings as often as possible for 3-4 hours before termination and repeat with remaining samples from same net following gut evacuation for 24 hours.	Experiment terminated after 6.5 hours immediately after final reading): - 3 15 ml vials filled with 12 ml water for NH_4 analysis (frozen at -80 °C) - remaining water filtered down over 47 mm ashed GF/F filter, catching animal in slotted spoon - animals frozen in individual Eppendorfs (-80 °C) - faecal matter retained	

							on filter and left to air dry in fume hood for 24 hours; storage at -20 C until transport home for CHN analysis	
22:16:00 10/12/2014 11/12/2014 20:23:00	115 131	WCB 3.2N WCB 4.2	-53.36127 -53.84489	-38.08295 -37.93716	**FP fixation**	<u>12.12.14</u>: *E. superba* FPs taken from RMT 8 sample (ID 131). Topped up with 1,000 m CTD water (ID 115). First day fixed with 1 ml 10 % formalin.	Taped together and stored in chemical store 1	CTD sub-sample stored in -80 C freezer.
22:16:00 10/12/2014 11/12/2014 20:23:00	115 131	WCB 3.2N WCB 4.2	-53.36127 -53.84489	-38.08295 -37.93716	**FP fixation**	<u>12.12.14</u>: *E. superba* FPs taken from RMT 8 sample (ID 131). Topped up with 300 m CTD water (ID 115). First day fixed with 1 ml 10 % formalin.	Taped together and stored in chemical store 1	CTD sub-sample stored in -80 C freezer.
12/12/2014	133	WCB 4.2	-53.45155	-38.64539	**E. triacantha incubation: CL_INC6**	1 *E. triacantha* per bottle (P1-3, Z1-3, CL1-3, CL5-7) plus controls (P4, Z4, CL4, CL8) Taking respiration readings as often as possible for 3-4 hours before termination and repeat with remaining samples from same net following gut evacuation for 24 hours.	Experiment terminated after 4 hours immediately after final reading): - 3 15 ml vials filled with 12 ml water for NH4 analysis (frozen at -80 °C) - remaining water filtered down over 47 mm ashed GF/F filter, catching animal in slotted spoon - animals frozen in individual Eppendorfs (-80 °C) - faecal matter retained	Animals not in best condition at time of incubation but best/ most active ones selected for experiment. However, one dead specimen replaced between set-up and first measurement. Some labels on NH4 tubes (Ps and Zs) incorrectly labelled ID 113 instead of ID 133 -

							on filter and left to air dry in fume hood for 24 hours; storage at -20 C until transport home for CHN analysis	caps are correct however. P2 samples frozen although appeared to have died in between last measurement and filtering.

7.6.4.2 Materials and methods

7.6.4.2.1 Faecal pellet degradation experiments

Full details of the FP degradation experiments are given in the below CTD section, were it corresponds to the sub-samples collected from the same bottles.

7.6.4.2.2 Respiration incubations

Respiration incubations were undertaken as described in the earlier MOCNESS section. The only difference was that water from all incubations and sample bottles (excluding those which contained dead specimens) was filtered down to collect faecal material.

7.6.4.3 Sample preservation and storage

7.6.4.3.1 Faecal pellet degradation experiments

Centrifuge tubes containing the faecal pellets, once fixed with 10 % formalin, were taped together and placed in a labelled bag in Chemical store 1, for transport back to BAS labs for later analysis.

7.6.4.3.2 Respiration incubations

Products of respiration experiments were stored as follows:

- Water decanted into centrifuge tubes for ammonia analysis were taped together, bagged up and stored immediately at -80 °C
- Specimens were collected during filtration and immediately transferred to a labelled Eppendorf and frozen at -80 °C
- Filters containing residual faecal matter and other detritus were air dried for 24 hours in the fume cupboard (see Figure 7-24), then boxed up and stored at -20 °C before transport back to BAS labs for elemental analysis.

Figure 7-24: Filters air-drying in fume hood

7.6.5 CTD water samples

7.6.5.1 Scientific purpose

Water from the CTD was collected for two main purposes:

- Faecal pellet vertical distribution and flux: water samples from up to six depths collected from day- and night-time deployments to obtain a depth-stratified distribution and condition of faecal material in the water column, insight into its diel variability, and insight into active vertical flux. The protocol followed was modified from (Dagg et al., 2014).
- Faecal pellet degradation in different water masses: water collected from 300 m and 1,000 m used to incubate faecal material harvested from *E. superba* caught in RMT 8 net hauls for degradation experiments.

All CTD deployments and descriptions of sample fates are summarised in Table 7-14.

Table 7-14: CTD water samples taken for vertical profiles and faecal pellet degradation experiments

Date/ time GMT	Event ID	Station	Activity	Depth deployed	Depths bottles fired at	Notes
25/11/2014 18:12	14	Ice	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
26/11/2014 16:55	32	Ice	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
29/11/2014 03:04	54	6	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
09/12/2014 00:17	90	WCB/1.2N	**CTD vertical profile + water for FPs**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, **300m**	400 m sample missed so replaced with 300 m collecting water for FP experiments in 1 L Nalgene bottle as filtered).
09/12/2014 07:48	94	WCB/1.2S	**CTD vertical profile**	200 m	4 CTD bottles taken: 5m, 20m, 40m, 100m	
09/12/2014 22:07	101	WCB 2.2S	**CTD vertical profile**	200 m	4 CTD bottles taken: 5m, 20m, 40m, 100m	
10/12/2014 05:55	105	WCB/ 2.2N	**CTD vertical profile + water for FPs**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
10/12/2014 22:38	115	WCB 3.2N	**CTD vertical profile + water for FPs**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
11/12/2014 06:20	119	WCB/ 3.2S	**CTD vertical profile**	125 m	4 CTD bottles taken: 5m, 20m, 40m, 100m	
13/12/2014 14:12	147	P3	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
13/12/2014	154	P3	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	
14/12/2014	158	Upwelling	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	5 m fired at 4 m; 200 m discarded as Niskin leaked on ascent
14/12/2014	163	Upwelling	**CTD vertical profile**	1,000 m	6 CTD bottles taken: 5m, 20m, 40m, 100m, 200m, 400m	

7.6.5.2 Materials and methods

7.6.5.2.1 Faecal pellet vertical distribution and flux

Water was collected in 12 L Niskin bottles from 1,000 m CTD deployments at time stations and deep- and shallow-water deployments during the Western Core Box (WCB) transects. At time station and deep water deployments, bottles were fired at 5 m, 20 m, 40 m, 100 m, 200 m and 400 m (with the exception of E090 in which 300 m was collected instead of 400 m). At shallower deployments, bottles were fired up to 200 m or shallower, depending on the depth of the shelf.

Water was gently siphoned off from the Niskin bottles via a rinsed piece of tubing into 20 L carboys (see Figure 7-25). To ensure collection of all possible faecal material, the bottoms of the bottles were opened and thoroughly rinsed out with FSW and the water collected in separate 250 ml Nalgene bottles.

Figure 7-25: Set-up of siphoning system to decant CTD water from carboys to filter

The contents of the carboys and Nalgene bottles was then gently filtered through a 53 µm mesh and bottles rinsed through with FSW. The contents of each filter was then backwashed into a 250 ml Nalgene bottle using a 5 % formalin-seawater solution.

Bottles were stored for further analysis back at BAS labs.

7.6.5.2.2 Faecal pellet degradation under different water mass characteristics

Fresh faecal pellets (FPs) were harvested from *E. superba* specimens collected from RMT 8 net hauls during the WCB and were topped up with CTD water collected in 1 L or 500 ml Nalgene bottles from 300 m and 1,000 m depths. For the first experiment (E081, E090) FPs were kept in FSW for a day before the water from the first CTD was obtained. For the third experiment (E115, E131) FPs were harvested the day following CTD water collection and water was kept in the dark in the cold room until incubation.

FPs were fixed with 1 ml of 10 % formalin every day at approximately the same time, for a period of five consecutive days. At the end of the experiment, bottles were placed in a labelled bag and stored in the chemical store until transport back to BAS labs.

A sub-sample of water from the 300 m and 1,000 m Niskin bottles was collected in a 15 ml centrifuge tube for bacterial analysis and stored immediately at -80 C. With the exception of the first experiment (E081, E090), for which the sub-samples were taken from the Nalgene bottles, sub-samples were taken directly from the Niskin.

7.6.5.3 Sample preservation and storage

7.6.5.3.1 Faecal pellet vertical distribution and flux

Formalin-preserved samples were labelled and stored in the chemical cupboard until arrival back at BAS labs.

7.6.5.3.2 Faecal pellet degradation under different water mass characteristics

Formalin-preserved samples were labelled and stored in the chemical cupboard until arrival back at BAS labs. The sub-samples were stored in a labelled bag in the -80 °C freezer until arrival back at BAS labs for analysis.

7.6.6 References

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7.7 Shell chemistry of thecosome pteropods

Sebastian Flöter , GEOMAR - Helmholtz-Centre for Ocean Research Kiel, Research Division: Marine Biogeochemistry

7.7.1 Introduction

The following investigation was done within the frame of my PhD thesis at the GEOMAR under supervision of Prof. Anton Eisenhauer, Prof. Marcus Kienast (Dalhousie University, Halifax) and Dr. Marcus Gutjahr and in cooperation with Dr. Clara Manno from BAS who provided this great opportunity.

Thecosome pteropods build up shells of aragonite, which are susceptible to ocean acidification because of its higher solubility compared with calcite (e.g. Berger 1978, Lalli & Gilmer 1989). This feature may become critical during decreasing pH of the pteropod surrounding water by ocean acidification since calcification may no longer be possible under aragonite undersaturation (e.g. Bednarsek et al. 2012, 2014). Since the well-being of these organisms is likely pH depend (e.g. Lischka & Riebesell 2012, Manno et al. 2012) they might be used as a proxy for ocean acidification in recent and past times. In order to use pteropod shells as a proxy for seawater chemistry it is important to first understand their ecology and quantify elemental and isotopic trends of these thecosome pteropods during biomineralization in response to changing ambient seawater aragonite saturation states.

The aim of this cruise was therefore to collect thecosome pteropods as well as water samples at the same location to analyse its water chemistry to assess if and to which degree environmental factors (e.g. Temperature, Salinity, pH) are stored in their shells.

7.7.2 The collected shells will be used for the following measurements:

Laser ablation –Inductively Coupled Plasma Mass Spectrometry (LA-ICPMS) and Electron Micro Probe (EMP) to study how salinity and temperature changes during pteropod growth are stored in their shells. These parameters likely influence the partitioning coefficient for several elements in the shell (e.g. Hirabayashi et al. 2013, Dawber & Tripati 2012, Shirai et al. 2008) in conjunction with seawater carbonate chemistry (e.g. Allen & Hönisch 2012, Russel et al. 2004).

Boron isotopic composition ($\delta^{11}B$) in shells for pH reconstruction (e.g. Rae et al. 2011, Foster 2008) measured by LA-MC-ICPMS and solution-based MC-ICP-MS. Boron isotopes in marine calcifiers are an established tracer for ambient seawater pH since only borate ion is incorporated in carbonate shells during the mineralization process. Equilibrium pH-dependant isotopic fractionation between borate ion and boric acid in seawater makes boron isotopes in carbonates a powerful recorder of ambient ocean pH (e.g. Zeebe 2005). The quantification of possible vital effects in thecosome pteropod aragonite will be one key goal of this study (e.g. Weiner & Dove 2003, Hönisch 2004, Pagani et al. 2005)

$\delta^{18}O$ and $\delta^{13}C$ measurements by SIMS in pteropod shells for determination of their life span . The growth duration of the shell might be reconstructed by seasonal salinity and temperature variations which influence $\delta^{18}O$ composition of the aragonitic shell as well as by $\delta^{13}C$ as observed by Juranek et. al 2003. These variations might be influenced by the carbonate chemistry of the water or season-dependent changes in metabolic processes in thecosome pteropods.

$\delta^{15}N$ in shell organic matter to reconstruct trophic level (Koppelmann et al. 2013) measured with GC-MS.

7.7.3 Methods

During the cruise thecosome pteropods were sampled with Bongo net and MOCNESS catches (Table 1). In addition to the plankton samples water samples for $\delta^{15}N$ and main element concentrations (e.g. Mg, Sr, Ca) were taken. Thecosome pteropods were picked under a light microscope, washed in distilled water, and stored dry in slides on card board or in petri dishes. The underway system and CTD sampling rosette was used for sampling of seawater. The seawater was filtered with a vacuum pump system through burned glass fibre filters and acidified with concentrated HCl (trace analysis grade) for elemental analysis (100 ml underway or 5 m depth CTD sample water + 4 ml HCl). The $\delta^{15}N$ depth profile samples (~100 ml) from 5, 40, 100, 200 and 500 m depth collected by Niskin bottles were not acidified. After processing the samples (Table 1) they were stored frozen in a -20°C storage room.

Table 7-15: Samples taken during JR 304. (+ sample taken; - no sample taken), EC (samples for analysis of elemental composition of seawater), δ15N (samples for analysis of δ15N of nitrate in seawater).

Datum	Event number	Bongo (B) /MOCNESS (M)	Species	Abundance	EC	$\delta^{15}N$
17.11.14	001 & 002	B	*Limacina retroversa & L. helicina*	~130	-	-
19.11.14	006	B	*L. retroversa*	40	+	-
25.11.14		-	-	-	+	+
26.11.14	024	M	*L. helicina*	9	+	-
27.11.14	038	B	*L. helicina*	9	+	-
28.11.14	040, 047 & 045	B & M	*L. helicina*	~200	+	+
29.11.14	053	B	*L. helicina*	10	+	-
3.12.14	076	B	*L. helicina*	1	+	-
10.12.14	103, 104 & 114	B	*L. helicina*	10	+	-
13.12.14	146 & 152	B	*L. retroversa & Clio pyramidata*	40, 2	+	+
14.12.14	159, 160, 164, 165	B	*L. retroversa & C. pyramidata*	~100, 1	+	+
15.12.14	170	B	*L. retroversa*	~150	-	-
16.12.14	174	B	*L. retroversa*	~200	-	-

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7.8 Foraminifera collection and CTD water sampling: investigating the use of foraminiferal oxygen isotopes for reconstructing seasonality in the Southern Ocean (cgs 95)

Vicky Peck, British Antarctic Survey; Anna Mikis, School of Earth and Ocean Sciences, Cardiff University

7.8.1 Introduction

The oxygen isotope ratio ($\delta^{18}O$) of foraminiferal calcite records the $\delta^{18}O$ of seawater and the temperature of the seawater in which the foraminifera calcified. As part of a PhD project single specimen foraminiferal $\delta^{18}O$ analysis is used to investigate changes in growing conditions on seasonal timescales. As seawater temperatures have a greatly reduced seasonal variation around the Southern Ocean, individual foraminiferal $\delta^{18}O$ most likely reflects seawater $\delta^{18}O$ variability. In the open ocean areas of the Southern Ocean this seasonal variability of seawater is most likely driven by variations in the source waters of the intermediate water mass, the Subantarctic Mode Water (Meredith et al., 1999). Foraminiferal $\delta^{13}C$ is also sensitive to variations in water masses and to changing productivity which can be promoted by upwelling, glacially derived nutrients and/or meltwater stratification.

The aim for the cruise was to calibrate modern single specimen foraminiferal $\delta^{18}O$ and $\delta^{13}C$ to a range of oceanic parameters. To achieve this co-located foraminifera, seawater and particulate organic carbon (POC) samples were collected during the course of the cruise. The samples will be analysed for their stable isotope signatures after their arrival to the UK. The foraminiferal $\delta^{18}O$ values will be compared to those expected from seawater values and temperatures from CTD depth transects, while the foraminiferal $\delta^{13}C$ values will be compared to $\delta^{13}C$ values of seawater dissolved inorganic carbon (DIC) and $\delta^{13}C_{POC}$. It is envisaged that these analyses will provide us with comprehensive information on the relationship between foraminiferal shell and seawater geochemistry.

7.8.2 Foraminifera collection with the Bongo net

A motion compensated Bongo net with a 100µm and a 200µm mesh was used to collect live foraminifera specimens from a maximum depth of 200 m. Specimens were picked only after live pterapods were removed from the collected water samples. Specimens were rinsed in deionised water, air dried in specimen slides and transported back to Cardiff University for cleaning and analysis.

Table 7-16: Foraminifera collection from Bongo nets. AM: Anna Mikis, VLP: Vicky Peck

Time	Bridge event number	Net mesh size microns	Number picked	Picked by	Fate of sample
14/12/2014 15:57	168	100	<100	AM	Air dried
14/12/2014 08:46	160	100	>100	AM	Air dried
14/12/2014 08:27	159	100	<100	AM	Air dried
13/12/2014 06:26	139	100	>100	AM	Air dried
10/12/2014 04:54	104	200	<20	VLP	Air dried
10/12/2014 04:54	104	100	<20	VLP	Air dried
08/12/2014 23:12	89	100	31	AM	Air dried
04/12/2014 21:56	80	100	8	AM/ VLP	Air dried
03/12/2014 15:54	76		>50	VLP	Air dried
03/12/2014 15:38	75		>50	AM	Air dried
29/11/2014 15:29	66	100	>100	AM	Air dried
29/11/2014 15:17	65	100	>100	Am	Air dried
29/11/2014 09:20	60	100		VLP	Air dried
29/11/2014 09:05	59	100		VLP	Air dried
29/11/2014 01:54	53	100		AM	Air dried
28/11/2014 19:44	48	100		AM	Air dried
28/11/2014 19:29	47	100		AM	Air dried
28/11/2014 08:23	40	100	>100	VLP	Air dried
27/11/2014 13:10	38	100		AM	Air dried
26/11/2014 14:52	30	100		AM	Air dried
26/11/2014 14:40	29	100		AM	Air dried
25/11/2014 19:28	18	100	~ 3	AM	Air dried
25/11/2014 19:13	17	100	~25	AM	Air dried
25/11/2014 15:53	12	100	~ 6	AM	Air dried
25/11/2014 15:49	11	100	~ 40	AM	Air dried
19/11/2014 11:24	6	100	~ 50	AM	Air dried
18/11/2014 16:21	4	100	~ 100	AM	Air dried
17/11/2014 18:38	1	200		AM	Air dried

7.8.3 Seawater sampling from CTD Niskin bottles

Seawater sampling took place during routine CTD deployments. Samples were collected in 12 L Niskin bottles which were fired at predetermined depths that covered the depth range of the Bongo nets with an additional sample at 500 m water depth. After recovery samples for $\delta^{18}O$ analysis were collected first to prevent any gas exchange. This was followed by the collection of samples for $\delta^{13}C_{POC}$, TA/DIC, $\delta^{13}C_{DIC}$ and nutrient analysis. A list of all CTD water samples can be found in the Table 7-17

Figure 7-26: Pre- (red) and post (white) gametogenesis specimens of Neogloboquadrina pachyderma sinistral. Pteropod veligers also shown. Scale bar 200 µm. Anna collecting water samples from Niskin bottles. Photos Vicky Peck and Jon Watkins.

The following guidelines were followed during the collection of seawater samples:

7.8.3.1 δ¹⁸O of seawater:

- Prior to first use, the Tygon tube is soaked in filtered sea water for at least one day to prevent bubble formation.
- Place tygon tubing over the Niskin outlet valve.
- Run a small volume of water through the tube to remove air and check there are no bubbles in the tube (tap the tube to remove any bubbles that form).
- Rinse the 30 ml nalgene bottle a few times with seawater.
- Fill the bottle with the seawater from the Niskin and allow to overflow three times (do thisby timing how long it takes to fill it up – then count again three times.
- Cap bottle and wrap parafilm around the lid.
- Label the bottle.
- Store at ambient temperature until shipped to laboratory.

7.8.3.2 $\delta^{13}C_{POC}$ (Henley et al., 2012):

- Seawater is filtered through muffle-furnaced 47 mm diameter GF/F filters, of pore size 0.7µm (or 0.22 µm), within two hours of collection.
- Place the combusted GF/F filter in filter housing using forceps rinsed in ethanol.
- Using the vacuum pump, filter through 4 L of seawater. Record the total volume of seawater filtered.
- Once the water is filtered through rinse the filter cup with DI water (do not include this in the filtered volume recorded).
- Carefully remove the filter from the housing, and fold twice.
- Place the folded filter into combusted (preferably) foil and fold loosely.

- Allow the filter to dry.
- Seal the foil tightly, and place in a plastic bag for storage.
- Freeze at -20°C.

7.8.3.3 TA/DIC (Bockmon and Dickson, 2014):

- Samples must be collected as soon as possible (at least within 10 minutes after the Niskin bottles have been opened on deck) to prevent gas exchange!
- Rinse the 250 mL borosilicate bottle twice with 30-50 mL of seawater from the Niskin bottle.
- Fill the bottle using Tygon tubing from the bottom overflow of the Niskin bottle, leave it to overflow at least once to remove all bubbles from the bottle. If some still remains, tap the sides of the bottle and keep overfilling until all bubble are removed.
- Place in the stopper to displace an appropriate volume of water for the lid.
- With a pipette remove another 2.5 mL water from the bottle to allow 1% headspace.
- Poison the sample with 50 µL saturated mercuric chloride solution (7g/100 mL in DI water, if this clogs the pipette, use 100 µL 50% saturated solution.
- Wipe off water from the inside neck of the bottle and the stopper.
- Grease the top of the stopper with Apiezon L grease; make sure that you the grease is not introduced into the sample. Top the bottle with the stopper and twist the stopper to squeeze air out of the grease.
- Seal the bottle with electrical tape and label.
- Shake well to homogenise the mercuric chloride.
- Store in a cool dark place with foam inserts.

7.8.3.4 $\delta^{13}C_{DIC}$ (NERC Isotope Geosciences Laboratory):

Total dissolved inorganic carbon in a water sample is precipitated as $BaCO_3$ by addition of a solution of barium chloride and sodium hydroxide. CO_2 generated by reaction of the $BaCO_3$ with phosphoric acid is analysed for its $\delta^{13}C$ ratio by mass spectrometry.

Preparation of alkaline barium chloride solution:

- Make up a c. 1 Molar (2 Normal) solution of alkaline $BaCl_2$ by adding 244g $BaCl_2.2H_2O$ and 35g NaOH pellets to c. 700ml deionised water in a clear glass bottle, making volume up to 1 litre, and stirring to dissolve.
- Minimise contact with air (i.e. cap the bottle whilst mixing – though note that the solution may generate some heat, so loosen the cap initially to release air pressure).
- Allow the bottle to stand, firmly capped, for several days to allow any $BaCO_3$ to settle.
- For use in the field, gently decant the clear solution into small bottles (which will minimise the number of times a bottle is opened). E.g. a 50 ml bottle will contain enough for 3 samples.
- Alternatively, 15 ml aliquots into sealed, pre-scored 20 ml glass ampoules (serving one sample each) are useful for long-term storage. Containers should be marked toxic and corrosive.

Sample collection:

- 100 ml of water should suffice for waters in carbonate terrain. If the precipitation and filtration of barium carbonate can be done within a few days, soft plastic (e.g. LDPE) bottles may be used. For longer-term storage, where the bottle's permeability to CO_2 may be an issue, HDPE or ideally glass bottles should be used. A mark showing the position of 15 ml below brim-full will aid in adding the barium chloride.

Sample collection and addition of alkaline barium chloride:

- If the water is likely to contain particulate carbonate, this must be removed by filtering before sample collection.
- Fill the bottle with as little headspace as possible, and cap tightly. As soon as practical thereafter, pour off about 15 ml of sample, and add 15 ml of barium chloride (the amount need only be approximate). Cap tightly, and mix. Allow the bottle to stand for at least 24 hours, before recovering the barium carbonate.

