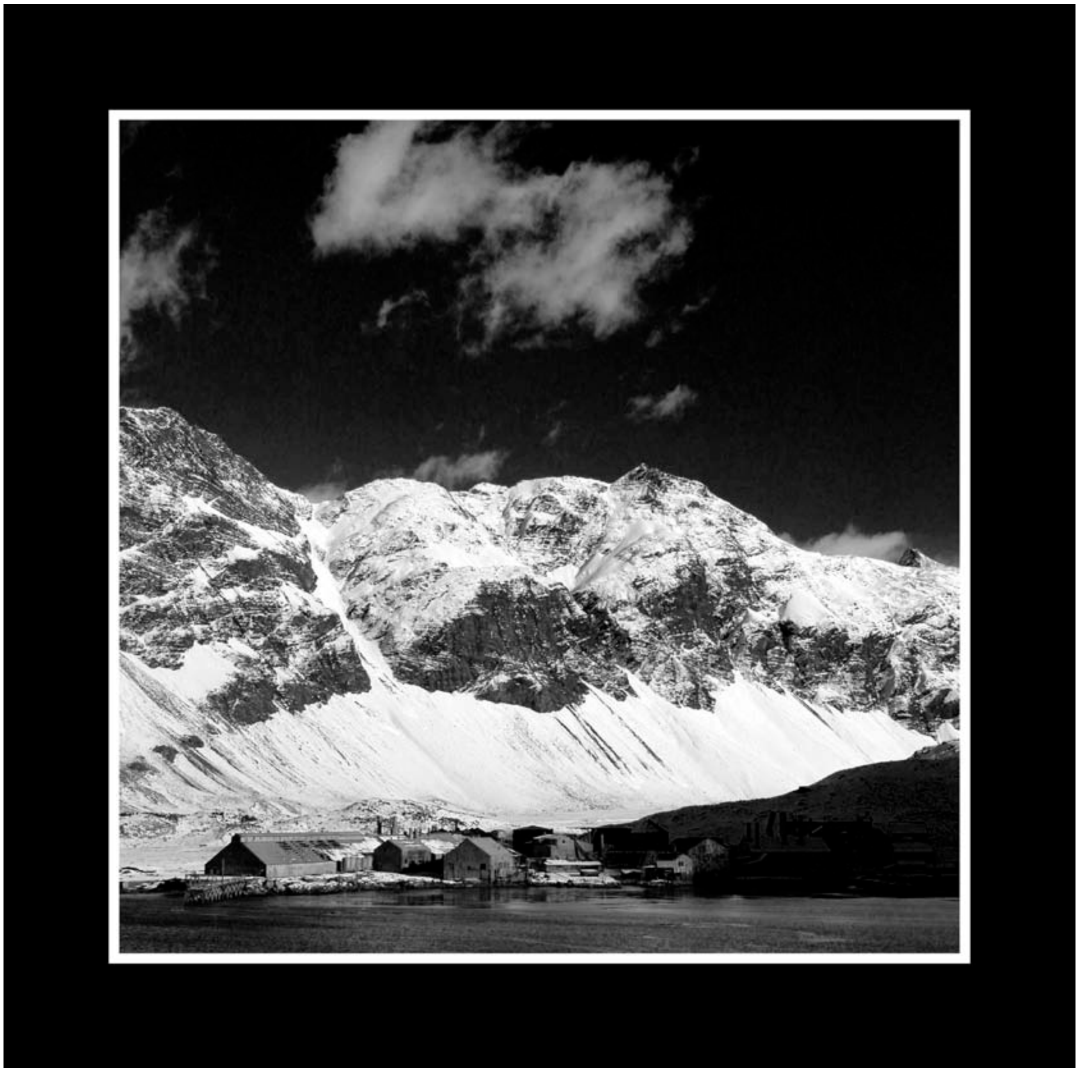
JR200 - AUTUMN CRUISE



Leith Station, South Georgia. Picture courtesy of J. Klepacki

11th March to 18th April, 2009

Life cycles and trophic interactions of the Scotia Sea pelagic community: from the South Orkneys to the Polar Front

DISCOVERY 2010.

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1. INTRODUCTION

1.1 Background rationale to JR200

Rebecca Korb PSO

JR200 was the third of 3 cruises to the Scotia Sea region of the Southern Ocean, providing an autumn perspective to the fieldwork campaign of the DISCOVERY 2010 programme. Previous cruises include JR161 (spring) and JR177 (summer). The three cruises were designed to follow a similar cruise track (to allow inter cruise comparisons) and to sample across the range of environments that typify the Southern Ocean: the ice edge, shelf-seas, open-ocean, HNLC conditions, iron-enriched conditions and frontal areas. Through 2 BAS core science projects and a number of collaborations, we aimed to characterise ecosystem processes, from the impact of micro- and macronutrient availability on primary productivity, through to primary (zooplankton) and secondary (nekton) consumer processes and up to higher predator studies on abundance, distribution and diet.

The FLEXICON (Flexibility and Constraints in Life Histories) project consisted largely of a depth-discrete sampling programme to consider the distribution of different life-cycle stages and body states of key zooplankton species. Acoustic data supplemented these studies as well as providing detailed information on krill and fish swarm structures.

The FOODWEBS (Scotia Sea Food-webs) project took a number of complimentary approaches to consider linkages between different trophic levels, including micro- and macronutrient availability, phytoplankton studies, gut content examinations, stable-isotope analyses, higher-predator tracking studies. In addition, sediment traps deployed near to South Georgia will also provide key insights into carbon flux to the deep ocean. Full details on the background rationale for the Discovery 2010 projects and associated cruises can be found in the JR177 cruise report.