Recovery of barium carbonate:

- Unless gravimetric determination is sought, clear supernatant liquid can be gently poured off and discarded (loss of some $BaCO_3$ will not affect $\delta^{13}C$ determination).
- Wash out the remainder with de-ionised water through a 0.45 micron membrane filter made of nylon (ideally not cellulose nitrate), and then pass 5 or 6 washings of de-ionised water through the filtrate.
- We have found the Nalgene filter holder (cat. no. 300-4000) and vacuum pump (cat. no. 6130-0010) with 47 mm nylon filters well suited for field use.
- Contamination will occur if CO_2 comes in contact with the barium chloride.
- Minimise contact with air, and don't breathe over the sample!
- Where suction must be used, avoid prolonged passage of air through the filter, or ideally perform the operation under a CO_2-free atmosphere.
- The recovered $BaCO_3$ must be completely free of any residual barium chloride.
- If necessary, check the final washing with silver nitrate solution (turns cloudy if chloride is present).
- Roll the filter+filtrate into a small glass sample tube, (or wash the filtrate off the filter into a tube), and dry in an oven if possible before dispatch. Keep it at room temperature.

7.8.3.5 Nutrient analysis:

- Water samples are collected from Niskin bottles after dissolved oxygen samples have been removed.
- 60 mL Nalgene bottles are used to collect the samples.
- In high productivity regions water samples are collected into new or pre-acid cleaned 60 mL syringes with 0.45 µm SFCA syringe filters attached to them.
- The syringe barrel and plunger are rinsed three times with sample water before filtering the sample.
- Sample bottles are rinsed three times with approximately 5-10 mL of clean filtrate for each rinse.
- The bottles are then filled about ¾ full (35-40 mL) so that there is room for the sample to expand when frozen.
- If not in high productivity region, rinse the bottle out three times with water from the Niskin bottle.
- Fill up bottle without filtering, leaving headspace to allow for expansion during freezing.
- Label the bottle.
- All samples are stored frozen at -20°C until analysis.

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Table 7-17: Water samples collected from CTD. Fate of samples: A: Stored at cold room until analysis, B: Barium carbonate precipitation, C: Stored at -20°C freezer until analysis, D: Filtration

Time	Bridge event number	Bottle number	Sample ID	Volume sampled	Fate of sample	TA/DIC	$\delta^{18}O$	$\delta^{13}C_{DIC}$	$\delta^{13}C_{POC}$	Nutrients
14/12/2014 14:37	163	24	UW 5 m	4 L	D				✓	
14/12/2014 14:37	163	24	UW 5 m	250 mL	A	✓				
14/12/2014 14:37	163	24	UW 5 m	30 mL	A		✓			
14/12/2014 14:37	163	24	UW 5 m	100 mL	B			✓		
14/12/2014 14:33	163	19	UW 40 m	4 L	D				✓	
14/12/2014 14:33	163	19	UW 40 m	250 mL	A	✓				
14/12/2014 14:33	163	19	UW 40 m	30 mL	A		✓			
14/12/2014 14:33	163	19	UW 40 m	100 mL	B			✓		
14/12/2014 14:31	163	16	UW 60 m	4 L	D				✓	
14/12/2014 14:31	163	16	UW 60 m	250 mL	A	✓				
14/12/2014 14:31	163	16	UW 60 m	30 mL	A		✓			
14/12/2014 14:31	163	16	UW 60 m	100 mL	B			✓		
14/12/2014 14:28	163	12	UW 100 m	4 L	D				✓	
14/12/2014 14:28	163	12	UW 100 m	250 mL	A	✓				
14/12/2014 14:28	163	12	UW 100 m	30 mL	A		✓			
14/12/2014 14:28	163	12	UW 100 m	100 mL	B			✓		
14/12/2014 14:27	163	11	UW 125 m	4 L	D				✓	
14/12/2014 14:27	163	11	UW 125 m	250 mL	A	✓				
14/12/2014 14:27	163	11	UW 125 m	30 mL	A		✓			
14/12/2014 14:27	163	11	UW 125 m	100 mL	B			✓		
14/12/2014 14:25	163	9	UW 200 m	4 L	D				✓	
14/12/2014 14:25	163	9	UW 200 m	250 mL	A	✓				
14/12/2014 14:25	163	9	UW 200 m	30 mL	A		✓			

14/12/2014 14:25	163	9	UW 200 m	100 mL	B			✓		
14/12/2014 14:17	163	5	UW 500 m	4 L	D				✓	
14/12/2014 14:17	163	5	UW 500 m	250 mL	A	✓				
14/12/2014 14:17	163	5	UW 500 m	30 mL	A		✓			
14/12/2014 14:17	163	5	UW 500 m	100 mL	B			✓		
13/12/2014 00:14	134	23	P3 5 m	4 L	D				✓	
13/12/2014 00:14	134	23	P3 5 m	250 mL	A	✓				
13/12/2014 00:14	134	23	P3 5 m	30 mL	A		✓			
13/12/2014 00:14	134	23	P3 5 m	100 mL	B			✓		
13/12/2014 00:14	134	23	P3 5 m	60 mL	C					✓
13/12/2014 00:08	134	19	P3 50 m	4 L	D				✓	
13/12/2014 00:08	134	19	P3 50 m	250 mL	A	✓				
13/12/2014 00:08	134	19	P3 50 m	30 mL	A		✓			
13/12/2014 00:08	134	19	P3 50 m	100 mL	B			✓		
13/12/2014 00:08	134	19	P3 50 m	60 mL	C					✓
13/12/2014 00:06	134	18	P3 60 m	4 L	D				✓	
13/12/2014 00:06	134	18	P3 60 m	250 mL	A	✓				
13/12/2014 00:06	134	18	P3 60 m	30 mL	A		✓			
13/12/2014 00:06	134	18	P3 60 m	100 mL	B			✓		
13/12/2014 00:06	134	18	P3 60 m	60 mL	C					✓
13/12/2014 00:02	134	15	P3 100 m	250 mL	A	✓				
13/12/2014 00:02	134	15	P3 100 m	30 mL	A		✓			
13/12/2014 00:02	134	15	P3 100 m	100 mL	B			✓		
13/12/2014 00:02	134	15	P3 100 m	60 mL	C					✓
13/12/2014 00:02	134	15	P3 100 m	4 L	D				✓	
13/12/2014 00:00	134	14	P3 125 m	250 mL	A	✓				
13/12/2014 00:00	134	14	P3 125 m	30 mL	A		✓			
13/12/2014 00:00	134	14	P3 125 m	100 mL	B			✓		

13/12/2014 00:00	134	14	P3 125 m	60 mL	C					✓
13/12/2014 00:00	134	14	P3 125 m	4 L	D				✓	
12/12/2014 23:55	134	11	P3 175 m	250 mL	A	✓				
12/12/2014 23:55	134	11	P3 175 m	30 mL	A		✓			
12/12/2014 23:55	134	11	P3 175 m	100 mL	B			✓		
12/12/2014 23:55	134	11	P3 175 m	60 mL	C					✓
12/12/2014 23:55	134	11	P3 175 m	4 L	D				✓	
12/12/2014 23:53	134	10	P3 200 m	250 mL	A	✓				
12/12/2014 23:53	134	10	P3 200 m	30 mL	A		✓			
12/12/2014 23:53	134	10	P3 200 m	100 mL	B			✓		
12/12/2014 23:53	134	10	P3 200 m	60 mL	C					✓
12/12/2014 23:53	134	10	P3 200 m	4 L	D				✓	
09/12/2014 08:02	94	13	WCB 5 m	250 mL	A	✓				
09/12/2014 08:02	94	13	WCB 5 m	30 mL	A		✓			
09/12/2014 08:02	94	13	WCB 5 m	100 mL	B			✓		
09/12/2014 08:02	94	13	WCB 5 m	60 mL	C					✓
09/12/2014 08:02	94	13	WCB 5 m	4 L	D				✓	
09/12/2014 08:00	94	10	WCB 20 m	250 mL	A	✓				
09/12/2014 08:00	94	10	WCB 20 m	30 mL	A		✓			
09/12/2014 08:00	94	10	WCB 20 m	100 mL	B			✓		
09/12/2014 08:00	94	10	WCB 20 m	60 mL	C					✓
09/12/2014 08:00	94	10	WCB 20 m	4 L	D				✓	
09/12/2014 07:59	94	9	WCB 40 m	250 mL	A	✓				
09/12/2014 07:59	94	9	WCB 40 m	30 mL	A		✓			
09/12/2014 07:59	94	9	WCB 40 m	100 mL	B			✓		
09/12/2014 07:59	94	9	WCB 40 m	60 mL	C					✓
09/12/2014 07:59	94	9	WCB 40 m	4 L	D				✓	
09/12/2014 07:57	94	7	WCB 60 m	250 mL	A	✓				

09/12/2014 07:57	94	7	WCB 60 m	30 mL	A		✓			
09/12/2014 07:57	94	7	WCB 60 m	100 mL	B			✓		
09/12/2014 07:57	94	7	WCB 60 m	60 mL	C					✓
09/12/2014 07:57	94	7	WCB 60 m	4 L	D				✓	
09/12/2014 07:55	94	5	WCB 100 m	250 mL	A	✓				
09/12/2014 07:55	94	5	WCB 100 m	30 mL	A		✓			
09/12/2014 07:55	94	5	WCB 100 m	100 mL	B			✓		
09/12/2014 07:55	94	5	WCB 100 m	60 mL	C					✓
09/12/2014 07:55	94	5	WCB 100 m	4 L	D				✓	
09/12/2014 07:51	94	2	WCB 150 m	250 mL	A	✓				
09/12/2014 07:51	94	2	WCB 150 m	30 mL	A		✓			
09/12/2014 07:51	94	2	WCB 150 m	100 mL	B			✓		
09/12/2014 07:51	94	2	WCB 150 m	60 mL	C					✓
09/12/2014 07:51	94	2	WCB 150 m	4 L	D				✓	
09/12/2014 07:48	94	1	WCB 200 m	250 mL	A	✓				
09/12/2014 07:48	94	1	WCB 200 m	30 mL	A		✓			
09/12/2014 07:48	94	1	WCB 200 m	100 mL	B			✓		
09/12/2014 07:48	94	1	WCB 200 m	60 mL	C					✓
09/12/2014 07:48	94	1	WCB 200 m	4 L	D				✓	
03/12/2014 18:40	78	15	C. Bay 4 m	250 mL	A	✓				
03/12/2014 18:40	78	15	C. Bay 4 m	30 mL	A		✓			
03/12/2014 18:40	78	15	C. Bay 4 m	100 mL	B			✓		
03/12/2014 18:40	78	15	C. Bay 4 m	60 mL	C					✓
03/12/2014 18:40	78	15	C. Bay 4 m	4 L	D				✓	
03/12/2014 18:39	78	14	C. Bay 12 m	250 mL	A	✓				
03/12/2014 18:39	78	14	C. Bay 12 m	30 mL	A		✓			
03/12/2014 18:39	78	14	C. Bay 12 m	100 mL	B			✓		
03/12/2014 18:39	78	14	C. Bay 12 m	60 mL	C					✓

03/12/2014 18:39	78	14	C. Bay 12 m	4 L	D				✓	
03/12/2014 18:38	78	13	C. Bay 14 m	250 mL	A	✓				
03/12/2014 18:38	78	13	C. Bay 14 m	30 mL	A		✓			
03/12/2014 18:38	78	13	C. Bay 14 m	100 mL	B			✓		
03/12/2014 18:38	78	13	C. Bay 14 m	60 mL	C					✓
03/12/2014 18:38	78	13	C. Bay 14 m	4 L	D				✓	
03/12/2014 18:37	78	12	C. Bay 25 m	250 mL	A	✓				
03/12/2014 18:37	78	12	C. Bay 25 m	30 mL	A		✓			
03/12/2014 18:37	78	12	C. Bay 25 m	100 mL	B			✓		
03/12/2014 18:37	78	12	C. Bay 25 m	60 mL	C					✓
03/12/2014 18:37	78	12	C. Bay 25 m	4 L	D				✓	
03/12/2014 18:35	78	10	C. Bay 65 m	250 mL	A	✓				
03/12/2014 18:35	78	10	C. Bay 65 m	30 mL	A		✓			
03/12/2014 18:35	78	10	C. Bay 65 m	100 mL	B			✓		
03/12/2014 18:35	78	10	C. Bay 65 m	60 mL	C					✓
03/12/2014 18:35	78	10	C. Bay 65 m	4 L	D				✓	
03/12/2014 18:33	78	8	C. Bay 105 m	250 mL	A	✓				
03/12/2014 18:33	78	8	C. Bay 105 m	30 mL	A		✓			
03/12/2014 18:33	78	8	C. Bay 105 m	100 mL	B			✓		
03/12/2014 18:33	78	8	C. Bay 105 m	60 mL	C					✓
03/12/2014 18:33	78	8	C. Bay 105 m	4 L	D				✓	
03/12/2014 18:30	78	6	C. Bay 145 m	250 mL	A	✓				
03/12/2014 18:30	78	6	C. Bay 145 m	30 mL	A		✓			
03/12/2014 18:30	78	6	C. Bay 145 m	100 mL	B			✓		
03/12/2014 18:30	78	6	C. Bay 145 m	60 mL	C					✓
03/12/2014 18:30	78	6	C. Bay 145 m	4 L	D				✓	
03/12/2014 18:27	78	3	C. Bay 205 m	250 mL	A	✓				
03/12/2014 18:27	78	3	C. Bay 205 m	30 mL	A		✓			

03/12/2014 18:27	78	3	C. Bay 205 m	100 mL	B			✓		
03/12/2014 18:27	78	3	C. Bay 205 m	60 mL	C					✓
03/12/2014 18:27	78	3	C. Bay 205 m	4 L	D				✓	
28/11/2014 13:41	42	24	P2 5 m	250 mL	A	✓				
28/11/2014 13:41	42	24	P2 5 m	30 mL	A		✓			
28/11/2014 13:41	42	24	P2 5 m	60 mL	B					✓
28/11/2014 13:41	42	24	P2 5 m	100 mL	B			✓		
28/11/2014 13:41	42	24	P2 5 m	4 L	C				✓	
28/11/2014 13:36	42	20	P2 40 m	250 mL	A	✓				
28/11/2014 13:36	42	20	P2 40 m	30 mL	A		✓			
28/11/2014 13:36	42	20	P2 40 m	100 mL	B			✓		
28/11/2014 13:36	42	20	P2 40 m	60 mL	C					✓
28/11/2014 13:36	42	20	P2 40 m	4 L	D				✓	
28/11/2014 13:34	42	18	P2 60 m	250 mL	A	✓				
28/11/2014 13:34	42	18	P2 60 m	30 mL	A		✓			
28/11/2014 13:34	42	18	P2 60 m	100 mL	B			✓		
28/11/2014 13:34	42	18	P2 60 m	60 mL	C					✓
28/11/2014 13:34	42	18	P2 60 m	4 L	D				✓	
28/11/2014 13:32	42	15	P2 150 m	250 mL	A	✓				
28/11/2014 13:32	42	16	P2 100 m	30 mL	A		✓			
28/11/2014 13:32	42	16	P2 100 m	100 mL	B			✓		
28/11/2014 13:32	42	16	P2 100 m	60 mL	C					✓
28/11/2014 13:32	42	16	P2 100 m	4 L	D				✓	
28/11/2014 13:30	42	16	P2 100 m	250 mL	A	✓				
28/11/2014 13:30	42	15	P2 150 m	30 mL	A		✓			
28/11/2014 13:30	42	15	P2 150 m	100 mL	B			✓		
28/11/2014 13:30	42	15	P2 150 m	60 mL	C					✓
28/11/2014 13:30	42	15	P2 150 m	4 L	D				✓	

28/11/2014 13:27	42	13	P2 200 m	250 mL	A	✓				
28/11/2014 13:27	42	13	P2 200 m	30 mL	A		✓			
28/11/2014 13:27	42	13	P2 200 m	100 mL	B			✓		
28/11/2014 13:27	42	13	P2 200 m	60 mL	C					✓
28/11/2014 13:27	42	13	P2 200 m	4 L	D				✓	
28/11/2014 13:17	42	9	P2 500 m	250 mL	A	✓				
28/11/2014 13:17	42	9	P2 500 m	30 mL	A		✓			
28/11/2014 13:17	42	9	P2 500 m	100 mL	B			✓		
28/11/2014 13:17	42	9	P2 500 m	60 mL	C					✓
28/11/2014 13:17	42	9	P2 500 m	4 L	D				✓	
25/11/2014 11:24	7	24	CTD1 Depth 1- 5 m	250 mL	A	✓				
25/11/2014 11:24	7	24	CTD1 Depth 1- 5 m	30 mL	A		✓			
25/11/2014 11:24	7	24	CTD1 Depth 1- 5 m	100 mL	B			✓		
25/11/2014 11:24	7	24	CTD1 Depth 1- 5 m	4 L	C				✓	
25/11/2014 11:24	7	24	CTD1 Depth 1- 5 m	60 mL	D					✓
25/11/2014 11:19	7	21	CTD1 Depth 2- 40 m	250 mL	A	✓				
25/11/2014 11:19	7	21	CTD1 Depth 2- 40 m	30 mL	A		✓			
25/11/2014 11:19	7	21	CTD1 Depth 2- 40 m	100 mL	B			✓		
25/11/2014 11:19	7	21	CTD1 Depth 2- 40 m	4 L	C				✓	
25/11/2014 11:19	7	21	CTD1 Depth 2- 40 m	60 mL	D					✓
25/11/2014 11:18	7	20	CTD1 Depth 3- 50 m	250 mL	A	✓				
25/11/2014 11:18	7	20	CTD1 Depth 3- 50 m	30 mL	A		✓			
25/11/2014 11:18	7	20	CTD1 Depth 3- 50 m	100 mL	B			✓		
25/11/2014 11:18	7	20	CTD1 Depth 3- 50 m	4 L	C				✓	
25/11/2014 11:18	7	20	CTD1 Depth 3- 50 m	60 mL	D					✓
25/11/2014 11:15	7	18	CTD1 Depth 4- 60 m	250 mL	A	✓				
25/11/2014 11:15	7	18	CTD1 Depth 4- 60 m	30 mL	A		✓			
25/11/2014 11:15	7	18	CTD1 Depth 4- 60 m	100 mL	B			✓		

25/11/2014 11:15	7	18	CTD1 Depth 4- 60 m	4 L	C				✓	
25/11/2014 11:15	7	18	CTD1 Depth 4- 60 m	60 mL	D					✓
25/11/2014 10:56	7	8	CTD1 Depth 5- 500 m	250 mL	A	✓				
25/11/2014 10:56	7	8	CTD1 Depth 5- 500 m	30 mL	A		✓			
25/11/2014 10:56	7	8	CTD1 Depth 5- 500 m	100 mL	B			✓		
25/11/2014 10:56	7	8	CTD1 Depth 5- 500 m	60 mL	C					✓
25/11/2014 10:56	7	8	CTD1 Depth 5- 500 m	4 L	D				✓	

7.9 Box core at Cumberland Flare site

Vicky Peck and Gabriele Stowasser

On 03.12.2014 the BAS box corer was used to collect surface sediment samples at the Cumberland Bay Flare site, Cumberland East Bay, South Georgia. The objective was to investigate the occurrence of planktonic foraminifera and pteropods shells at the sea floor and to assess the export and preservation of these calcareous shells compared with Bongo samples from the overlying water mass. Two surface samples (upper 2 cm) of sediment were removed by a hoe and frozen. Two sub-cores, each of 27 cm cm in length, we recovered to preserve the stratigraphy of the upper sediment layers and were also frozen.

Figure 7-27: Box corer recovery and sample (Photo Jon Watkins and Anna Mikis). Sides of box corer measure 30 cm

Table 7-18: Details of box core undertaken in Cumberland Bay, Event 77, BC721

Date	Time at sea floor (GMT)	Lat	Long	Water depth (m)	Sub-core recovered (cm)	Bagged surface sample
03/12/2014	16:50:00	-54.20242	-36.45428	258	27 x2(frozen)	x2(frozen)

7.10 Sampling Highly-branched Isoprenoids (HBIs)

Gabi Stowasser

In Antarctica, a di-unsaturated Highly-branched isoprenoids (HBIs) isomer (diene) was isolated in lipid fractions from diatom communities in sea ice, whereas tri-unsaturated isomers were absent in sea ice samples but present in ice edge and open ocean phytoplankton communities. The aim of this study was to evaluate the usefulness of HBIs for estimating the contribution of organic matter derived from ice algae in pelagic consumers in Antarctic waters. This

POM samples were filtered from the underway water supply, along a transect from international waters off Southern Chile to Signy Island. Diatoms were filtered from Bongo nets collected in South Georgia waters and sea ice collected in Signy waters. In addition samples of *Calanoides acutus* were sampled from one MOCNESS haul in Signy waters. Both POM and copepod samples were frozen at -80°C prior to analysis in the laboratory. This study was carried out in collaboration with Simon Bell and Thomas Brown at Plymouth University.

8 Continuous Plankton Recorder (cgs 101)

Marianne Wootton, Sir Alister Hardy Foundation for Ocean Science and Geraint Tarling, BAS.

8.1 Introduction

The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) is an internationally funded charity that operates the Continuous Plankton Recorder (CPR) Survey in Plymouth, UK. The survey has been in operation since 1931 and is the longest running, most geographically expanse, marine monitoring program of its kind in the world. The CPR is a tool used in the long-term monitoring of the oceans, at a basin scale, and allows for long-term comparisons of biodiversity, abundance, biomass and biogeography, of both phytoplankton and zooplankton, to be made.

Primarily operating in the North Atlantic, the survey uses ships-of-opportunity to tow regular transects, at approximately 6-10m depth, at monthly intervals. Due to the robust nature and cost effectiveness of using a CPR (one set of silk gauzes can sample up to 500 nmiles of ocean), it is now used to monitor the plankton in nearly all of the major ocean basins.

Since 2005 SAHFOS and BAS have collaborated in collecting a series of CPR samples from the Scotia Sea, during austral summer months, along 3 transects running between: South Georgia and the Falkland Islands, South Georgia and the South Orkney Islands and between the South Orkney Islands and the Falkland Islands. The data provide a baseline for monitoring change at the basin scale within this part of the Southern Ocean which hosts fisheries interests within the Falkland Islands and the South Georgia Economic Zones. The fauna and flora found along the route are characterised by great contrasts in taxonomic composition and productivity which are often most clearly seen on either side of the Polar Front. The PF forms the major transition that occurs between the Polar Frontal Zone (PFZ) and Antarctic Zone (AZ) and can oscillate in its locations across many degrees of latitude (Moore et al. 1999). Within the AZ, BAS has carried out extensive plankton surveys, throughout the Scotia Sea (Ward et al, 2003, 2004, 2006). However, the PFZ and sub-Antarctic regions have been less sampled by BAS and our taxonomic knowledge of many of the forms is less comprehensive.

Equally the spatial relationship between plankton assemblages identified through point samples (bongo net samples, 0-200 m depth) and those from transecting (CPR tows ~10 m depth) is also currently unclear. With both methods being widely/increasingly used to define plankton communities (Hunt and Hosie 2003), this needs investigating.

The proved success of CPR operations in the Southern Ocean, known as the SF routes, has prompted more opportunistic collaborative work to be undertaken, in addition to the current routine sampling.

8.2 Rationale

8.2.1 Increased Taxonomic resolution Reference Material

This collaboration provides us with the opportunity to obtain a comprehensive set of bongo net samples from the sub-Antarctic and Polar Frontal Zones which will enable more consistent taxonomic identification, particularly of the smaller more abundant taxa. The CPR catches the plankton between two moving bands of silk with a mesh size 270um and fixes and preserves the plankton in-situ, using formaldehyde from an onboard reservoir. The plankton typically becomes squashed as it progresses through the internal mechanism of the CPR and zooplankton specimens in particular, can become flattened, damaged and distorted. This, on occasions, can limit the taxonomic resolution to which standard identification and enumeration of the plankton can be carried out. To maintain high standards and to continue providing analysis results of high quality, our aim is to collect intact planktonic specimens from the Scotia Sea using Bongo nets, and other net types when available, to provide SAHFOS with a set of voucher specimens for their reference collection. These complete specimens will prove invaluable for the internal quality procedures that SAHFOS employs for the SF routes and will be used as ongoing training tools to prevent skills drift.

8.2.2 Dual-method sampling

In 2013, BAS carried out the first joint survey of CPR and Bongo nets in the Scotia Sea. The datasets provided unique insights through matching highly resolved spatial transects of the epipelagic layers with depth-integrated (0-200m) community structures obtained from the Bongo nets. The datasets covered the summer bloom period, when the plankton community is peaking in productivity levels. This proposal will allow us to place these results within a seasonal context, through carrying out a similar dual-method survey in an early-season (pre bloom) situation.

8.2.3 Western Core Box

This long established set of monitoring transects, located to the northwest of South Georgia, play a significant scientific role in each annual BAS research cruise to the Scotia Sea region. Although numerous types of sampling equipment are employed to complement the acoustic surveys along these transects, there has never been a simultaneous continuous assessment made of the phytoplankton and zooplankton to partner the acoustic data. The CPR is able to fulfil this role, whilst causing minimal disruption to the ships schedule and to the progress of the standard WCB programme.

8.3 Results

8.3.1 Increased Taxonomic resolution Reference Material

Throughout the cruise, whenever interesting taxa of zooplankton were found, either in Bongo, MOCNESS or RMT samples, specimens were fixed in 4% formaldehyde solution and placed into glass vials. Of particular interest were several specimens of a, so far, uncertain species of a copepod belonging to the genus *Candacia*. The specimens will be more closely looked at up on return to the SAHFOS laboratory.

8.3.2 Dual Sampling

One of the original aims of the BAS-SAHFOS collaboration on the cruise was to place the 2013 bongo net and CPR sampling results within a seasonal context, through carrying out a similar dual-method survey in an early-season (pre bloom) situation. However, since the planning phase of the cruise, unforeseen circumstances arose which led to the delayed departure of the JCR from Punta Arenas. One of the consequences of this delay was that when the sampling did commence it was too late to sample the pre-bloom condition. Despite this, the CPR was deployed throughout times of passage where steaming time exceeded 6 hours. As the CPR can be deployed at speeds >10kts there was minimal impact on the ships schedule. Three CPR deployments were made whilst steaming, each complemented with Bongo nets being deployed at the start, in the middle and at the end of each transect.

8.3.3 Western Core Box

A CPR was towed for each leg of the Western Core Box, generating a further four transects of silk.

Each pair of CPR silks is capable of sampling up to 500nmiles before replenishment of the silk is necessary. To make efficient use of the amount of silk wound onto each internal cassette, more than one transect tow was consecutively sampled on a length of silk. The shorter leg tows (<100nmiles) of the Western Core Box transects were all sampled on the same pair of silks, using the same internal mechanism and a method employed, of progressing the silk several marker divisions until unused silk was seen, to ensure discrete consecutive transects were sampled on the silk.

For each CPR tow a record was made of: the CPR number; the CPR internal mechanism number; the time and date the CPR was deployed; the position of deployment; the time and date the CPR was retrieved; the position of retrieval; the silk start and end division readings; any other comments. Any altered courses the ship may have made in-between the start and end positions of each tow are available via the ships log and will be retrieved at 1 minute intervals, to build a clear picture of the position of each sample. Please see Table 8-1 for details of each CPR tow. The CPR silks collected during the cruise will be processed and samples analysed upon return to the SAHFOS laboratory in Plymouth. The samples will be analysed using the standard SAHFOS methodology of 'on-silk' analysis (Richardson et al 2006).

8.4 References

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Ward P, Grant S, Brandon M, Siegel V, Sushin V, Loeb V, Griffiths H (2004) *Mesozooplankton community structure in the Scotia Sea during the CCAMLR 2000 Survey: January-February 2000*. Deep-Sea Research Part Ii-Topical Studies in Oceanography 51:1351-1367;

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Ward P, Whitehouse M, Brandon M, Shreeve R, Wooddwalker R (2003) Mesozooplankton community structure across the Antarctic circumpolar current to the north of South Georgia: Southern Ocean. Marine Biology 143:121-130

Table 8-1: CPR deployment and retrieval details

Date/Time	Bridge event number	Latitude	Longitude	CPR number	CPR Mech number	Prop setting	Comment
17/11/2014 19:45	3	-56.6635	-58.165	184	184-0	60	Shoot. Start 1.0 divs. Punta to Signy.
18/11/2014 16:05	3	-58.9818	-51.811	184	184-0	60	Mid-course haul. Punta to Signy.
18/11/2014 17:08	5	-58.9982	-51.7688	184	184-0	60	Mid-course shoot. Punta to Signy.
19/11/2014 11:12	5	-60.7718	-46.4841	184	184-0	60	Haul. Punta to Signy.. End silk reading 79.9 + 2.4 = 82.3 divs
26/11/2014 21:49	37	-59.9739	-46.0762	184	184-1	60	Shoot. Start 1.0 divs. Ice Station to P2 southern mooring.
27/11/2014 13:05	37	-57.607	-43.6746	184	184-1	60	Mid-course haul. Ice Station to P2 southern mooring.
27/11/2014 13:38	39	-57.6044	-43.6696	184	184-1	60	Mid-course shoot. Ice Station to P2 southern mooring.
28/11/2014 08:08	39	-55.2444	-41.2474	184	184-1	60	Haul. Ice Station to P2 southern mooring. End silk reading 45.4 divs
08/12/2014 08:50	82	-53.321	-39.6105	184	184-2	60	Shoot. Start = 1.0 divs. Start of Western Core Box Transect 1

08/12/2014 19:27	82	- 53.3055	-39.3077	184	184-2	60	Haul. End silk: 15.2+2.4 = 17.6 divs. End of Western Core box Transect 1.
09/12/2014 09:37	95	- 53.9987	-38.8227	184	184-2	60	Shoot. Start: 18.4 divs at gasket. Western Core Box transest 2.
09/12/2014 20:04	95	- 53.9668	-38.5326	184	184-2	60	Haul. End silk: 33.5+2.4 = 35.9 divs. End of Western Core Box transect 2.
10/12/2014 08:50	107	- 53.2082	-38.4438	184	184-2	60	Shoot. Start: 35.9 divs at gasket. Start of Western Core Box transect 3.
10/12/2014 18:52	107	- 53.1796	-38.1582	184	184-2	60	Haul. End silk: 53.0+2.4 = 55.4 divs. End of Western Core Box transect 3.
11/12/2014 08:49	120	- 53.8804	-37.7116	184	184-2	60	Shoot. Start = 56.1 divs at gasket. Start of Western Core Box transect 4.
11/12/2014 19:06	120	- 53.8649	-37.6133	184	184-2	60	Haul. End silk: 70.4+2.4 = 72.8 divs. End of Western Core Box transect 4.
14/12/2014 16:32	170	- 52.6004	-39.206	184	184-1	60	Shoot. Silk start = 3.2 at Gasket. Upwelling to Stanley.
15/12/2014 16:07	170	- 52.2514	-46.1294	184	184-1	60	Mid-course haul. Upwelling to Stanley
15/12/2014 16:48	173	- 52.2511	-46.1331	184	184-1	60	Mid course shoot. Upwelling to Stanley
16/12/2014 16:03	173	- 51.8942	-53.1721	184	184-1	60	Haul. Upwelling to Stanley . End silk: 96.6+2.4 = 99.0 divs.

9 Antarctic Marine EngineeringCruise

Seth Thomas

9.1 LAB Instruments

Instrument	S/N Used	Comments
AutoSal	65763	
Magnetometr STCM1		
XBT		White launcher starts acquisition prematurely. Orange launcher works

9.2 Acoustic Instruments

Instrument	S/N Used	Comments
ADCP	Y	
PES		
EM120		
TOPAS		
EK60	Y	
SSU	Y	
USBL		
10kHz IOS pinger		
Benthos 12kHz pinger S/N 1316 + bracket		
Benthos 12kHz pinger S/N 1317 + bracket		
MORS 10kHz transponder		

9.3 Oceanlogger

Instrument	S/N Used	Comments
Barometer1(UIC)	V1450002	
Barometer1(UIC)	V1450003	
Seawater Temp1 SBE38	38-0767	
Seawater Temp2 SBE38	38-0771	
Foremast Sensors		
Air humidity & temp1	0060743898	
Air humidity & temp2	0060743896	
TIR1 sensor (pyranometer)	112993	
TIR2 sensor (pyranometer)	112992	Not working
PAR1 sensor	110127	
PAR2 sensor	110126	
prep lab		
Thermosalinograph SBE45	T0130	
Fluorometer	1100243	
Flow meter	05/811950	
Transmissometer C-Star	CST1279DR	

9.4 CTD (all kept in cage/ sci hold when not in use)

Instrument	S/N Used	Comments
Deck unit SBE11plus	11P15759-0458	
Underwater unit SBE9plus	0541	
Temp1 sensor SBE3plus	03P5043	
Temp2 sensor SBE3plus	03P2307	
Cond1 sensor SBE 4C	043491	
Cond2 sensor SBE 4C	044090	
Pump1 SBE5T	053415	
Pump1 SBE5T	052371	
Standard Thermo SBE35	NA	
Transmissometer C-Star	CST1497DR	
Oxygen sensor SBE43	0620	
Flourometer	12-8513-01	
PAR sensor	7235	
Altimeter PA200	10127.244739	
CTD swivel linkage	196111	
LADCP	14897	
Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc		

9.5 AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	Working	Comments
EA600		

Anemometer	Y	
Gyro	Y	
DopplerLog	Y	
EMLog	Y	

9.6 End of Cruise Procedure

At the end of the cruise, please ensure that:

- the XBT is left in a suitable state (store in cage if not to be used for a while – do not leave on deck or in UIC as it will get kicked around). Remove all deck cables at end of cruise prior to refit.
- the salinity sample bottles have been washed out and left with deionised water in – please check this otherwise the bottles will build up crud and have to be replaced.
- the CTD is left in a suitable state (washed (including all peripherals), triton + deionised water washed through TC duct, empty syringes put on T duct inlets to keep dust out and stored appropriately). Be careful about freezing before next use – this will damage the C sensors (run through with used standard seawater to reduce the chance of freezing before the next use). Remove all the connector locking sleeves and wash with fresh water. Blank off all unconnected connectors. See the CTD wisdom file for more information. If the CTD is not going to be used for a few weeks, at the end of your cruise please clean all connectors and attach dummy plugs or fit the connectors back after cleaning if they are not corroded.
- the CTD winch slip rings are cleaned if the CTD has been used – this prevents failure through accumulated dirt.
- the SVP is left in a suitable state (washed and stowed). Do not leave this on deck without a cover for any length of time as it rusts. Stow inside at end of cruise.
- all manuals have been returned to the designated drawers and cupboards.
- you clean all the fans listed below every cruise or every month, whichever is the longer.

Please clean the intake fans on the following machines:

Instrument	Cleaned?
Oceanlogger	Y
EM120, TOPAS, NEPTUNE UPSs	Y
Seatex Seapath	Y
EM120 Tween Deck	Y
TOPAS Tween Deck	Y

9.7 Additional notes and recommendations for change / future work

9.7.1 Spare CTD Frame.

The new frame is bent. The top circle is not central to the mounting and lifting circle in the middle. It is my opinion that this will not allow a set of 20 litre bottles to be fitted as clearance on one side will be too limited. A chat with the new chief engineer has suggested that this could be straightened using shore side facilities during refit. Hence the new frame has not yet been assembled.

Figure 9-1: Views of the spare CTD frame showing distortion in position of main tubes

9.7.2 New -80 freezer in science hold.

It's a chronic nuisance when trying to fetch or stow any CTD frame hardware or bottles, and leaves no stowage space under the racking for the salinometers in addition to the power cable trailing over the top racking for added inconvenience.

9.7.3 Turner 10-AU Fluorometer.

The fluorometer has been giving strange spikes (uniform amplitude and fairly regular intervals). In addition to this, there has been some leakage noticed at the top of the flow tube (cuvette). Having docked at Stanley when the system was no longer in use, the instrument was stripped and cleaned and the cuvette and o-rings replaced. The metal pipe fittings on instrument were seen to be very corroded which had left much discolouration of the flow tube (which will affect readings substantially). The outlet fitting (upper end) was very corroded indeed and the 3/8" blank on the top had very little thread remaining which I suspect was the cause of the leakage.

I am of the opinion that use of dissimilar metals in the flow system is to blame for this degradation. I see aluminium fittings into steel fittings which I think to be a cause of galvanic corrosion.

I'll look into replacing these with either nickel plated brass (as I use in my computer systems) or plastic fittings when I get back to Cambridge. (I'll give Mark a nickel plated or plastic blank from my spares as I don't think the top blanking plug will hold for much longer)

Figure 9-2: Views of the worn parts on the oceanlogger Turner fluorometer

10 JR304 ICT Engineer's Report

Jeremy Robst, BAS

10.1 Data Logging / SCS

The SCS server and data logging systems generally worked well throughout the cruise, the major events are listed in Table 10-1 below. Of some concern is the several large (10s of seconds) time changes that affected JRLB (the main unix fileserver) and the SCS server throughout the cruise. No definite cause was found for these but further investigation is needed to understand and prevent these if future.

Table 10-1: SCS server and data logging major incidents occurring during cruise JR304

Time & Date (GMT)	Event
2014/11/12 18:42	ACQ restarted, newleg run (**Cruise: 20141112**)
2014/11/14 16:20	Emergency generator test; dopplerlog, glonass, gyro affected
2014/11/15 15:19	Time on JRLB out by approx 30s – NTP not synced
2014/11/15 19:35	Seatex heading offset corrected, EM122 offset corrected
2014/11/16 15:18	Time on JRLB corrected
2014/11/19 14:39	Time on JRLB had spikes of 3 to 18 s during the day
2014/12/07 13:46 & 13:48	ACQ restarted (twice) due to samba being overloaded by data transfer and SCS server failing to write to U: drive. Compress output of streams rebuilt.
2014/12/09 02:08	Time on jrlb approx 10s out, restarted NTP & Tardis on SCS (6.5s change)
2014/12/13 20:50	SCS time 3.4s out, restarted Tardis.
2014/12/16 13:43	ACQ restarted due to samba error on jrlb and SCS server failing to write to U: drive. Compress output of streams rebuilt.
2014/12/18 ??:??	ACQ ewstarted, newleg run

10.2 RAW to ACO conversion

There is a memory leak in the raw to aco conversion process (raw2compress.pl) running on JRLB that requires a restart of the conversion every couple of days. Whilst this doesn't cause any significant issues it should be resolved to give a more reliable system.

10.3 Unix / fileserver systems

At one point in the cruise a large amount of data (several GBs) was being transferred to JRLB; this caused the SCS to lose connection to the samba U: drive and stop writing its backup copy of the underway data. This required a restart of the SCS logging program ACQ to resolve. Is it not clear if the issue is network bandwidth - JRLB has an interface for the general LAN, and an interface for the data LAN, which the SCS uses so the bandwidth should be independent. It might be an issue with memory or CPU resource, further investigation needs to be carried out when this won't affect a science cruise.

10.4 ESX server

The new ESX servers worked well, although the VEEAM backup of JRLB did fail due to a full disk on the JRW-VEEAM-S2 several times, a resolution to this is being worked on.

11 Data management report

Jenny Thomas

11.1 Cruise numbering

JR304 consists of one leg known as JR20141112 which was named after the date the science party joined the ship. All data are organised under the one leg.

11.2 Relationship to previous cruises

The western core box surveys relates to many cruises undertaken by BAS. A good summary of this survey can be found in this cruise report.

P2 and P3 mooring and stations were first deployed/studied on JR161.

The upwelling site was discovered following analyses of data collected on JR177.

11.3 Pre-cruise preparation

Met with PSO to discuss role and what the cruise would entail.
Attended cruise planning meeting with PSO and other scientists. Gave a short presentation about data management and role on board.
Read a few related cruise reports.
Copied relevant data, software and other resources to a hard drive to take.

11.4 Start of cruise set up:

Set up digital event logs in discussion with scientists. Held a meeting for those that wanted assistance with their use and those that had not used them before.
Attended science planning meetings to keep in the loop with planning, organisation of events and help with any data enquiries. Helped to organise CTD water sampling schedule.
Helped with unpacking and mobilisation of science equipment.
Set up L:\drive folders in discussion with PSO and made everyone aware at a science meeting about how to use folders.
Following discussion with Jon, Jeremy and Sophie about station, event and sample numbering, Jeremy set up a test system to try out linking within the digital event logs, i.e. events, sub events and sampling could be entered into this system and hierarchies applied to link these together using drop down lists of station/event numbers.

11.5 During cruise:

Maintained digital event logs for CTD, data management, snow camera, XBT and LADCP.
Took regular underway water samples.
Assisted with CTD operation and took water samples. Assisted with XBT and LADCP operations. Helped with various other equipment deployments.
Answered various data requests (see 11.8).
Started preparation for cruise report (in discussion with Jon). Began data management section and creation of tables as necessary throughout the cruise.
Maintained a list of equipment used/deployed during cruise.
Regularly checked bridge event log and asked for corrections to be made.
Processed some swath bathymetry (EM122) data.

Collected and scanned in paper logs. All saved in relevant folders within L:\scientific_work_areas as noted in11.8
Watch leader 12 – 4 during station work.
Prepared cruise quiz.
Helped to process data from plankton camera CTD.
Updated cue cards in discussion with Jeremy, Sophie and Seth for equipment in UIC following instructions from Ellen Bazeley-White (PDC).
Checked M:\drive folder containing cruise reports and updated with those that were missing.
Sent a scan of the letter from PML requesting all CTD data be sent to the Met Office, to the PDC so they are aware of the data being sent elsewhere.

11.6 End of cruise:

Completed data management and physical oceanography sections of cruise report. Helped others with creation of tables.
Tallied equipment being loaded into containers in Stanley.
Ensured all data had been entered into digital event logs.
Tidied up L:\drive folders.

11.7 Other non-cruise related tasks:

Sent Kim Quince short blurb about activities for Cambridge science festival 2015.
Altered MATLAB scripts for climate data processing for SONA project.

11.8 Data requests.

During the cruise several requests for data and information were received. These are summarised below. All data provided/output and code used was saved within the work folder: L:\data_management\data_requests under the name of the request below.

Request	**Date**	**By whom**	**Outcome**	**Output file name**
Amundsen Sea geotiffs – output of the geotiffs with graticules to check against existing maps which may be incorrect.	23/11/2014	Hyoung-Sul La	Produced geo-referenced output map in ArcGIS using existing geotiffs provided by La.	Amundsen_sea_sic.mxd
CPR cruise tracks – produce cruise tracks and other underway data with 1 minute resolution for duration of CPR deployments.	17/11/2014	Maz Wootton	Csv file for each CPR deployment event taken from seatex-gga stream.	Cpr_tow_data_eventXXX.csv Code: code_cpr_tow_data_txt.

Mooring bathymetry – wanted to see the bathymetry of area surrounding the mooring P2 location.	20/11/2014	Hyoung-Sul La	Showed output map of bathymetry that BAS hold for the area in ArcGIS.	SIS1415.mxd. Note that the files required for this output are not saved to the work folder. They can be supplied by the Geophysics Data Manager in the PDC, BAS.
South of 60 – requirement of KOPRI that there is official documentation of when their staff work south of 60°S.	03/12/2014	Hyoung-Sul-La	No official document or log to copy. Provided output from scs seatex-gga stream using listit command (1 sec resolution) with exact date, time and coordinates of when 60°S crossed.	Crossing_60_degs.txt (output given to La). Cruise_track_seatex_gga_1sec.csv – 3 files containing the output of the listit command. Code: code_cruise_track_1sec_north/south.txt.
Southern Ocean bathymetry -	13/12/2014	Richard Lampitt	Output ascii file of GEBCO raster.	geb08south_cut2.flt
Visualise_cruise_track – interest in our route during the cruise.	30/11/2014	Various	Used listit command on scs seatex-gga stream to produce output of cruise track with 30 minute resolution. Added into ArcGIS map and plotted with bathymetry.	ArcGIS output created at ad hoc periods.
Cruise report – JR284	15/12/2014	Scott Polfrey	Emailed Elanor Gowland for copy.	
CTD data – cast 007 to compare with data from snow catcher CTD that was attached to the main CTD frame for calibration	03/12/2014	Anna Belcher	Did first step of processing in SeaBird software.	/data/cruise/jcr/20141112/work/scientific_work_areas/ctd/processed_data/JR304_007*
Coordinates in Cumberland Bay – location of bongo deployment in this area on JR274 where pteropods were	03/12/2014	Vicky Peck	Found list of bongo events in cruise report.	Provided with coordinates of deployment.

found				
Presentation resources – BAS templates.	23/11/2014	Gabi Stowasser	Brought resources with me.	Copied to M:\jcr\BAS Information Services\Presentations and Posters\Presentation resources – contains background images, images, blank slides.

11.9 Data set summary

CTD

Paper log	Paper	CTD sampling log sheets – taken back to BAS and archived in PDC.
	Scans	Saved in L:\scientific_work_areas\ctd\scanned_paper_logs
Digital log		JR304_CTD_deployments (JT), JR304_CTD_water_sampling (JT), JR304_CTD_water_samples (AB, MD, AM, SF, JG, CL, JT)
Data	Raw	K:\ctd
	Processed	L:\scientific_work_areas\ctd\processed_data
	Processing	
Calibration		Calibration files in L:\scientific_work_areas\ctd\
Water samples taken		Nucleic analysis (MD), Protein assessment (MD), CARDFISH (MD), TA & DIC
Long term data management and data centre		NERC. Data managed by Polar Data Centre, BAS and after processing, by BODC.
Ownership		NERC

EK60

Simrad EK-60 echosounder

Paper log	None
Digital log	EK60

Data	Raw	K:\ek60\raw
	Processed	Not processed during cruise
Calibration		Calibrated in Stromness Bay on
Long term data management and data centre		Held on servers at BAS for management by the Polar Data Centre at BAS.
Ownership		NERC

EA600

Paper log		None
Digital log		None – some general information recorded in JR304_general_information
Data	Raw	K:\ea600
	Processed	None processed during JR304
Calibration		Not calibrated during JR304
Long term data management and data centre		Data kept on servers at BAS and managed by the Polar Data Centre at BAS.
Ownership		NERC

EM122

Simrad EM122 multibeam echosounder

Paper log		None
Digital log		EM122
Data	Raw	K:\em122
	Processed	L:\scientific_work_areas\em122\processed_data – only a small number of files processed.
	Processing	Used methods described in JR254 cruise report.
Calibration		Not calibrated during JR304.
Long term data management		Data stored on servers at BAS and managed by the Polar Data

and data centre		Centre at BAS.
Ownership		NERC

ADCP

Paper log		None
Digital log		ADCP
Data	Raw	K:\adcp
	Processed	
	Processing	
Calibration		
Long term data management and data centre		
Ownership		NERC

XBT

Lockheed Martin Sippican T-5/T-7 probe

Paper log	Paper	Complete set
	Scans	All scanned
Digital log		JR304_XBT
Data	Raw	K:\xbt
	Processed	No processing done during JR304
Calibration		
Long term data management and data centre		Data stored on servers at BAS and managed by Polar Data Centre at BAS.
Ownership		NERC

LADCP

Paper log	Paper	Complete set.
	Scans	All scanned.
Digital log		JR304_LADCP
Data - raw	Raw	K:\ladcp
	Processed	No processing done during JR304
Calibration		See page 233 for calibration certificate. No data.
Long term data management and data centre		Data stored on servers at BAS and managed by Polar Data Centre at BAS.
Ownership		NERC

Marine snow camera – Holo-cam, P-cam, CTD

Paper log		None – records kept by Richard Lampitt/bridge log
Digital log		JR304_snow_camera
Data - raw	Raw	L:\scientific_work_areas\snow_camera
	Processed	L:\scientific_work_areas\snow_camera
Calibration		Not calibrated during JR304
Long term data management and data centre		Not currently stored in a data centre but intention is to store data with the British Oceanographic Data Centre (BODC).
Ownership		NERC

Marine snow catcher

Paper log	Paper	Yes for all deployments
	Scans	All scanned
Digital log		
Data and samples		On paper logs and samples taken back. Photos in

	L:\scientific_work_areas\snow_catcher
Calibration	CTD calibrated
Water samples taken	Filtered on board. Chl samples processed.
Long term data management and data centre	Processed chlorophyll samples on board from underway, CTD and snow catcher. Other samples taken back to NOC. Nutrient samples staying on ship to go back. All going back to NOC.
Ownership	NERC, University of Southampton

MOCNESS

Paper log	Paper	Deployment and sample logs (missing event 150)
	Scans	All scanned (missing event 150)
Digital log		MOCNESS
Samples		Samples preserved or incubated on board.
Long term data management and data centre		Preserved and taken back to BAS then processed at BAS.
Ownership		NERC

RMT8

Paper log	Paper	Gabi has these.
	Scans	Not scanned.
Digital log		RMT8
Samples	Raw	Taken back to BAS.
	Processed	Some samples processed on board.
Data storage		Krill photography, weight and length data in L:\scientific_work_areas\RMT8.
Long term data management and data centre		Remaining samples brought back to BAS and organisations listed below for analysis to the following people: Sophie Fieldig, Gabi

		Stowasser, Cecilia Liszka, Will Goodall-Copestake, Ryan Saunders, SAMS (David Pond), SAHFOS (Maz Wootton).
Ownership		NERC

LHPR

Longton Hardy Plankton Recorder

Paper log	Paper	Complete set for deployments.
	Scans	All scanned
Digital log		LHPR
Samples		Taken back to BAS for processing and analysis.
Long term data management and data centre		Samples processed at BAS.
Ownership		NERC

Bongo

Paper log	Paper	Deployment and sampling on same logs. Missing 20, 21, 114, 118.
	Scans	All scanned (missing as above).
Digital log		JR304_bongo, JR304_bongo_sampling
Samples		Some processed on board for incubations, some taken back to BAS for processing.
Long term data management and data centre		Samples taken back to BAS for processing.
Ownership		NERC

CPR

Continuous PLaknton Recorder

Paper log	Paper	Maintained by Maz Wootton
	Scans	Not scanned

Digital log	JR304_CPR
Samples	Taken back to SAHFOS for analysis.
Calibration	Not calibrated on this cruise.
Long term data management and data centre	Data will be entered into database at SAHFOS.
Data access	Data openly available through database at SAHFOS but enquirer has to go through SAHFOS so they can explain how the data can be used.
Ownership	Joint AFI-CGS project between BAS and SAHFOS. Neither party sure about who owns the data and who controls data access.

SUCS camera

Paper log		None
Digital log		None
Data	Raw	K:\sucs
	Processed	
Long term data management and data centre		Held on servers at BAS.
Ownership		NERC

ES853 (Only calibration data)

Simrad ES853 Echosounder

Paper log	None
Digital log	None
Data (from calibration only)	L:\scientific_work_areas\ES853
Long term data management and data centre	Saved on server at BAS.
Ownership	NERC

Box corer

Paper log	None
Digital log	None
Samples	1 sediment core taken frozen and taken back to BAS, Cambridge.
Long term data management and data centre	Will be worked on by BAS and student from Nottingham University, then archived with all other cores at BAS as sample number 721.
Ownership	NERC

MOORINGS

Paper log		Pete kept written notes about mooring preparation.
Digital log		None
Data	Downloaded	
	Setup files	
Long term data management and data centre		Data held by BAS.
Ownership		NERC

12 Appendices

12.1 Appendix 1 – Event log

Date & Time (GMT)	Event	Lat	Lon	Comment
17/11/2014 18:21	Station 1	-56.6676	-58.1735	V/l on DP (Station 1)
17/11/2014 18:38	1	-56.6675	-58.1739	Bongo Net 001 off the deck
17/11/2014 18:40	1	-56.6675	-58.1739	Bongo Net 001 deployed
17/11/2014 18:46	1	-56.6675	-58.1739	Bongo Net 001 at 200m. Commenced recovery
17/11/2014 19:01	1	-56.6675	-58.1739	Bongo Net at the surface
17/11/2014 19:03	1	-56.6675	-58.1739	Bongo Net 001 on deck
17/11/2014 19:07	2	-56.6675	-58.1739	Bongo Net 002 off the deck
17/11/2014 19:08	2	-56.6675	-58.1739	Bongo Net 002 deployed
17/11/2014 19:13	2	-56.6675	-58.1739	Bongo Net 002 at 200m. Commenced recovery
17/11/2014 19:26	2	-56.6675	-58.1739	Bongo Net 002 at the surface
17/11/2014 19:28	2	-56.6675	-58.1739	Bongo Net 002 on deck
17/11/2014 19:35	Station 1	-56.6676	-58.1739	Decks, Cranes and Gantries secure. Vessel off DP and proceeding
17/11/2014 19:44	3	-56.6636	-58.1670	CPR 001 off the deck
17/11/2014 19:45	3	-56.6635	-58.1650	CPR 001 in the water.
17/11/2014 19:52	3	-56.6684	-58.1336	CPR 001 fully deployed.
18/11/2014 16:02	3	-58.9800	-51.8167	Reduced speed and commenced recovery of CPR 001
18/11/2014 16:05	3	-58.9818	-51.8110	CPR at the surface
18/11/2014 16:07	3	-58.9829	-51.8072	CPR 001 fully recovered
18/11/2014 16:14	Station 2	-58.9890	-51.8007	V/l on DP (Station 2)
18/11/2014 16:21	4	-58.9893	-51.8018	Bongo Net 003 off the deck
18/11/2014 16:22	4	-58.9894	-51.8018	Bongo Net 003 deployed
18/11/2014 16:27	4	-58.9893	-51.8019	Bongo Net 003 at 200m. Commenced recovery
18/11/2014 16:41	4	-58.9893	-51.8018	Bongo Net 003 at the surface
18/11/2014 16:43	4	-58.9894	-51.8019	Bongo Net 003 on deck

18/11/2014 16:51	Station 2	-58.9894	-51.8018	V/l off DP
18/11/2014 17:05	5	-58.9961	-51.7754	CPR 002 off the deck
18/11/2014 17:08	5	-58.9982	-51.7689	CPR 002 in the water
18/11/2014 17:14	5	-59.0051	-51.7487	CPR 002 fully deployed
19/11/2014 11:00	5	-60.7579	-46.5096	Reduced speed and commenced recovery of CPR 002
19/11/2014 11:12	5	-60.7718	-46.4841	CPR 002 fully recovered
19/11/2014 11:18	Station 3	-60.7746	-46.4817	V/l on DP (Station 3)
19/11/2014 11:24	6	-60.7746	-46.4822	Bongo Net 004 deployed
19/11/2014 11:27	6	-60.7746	-46.4822	Bongo Net 004 at 115m. Commenced recovery
19/11/2014 11:37	6	-60.7746	-46.4822	Bongo Net 004 recovered
19/11/2014 11:47	Station 3	-60.7746	-46.4822	V/l off DP
25/11/2014 02:24	Inaccessible Mooring	-60.5750	-46.5194	V/L on DP
25/11/2014 02:34	Inaccessible Mooring	-60.5749	-46.5194	Mooring pinged 5 times with no response
25/11/2014 02:36	Inaccessible Mooring	-60.5749	-46.5193	V/L off DP man. on passage
25/11/2014 07:46	Station 4 (Ice Station)	-59.9622	-46.1594	Vessel on DP station 4- Ice Station
25/11/2014 09:43	7	-59.9623	-46.1598	CTD 001 off deck
25/11/2014 09:44	7	-59.9623	-46.1597	CTD 001 deployed
25/11/2014 10:14	8	-59.9623	-46.1598	Snow Catcher 001 off the deck
25/11/2014 10:16	8	-59.9623	-46.1598	Snow Catcher 001 deployed
25/11/2014 10:21	7	-59.9623	-46.1597	CTD 001 at depth. Wire out 2000m. EA600 water depth 4846m. Commenced recovery
25/11/2014 10:22	8	-59.9623	-46.1597	Snow Catcher 001 at the surface
25/11/2014 10:23	8	-59.9623	-46.1597	Snow Catcher 001 on deck
25/11/2014 10:36	9	-59.9623	-46.1598	Snow Catcher 002 off the deck
25/11/2014 10:38	9	-59.9623	-46.1598	Snow Catcher 002 deployed
25/11/2014 10:50	9	-59.9623	-46.1598	Snow Catcher 002 at the surface
25/11/2014 10:52	9	-59.9623	-46.1598	Snow Catcher 002 on deck
25/11/2014 11:26	7	-59.9623	-46.1598	CTD 001 on deck
25/11/2014 11:37	10	-59.9623	-46.1598	V/L off DP man. to midday MOCNESS tow start position

25/11/2014 12:07	10	-59.9923	-46.2221	V/L on DP at Midday MOCNESS start position
25/11/2014 13:38	10	-59.9923	-46.2222	V/L off DP increase speed to 2 kts for MOCNESS tow
25/11/2014 13:43	10	-59.9908	-46.2185	MOCNESS depolyed
25/11/2014 13:46	10	-59.9894	-46.2158	No readings possible junction box problem. Commence recovery
25/11/2014 13:56	10	-59.9850	-46.2064	Mocness recovered on deck
25/11/2014 13:57	Ice Station	-59.9847	-46.2055	V/L on DP full auto pos
25/11/2014 15:03	Ice Station	-59.9843	-46.2048	V/l off DP proceeding back to Ice Station position
25/11/2014 15:21	Ice Station	-59.9631	-46.1612	V/l on DP back at Ice Station
25/11/2014 15:40	11	-59.9624	-46.1597	Bongo Net 005 deployed
25/11/2014 15:44	11	-59.9624	-46.1597	Bongo at depth 100m commence hauling
25/11/2014 15:49	11	-59.9624	-46.1597	Bongo Net 005 recovered
25/11/2014 15:53	12	-59.9624	-46.1597	Bongo Net 006 deployed
25/11/2014 15:58	12	-59.9624	-46.1597	Bongo at depth 200m commence hauling
25/11/2014 16:08	12	-59.9624	-46.1597	Bongo Net 006 recovered
25/11/2014 16:39	13	-59.9624	-46.1597	Plankton Camera 001 deployed
25/11/2014 17:00	13	-59.9624	-46.1597	Plankton Camera at depth 250m commence hauling
25/11/2014 17:33	13	-59.9624	-46.1597	Plankton Camera 001 recovered
25/11/2014 17:51	14	-59.9624	-46.1596	CTD 002 deployed
25/11/2014 18:12	14	-59.9624	-46.1597	CTD 002 at depth. Wire out 1000m. EA600 water depth 4844m. Commenced recovery
25/11/2014 18:18	15	-59.9623	-46.1597	Snow Catcher 003 deployed
25/11/2014 18:25	15	-59.9623	-46.1597	Snow Catcher at depth 70m commence recovery
25/11/2014 18:29	15	-59.9623	-46.1597	Snow Catcher 003 on deck
25/11/2014 18:39	16	-59.9623	-46.1597	Snow Catcher 004 deployed
25/11/2014 18:47	16	-59.9623	-46.1597	Snow Catcher at depth 170m commence recovery
25/11/2014 18:53	16	-59.9623	-46.1597	Snow Catcher 004 on deck
25/11/2014 19:04	14	-59.9624	-46.1597	CTD 002 at the surface
25/11/2014 19:06	14	-59.9624	-46.1597	CTD 002 on deck
25/11/2014 19:13	17	-59.9624	-46.1597	Bongo Net 007 off the deck

25/11/2014 19:15	17	-59.9624	-46.1597	Bongo Net 007 deployed
25/11/2014 19:17	17	-59.9624	-46.1597	Bongo Net 007 at 100m. Commenced recovery
25/11/2014 19:22	17	-59.9624	-46.1597	Bongo Net 007 at the surface
25/11/2014 19:23	17	-59.9624	-46.1597	Bongo Net 007 on deck
25/11/2014 19:28	18	-59.9624	-46.1597	Bongo Net 008 off deck
25/11/2014 19:29	18	-59.9624	-46.1597	Bongo Net 008 deployed
25/11/2014 19:35	18	-59.9624	-46.1597	Bongo Net 008 at 200m. Commenced recovery
25/11/2014 19:45	18	-59.9624	-46.1597	Bongo Net 008 at the surface
25/11/2014 19:46	18	-59.9624	-46.1597	Bongo Net 008 on deck
25/11/2014 22:59	19	-59.9623	-46.1598	Plankton Camera 002 off deck
25/11/2014 23:00	19	-59.9623	-46.1598	Plankton Camera 002 deployed
25/11/2014 23:43	19	-59.9623	-46.1597	Plankton Camera 002 recovered
25/11/2014 23:58	20	-59.9623	-46.1597	Bongo Net 009 deployed
26/11/2014 00:12	20	-59.9623	-46.1598	Bongo Net 009 recovered
26/11/2014 00:18	21	-59.9623	-46.1598	Bongo net 010 deployed
26/11/2014 00:25	21	-59.9623	-46.1598	Bongo Net 010 at depth
26/11/2014 00:42	21	-59.9623	-46.1597	Bongo net 010 on deck
26/11/2014 00:55	22	-59.9623	-46.1597	Snow Catcher 005 deployed
26/11/2014 01:03	22	-59.9623	-46.1597	Snow Catcher 005 recovered
26/11/2014 01:19	23	-59.9623	-46.1597	Snow Catcher 006 deployed
26/11/2014 01:32	23	-59.9623	-46.1597	Snow Catcher 006 on deck
26/11/2014 01:41	24	-59.9623	-46.1597	Off DP man. to start tow position
26/11/2014 02:09	24	-59.9901	-46.2146	V/L at 2 kts Midnight Mocness deployed
26/11/2014 03:46	24	-59.9496	-46.1349	Mocness at depth 1000m, wire out 2172m. Commence hauling
26/11/2014 05:12	24	-59.9163	-46.0608	Commence recovery of Mocness 001 to deck
26/11/2014 05:18	24	-59.9141	-46.0551	Mocness 001 fully recovered
26/11/2014 05:26	Ice Station	-59.9111	-46.0472	V/l repositioning back to ice station
26/11/2014 06:07	Ice Station	-59.9629	-46.1641	V/l on DP
26/11/2014 06:10	25	-59.9627	-46.1633	Plankton Camera 003 deployed

26/11/2014 06:51	25	-59.9624	-46.1601	Plankton Camera 003 recovered
26/11/2014 07:05	26	-59.9624	-46.1601	Bongo Net 011 off deck
26/11/2014 07:06	26	-59.9624	-46.1601	Bongo Net 011 deployed
26/11/2014 07:10	26	-59.9624	-46.1601	Bongo Net 011 at 100m. Commenced recovery
26/11/2014 07:17	26	-59.9624	-46.1601	Bongo Net 011 at the surface
26/11/2014 07:18	26	-59.9624	-46.1602	Bongo Net 011 on deck
26/11/2014 07:20	27	-59.9624	-46.1601	Bongo Net 012 off deck
26/11/2014 07:21	27	-59.9624	-46.1601	Bongo Net 012 deployed
26/11/2014 07:28	27	-59.9624	-46.1601	Bongo Net 012 at 200m. Commenced recovery
26/11/2014 07:42	27	-59.9624	-46.1601	Bongo Net 012 at the surface
26/11/2014 07:43	27	-59.9624	-46.1601	Bongo Net 012 on deck
26/11/2014 10:27	Ice Station	-59.9624	-46.1601	Vessel off DP and repositioning for LHPR 001
26/11/2014 10:50	28	-59.9687	-46.2285	LHPR 001 off the deck. Heading 080°. Speed 2.0kts
26/11/2014 10:52	28	-59.9682	-46.2262	LHPR 001 deployed
26/11/2014 12:17	28	-59.9616	-46.1392	Commence recovery of LHPR
26/11/2014 13:39	28	-59.9483	-46.0288	LHPR 001 on deck, increase speed and man. back to ice station
26/11/2014 14:12	Ice Station	-59.9629	-46.1602	V/L on DP full auto pos
26/11/2014 14:40	29	-59.9629	-46.1603	Bongo Net 013 deployed
26/11/2014 14:42	29	-59.9629	-46.1603	Bongo Net 013 at depth 100m commence recovery
26/11/2014 14:48	29	-59.9629	-46.1602	Bongo Net 013 on deck
26/11/2014 14:52	30	-59.9629	-46.1602	Bongo Net 014 deployed
26/11/2014 14:57	30	-59.9629	-46.1603	Bongo Net 014 at 200m commence recovery
26/11/2014 15:08	30	-59.9629	-46.1602	Bongo Net 014 on deck
26/11/2014 15:28	31	-59.9629	-46.1602	Plankton Camera 004 deployed
26/11/2014 15:47	31	-59.9629	-46.1602	Plankton Camera at depth 250m commence hauling
26/11/2014 16:11	31	-59.9629	-46.1602	Plankton Camera 004 recovered
26/11/2014 16:28	32	-59.9629	-46.1602	CTD 003 deployed
26/11/2014 16:44	33	-59.9629	-46.1603	Snow Catcher 007 deployed
26/11/2014 16:48	33	-59.9629	-46.1602	Snow Catcher at depth 60m commence recovery

26/11/2014 16:51	33	-59.9629	-46.1602	Snow Catcher 007 recovered
26/11/2014 16:55	32	-59.9629	-46.1602	CTD 003 at depth. Wire out 1000m. EA600 water depth 4844m. Commenced recovery
26/11/2014 17:00	34	-59.9629	-46.1602	Snow Catcher 008 deployed
26/11/2014 17:06	34	-59.9629	-46.1602	Snow Catcher at depth 160m commence recovery
26/11/2014 17:12	34	-59.9629	-46.1603	Snow Catcher 008 recovered
26/11/2014 17:29	32	-59.9629	-46.1602	CTD 003 on deck
26/11/2014 17:41	035 Test Mocness	-59.9629	-46.1602	V/l off DP for test Mocness
26/11/2014 17:57	035 Test Mocness	-59.9640	-46.1423	Test Mocness deployed
26/11/2014 18:04	035 Test Mocness	-59.9648	-46.1338	Mocness at depth 40m commence hauling
26/11/2014 18:11	035 Test Mocness	-59.9654	-46.1254	Test Mocness recovered
26/11/2014 18:48	36	-59.9545	-46.2479	Mocness 002 deployed at 2kts downwind
26/11/2014 20:05	36	-59.9621	-46.1628	Mocness 002. Wire out 1943m. Commenced recovery
26/11/2014 21:22	36	-59.9703	-46.0991	Mocness 002 at the surface
26/11/2014 21:25	36	-59.9707	-46.0967	Mocness 002 on deck
26/11/2014 21:48	37	-59.9738	-46.0771	CPR 003 off the deck. Vessel head to wind at 1.5 kts
26/11/2014 21:49	37	-59.9739	-46.0762	CPR 003 deployed. Vessel increasing to passage speed
26/11/2014 21:56	37	-59.9758	-46.0493	CPR 003 full deployed. Vessel at passage speed
27/11/2014 12:15	37	-57.7222	-43.7940	Reducing speed for CPR recovery
27/11/2014 13:05	37	-57.6070	-43.6746	CPR on deck
27/11/2014 13:10	Station 5	-57.6057	-43.6728	V/L on DP full auto pos
27/11/2014 13:15	38	-57.6057	-43.6729	Bongo Net 015 deployed
27/11/2014 13:20	38	-57.6057	-43.6729	Bongo Net 015 at 200m commence recovery
27/11/2014 13:30	38	-57.6057	-43.6728	Bongo Net 015 on deck
27/11/2014 13:32	39	-57.6057	-43.6728	V/l off DP increasing to 2kts for CPR deployment
27/11/2014 13:38	39	-57.6044	-43.6696	CPR 004 deployed at 2kts increasing to passage speed
27/11/2014 13:47	Station 5	-57.5941	-43.6624	V/l at passage speed
28/11/2014 08:00	39	-55.2514	-41.2699	Commenced recovery of CPR 004
28/11/2014 08:08	39	-55.2444	-41.2474	CPR 004 at the surface

28/11/2014 08:09	39	-55.2444	-41.2454	CPR 004 on deck. Repositioning vessel for station.
28/11/2014 08:23	Station 6	-55.2438	-41.2617	Vessel set up on station in full auto pos DP 500m downwind of mooring
28/11/2014 08:23	40	-55.2438	-41.2617	Bongo Net 016 off the deck
28/11/2014 08:24	40	-55.2438	-41.2617	Bongo Net 016 deployed
28/11/2014 08:30	40	-55.2438	-41.2618	Bongo Net 016 at 200m. Commenced recovery
28/11/2014 08:38	40	-55.2438	-41.2618	Bongo Net 016 at the surface
28/11/2014 08:39	40	-55.2438	-41.2618	Bongo Net 016 on deck
28/11/2014 08:56	041- Southern Mooring Recovery	-55.2438	-41.2617	Southern Mooring Recovery. Ranged and released.
28/11/2014 08:58	41	-55.2438	-41.2618	Southern Mooring Recovery. Mooring on the surface.
28/11/2014 09:00	41	-55.2438	-41.2618	Southern Mooring Recovery. Vessel off DP and repositioning for recovery
28/11/2014 09:12	41	-55.2450	-41.2595	Southern Mooring Recovery. Vessel in JSAH DP approaching mooring.
28/11/2014 09:21	41	-55.2475	-41.2645	Southern Mooring Recovery. Mooring hooked.
28/11/2014 09:27	41	-55.2482	-41.2662	Southern Mooring Recovery. Top float clear of the water.
28/11/2014 09:28	41	-55.2486	-41.2669	Southern Mooring Recovery. Top flaot on deck. Recovering mooring.
28/11/2014 10:23	41	-55.2528	-41.2996	Southern Mooring Recovery. Mooring fully recovered to deck. vessel stopped on DP.
28/11/2014 11:18	42	-55.2527	-41.3022	CTD 004 deployed
28/11/2014 11:33	43	-55.2527	-41.3022	Snow Catcher 009 deployed
28/11/2014 11:36	43	-55.2527	-41.3021	Snow Catcher 009 at depth 55m commence recovery
28/11/2014 11:39	43	-55.2527	-41.3021	Snow Catcher 009 on deck
28/11/2014 11:51	44	-55.2527	-41.3022	Snow Catcher 010 deployed
28/11/2014 11:56	44	-55.2527	-41.3021	Snow Catcher 010 at 155m commence recovery
28/11/2014 12:02	44	-55.2527	-41.3023	Snow Catcher 010 at the surface
28/11/2014 12:03	44	-55.2527	-41.3023	Snow Catcher 010 on deck
28/11/2014 12:20	42	-55.2528	-41.3024	CTD 004 at depth. Wire out 3399m (EA600 depth 3438m). Commenced recovery.
28/11/2014 13:44	42	-55.2527	-41.3024	CTD 004 on deck
28/11/2014 14:07	Station 6	-55.2527	-41.3024	V/L off DP repos. for mocness

28/11/2014 14:23	45	-55.2735	-41.3168	in position for Mocness STW 2.0kts
28/11/2014 14:30	45	-55.2735	-41.3167	Mocness 003 deployed
28/11/2014 14:36	45	-55.2712	-41.3159	No data fom mocness recovered to deck. V/L on DP full auto pos
28/11/2014 14:50	45	-55.2699	-41.3128	off dp increase to 2kts STW for redeployment
28/11/2014 14:53	45	-55.2690	-41.3103	Mocness 003 redeployed
28/11/2014 16:24	45	-55.2364	-41.2327	Mocness at depth 1087m wire out 2200m. Commence hauling
28/11/2014 17:50	45	-55.2422	-41.1313	Mocness 003 at the surface
28/11/2014 17:54	45	-55.2427	-41.1266	Mocness 003 recovered
28/11/2014 17:56	Station 6	-55.2430	-41.1240	V/l re-positioning back to station
28/11/2014 18:31	Station 6	-55.2493	-41.2630	V/l on DP
28/11/2014 18:43	46	-55.2484	-41.2640	Plankton Camera 005 deployed
28/11/2014 19:03	46	-55.2484	-41.2640	Plankton Camera 005 at depth 250m commence hauling
28/11/2014 19:24	46	-55.2485	-41.2640	Plankton Camera 005 at the surface
28/11/2014 19:25	46	-55.2485	-41.2639	Plankton Camera 005 on deck
28/11/2014 19:29	47	-55.2485	-41.2640	Bongo Net 017 off the deck
28/11/2014 19:30	47	-55.2484	-41.2640	Bongo Net 017 deployed
28/11/2014 19:33	47	-55.2484	-41.2639	Bongo net 017 at 100m. Commenced recovery
28/11/2014 19:38	47	-55.2484	-41.2640	Bongo Net 017 at the surface
28/11/2014 19:39	47	-55.2484	-41.2640	Bongo Net 017 on deck
28/11/2014 19:44	48	-55.2484	-41.2640	Bongo Net 018 off the deck
28/11/2014 19:45	48	-55.2484	-41.2640	Bongo Net 018 deployed
28/11/2014 19:51	48	-55.2484	-41.2640	Bongo Net 018 at 200m. Commenced recovery
28/11/2014 19:59	48	-55.2485	-41.2640	Bongo Net 018 at the surface
28/11/2014 20:00	48	-55.2485	-41.2640	Bongo Net 018 on deck
28/11/2014 20:13	49	-55.2484	-41.2640	Snow Catcher 011 off the deck
28/11/2014 20:14	49	-55.2484	-41.2640	Snow Catcher 011 deployed
28/11/2014 20:16	49	-55.2484	-41.2640	Snow Catcher 011 at 55m. Commenced recovery
28/11/2014 20:19	49	-55.2484	-41.2640	Snow Catcher 011 at the surface
28/11/2014 20:21	49	-55.2484	-41.2640	Snow Catcher 011 on deck

28/11/2014 20:29	50	-55.2484	-41.2640	Snow Catcher 012 off the deck
28/11/2014 20:30	50	-55.2484	-41.2640	Snow Catcher 012 deployed
28/11/2014 20:36	50	-55.2484	-41.2640	Snow catcher 012 at 155m. Commenced recovery
28/11/2014 20:41	50	-55.2484	-41.2640	Snow Catcher 012 at the surface
28/11/2014 20:43	50	-55.2484	-41.2640	Snow Catcher 012 on deck. Vessel repositioning for LHPR deployment
28/11/2014 21:10	51	-55.2864	-41.2797	LHPR 002 off the deck
28/11/2014 21:12	51	-55.2853	-41.2795	LHPR 002 deployed
28/11/2014 22:44	51	-55.2320	-41.2585	LHPR 002. Wire out 2266m. Commenced recovery
29/11/2014 00:14	51	-55.2055	-41.1697	LHPR 002 on deck
29/11/2014 00:16	51	-55.2061	-41.1665	V/L man. back to station
29/11/2014 00:55	Station 6	-55.2477	-41.2662	V/L on DP
29/11/2014 01:02	52	-55.2477	-41.2662	Plankton Camera 006 deployed
29/11/2014 01:40	52	-55.2477	-41.2662	Plankton Camera 006 on deck
29/11/2014 01:54	53	-55.2477	-41.2662	Bongo Net 019 deployed
29/11/2014 01:57	53	-55.2477	-41.2662	Bongo Net 019 at 100m commence recovery
29/11/2014 02:05	53	-55.2477	-41.2662	Bongo Net 019 on deck
29/11/2014 02:42	54	-55.2476	-41.2661	CTD 005 deployed
29/11/2014 03:04	54	-55.2476	-41.2662	CTD 005 at depth. Wire out 1000m. EA600 3376m. Commenced recovery
29/11/2014 03:06	55	-55.2476	-41.2661	Snow Catcher 013 deployed
29/11/2014 03:09	55	-55.2477	-41.2661	Snow Catcher 013 at depth 35m commence recovery
29/11/2014 03:13	55	-55.2477	-41.2661	Snow Catcher 013 on deck. Failed to fire.
29/11/2014 03:16	55	-55.2476	-41.2662	Snow Catcher 013 re-deployed
29/11/2014 03:19	55	-55.2477	-41.2661	Snow Catcher 013 at depth 35m commence recovery
29/11/2014 03:21	55	-55.2477	-41.2662	Snow Catcher 013 on deck
29/11/2014 03:41	54	-55.2477	-41.2661	CTD 005 on deck
29/11/2014 03:53	56	-55.2477	-41.2661	Snow Catcher 014 deployed
29/11/2014 03:59	56	-55.2477	-41.2661	Snow Catcher 014 at depth 135m commence recovery
29/11/2014 04:04	56	-55.2477	-41.2660	Snow Catcher 014 on deck
29/11/2014 04:28	57	-55.2477	-41.2661	V/l off DP increasing to 2kts for Mocness deployment

29/11/2014 04:35	57	-55.2442	-41.2687	Mocness 004 deployed
29/11/2014 06:07	57	-55.1989	-41.2945	Mocness 004 at depth 2100m commence hauling
29/11/2014 07:23	57	-55.1655	-41.3107	Mocness 004 at the surface.
29/11/2014 07:29	57	-55.1627	-41.3128	Mocness 004 on deck. Repositioning vessel for Phankton Camera
29/11/2014 08:14	Station 6	-55.2478	-41.2649	Vessel set up on station in full auto pos DP
29/11/2014 08:16	58	-55.2477	-41.2648	Plankton Camera 007 off the deck
29/11/2014 08:17	58	-55.2477	-41.2648	Plankton Camera 007 deployed
29/11/2014 08:36	58	-55.2478	-41.2648	Plankton Camera 007 at 250m. Commenced recovery
29/11/2014 08:56	58	-55.2478	-41.2649	Plankton Camera 007 at the surface
29/11/2014 08:57	58	-55.2478	-41.2649	Plankton Camera 007 on deck
29/11/2014 09:05	59	-55.2478	-41.2648	Bongo Net 020 off the deck
29/11/2014 09:07	59	-55.2478	-41.2648	Bongo Net 020 deployed
29/11/2014 09:11	59	-55.2478	-41.2648	Bongo Net 020 at 100m. Commenced recovery
29/11/2014 09:17	59	-55.2478	-41.2648	Bongo Net 020 at the surface
29/11/2014 09:18	59	-55.2478	-41.2649	Bongo net 020 on deck
29/11/2014 09:20	60	-55.2477	-41.2649	Bongo Net 021 off the deck
29/11/2014 09:21	60	-55.2477	-41.2649	Bongo Net 021 deployed
29/11/2014 09:28	60	-55.2478	-41.2649	Bongo Net 021 at 200m. Commenced recovery
29/11/2014 09:41	60	-55.2477	-41.2649	Bongo Net 021 at the surface
29/11/2014 09:42	60	-55.2477	-41.2649	Bongo Net 021 on deck
29/11/2014 09:53	61	-55.2476	-41.2649	Snow Catcher 015 off the deck
29/11/2014 09:54	61	-55.2477	-41.2649	Snow Catcher 015 deployed
29/11/2014 09:56	61	-55.2476	-41.2649	Snow Catcher 015 at 35m. Commenced recovery
29/11/2014 09:57	61	-55.2476	-41.2649	Snow Catcher 015 at the surface
29/11/2014 09:58	61	-55.2476	-41.2649	Snow Catche 015 on deck
29/11/2014 10:06	62	-55.2476	-41.2650	Snow Catcher 016 off the deck
29/11/2014 10:07	62	-55.2477	-41.2649	Snow Catcher 016 deployed
29/11/2014 10:11	62	-55.2477	-41.2649	Snow Catcher 016 at 135m. Commenced recovery
29/11/2014 10:16	62	-55.2477	-41.2650	Snow Catcher 016 at the surface

29/11/2014 10:18	62	-55.2477	-41.2650	Snow Catcher 016 on deck
29/11/2014 10:36	Station 6	-55.2476	-41.2650	Aft deck reconfigured for LHPR. Vessel off DP and repositioning for LHPR deployment
29/11/2014 11:06	63	-55.2835	-41.2444	LHPR 003 deployed
29/11/2014 12:22	63	-55.2333	-41.2723	LHPR 003 at depth 1000m wire out 2336m commence recovery
29/11/2014 13:51	63	-55.1816	-41.3045	LHPR 003 on deck
29/11/2014 13:54	63	-55.1780	-41.3071	V/L increase speed and man. to station
29/11/2014 14:28	Station 6	-55.2475	-41.2650	V/L on DP full auto pos
29/11/2014 14:32	64	-55.2475	-41.2650	Plankton camera 008 deployed
29/11/2014 14:52	64	-55.2475	-41.2651	Plankton camera 008 at depth 250m commence recovery
29/11/2014 15:13	64	-55.2475	-41.2650	Plankton Camera 008 on deck
29/11/2014 15:17	65	-55.2475	-41.2650	Bongo Net 022 deployed
29/11/2014 15:21	65	-55.2475	-41.2649	Bongo Net 022 at 100m commenced recovery
29/11/2014 15:27	65	-55.2475	-41.2650	Bongo Net 022 on deck
29/11/2014 15:29	66	-55.2475	-41.2650	Bongo Net 023 deployed
29/11/2014 15:35	66	-55.2475	-41.2649	Bongo Net 023 at 200m commenced recovery
29/11/2014 15:45	66	-55.2475	-41.2650	Bongo Net 023 on deck
29/11/2014 16:01	67	-55.2475	-41.2650	CTD 006 deployed
29/11/2014 16:05	67	-55.2475	-41.2650	CTD 006 failed and recovered
29/11/2014 16:30	67	-55.2475	-41.2650	CTD 006 deployed
29/11/2014 16:33	67	-55.2476	-41.2650	CTD 006 failed and recovered
29/11/2014 17:18	67	-55.2475	-41.2651	CTD 006 deployed
29/11/2014 17:32	68	-55.2474	-41.2651	Snow Catcher 017 deployed
29/11/2014 17:35	68	-55.2475	-41.2651	Snow catcher 017 at 45m. Commenced recovery
29/11/2014 17:37	68	-55.2475	-41.2651	Snow Catcher 017 on deck
29/11/2014 17:42	67	-55.2475	-41.2651	CTD 006 at depth. Wire out 1000m. EA600 3376m. Commenced recovery
29/11/2014 17:47	69	-55.2475	-41.2651	Snow Catcher 018 deployed
29/11/2014 18:02	69	-55.2475	-41.2651	Snow Catcher 018 at 450m. Commenced recovery
29/11/2014 18:11	67	-55.2475	-41.2651	CTD 006 recovered

29/11/2014 18:21	69	-55.2475	-41.2651	Snow Catcher 018 on deck
30/11/2014 11:49	Station 6	-55.2477	-41.2652	V/L off DP repositioning for mooring deployment
30/11/2014 12:14	070- Southern Mooring Deployment	-55.2222	-41.2272	V/L on DP 2' downwind of mooring deployment position
30/11/2014 12:45	Southern Mooring	-55.2227	-41.2280	V/L tracking 220 x 0.1kts hdg 210
30/11/2014 13:15	Southern Mooring	-55.2240	-41.2299	VHF beacon tested and signal recieved 160.725 MHz
30/11/2014 13:18	Southern Mooring	-55.2241	-41.2301	Commence deploying Mooring increase SOG to 0.5kts
30/11/2014 13:20	Southern Mooring	-55.2244	-41.2305	Main buoy deployed
30/11/2014 13:25	Southern Mooring	-55.2247	-41.2310	V/L reduce SOG to 0.3kts
30/11/2014 13:37	Southern Mooring	-55.2255	-41.2321	Seaguard current metre and O2 sensor deployed
30/11/2014 13:38	Southern Mooring	-55.2256	-41.2322	Trimsin buoys and water sampler deployed V/L increase SOG to 0.5kts
30/11/2014 13:40	Southern Mooring	-55.2257	-41.2325	V/L increase SOG to 0.8kts for paying out of 1400m Kevlar rope
30/11/2014 13:42	Southern Mooring	-55.2260	-41.2330	Increase SOG to 1.5kts
30/11/2014 13:54	Southern Mooring	-55.2291	-41.2376	Reducing SOG to 1.0kts
30/11/2014 14:05	Southern Mooring	-55.2314	-41.2408	V/L reducing SOG to 0.5kts
30/11/2014 14:16	Southern Mooring	-55.2329	-41.2431	Trimsin buoy cluster deployed
30/11/2014 14:21	Southern mooring	-55.2337	-41.2442	Current metre and sediment trap deployed
30/11/2014 14:21	Southern Mooring	-55.2337	-41.2442	V/L increasing SOG to 1.5kts
30/11/2014 14:48	Southern Mooring	-55.2422	-41.2567	Reducing SOG to 1.2kts
30/11/2014 14:50	070- Southern Mooring Deployment	-55.2427	-41.2575	Mooring Buoy fully deployed weight deployed in position 55 14.5 S 041 15.4W
30/11/2014 15:36	070- Southern Mooring Deployment	-55.2428	-41.2575	Mooring pinged distance of 3355m
30/11/2014 16:14	Station 6	-55.2427	-41.2575	V/l off DP and proceeding
01/12/2014 19:55	Station 7	-54.1590	-36.6871	Vessel set up on station in full auto pos DP in Stromness Harbour for instrument calibrations
01/12/2014 20:21	71	-54.1589	-36.6872	Calibration CTD off the deck
01/12/2014 20:22	71	-54.1589	-36.6871	Calibration CTD (7) deployed
01/12/2014 20:26	71	-54.1589	-36.6872	Calibration CTD at depth. Wire out 50m (EA600 depth 90.6m). Commenced recovery

01/12/2014 20:30	71	-54.1589	-36.6872	Calibration CTD at the surface
01/12/2014 20:31	71	-54.1589	-36.6872	Calibration CTD (7) on deck
02/12/2014 14:20	72	-54.1585	-36.6934	RV Doughnut deployed
02/12/2014 15:02	72	-54.1584	-36.6934	RV Doughnut running repairs at the rail
02/12/2014 15:14	72	-54.1584	-36.6934	RV Doughnut re-deployed
02/12/2014 15:48	72	-54.1585	-36.6934	RV Doughnut at the rail
02/12/2014 16:03	72	-54.1585	-36.6934	RV Doughnut re-deployed
02/12/2014 16:50	72	-54.1585	-36.6934	RV Doughnut recovered. Calibrations complete
02/12/2014 17:42	Station 7	-54.1583	-36.6950	V/l off DP proceeding to KEP
03/12/2014 13:25	Station 8 Cumberland	-54.2029	-36.4528	V/L on DP Station 8
03/12/2014 13:53	73	-54.2025	-36.4538	SUCS 001 deployed
03/12/2014 13:58	73	-54.2026	-36.4538	SUCS recovered for wire rearrangement on gantry
03/12/2014 14:01	74	-54.2026	-36.4538	SUCS 001 redeployed
03/12/2014 14:11	74	-54.2026	-36.4538	SUCS 001 on the bottom
03/12/2014 14:18	74	-54.2026	-36.4539	move ahead 10m
03/12/2014 14:27	74	-54.2025	-36.4541	move ahead 10m
03/12/2014 14:36	74	-54.2025	-36.4541	Move ahead 10m
03/12/2014 14:57	74	-54.2024	-36.4543	Commence recovery of SUCS 001
03/12/2014 15:03	74	-54.2024	-36.4543	SUCS 001 recovered
03/12/2014 15:38	75	-54.2025	-36.4543	Bongo Net 024 deployed
03/12/2014 15:42	75	-54.2025	-36.4543	Bongo at depth 100m commence hauling
03/12/2014 15:48	75	-54.2025	-36.4543	Bongo net 024 on deck
03/12/2014 15:54	76	-54.2024	-36.4543	Bongo Net 025 deployed
03/12/2014 16:01	76	-54.2024	-36.4543	Bongo Net 025 at 200m commenced recovery
03/12/2014 16:16	76	-54.2024	-36.4543	Bongo net 025 on deck
03/12/2014 16:42	77	-54.2025	-36.4543	Box Corer 001 deployed
03/12/2014 16:50	77	-54.2024	-36.4543	Box Corer on the seabed
03/12/2014 16:51	77	-54.2024	-36.4543	Commence hauling Box Corer
03/12/2014 17:00	77	-54.2024	-36.4543	Box Corer 001 recovered

03/12/2014 17:35	Station 8	-54.2025	-36.4543	V/l off DP proceeding to next station
03/12/2014 18:03	Station 9 Cumberland East Bay	-54.2666	-36.4333	V/L on DP Station 9
03/12/2014 18:17	78	-54.2666	-36.4333	CTD 008 deployed
03/12/2014 18:25	78	-54.2665	-36.4333	CTD at depth 251m EA600 depth= 255m. Commence recovery
03/12/2014 18:43	78	-54.2666	-36.4333	CTD 008 on deck
03/12/2014 18:48	Station 9	-54.2665	-36.4333	V/l off DP proceeding to next station
03/12/2014 18:58	Station 10	-54.2780	-36.4385	V/l on DP (Station 10)
03/12/2014 19:11	79	-54.2779	-36.4379	SUCS 002 off the deck
03/12/2014 19:12	79	-54.2779	-36.4379	SUCS 002 deployed
03/12/2014 19:17	79	-54.2778	-36.4379	SUCS 002 on the seabed
03/12/2014 19:20	79	-54.2779	-36.4379	SUCS 002. Ships head 250Â°. Moving ahead 10m.
03/12/2014 19:23	79	-54.2780	-36.4381	SUCS 002. Ships head 250Â°. Moving ahead 10m.
03/12/2014 19:27	79	-54.2779	-36.4382	SUCS 002. Ships head 250Â°. Moving ahead 10m.
03/12/2014 19:34	79	-54.2780	-36.4384	SUCS 002. Ships head 250Â°. Moving ahead 10m.
03/12/2014 19:40	79	-54.2780	-36.4385	SUCS 002. Ships head 260Â°. Moving ahead 10m.
03/12/2014 19:46	79	-54.2781	-36.4387	SUCS 002. Ships head 260Â°. Moving ahead 10m.
03/12/2014 19:50	79	-54.2781	-36.4389	SUCS 002. Ships head 260Â°. Moving ahead 10m.
03/12/2014 19:54	79	-54.2780	-36.4390	SUCS 002. Ships head 260Â°. Moving ahead 10m.
03/12/2014 20:05	79	-54.2781	-36.4392	SUCS 002. Off the seabed. Commenced recovery
03/12/2014 20:10	79	-54.2778	-36.4393	SUCS 002 at the surface
03/12/2014 20:11	079 / Station 10	-54.2779	-36.4393	SUCS 002 on deck. Vessel remaining on station over night.
04/12/2014 21:20	Station 11	-54.2655	-36.4332	Vessel on DP (Station 11)
04/12/2014 21:42	80	-54.2666	-36.4332	Bongo Net 026 deployed
04/12/2014 21:47	80	-54.2666	-36.4332	Bongo Net 026 at 200m. Commenced recovery
04/12/2014 21:55	80	-54.2666	-36.4332	Bongo Net 026 at the surface
04/12/2014 21:56	80	-54.2666	-36.4332	Bongo Net 026 on deck
04/12/2014 22:19	Station 011	-54.2666	-36.4332	Deck secure. Vessel off station and proceeding
07/12/2014 18:33	WCB Shallow Mooring	-53.8048	-37.9324	V/l stopped on DP 500m downwind of WCB shallow mooring site

07/12/2014 18:36	WCB Shallow Mooring	-53.8047	-37.9322	V/l off DP moving towards mooring location hdg 320
07/12/2014 18:50	WCB Shallow Mooring	-53.8031	-37.9355	V/l stopped on DP getting readings from mooring
07/12/2014 18:56	WCB Shallow Mooring	-53.8031	-37.9356	No clear readings v/l moving ahead in DP hdg 325
07/12/2014 19:08	WCB Shallow Mooring	-53.8006	-37.9396	Vessel stopped 170m NW of deployment position. Hydrophone deployed.
07/12/2014 19:15	WCB Shallow Mooring	-53.8007	-37.9396	Hydrophone recovered.
07/12/2014 19:16	WCB Shallow Mooring	-53.8006	-37.9396	Vessel moving back over deployment position
07/12/2014 19:21	WCB Shallow Mooring	-53.8017	-37.9379	Vessel stopped over deployment position
07/12/2014 19:37	WCB Shallow Mooring	-53.8017	-37.9378	Vessel off DP and moving clear for RMT 8 test deployment
07/12/2014 20:06	81	-53.7900	-37.9502	RMT8 (001 Test). Commenced deployment
07/12/2014 20:11	81	-53.7878	-37.9545	RMT8 (001 Test). Deployed
07/12/2014 20:19	81	-53.7840	-37.9607	RMT8 (001 Test). Commenced recovery
07/12/2014 20:21	81	-53.7830	-37.9622	RMT8 (001 Test). At the surface
07/12/2014 20:28	81	-53.7798	-37.9667	RMT8 (001 Test). On deck
07/12/2014 20:53	81	-53.7658	-37.9822	Deck secure. Vessel repositioning for WCB Mooring acoustic search
07/12/2014 21:22	WCB Shallow Mooring	-53.8013	-37.9441	Commenced acoustic search pattern for mooring
07/12/2014 22:20	WCB Shallow Mooring	-53.8015	-37.9441	Completed acoustic search for mooring. Vessel departing for start of the Core Box
08/12/2014 06:36	WCB/ T1.1N	-53.3184	-39.6120	V/l on DP
08/12/2014 08:35	WCB/ T1.1N	-53.3171	-39.6139	Vessel off DP and positioning for start of Transect 1.1
08/12/2014 08:48	82	-53.3175	-39.6111	CPR 005 off the deck
08/12/2014 08:50	82	-53.3210	-39.6105	CPR 005 deployed
08/12/2014 09:06	WCB/ T1.1N	-53.3477	-39.6023	Commenced Transect 1.1
08/12/2014 09:06	83	-53.3477	-39.6023	XBT 001 deployed. Ships speed 6kts
08/12/2014 09:08	83	-53.3509	-39.6013	XBT 001 OK. Increasing ships speed to 10 knots
08/12/2014 09:12	82	-53.3601	-39.5985	CPR 005 fully deployed
08/12/2014 10:14	84	-53.5238	-39.5503	XBT 002 deployed. Ships speed 6kts
08/12/2014 10:20	84	-53.5336	-39.5473	XBT 002 OK. Increasing ships speed to 10 knots
08/12/2014 11:24	85	-53.7008	-39.4974	XBT 003 deployed. Speed 6kts
08/12/2014 11:29	85	-53.7089	-39.4951	XBT 003 OK. Increase speed to 10kts

08/12/2014 12:35	86	-53.8775	-39.4452	XBT 004 deployed. spd 6kts
08/12/2014 12:37	86	-53.8806	-39.4443	XBT 004 OK. Increase spd to 10kts
08/12/2014 13:44	87	-54.0553	-39.3916	XBT 005 deployed. spd 6kts
08/12/2014 13:46	87	-54.0586	-39.3906	XBT 005 ok. increase spd 10kts.
08/12/2014 13:49	WCB/ T1.1N	-54.0635	-39.3860	Transect 1.1 completed. man. to transect 1.2
08/12/2014 15:00	WCB/ T1.2S	-54.0141	-39.0918	Commence transect 1.2
08/12/2014 19:21	WCB/ T1.2S	-53.3149	-39.3046	Completed transect
08/12/2014 19:24	82	-53.3089	-39.3066	CPR 005. Commenced recovery
08/12/2014 19:27	82	-53.3055	-39.3077	CPR 005. At the surface
08/12/2014 19:28	82	-53.3045	-39.3080	CPR 005. On Deck. Relocating vessel for 1.2N station
08/12/2014 21:12	88	-53.4881	-39.2027	RMT8 (002) off the deck
08/12/2014 21:18	88	-53.4889	-39.2108	RMT8 (002) deployed
08/12/2014 21:54	88	-53.4944	-39.2632	RMT8 (002). Wire out 476m. Commenced recovery
08/12/2014 22:28	88	-53.4995	-39.3112	RMT8 (002) At the surface
08/12/2014 22:33	88	-53.5002	-39.3189	RMT8 (002). On deck
08/12/2014 22:41	88	-53.5013	-39.3316	Deck secure. Reposition vessel for Bongo and CTD
08/12/2014 23:08	WCB/1.2N	-53.4930	-39.2540	V/L on DP
08/12/2014 23:12	89	-53.4930	-39.2540	Bongo Net 027 deployed
08/12/2014 23:20	89	-53.4930	-39.2540	Bongo Net at 200m. Commenced recovery
08/12/2014 23:35	89	-53.4930	-39.2540	Bongo Net 027 on deck
08/12/2014 23:55	90	-53.4930	-39.2541	CTD 009 deployed
09/12/2014 00:17	90	-53.4930	-39.2541	CTD at depth 1000m (EA600 3158m) Commence recovery
09/12/2014 00:50	90	-53.4930	-39.2540	CTD 009 on deck
09/12/2014 01:00	WCB/1.2N	-53.4931	-39.2541	V/L off DP man. to 1000m contour
09/12/2014 02:51	91	-53.6385	-39.1903	RMT 003 deployed. STW 3kts
09/12/2014 03:04	91	-53.6432	-39.2040	Commence hauling for recovery
09/12/2014 03:16	91	-53.6471	-39.2187	RMT 003 recovered
09/12/2014 04:44	92	-53.8389	-39.0859	V/l heading downwind reduced to 2.5kts for RMT deployment
09/12/2014 04:47	92	-53.8393	-39.0893	RMT 004 deployed

09/12/2014 05:25	92	-53.8465	-39.1479	Commence hauling for recovery
09/12/2014 05:54	92	-53.8521	-39.1940	RMT 004 at the surface
09/12/2014 06:02	92	-53.8536	-39.2070	RMT 004 recovered
09/12/2014 06:14	WCB/1.2S	-53.8552	-39.2235	Decks secure. V/l repositioning for 1.2S station
09/12/2014 06:42	WCB/1.2S	-53.8468	-39.1409	V/l on DP
09/12/2014 06:59	93	-53.8465	-39.1426	Bongo Net 028 deployed
09/12/2014 07:08	93	-53.8468	-39.1426	Bongo Net 028 at 200m. Commenced recovery
09/12/2014 07:22	93	-53.8476	-39.1432	Bongo Net 028 at the surface
09/12/2014 07:24	93	-53.8477	-39.1433	Bongo Net 028 on deck
09/12/2014 07:39	94	-53.8477	-39.1433	CTD 010 off the deck
09/12/2014 07:41	94	-53.8477	-39.1433	CTD 010 deployed
09/12/2014 07:48	94	-53.8477	-39.1433	CTD 010 at depth. Wire out 200m (EA600 water depth 292m). Commenced recovery.
09/12/2014 08:04	94	-53.8477	-39.1433	CTD 010 at the surface
09/12/2014 08:06	94	-53.8477	-39.1434	CTD 010 on deck
09/12/2014 08:21	WCB/1.2S	-53.8477	-39.1434	Deck and gantry secure. Vessel off DP and proceeding to next site.
09/12/2014 09:35	95	-54.0006	-38.8258	CPR 006 off the deck
09/12/2014 09:37	95	-53.9987	-38.8227	CPR 006 deployed
09/12/2014 09:40	95	-53.9954	-38.8182	CPR 006 fully deployed.
09/12/2014 09:41	WCB/ T2.1	-53.9939	-38.8184	Commenced transect 2.1 (south to north)
09/12/2014 09:41	96	-53.9939	-38.8184	XBT 006 deployed. Ships speed 6kts
09/12/2014 09:42	96	-53.9923	-38.8192	XBT 006 ok. Increased ships speed to 10kts
09/12/2014 10:50	97	-53.8170	-38.8739	XBT 007 Deployed. Ships speed 6kts
09/12/2014 10:51	97	-53.8154	-38.8745	XBT 007. XBT ok increasing speed to 10kts
09/12/2014 11:00	WCB/ T2.1	-53.7925	-38.8773	A/C 005Â° to pass iceberg on track.
09/12/2014 12:04	98	-53.6405	-38.9291	XBT 008 deployed. Spd 6kts
09/12/2014 12:06	98	-53.6374	-38.9302	XBT 008 ok. Increase spd to 10kts
09/12/2014 13:15	99	-53.4630	-38.9841	XBT 009 deployed. Spd 6kts
09/12/2014 13:17	99	-53.4599	-38.9851	XBT 009 failed. Increase spd to 10kts

09/12/2014 14:25	100	-53.2880	-39.0382	XBT 010 deployed. Spd 6kts
09/12/2014 14:27	100	-53.2847	-39.0391	XBT 010 ok. increase spd 10kts
09/12/2014 14:28	WCB/2.1	-53.2829	-39.0398	Transect complete. man. to T2.2N
09/12/2014 19:58	WCB/ T2.2	-53.9631	-38.5262	Completed transect 2.2
09/12/2014 20:00	95	-53.9650	-38.5283	CPR 006. Commenced recovery
09/12/2014 20:04	95	-53.9668	-38.5326	CPR 006. CPR at the surface
09/12/2014 20:06	95	-53.9677	-38.5359	CPR 006. CPR on deck
09/12/2014 20:10	95	-53.9699	-38.5427	Deck secure. Vessel repositioning for RMT8 2.5 miles downwind of station WCB 2.2S
09/12/2014 21:24	WCB 2.2S	-53.7792	-38.5271	Sea conditions deemed too rough to deploy. Repositioning for CTD deployment
09/12/2014 21:46	WCB 2.2S	-53.7849	-38.5833	Vessel on DP station 2.2S
09/12/2014 21:58	101	-53.7848	-38.5833	CTD 011 off the deck
09/12/2014 22:00	101	-53.7849	-38.5832	CTD 011 deployed
09/12/2014 22:07	101	-53.7849	-38.5833	CTD 011. At depth. Wire out 196m (EA600 water depth 208m). Commenced recovery.
09/12/2014 22:19	101	-53.7849	-38.5833	CTD 011 at the surface
09/12/2014 22:21	101	-53.7849	-38.5833	CTD 011 on deck
10/12/2014 00:30	WCB 2.2S	-53.7849	-38.5832	V/L off DP
10/12/2014 01:23	102	-53.7647	-38.5884	RMT005 deployed
10/12/2014 01:46	102	-53.7671	-38.6131	RMT 005 on deck
10/12/2014 02:03	102	-53.7702	-38.6298	deck secure man. to next station
10/12/2014 04:00	WCB/ 2.2N	-53.4332	-38.6871	V/l on DP station 2.2N
10/12/2014 04:35	103	-53.4323	-38.6940	Bongo Net 029 deployed
10/12/2014 04:40	103	-53.4323	-38.6941	Bongo at depth 100m commence hauling
10/12/2014 04:48	103	-53.4324	-38.6947	Bongo Net 029 recovered
10/12/2014 04:54	104	-53.4323	-38.6946	Bongo Net 030 deployed
10/12/2014 05:00	104	-53.4324	-38.6953	Bongo at depth 200m commence hauling
10/12/2014 05:15	104	-53.4324	-38.6973	Bongo 030 recovered
10/12/2014 05:34	105	-53.4320	-38.6949	CTD 012 deployed

10/12/2014 05:55	105	-53.4320	-38.6949	CTD 012 at depth. Wire out 1000m. EA600 3500m. Commenced recovery
10/12/2014 06:42	105	-53.4320	-38.6949	CTD 012 on deck
10/12/2014 06:53	WCB/ 2.2N	-53.4321	-38.6949	V/l off DP proceeding to T3.1
10/12/2014 08:27	WCB 3.1	-53.2061	-38.4327	Vessel stopped on DP 1' NE of transect start position
10/12/2014 08:44	WCB 3.1	-53.2061	-38.4327	Vessel off DP and proceeding to start of Transect 3.1
10/12/2014 08:45	106	-53.2062	-38.4336	CPR 007 off the deck
10/12/2014 08:47	106	-53.2069	-38.4369	CPR 007 deployed
10/12/2014 08:50	106	-53.2082	-38.4438	CPR 007 fully deployed
10/12/2014 09:00	107	-53.2215	-38.4488	XBT 011 deployed. Ships speed 6kts
10/12/2014 09:00	WCB 3.1	-53.2215	-38.4488	Commenced Transect 3.1 (North to South)
10/12/2014 09:04	107	-53.2280	-38.4466	XBT 011 Failed.
10/12/2014 09:05	108	-53.2297	-38.4460	XBT 012 deployed. Ships speed 6kts
10/12/2014 09:08	108	-53.2348	-38.4443	XBT 012 ok. Increasing ships speed to 10kts
10/12/2014 10:10	109	-53.3983	-38.3918	XBT 013 deployed. Ships speed 6kts
10/12/2014 10:15	109	-53.4062	-38.3892	XBT 013 ok. Increasing ships speed to 10kts
10/12/2014 11:20	110	-53.5748	-38.3341	XBT 014 deployed. spd 6kts
10/12/2014 11:25	110	-53.5831	-38.3315	XBT 014 ok. increase spd 10kts
10/12/2014 12:28	111	-53.7497	-38.2780	XBT 015 deployed. Spd 6kts
10/12/2014 12:30	111	-53.7530	-38.2770	XBT 015 ok Increase to 10kts
10/12/2014 13:33	112	-53.9264	-38.2204	XBT 016 deployed. Spd 6kts
10/12/2014 13:35	112	-53.9298	-38.2197	XBT 016 ok increase to 10kts
10/12/2014 13:36	WCB 3.1	-53.9314	-38.2185	Transect completed man. to next
10/12/2014 14:37	WCB/ T3.2	-53.8936	-37.9213	Start of transect 3.2
10/12/2014 18:46	WCB/ T3.2	-53.1809	-38.1429	Completed transect 3.2
10/12/2014 18:47	106	-53.1806	-38.1458	Commenced recovery of CPR 007
10/12/2014 18:52	106	-53.1796	-38.1582	CPR 007 fully recovered
10/12/2014 19:04	WCB 3.2	-53.1770	-38.1907	Vessel repositioning 2 miles downwind of WCB 3.2N for RMT8
10/12/2014 20:13	113	-53.3669	-38.1372	RMT8 (006). Commenced deployment
10/12/2014 20:18	113	-53.3663	-38.1316	RMT8 (006). Deployed

10/12/2014 20:48	113	-53.3632	-38.1033	RMT8 (006). Wire out 421m. Commenced recovery
10/12/2014 21:17	113	-53.3603	-38.0764	RMT8 (006) at the surface
10/12/2014 21:22	113	-53.3596	-38.0717	RMT8 (006) on deck
10/12/2014 21:25	WCB 3.2N	-53.3592	-38.0686	Aft Deck secure. Vessel repositioning for Bong Net and CTD deployment
10/12/2014 21:42	WCB 3.2N	-53.3613	-38.0829	Vessel set up on station in full auto pos DP
10/12/2014 21:43	114	-53.3613	-38.0829	Bongo net 031 off the deck
10/12/2014 21:44	114	-53.3613	-38.0830	Bongo Net 031 deployed
10/12/2014 21:49	114	-53.3612	-38.0830	Bongo Net 031 at 200m. Commenced recovery
10/12/2014 21:59	114	-53.3612	-38.0830	Bongo Net 031 at the surface
10/12/2014 22:00	114	-53.3612	-38.0830	Bongo Net 031 on deck
10/12/2014 22:16	115	-53.3613	-38.0830	CTD 013 off the deck
10/12/2014 22:18	115	-53.3613	-38.0829	CTD 013 deployed
10/12/2014 22:38	115	-53.3613	-38.0829	CTD 013 at depth. Wire out 1000m (EA600 water depth 2665m). Commenced recovery
10/12/2014 23:08	115	-53.3612	-38.0829	CTD on deck
10/12/2014 23:20	WCB 3.2N	-53.3612	-38.0829	Off DP man. to target fishing
11/12/2014 01:52	116	-53.6041	-38.0129	RMT 007 deployed
11/12/2014 02:27	116	-53.6117	-37.9778	RMT 007 on deck
11/12/2014 03:13	WCB 3.2	-53.5921	-38.0491	Increase speed proceeding to next station (3.2S)
11/12/2014 03:54	117	-53.6924	-38.0232	V/l 2nm downwind of station 3.2S
11/12/2014 03:58	117	-53.6952	-38.0183	RMT 008 deployed
11/12/2014 04:08	117	-53.6996	-38.0084	Hauling RMT 008 visual check net
11/12/2014 04:15	117	-53.7027	-37.9997	Continue deployment of RMT 008
11/12/2014 04:33	117	-53.7101	-37.9800	Commence hauling RMT for recovery
11/12/2014 05:00	117	-53.7206	-37.9479	RMT 008 fully recovered
11/12/2014 05:18	WCB/ 3.2S	-53.7312	-37.9322	Deck secure. V/l repositioning for station 3.2S
11/12/2014 05:36	WCB/ 3.2S	-53.7139	-37.9717	V/l on DP station 3.2S
11/12/2014 05:40	118	-53.7142	-37.9681	Bongo Net 032 deployed
11/12/2014 05:46	118	-53.7142	-37.9676	Bongo at depth 100m commence hauling

11/12/2014 05:55	118	-53.7143	-37.9674	Bongo Net 032 recovered
11/12/2014 06:13	119	-53.7140	-37.9661	CTD 014 deployed
11/12/2014 06:20	119	-53.7140	-37.9661	CTD at depth 125m EA600 depth= 133m. Commence recovery
11/12/2014 06:36	119	-53.7140	-37.9661	CTD 014 on deck
11/12/2014 06:49	WCB/ 3.2S	-53.7140	-37.9661	V/l off DP proceeding to T4.1
11/12/2014 08:18	WCB 4.1	-53.8832	-37.6986	Vesel stopped on DP 1.3' south east of transect start position.
11/12/2014 08:42	WCB 4.1	-53.8832	-37.6986	Vessel off DP and proceeding to transect start position
11/12/2014 08:44	120	-53.8828	-37.7006	CPR 008 off the deck
11/12/2014 08:46	120	-53.8820	-37.7042	CPR 008 deployed
11/12/2014 08:49	120	-53.8804	-37.7116	CPR 008 fully deployed
11/12/2014 09:00	WCB 4.1	-53.8685	-37.7280	Commenced transect 4.1
11/12/2014 09:00	121	-53.8685	-37.7280	XBT 017 deployed. Ships speed 6kts
11/12/2014 09:01	121	-53.8669	-37.7286	XBT 017 ok. Increasing ships speed to 10kts
11/12/2014 10:08	122	-53.6927	-37.7874	XBT 018 deployed. Ships speed 6kts
11/12/2014 10:09	122	-53.6912	-37.7880	XBT 018 ok. Increasing ships speed to 10kts
11/12/2014 11:15	123	-53.5187	-37.8461	XBT 019 deployed. spd 6kts
11/12/2014 11:20	123	-53.5100	-37.8491	XBT 019 ok. increase to 10kts
11/12/2014 12:26	124	-53.3371	-37.9037	XBT 020 deployed. spd 6kts
11/12/2014 12:32	124	-53.3272	-37.9066	XBT 020 OK. Increase spd to 10kts
11/12/2014 13:34	125	-53.1643	-37.9642	XBT 021 deployed. speed 6kts
11/12/2014 13:36	125	-53.1611	-37.9653	XBT 021 ok. increase to 10kts
11/12/2014 13:37	WCB 4.1	-53.1591	-37.9659	Transect completed. man. to next transect
11/12/2014 14:12	WCB 4.2N	-53.1424	-37.8354	Commence transect
11/12/2014 14:16	126	-53.1487	-37.8322	XBT 022 deployed. spd 6kts
11/12/2014 14:21	126	-53.1572	-37.8292	XBT 022 ok. increase to 10kts
11/12/2014 15:28	127	-53.3240	-37.7734	XBT 023 deployed at 6kts
11/12/2014 15:34	127	-53.3361	-37.7692	XBT 023 ok. increase to 10kts
11/12/2014 16:38	128	-53.5008	-37.7137	XBT 024 deployed at 6kts
11/12/2014 16:45	128	-53.5139	-37.7094	XBT 024 ok. Increasing speed to 10kts

11/12/2014 17:46	129	-53.6765	-37.6544	XBT 025 deployed at 6kts
11/12/2014 17:50	129	-53.6841	-37.6519	XBT 025 ok. Increasing speed to 10kts
11/12/2014 18:52	130	-53.8530	-37.5945	XBT 026 deployed at 6kts
11/12/2014 18:56	130	-53.8597	-37.5938	XBT 026 ok. End of transect 4.2
11/12/2014 18:57	120	-53.8604	-37.5957	CPR 008. Commenced recovery
11/12/2014 19:02	120	-53.8629	-37.6055	CPR 008 at the surface
11/12/2014 19:04	120	-53.8639	-37.6093	CPR 008 on deck
11/12/2014 19:32	WCB 4.2	-53.8718	-37.6541	Proceeding to a position 2 miles downwind of station 2.2S for RMT fishing
11/12/2014 20:23	131	-53.8449	-37.9372	Swarm detected. Plot marked and vessel repositioning
11/12/2014 20:46	131	-53.8451	-37.9354	RMT8 (009) Vessel repositioned 4 cables down wind of swarm. Commenced RMT8 deployment
11/12/2014 20:49	131	-53.8448	-37.9390	TMT8 (009) deployed
11/12/2014 20:53	131	-53.8443	-37.9443	RMT8 (009). cable out 68m. Commenced recovery
11/12/2014 20:57	131	-53.8439	-37.9497	RMT8 (009) at the surface
11/12/2014 21:02	131	-53.8433	-37.9571	RMT8 (009) on deck
11/12/2014 21:05	131	-53.8430	-37.9620	Deck secure. Resuming passage to station 2.2N
11/12/2014 22:53	132	-53.7978	-38.5222	RMT8 (010). Commenced deployment. Vessel 2 miles downwind of station 2.2N
11/12/2014 22:57	132	-53.7971	-38.5268	RMT8 (010) deployed
11/12/2014 23:51	132	-53.7835	-38.5877	RMT8 (010) on deck
12/12/2014 02:00	133	-53.4516	-38.6454	RMT8 (011) deployed
12/12/2014 03:14	133	-53.4189	-38.7339	RMT 011 recovered
12/12/2014 03:24	WCB/ 2.2N	-53.4140	-38.7487	Deck secure. V/l proceeding to Northern Mooring location
12/12/2014 10:58	P3 Northern Mooring	-52.8090	-40.0497	Vessel stopped on station in DP two miles down wind of the Northern mooring position
12/12/2014 16:12	P3 Northern Mooring	-52.8283	-40.0618	V/l repositioned to 2nm downwind of mooring site
12/12/2014 17:21	P3 Northern Mooring	-52.7916	-40.0562	V/l repositioned to 2nm downwind of mooring site
12/12/2014 17:38	P3 Northern Mooring	-52.7929	-40.0600	Commence deployment of P3 Northern Mooring STW 1kt
12/12/2014 17:41	P3 Northern Mooring	-52.7933	-40.0611	Main buoy & SBE CTD deployed

12/12/2014 17:58	P3 Northern Mooring	-52.7954	-40.0670	Sediment trap Seaguard current meter & o2 sensor deployed
12/12/2014 18:11	P3 Northern Mooring	-52.7975	-40.0732	Trimsin buoy cluster deployed
12/12/2014 18:13	P3 Northern Mooring	-52.7979	-40.0743	Water sampler & CTD deployed
12/12/2014 18:42	P3 Northern Mooring	-52.8046	-40.0930	Trimsin buoy cluster deployed
12/12/2014 18:52	P3 Northern Mooring	-52.8054	-40.0956	Sediment trap deployed
12/12/2014 18:53	P3 Northern Mooring	-52.8056	-40.0961	Aquadop current meter deployed
12/12/2014 19:49	P3 Northern Mooring	-52.8140	-40.1189	Weight deployed. Water depth 3787m
12/12/2014 19:57	P3 Northern Mooring	-52.8149	-40.1214	Vessel stopped in DP to range mooring. Approx position 52Â° 48.7'S 040Â° 06.7'W
12/12/2014 20:42	P3 Northern Mooring	-52.8150	-40.1214	Vessel off DP and repositioning 5 mile East for CTD
12/12/2014 21:28	Station 12 (P3)	-52.8116	-39.9727	Vessel set up on station in DP for CTD
12/12/2014 21:34	134	-52.8116	-39.9727	CTD 015 deployed
12/12/2014 21:34	134	-52.8116	-39.9727	CTD 015 off the deck
12/12/2014 22:06	135	-52.8117	-39.9727	Snow Catcher 019 off the deck
12/12/2014 22:07	135	-52.8117	-39.9727	Snow Catcher 019 deployed
12/12/2014 22:10	135	-52.8116	-39.9727	Snow Catch 019 at 70m. Commenced recovery
12/12/2014 22:13	135	-52.8117	-39.9727	Snow Catcher 019 at the surface
12/12/2014 22:15	135	-52.8116	-39.9727	Snow Catcher 019 on deck
12/12/2014 22:27	136	-52.8116	-39.9727	Snow Catcher 020 off the deck
12/12/2014 22:28	136	-52.8116	-39.9727	Snow Catcher 020 deployed
12/12/2014 22:34	136	-52.8116	-39.9727	Snow Catcher 020 at 170m. Commenced recovery
12/12/2014 22:40	134	-52.8116	-39.9727	CTD 015 at depth. Wire out 3732m (EA600 water depth 3790m). Commenced recovery
12/12/2014 22:40	136	-52.8116	-39.9727	Snow Catcher 020 at the surface
12/12/2014 22:43	136	-52.8116	-39.9727	Snow Catcher 020 on deck
13/12/2014 00:17	134	-52.8117	-39.9727	CTD 015 on deck
13/12/2014 00:24	134	-52.8117	-39.9727	V/L off Dp man. to Mocness deployment position
13/12/2014 01:06	137	-52.8107	-39.9200	Mocness 005 deployed
13/12/2014 03:49	137	-52.7693	-40.0899	Mocness 005 at the surface

13/12/2014 03:54	137	-52.7695	-40.0964	Mocness 005 recovered
13/12/2014 05:30	138	-52.8121	-39.9724	Plankton camera 009 deployed
13/12/2014 05:52	138	-52.8121	-39.9724	Plankton Camera at depth 250m commence hauling
13/12/2014 06:15	138	-52.8121	-39.9724	Plankton Camera 009 on deck
13/12/2014 06:26	139	-52.8121	-39.9724	Bongo Net 033 deployed
13/12/2014 06:33	139	-52.8121	-39.9724	Bongo at depth 200m commence hauling
13/12/2014 06:51	139	-52.8121	-39.9724	Bongo 033 recovered
13/12/2014 07:04	140	-52.8121	-39.9724	Snow catcher 021 off the deck
13/12/2014 07:05	140	-52.8121	-39.9724	Snow Catcher 021 deployed
13/12/2014 07:09	140	-52.8121	-39.9724	Snow Catcher 021 at 70m. Commenced recovery
13/12/2014 07:11	140	-52.8121	-39.9724	Snow Catcher 021 at the surface
13/12/2014 07:13	140	-52.8121	-39.9724	Snow Catcher 021 on deck. Unit failed. Preping for redeployment
13/12/2014 07:16	141	-52.8121	-39.9724	Snow Catcher 022 off the deck
13/12/2014 07:17	141	-52.8121	-39.9724	Snow Catcher 022 deployed
13/12/2014 07:21	141	-52.8121	-39.9724	Snow Catcher 022 at 70m. Commenced recovery
13/12/2014 07:23	141	-52.8121	-39.9724	Snow Catcher 022 at the surface
13/12/2014 07:24	141	-52.8121	-39.9724	Snow Catcher 022 on deck. Unit failed. Preping for redeployment
13/12/2014 07:45	142	-52.8120	-39.9724	Snow Catcher 023 off the deck
13/12/2014 07:46	142	-52.8120	-39.9725	Snow Catcher 023 deployed
13/12/2014 07:49	142	-52.8120	-39.9724	Snow Catcher 023 at 70m. Commenced recovery
13/12/2014 07:52	142	-52.8120	-39.9725	Snow Catcher 023 at the surface
13/12/2014 07:54	142	-52.8120	-39.9724	Snow Catcher 023 on deck
13/12/2014 08:07	143	-52.8119	-39.9725	Snow Catcher 024 off the deck
13/12/2014 08:08	143	-52.8120	-39.9725	Snow Catcher 024 deployed
13/12/2014 08:14	143	-52.8120	-39.9725	Snow Catcher 024 at 170m. Commenced recovery
13/12/2014 08:23	143	-52.8120	-39.9724	Snow Catcher 024 at the surface
13/12/2014 08:25	143	-52.8120	-39.9724	Snow Catcher 024 on deck
13/12/2014 08:33	143	-52.8120	-39.9724	Deck secure. Vessel repositioning 4 miles north west for LHPR deployment
13/12/2014 09:16	144	-52.7622	-40.0701	LHPR 004 off the deck

13/12/2014 09:17	144	-52.7622	-40.0716	LHPR 004 deployed
13/12/2014 10:42	144	-52.7620	-40.1872	LHPR 004 at depth. Wire out 2344m. Commenced recovery
13/12/2014 12:12	144	-52.7622	-40.3027	LHPR 004 on deck
13/12/2014 12:14	Station 12 (P3)	-52.7622	-40.3037	V/L on DP full auto pos
13/12/2014 12:30	145	-52.7622	-40.3038	Plankton Camera 010 deployed
13/12/2014 12:50	145	-52.7621	-40.3037	Plankton Camera at depth 250m commence hauling
13/12/2014 13:10	145	-52.7622	-40.3037	Plankton Camera 010 on deck
13/12/2014 13:14	146	-52.7622	-40.3037	Bongo Net 034 deployed
13/12/2014 13:20	146	-52.7622	-40.3037	Bongo Net 034 at depth 200m commence recovery
13/12/2014 13:33	146	-52.7622	-40.3038	Bongo Net 034 on deck
13/12/2014 13:51	147	-52.7622	-40.3038	CTD 016 deployed
13/12/2014 14:03	148	-52.7623	-40.3039	Snow Catcher 025 deployed
13/12/2014 14:06	148	-52.7623	-40.3038	Snow Catcher 025 at 70m commence recovery
13/12/2014 14:10	148	-52.7623	-40.3038	Snow Catcher 025 on deck
13/12/2014 14:12	147	-52.7623	-40.3038	CTD 016 at depth 1000m (EA600 3484m) commence recovery
13/12/2014 14:21	149	-52.7623	-40.3038	Snow Catcher 026 deployed
13/12/2014 14:25	149	-52.7623	-40.3038	Snow Catcher at depth 170m commence recovery
13/12/2014 14:33	149	-52.7623	-40.3038	Snow Catcher 026 on deck
13/12/2014 14:45	147	-52.7623	-40.3039	CTD 016 on deck
13/12/2014 14:54	Station 12 (P3)	-52.7623	-40.3038	V/L off Dp man. to Mocness deployment position
13/12/2014 16:25	150	-52.7693	-40.0490	Mocness 006 deployed
13/12/2014 17:50	150	-52.7647	-40.1603	Mocness at depth 2427m commence hauling
13/12/2014 19:09	150	-52.7554	-40.2637	Mocness 006 at the surface
13/12/2014 19:12	150	-52.7551	-40.2668	Mocness 006 on deck
13/12/2014 19:19	150	-52.7540	-40.2730	Decks secure. Vessel repositioning to Station 12 (P3)
13/12/2014 20:23	Station 12 (P3)	-52.8118	-39.9726	Vessel set up on station in full auto pos DP
13/12/2014 20:33	151	-52.8118	-39.9726	Snow Camera 011 off the deck
13/12/2014 20:34	151	-52.8118	-39.9726	Snow Camera 011 deployed
13/12/2014 20:50	151	-52.8118	-39.9726	Snow Camera 011 at 250m. Commenced recovery

13/12/2014 21:13	151	-52.8118	-39.9726	Snow Camera 011 at the surface
13/12/2014 21:14	151	-52.8118	-39.9726	Snow Camera 011 on deck
13/12/2014 21:17	152	-52.8118	-39.9726	Bongo Net 035 off the deck
13/12/2014 21:18	152	-52.8118	-39.9726	Bongo Net 035 deployed
13/12/2014 21:23	152	-52.8118	-39.9726	Bongo Net 035 at 200m. Commenced recovery
13/12/2014 21:33	152	-52.8118	-39.9726	Bongo Net 035 at the surface
13/12/2014 21:34	152	-52.8118	-39.9726	Bongo Net 035 on deck
13/12/2014 21:39	153	-52.8118	-39.9726	Bongo Net 036 off the deck
13/12/2014 21:40	153	-52.8118	-39.9726	Bongo Net 036 deployed
13/12/2014 21:43	153	-52.8118	-39.9726	Bongo Net 036 at 100m. Commenced recovery
13/12/2014 21:47	153	-52.8118	-39.9726	Bongo Net 036 at the surface
13/12/2014 21:48	153	-52.8118	-39.9726	Bongo Net 036 on deck
13/12/2014 22:01	154	-52.8119	-39.9727	CTD 017 off the deck
13/12/2014 22:03	154	-52.8119	-39.9726	CTD 017 deployed
13/12/2014 22:14	155	-52.8119	-39.9727	Snow Catcher 027 off the deck
13/12/2014 22:15	155	-52.8119	-39.9726	Snow Catcher 027 deployed
13/12/2014 22:18	155	-52.8118	-39.9726	Snow Catcher 027 at 80m. Commenced recovery
13/12/2014 22:21	155	-52.8118	-39.9726	Snow Catcher 027 at the surface
13/12/2014 22:22	154	-52.8118	-39.9726	CTD 017 at depth. Wire out 1000m (EA600 water depth 3789m). Commenced recovery
13/12/2014 22:23	155	-52.8118	-39.9726	Snow Catcher 027 on deck
13/12/2014 22:32	156	-52.8118	-39.9727	Snow Catcher 028 off the deck
13/12/2014 22:33	156	-52.8118	-39.9727	Snow Catcher 028 deployed
13/12/2014 22:39	156	-52.8118	-39.9726	Snow catcher at 180m. Commenced recovery
13/12/2014 22:45	156	-52.8118	-39.9726	Snow Catcher 028 at the surface
13/12/2014 22:47	156	-52.8118	-39.9726	Snow Catcher 028 on deck
13/12/2014 22:55	154	-52.8118	-39.9727	CTD 017 at the surface
13/12/2014 22:56	154	-52.8118	-39.9727	CTD 017 on deck
13/12/2014 23:05	Station 12 (P3)	-52.8118	-39.9727	V/L off DP man. to Mocness deployment position

13/12/2014 23:35	157	-52.7632	-40.0490	V/L on position for Mocness hd to wind speed 2 - 2.5kts
13/12/2014 23:46	157	-52.7625	-40.0631	Mocness 007 deployed
14/12/2014 01:07	157	-52.7579	-40.1617	Mocness 007 wire out 2295m commence hauling
14/12/2014 02:46	157	-52.7474	-40.2699	Mocness 007 on deck
14/12/2014 03:16	Station 12 (P3)	-52.7466	-40.3031	Deck secure. Vessel proceeding to upwelling station
14/12/2014 07:19	Station 13 (Upwelling)	-52.6001	-39.1999	Vessel set up on station in full auto pos DP
14/12/2014 07:21	158	-52.6001	-39.1999	CTD 018 off the deck
14/12/2014 07:23	158	-52.6001	-39.2000	CTD 018 deployed
14/12/2014 07:44	158	-52.6001	-39.2000	CTD 018 at depth. Wire out 1000m (EA600 water depth 3744m). Commenced recovery
14/12/2014 08:10	158	-52.6000	-39.2000	CTD 018 at the surface
14/12/2014 08:12	158	-52.6001	-39.2000	CTD 018 on deck
14/12/2014 08:27	159	-52.6001	-39.1999	Bongo Net 037 off the deck
14/12/2014 08:28	159	-52.6000	-39.1999	Bongo Net 037 deployed
14/12/2014 08:32	159	-52.6001	-39.2000	Bongo Net 037 at 100m. Commenced recovery
14/12/2014 08:39	159	-52.6004	-39.1998	Bongo Net 037 at the surface
14/12/2014 08:40	159	-52.6005	-39.1998	Bongo Net 037 on deck
14/12/2014 08:46	160	-52.6008	-39.1997	Bongo Net 038 off the deck
14/12/2014 08:47	160	-52.6009	-39.1997	Bongo Net 038 deployed
14/12/2014 08:54	160	-52.6013	-39.1995	Bongo Net 038 at 200m. Commenced recovery
14/12/2014 09:09	160	-52.6018	-39.1994	Bongo Net 038 at the surface
14/12/2014 09:11	160	-52.6018	-39.1994	Bongo Net 038 on deck
14/12/2014 09:26	161	-52.6018	-39.1994	Snow Camera 012 off the deck
14/12/2014 09:27	161	-52.6018	-39.1994	Snow Camera 012 deployed
14/12/2014 09:48	161	-52.6018	-39.1994	Snow Camera 012 at 250m. Commenced recovery
14/12/2014 10:19	161	-52.6017	-39.1994	Snow Camera 012 at the surface
14/12/2014 10:20	161	-52.6018	-39.1994	Snow Camera 012 on deck
14/12/2014 10:30	Station 13 (Upwelling)	-52.6018	-39.1995	Deck secure. Vessel repositioning 2 miles downwind for Mocness deployment
14/12/2014 10:52	162	-52.5880	-39.1491	Mocness 008 off the deck

14/12/2014 10:54	162	-52.5885	-39.1512	Mocness 008 deployed
14/12/2014 12:05	162	-52.6046	-39.2220	Mocness wire out 2074m commence hauling
14/12/2014 13:11	162	-52.6179	-39.2884	Mocness 008 on deck
14/12/2014 13:12	162	-52.6181	-39.2894	V/L man. to upwelling station
14/12/2014 13:44	Station 13 (Upwelling)	-52.6004	-39.1994	V/L on DP
14/12/2014 13:47	163	-52.6004	-39.1997	CTD 019 deployed
14/12/2014 13:58	164	-52.6004	-39.1996	Snow Catcher 029 deployed
14/12/2014 14:02	164	-52.6004	-39.1996	Snowcatcher 029 at depth 70m commence recovery
14/12/2014 14:06	163	-52.6004	-39.1996	CTD 019 at depth 1000m (EA600 3744m) commence recovery
14/12/2014 14:07	164	-52.6004	-39.1996	Snow Catcher 029 on deck
14/12/2014 14:15	165	-52.6004	-39.1996	Snow Catcher 030 deployed
14/12/2014 14:20	165	-52.6004	-39.1996	Snow catcher 030 at depth 170m commence recovery
14/12/2014 14:27	165	-52.6004	-39.1996	Snow Catcher 030 on deck
14/12/2014 14:39	163	-52.6004	-39.1996	CTD 019 on deck
14/12/2014 14:59	166	-52.6004	-39.1997	Plankton Camera 013 deployed
14/12/2014 15:16	166	-52.6004	-39.1996	Plankton Camera at depth 250m commence hauling
14/12/2014 15:40	166	-52.6004	-39.1996	Plankton Camera 013 on deck
14/12/2014 15:44	167	-52.6004	-39.1996	Bongo Net 039 deployed
14/12/2014 15:47	167	-52.6004	-39.1996	Bongo at depth 100m commence hauling
14/12/2014 15:52	167	-52.6004	-39.1996	Bongo Net 039 on deck
14/12/2014 15:57	168	-52.6004	-39.1997	Bongo Net 040 deployed
14/12/2014 16:02	168	-52.6004	-39.1997	Bongo at depth 200m commence hauling
14/12/2014 16:11	168	-52.6004	-39.1996	Bongo Net 040 on deck
14/12/2014 16:25	Station 13 (Upwelling)	-52.6004	-39.1997	V/l off DP increasing to 2kts for CPR deployment
14/12/2014 16:27	169	-52.6006	-39.2008	AVOR L Float #7 deployed
14/12/2014 16:32	170	-52.6004	-39.2060	CPR 009 deployed
14/12/2014 16:38	170	-52.6000	-39.2272	V/l at passage speed
15/12/2014 16:02	170	-52.2517	-46.1227	Commenced recovery of CPR 009
15/12/2014 16:07	170	-52.2514	-46.1294	CPR 009 recovered

15/12/2014 16:08	Station 14	-52.2514	-46.1304	V/l on DP (Station 14)
15/12/2014 16:16	171	-52.2513	-46.1310	Bongo Net 041 deployed
15/12/2014 16:21	171	-52.2513	-46.1310	Bongo at depth 200m commence hauling
15/12/2014 16:32	171	-52.2515	-46.1283	Bongo Net 041 on deck
15/12/2014 16:41	Station 14	-52.2515	-46.1283	V/l off DP increasing to 2kts for CPR deployment
15/12/2014 16:45	172	-52.2513	-46.1299	AVOR L Float #8 deployed
15/12/2014 16:48	173	-52.2511	-46.1331	CPR 010 deployed
15/12/2014 16:56	173	-52.2504	-46.1534	V/L at passage speed
16/12/2014 16:00	173	-51.8949	-53.1673	Commence recovery of CPR 010
16/12/2014 16:03	173	-51.8942	-53.1721	CPR 010 recovered
16/12/2014 16:08	Station 15	-51.8937	-53.1772	V/l on DP (Station 15)
16/12/2014 16:16	174	-51.8936	-53.1776	Bongo Net 042 deployed
16/12/2014 16:22	174	-51.8939	-53.1778	Bongo at depth 200m commence hauling
16/12/2014 16:32	174	-51.8949	-53.1786	Bongo Net 042 on deck
16/12/2014 16:40	Station 15	-51.8949	-53.1786	V/l off DP
16/12/2014 16:48	Station 15	-51.8927	-53.1881	V/l at passage speed. End of science proceeding to Stanley

12.2 Appendix 2 - CTD sensor calibration sheets

Sea-Bird Electronics, Inc.
13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0620
CALIBRATION DATE: 02-May-14

SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS:
Soc = 0.4690
Voffset = -0.5275
Tau20 = 1.26

A = -4.4168e-003
B = 2.3518e-004
C = -3.4304e-006
E nominal = 0.036

NOMINAL DYNAMIC COEFFICIENTS
D1 = 1.92634e-4
D2 = -4.64803e-2
H1 = -3.300000e-2
H2 = 5.00000e+3
H3 = 1.45000e+3

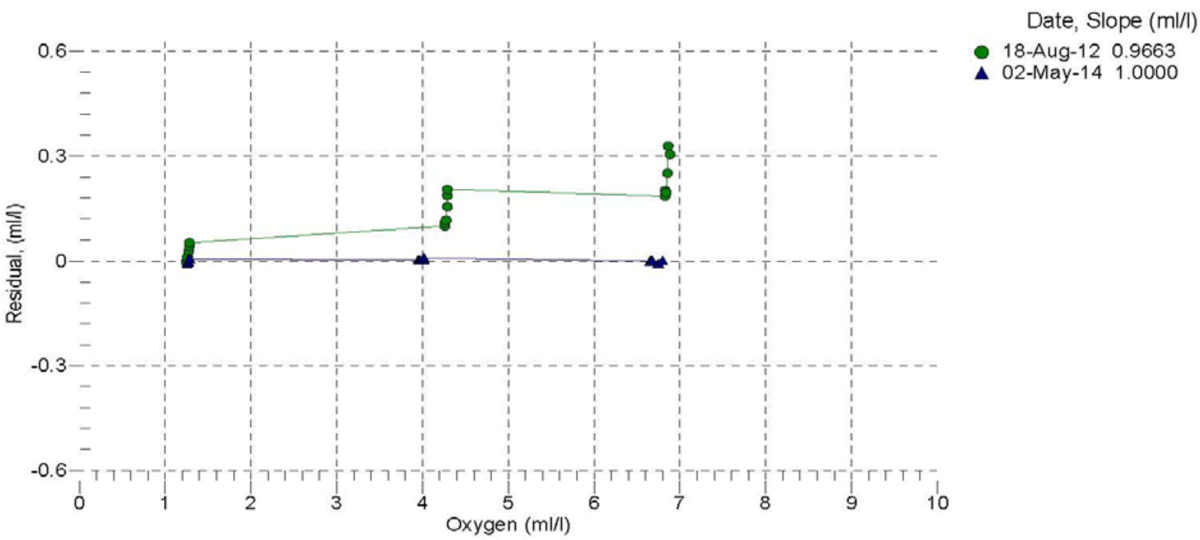
BATH OX (ml/l)	BATH TEMP (ITS-90)	BATH SAL (PSU)	INSTRUMENT OUTPUT (VOLTS)	INSTRUMENT OXYGEN (ml/l)	RESIDUAL (ml/l)
1.25	6.00	0.00	0.839	1.25	-0.01
1.26	2.00	0.00	0.805	1.25	-0.01
1.27	20.00	0.00	0.963	1.27	0.00
1.27	12.00	0.00	0.896	1.27	-0.00
1.28	30.00	0.00	1.056	1.29	0.01
1.29	26.00	0.00	1.021	1.29	0.01
3.95	2.00	0.00	1.405	3.95	0.00
3.96	6.00	0.00	1.515	3.96	0.00
3.97	12.00	0.00	1.680	3.97	0.00
4.01	30.00	0.00	2.169	4.02	0.01
4.02	26.00	0.00	2.062	4.02	0.00
4.02	20.00	0.00	1.908	4.03	0.01
6.65	2.00	0.00	2.004	6.65	-0.00
6.67	6.00	0.00	2.193	6.68	0.00
6.69	12.00	0.00	2.466	6.68	-0.00
6.74	20.00	0.00	2.834	6.73	-0.01
6.76	30.00	0.00	3.285	6.75	-0.01
6.80	26.00	0.00	3.123	6.80	0.00

Oxygen (ml/l) = Soc * (V + Voffset) * (1.0 + A * T + B * T^2 + C * T^3) * OxSol(T,S) * exp(E * P / K)

V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU], K = temperature [deg K]

OxSol(T,S) = oxygen saturation [ml/l], P = pressure [dbar]

Residual = instrument oxygen - bath oxygen



Sea-Bird GmbH

Postfach 1167, 87401 Kempten, Germany
Phone: +49 831 960994 701 Fax: +49 831 960994 709 Email: seabird.eu@seabird.com

SENSOR SERIAL NUMBER: 1913
CALIBRATION DATE: 23-Apr-14

SBE 4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g =  -4.02648322e+000
h =   5.31966393e-001
i =  -5.80467974e-004
j =   5.75913652e-005
```

```
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

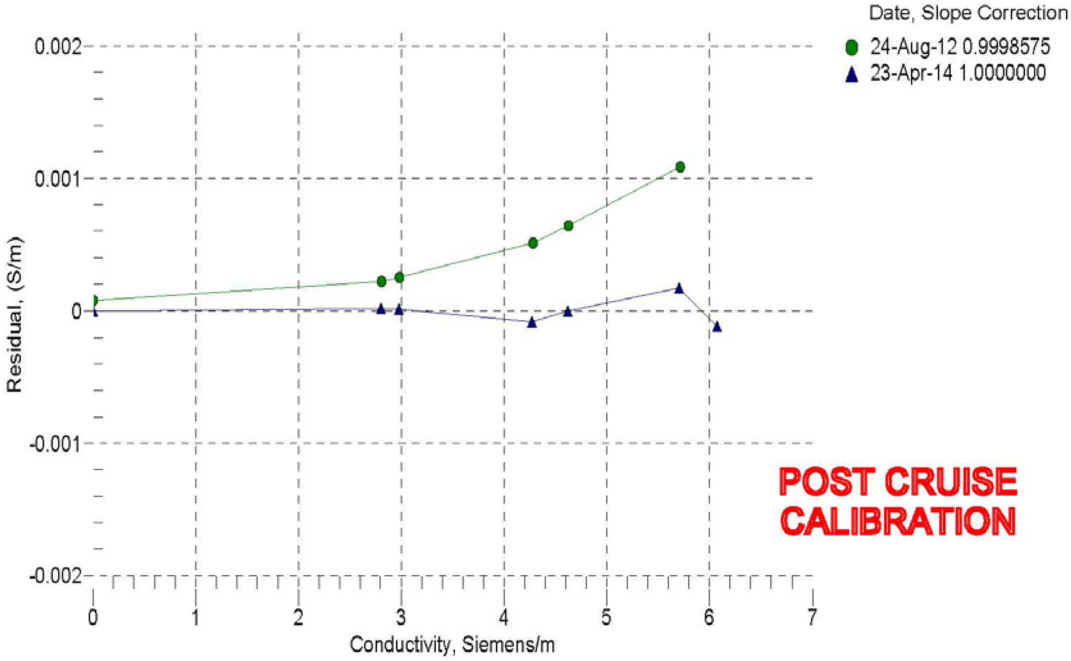
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.75420	0.00000	0.00000
-1.0000	34.8112	2.80420	7.77177	2.80422	0.00002
1.0000	34.8115	2.97559	7.97626	2.97561	0.00001
15.0000	34.8134	4.27130	9.37692	4.27121	-0.00008
18.5000	34.8128	4.61795	9.71696	4.61795	-0.00000
29.0000	34.8092	5.70129	10.70853	5.70146	0.00017
32.5000	34.8014	6.07369	11.02794	6.07357	-0.00012

f = INST FREQ / 1000.0

Conductivity = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$ Siemens / meter

t = temperatur e[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Sea-Bird GmbH
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SENSOR SERIAL NUMBER: 3491
CALIBRATION DATE: 23-Apr-14

SBE 4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:
g = -1.01229136e+001
h = 1.55948723e+000
i = -2.33469883e-003
j = 2.71941333e-004

CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

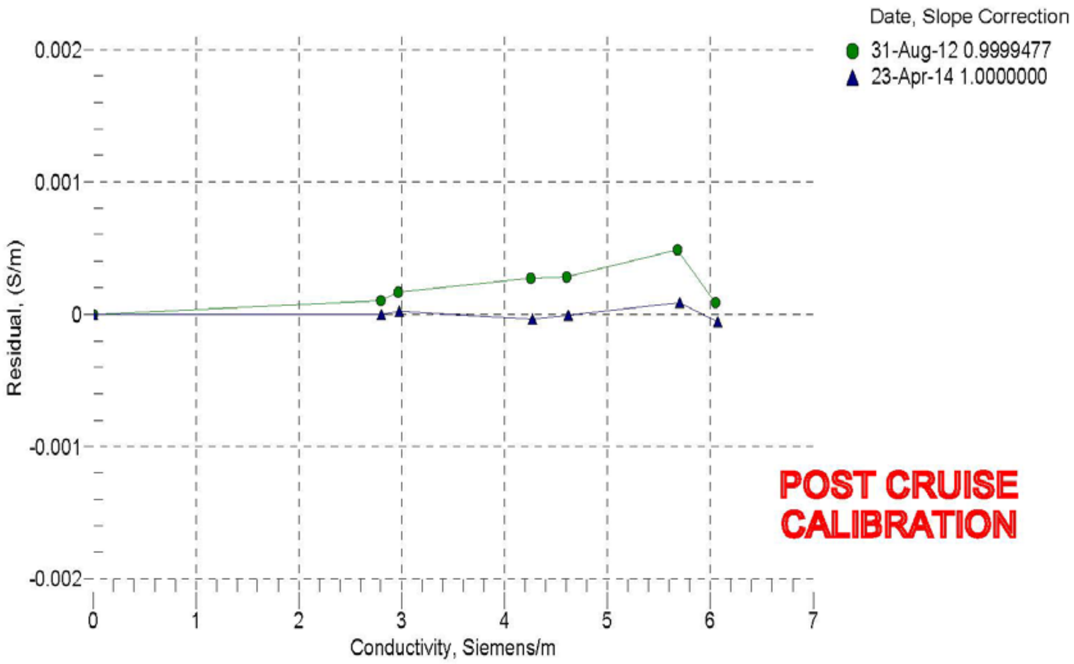
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.55120	0.00000	0.00000
-1.0000	34.8112	2.80420	4.95476	2.80420	-0.00000
1.0000	34.8115	2.97559	5.06475	2.97561	0.00002
15.0000	34.8134	4.27130	5.82894	4.27126	-0.00004
18.5000	34.8128	4.61795	6.01685	4.61795	-0.00001
29.0000	34.8092	5.70129	6.56914	5.70138	0.00009
32.5000	34.8014	6.07369	6.74834	6.07363	-0.00006

f = INST FREQ / 1000.0

Conductivity = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$ Siemens / meter

t = temperatur e[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Sea-Bird GmbH

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SENSOR SERIAL NUMBER: 4090
CALIBRATION DATE: 23-Apr-14

SBE 4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g =   -1.00147173e+001
h =    1.25631897e+000
i =   -2.13449312e-003
j =    2.10297733e-004

CPcor =  -9.5700e-008  (nominal)
CTcor =   3.2500e-006  (nominal)
```

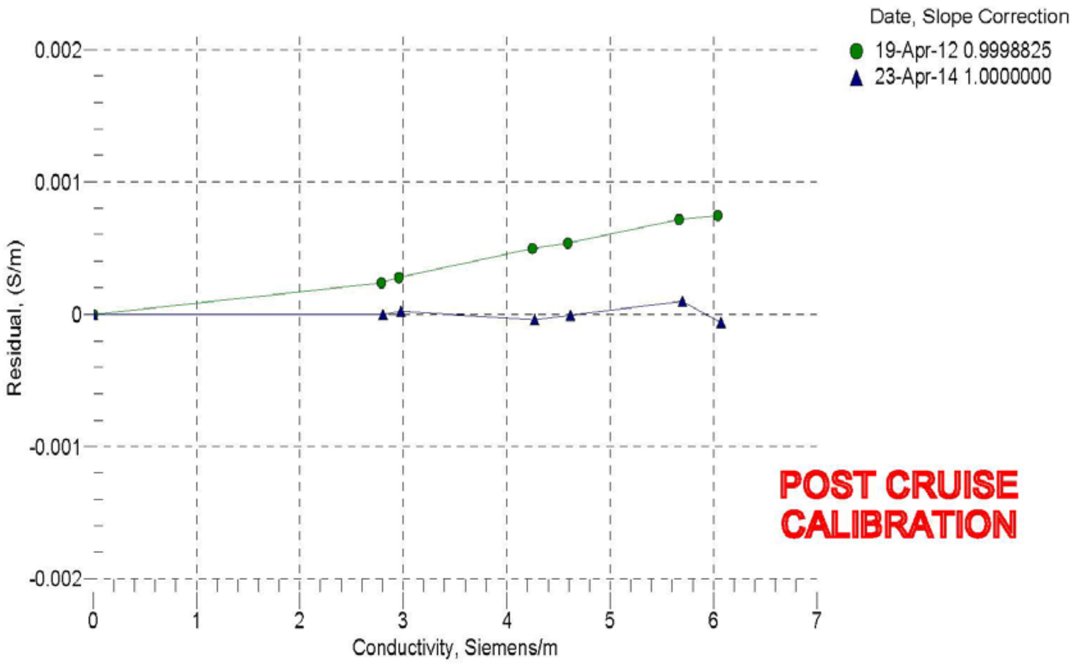
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.82828	0.00000	0.00000
-1.0000	34.8112	2.80420	5.51565	2.80420	-0.00000
1.0000	34.8115	2.97559	5.63845	2.97561	0.00002
15.0000	34.8134	4.27130	6.49144	4.27125	-0.00004
18.5000	34.8128	4.61795	6.70113	4.61795	-0.00001
29.0000	34.8092	5.70129	7.31732	5.70138	0.00010
32.5000	34.8014	6.07369	7.51720	6.07362	-0.00006

f = INST FREQ / 1000.0

Conductivity = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$ Siemens / meter

t = temperatur e[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Sea-Bird GmbH

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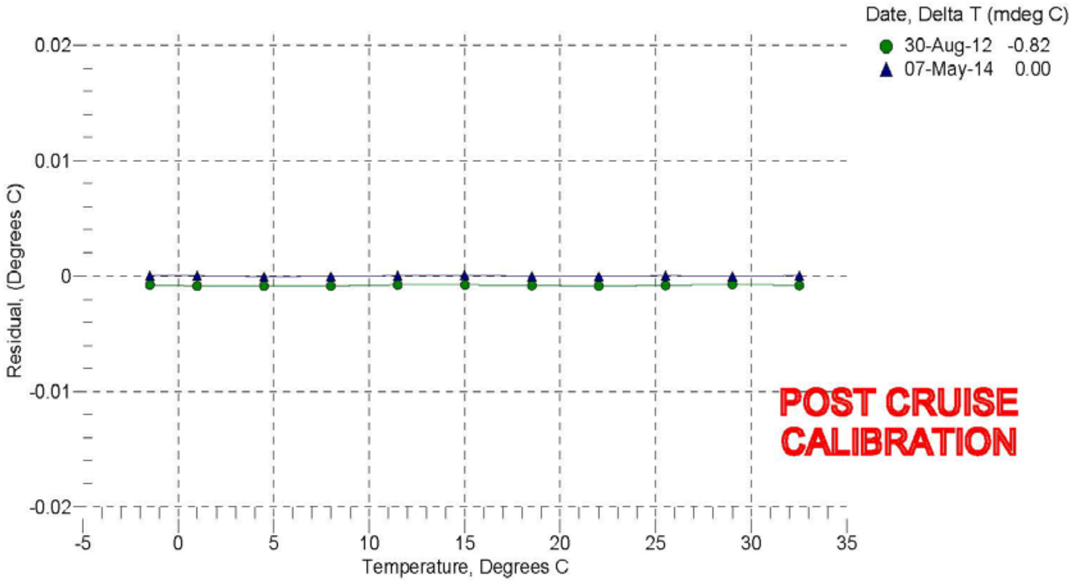
SENSOR SERIAL NUMBER: 2307
CALIBRATION DATE: 07-May-14

SBE 3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS:
g = 4.33439390e-003
h = 6.44457095e-004
i = 2.36511672e-005
j = 2.28085783e-006
f0 = 1000.0

BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2857.375	-1.5000	0.00002
1.0000	3021.397	1.0000	0.00000
4.5000	3262.335	4.4999	-0.00006
8.0000	3516.814	8.0000	-0.00001
11.5000	3785.189	11.5000	0.00002
14.9999	4067.810	15.0000	0.00009
18.5000	4365.024	18.5000	-0.00004
22.0000	4677.166	22.0000	-0.00004
25.5000	5004.558	25.5000	0.00002
29.0000	5347.490	29.0000	-0.00004
32.5000	5706.280	32.5000	0.00003

Temperature ITS-90 = $1/\{ g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)
Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 5043
CALIBRATION DATE: 08-May-14

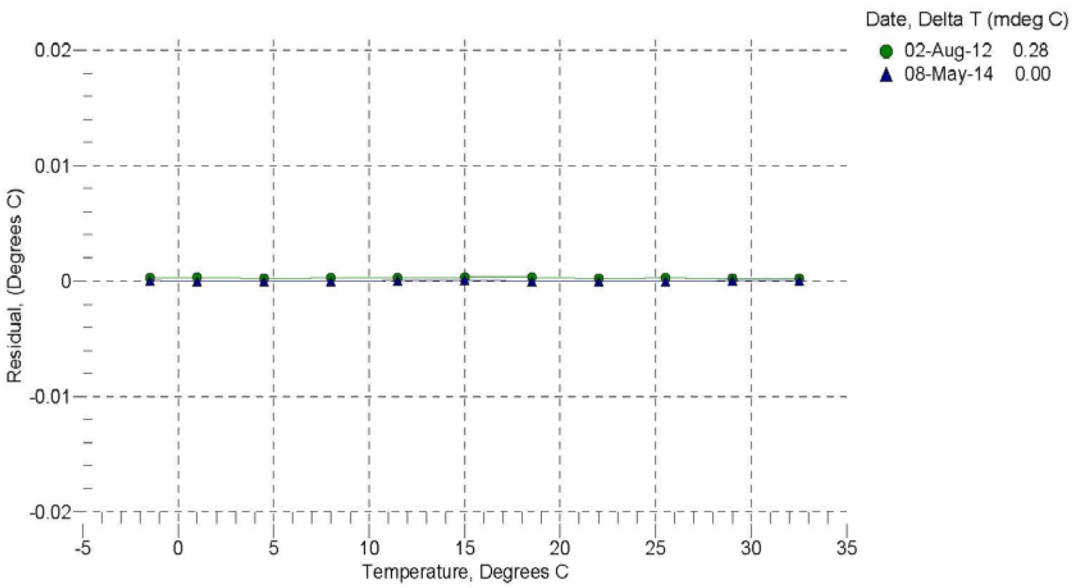
SBE 3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS:
g = 4.34458521e-003
h = 6.34941286e-004
i = 2.13222683e-005
j = 1.94237092e-006
f0 = 1000.0

BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5001	2944.994	-1.5001	0.00002
1.0000	3115.976	1.0000	-0.00002
4.5000	3367.261	4.5000	-0.00001
8.0000	3632.806	8.0000	-0.00002
11.5000	3913.009	11.5000	0.00003
14.9999	4208.236	15.0000	0.00006
18.5000	4518.873	18.5000	-0.00003
22.0000	4845.270	22.0000	-0.00003
25.5000	5187.778	25.5000	-0.00001
29.0000	5546.726	29.0000	0.00000
32.5000	5922.435	32.5000	0.00001

Temperature ITS-90 = $1/\{ g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



Sea-Bird GmbH

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SENSOR SERIAL NUMBER: 0541
CALIBRATION DATE: 21-May-14

SBE 9plus PRESSURE CALIBRATION DATA
FSR: 10000 psia S/N 75429

DIGIQUARTZ COEFFICIENTS:

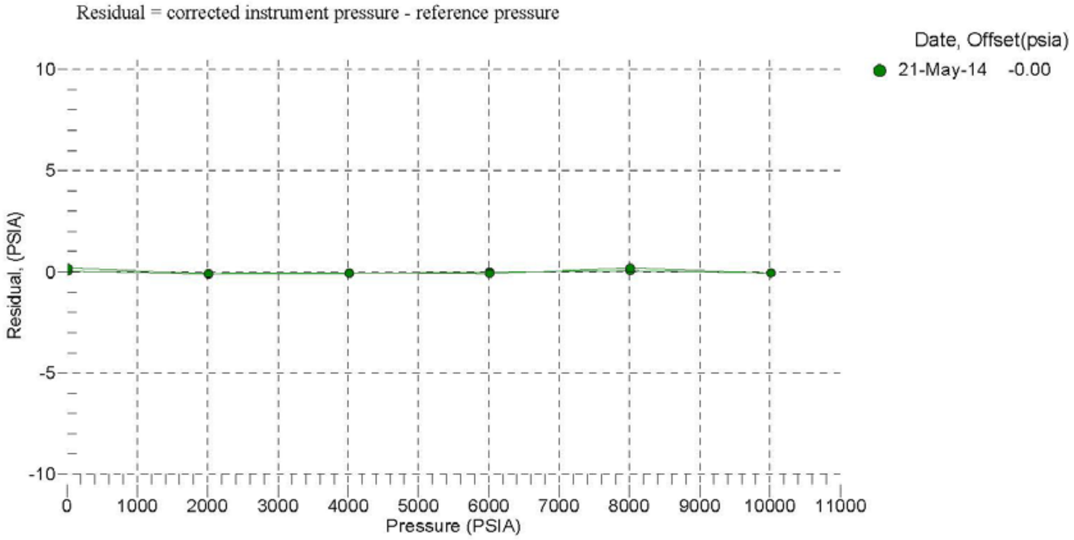
C1 = -4.398881e+004
C2 = -5.551403e-001
C3 = 1.279490e-002
D1 = 3.603000e-002
D2 = 0.000000e+000
T1 = 2.986716e+001
T2 = -5.274889e-004
T3 = 4.092900e-006
T4 = 1.616590e-009
T5 = 0.000000e+000

AD590M, AD590B, SLOPE AND OFFSET:

AD590M = 1.28842e-002
AD590B = -8.23017e+000
Slope = 0.99997
Offset = -0.7673 (dbars)

PRESSURE (PSIA)	INST OUTPUT (Hz)	INST TEMP (C)	INST OUTPUT (PSIA)	CORRECTED INST OUTPUT (PSIA)	RESIDUAL (PSIA)
13.522	33497.78	21.6	14.660	13.547	0.025
2013.895	34249.37	21.6	2014.971	2013.789	-0.107
4013.842	34982.34	21.6	4015.015	4013.764	-0.078
6013.772	35697.99	21.6	6015.092	6013.771	-0.001
8013.590	36397.32	21.7	8015.050	8013.661	0.071
10013.691	37081.35	21.8	10015.087	10013.628	-0.063
8013.576	36397.41	21.8	8015.165	8013.775	0.199
6013.902	35698.13	21.9	6015.127	6013.806	-0.095
4013.873	34982.53	22.0	4015.059	4013.808	-0.064
2013.876	34249.55	22.1	2014.972	2013.790	-0.086
13.382	33497.98	22.1	14.694	13.581	0.199

Residual = corrected instrument pressure - reference pressure



Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

LOG SENSOR

Calibration Date: 4/24/2013 R11612
Model Number: QCD-905L4S
Serial Number: 7235
Operator: TPC
Standard Lamp: V-031(3/7/12)
Operating Voltage Range: 6 to 15 VDC (+)

Note: The QCP-200L uses a log amplifier to measure the detector signal current with V = log I (Amps) / I_{Ref}
To calculate irradiance, use this formula:

Irradiance = Calibration factor * (10^Light Signal Voltage - 10^Dark Voltage)

With the appropriate (solar corrected) Irradiance Calibration Factor:

Dry Calibration Factor:	**1.67E+12**	**quanta/cm²·sec/"amps"**	**2.77E-06**	**µEinsteins/cm²·sec/"amps"**
Wet Calibration Factor:	**1.79E+12**	**quanta/cm²·sec/"amps"**	**2.98E-06**	**µEinsteins/cm²·sec/"amps"**

Sensor Test Data and Results[4)]

Sensor Supply Current (Dark):	67.0	mA		
Supply Voltage:	6	Volts		
Lamp Integrated PAR Irradiance:	1.04E+16	quanta/cm²·sec	0.01733	µEinsteins/cm²sec
Q2-3 Immersion Coefficient:	0.931	Scalar Correction: 1	PAR Solar Correction:	1.0000

Nominal Filter OD	Calibrated Trans.	Sensor Voltage	Measured Trans.		Measured Signal (Amps)	Estimated Signal (Amps)	Calc. Output (Volts)	Error (Volts)	Error (%)	Test Irrad. (quanta/ cm²·sec)
No Filter	100.00%	3.796	100.00%		6.25E-07	6.25E-07	3.796	0.000	0.0	1.04E+16
0.3	36.10%	3.354	36.13%		2.26E-07	2.26E-07	3.354	0.000	-0.1	3.77E+15
0.5	27.60%	3.240	27.77%		1.74E-07	1.73E-07	3.237	-0.003	-0.6	2.90E+15
1	9.27%	2.769	9.37%		5.86E-08	5.80E-08	2.764	-0.004	-1.0	9.77E+14
2	1.11%	1.854	1.12%		7.00E-09	6.94E-09	1.850	-0.003	-0.8	1.17E+14
3	0.05%	0.784	0.07%		4.67E-10	3.34E-10	0.677	-0.107	-28.5	7.79E+12
RG780	0%	0.56	0.04%		2.22E-10	0.00E+00	0.151	-0.409	-100.0	3.70E+12

Dark Before:	0.151	Volts			
Light - No Filter Hldr.:	3.796	Volts	I_{Ref} =	1.00E-10	Amps
Dark After - NFH:	0.151	Volts	I_{Dark} =	1.42E-10	Amps
Average Dark	0.151	Volts	10^{VDark} =	1.415794	Amps

Notes:
1. Annual calibration is recommended.
2. There is increasing error associated with readings below zero.

QXX-nnnL Ver. 12/7/98 DGG

TELEDYNE
RD INSTRUMENTS
A Teledyne Technologies Company

REPAIR REPORT

Customer: British Antarctic Survey
Chassis No.: N/A
Transducer / System No.: 14897
RMA No.: 28 77644

Date: 9/9/2013
Configuration: WHM
Frequency: 300 KHz
Firmware Version: 50.40

I. Reason for Return – Beam 2 failure.

II. Inspection - The following discrepancies were noted:

A. Electronics Chassis:
   a. The electronics chassis is up to date and passes all incoming bench tests.
   b. Both 2BG recorder cards must be replaced with Delkin cards.

B. Transducer:
   a. The cause of the customer complaint is a faulty beam 2 ceramic, which fails for excessively low capacitance.

C. Housing and Endcap:
   a. The I/O connector and dummy plug are both RoHS and must be replaced with the latest build.

III. Corrective action - The following repairs and or upgrades were performed:

A. Electronics Chassis:
   a. Both 2GB recorder cards were replaced with Delkin cards.
   b. The electronics chassis passes all final inspection bench tests, including water and pressure tests.

B. Transducer:
   a. The transducer was replaced.
   b. The new transducer passes all final inspection bench tests, including water and pressure tests.

C. Housing and Endcap:
   a. The I/O connector, dummy plug, all o-rings, and desiccant were all re-placed.
   b. The assembled system passes all final inspection bench tests, including water and pressure tests.

TELEDYNE
RD INSTRUMENTS
Everywhereyoulook™

Workhorse Configuration Summary

Date	9/9/2013
Customer	British Antarctic Survey
Sales Order or RMA No.	2877644
System Type	Monitor
Part number	WHM300-I-UG301
Frequency	300 kHz
Depth Rating (meters)	6000

SERIAL NUMBERS: / **REVISION:**

	Serial Number	Rev.
System	14897	
CPU PCA	14360	M1
PIO PCA	8231	G1
DSP PCA	16021	H0
RCV PCA	16458	E6
AUX PCA		
Transducer SN	20208	

FIRMWARE VERSION:

CPU: 50.40

SENSORS INSTALLED:

Temperature ☑ Heading ☑ Pitch / Roll ☑ Pressure ☐ Rating N/A meters

FEATURES INSTALLED

- ☑ Water Profile
- ☐ High Accuracy Bottom Tracking +/- 0.4%
- ☐ High Resolution Water Modes
- ☑ LADCP/Surface Track
- ☐ High Rate Pinging
- ☐ Shallow Bottom Mode
- ☐ Wave Guage Acquisition
- ☐ River Survey ADCP *
- SxS Pro Key
- ☐ Section by Section (SxS)
- ☐ Standard Bottom Tracking +/- 1.15%

** Includes Water Profile, Bottom Track and High Resolution Water Modes*

COMMUNICATIONS:

Communication	RS-232
Baud Rate	9600
Parity	NONE
Recorder Capacity	4000 MB (installed)
Power Configuration	20-50 VDC
Cable Length	0 meters

14020 Stowe Drive, Poway, CA 92064, (858)842-2600, FAX (858)842-2822, Customer Service: rdifs@teledyne.com, Sales: rdisales@teledyne.com

Chelsea Technologies Group Ltd
Certificate Of Calibration

Chelsea Technologies Group Ltd

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Surrey KT8 2QZ
United Kingdom
Tel: +44 (0)20 8481 9000
Fax: +44 (0)20 8941 9319
sales@chelsea.co.uk
www.chelsea.co.uk

CERTIFICATE OF CALIBRATION

All test equipment and standards used are of known accuracy and traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Date of Issue:	9th May 2014
Part Number:	0088-3598C
WOT Number:	WO149744
Description:	AQUATRACKA MKIII
Serial Number:	12-8513-001

REPORT

The fluorimeter was exposed to various concentrations of Chlorophyll-a dissolved in acetone in addition to pure water and pure acetone. The following formula was derived from the readings to relate instrument output to chlorophyll-a concentration.

$$\textbf{Conc.} = (0.008112 \times 10^{\text{Output}}) - 0.014920$$

Where:-

Conc. = fluorophor concentration in μg/l
Output = Aquatracka output in volts

The above formula can be used in the range 0 - 100 microgrammes per litre to an uncertainty of 0.02 microgrammes per litre plus 3% of value.

Notes

The above formula has been derived using Chlorophyll-a dissolved in acetone. No guarantee is given as to the performance of the instrument to biologically active chlorophyll in sea-water.

The zero offset has been determined in the laboratory using purified water from a reverse osmosis/ion exchange column. It is possible that purer water may be found in clean deep ocean conditions. Under these conditions, the offset shown in the above formula should be replaced by the antilogarithm of the Aquatracka output in the purest water found, multiplied by the scale factor.

Registration No: 00832429
Registered at the above address

Distribution List: Works Order Traveller **Product History Folder (Electronic Copy)**

Chelsea Technologies Group Ltd
Certificate Of Calibration

Fluorimeter calibration readings

Ambient temperature 20^{o}C

Output for detector mechanically blanked 0.2447 Volts

Output for pure water 0.2647 Volts

chlorophyll concentration in acetone (µg/l)	Output (volts)
Acetone (pure)	0.3422
0.1	1.1344
0.3	1.5641
1.0	2.1091
3.0	2.6027
9.9	3.1146
29.1	3.5677
90.9	4.0351

The uncertainty of the chlorophyll concentration is estimated not to exceed 3%. The uncertainty of output voltage measurement is estimated not to exceed 2mV.

Equipment used during calibration:-
Thurlby Dvm Cil 024
Weir Psu Cil 098

Signed **Date 9th May 2014**

M.J.Nicholson

Page 2 of 2

Chelsea Technologies Group Ltd
Certificate Of Pressure Test

Chelsea Technologies Group Ltd

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www.chelsea.co.uk

TEST REPORT

All test equipment and standards used are of known accuracy and traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Date of Issue:	8th May 2014
Part Number:	0088-3598C
WOT Number:	WO149744
Description:	AQUATRACKA MKIII
Serial Number:	12-8513-001

This is to certify that Aquatracka III (Titanium) has been pressure tested for 1 hour at 60 bars and is suitable for use to a maximum depth of 6000 Metres.

Equipment used during testing:-
Pressure chamber Cil 219

Signed: **M J Nicholson**

Date: 8th May 2014

Registration No: 00832429
Registered at the above address

Page 1 of 1 **Distribution List: Works Order Traveller** **Product History Folder (Electronic Copy)**

PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

C-Star Calibration

Date	June 2, 2014	S/N#	CST-1497DR	Pathlength	25cm

	Analog output	Digital output
V_d	**0.006** V	**0** counts
V_{air}	**4.819** V	**15829** counts
V_{ref}	**4.704** V	**15449** counts

Temperature of calibration water	**23.1** °C
Ambient temperature during calibration	**21.6** °C

Relationship of transmittance (Tr) to beam attenuation coefficient (c), and pathlength (x, in meters): **$Tr = e^{-cx}$**

To determine beam transmittance: **$Tr = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark})$**

To determine beam attenuation coefficient: **$c = -1/x * \ln(Tr)$**

V_d Meter output with the beam blocked. This is the offset.
V_{air} Meter output in air with a clear beam path.
V_{ref} Meter output with clean water in the path.
Temperature of calibration water: temperature of clean water used to obtain V_{ref}.
Ambient temperature: meter temperature in air during the calibration.
V_{sig} Measured signal output of meter.