In addition to the core DISCOVERY 2010 work, supplementary projects were supported on the cruise. The Dipycnal and Isopycnal Mixing Experiment in the Scotia Sea (DIMES) programme, of the Physical Sciences Division, had a remit to obtain greater resolution in physical oceanographic parameters across the Scotia Sea. Integration of DIMES into the cruise track increased the frequency of full-depth CTDs between core-sampling stations. The Antarctic Funding Initiative, Collaborative Gearing Scheme (AFI-CGS) project "Diseases of krill in the southern ocean: effects on standing stock and implications of changing climates", took advantage of our regular catches of live krill. Preserved samples will be examined in the UK at CEFAS and a pathogen profile generated. The AFI-CGS project "Iron availability and effects on phytoplankton communities in contrasting production regimes of the Scotia Sea: a seasonal perspective" contributed directly to the aims of FOODWEBS. Measurements of iron concentration were made throughout the cruise, and bioassays carried out, to examine the controlling influence of this micro-nutrient on primary productivity. This cruise also hosted three independently funded collaborators (Jose Xavier, Yves Cherel and Anton van de Putte) to assist in the fishing work throughout the cruise and in particular at the Polar Front.

1.2 JR200 Cruise overview

Rebecca Korb PSO

The design of the main cruise track is described in the JR177 cruise report. Here we specifically describe the criteria relevant to the JR200 cruise track:

1) To cover the largest possible range of oceanographic environments common to the Scotia Sea region such as shelf-seas, open ocean, HNLC conditions, iron-enriched conditions and frontal areas. Previously the ice- edge was also included. However, due to its southerly position this year (see Fig 1.2.1) it was not possible to include ice edge stations on JR200.
2) As on previous cruises, a number of station locations needed to be responsive, i.e. not fixed positions. Here, we chose to sample at low Fe (R2) and high Fe (R3) environments. The location of these stations was determined by ocean colour, and dynamic height, satellite images. We did not sample responsively at the ice edge (R1), as we did on previous cruises. Instead, we repeated sampling at the location of the JR177 ice station (to the north-west of Signy) and named this R1.
3) Other station locations remained fixed so that inter-seasonal (inter-cruise) comparisons are possible.
4) Target fishing was more opportunistic in nature than it has been on previous cruises. We searched for targets to fish during transit time between stations and only deployed the RMT8 when we saw a swarm.
5) Day time RMT25 fishing was removed from our programme and replaced with extra night time deployments.
6) Moorings were only re-deployed at our sediment trap sites (P2 and P3). They had been recovered on a previous cruise.
7) A separate cruise to the South Georgia area was cancelled and elements incorporated into JR200. These included 3 nights fishing at the Polar Front (PF), an acoustic calibration of the echosounder in Rosita Harbour (this actually took place in Stromness due to weather issues) and the recovery/re-deployment of the WCB shallow mooring.
8) A logistics call to BI needed to be carried out near the end of the cruise.

1.2.1 Cruise transect

The transect line ran southwards from Stanley, FI to our first bio station at R1, then ran eastwards along the northern side of the South Orkneys shelf. East of the South Orkneys, we headed northwards following the usual ERS satellite altimeter track up to the west of South Georgia (see Figs 1.2.2 and 1.2.4). Once at the final station on the altimeter track (P3) we headed west towards the “reactive” high chlorophyll station (R3) then headed northeastwards to a station near to the Polar Front (PFS). The track then ran to Bird Island for logistic purposess, to Stromness for an acoustic calibration and then to the WCB to recover a shallow water mooring before heading back to Stanley.

The underway seawater supply was analysed continuously throughout the cruise for Chl-a concentration, macronutrients, and phytoplankton physiology. Pumped seawater was supplied to the clean container, for micronutrient analysis, using a towfish deployed from the starboard quarter. XBT's were deployed en-route from the last "bio-station", R3, up to the Polar Front South station (PFS).

1.2.2 Cruise stations

On the main transect leg of JR200, there were 2 types of stations: "bio-stations" and CTD stations. The former consisted of stations that were occupied for ~2 days and where a range of activities were carried out. The latter consisted of near-bottom, CTD casts only (part of the DIMES project). Six "fixed" bio-station locations were retained from last year (R1, C2, C3, C4, P2, P3). Two (R2, R3) were left flexible to be "responsive" to low Fe and high Fe features observed during the cruise. The DIMES CTD's were numbered D1 to D21 irrespective of whether or not they fell in a "bio-station" location or not. Thus a number of stations have 2 names to reflect the "bio-station" location as well as the DIMES CTD location. See Fig 1.2.2 for all station locations and names

There was a set plan of activities to occur over a 48 h period at each of the 8 bio-stations (Fig 1.2.3). This included: full depth CTD's for physical oceanography, chlorophyll, nutrients, particulates (2000 m CTD) and mesozooplankton (400 m CTD); GoFLO bottles for iron chemistry; an FRRF to measure the physiological state of phytoplankton; and a range of nets to sample meso- and macrozooplankton, krill and myctophid fish. The 48 hours included a 12 hour acoustic survey. Previously on JR177 this was a 24 mesoscale survey at the five 'fixed' stations or a 6 h survey at the 'responsive' stations.

In addition, each bio-station had an 6 hours allocated to target fishing with the RMT8. This time slot was largely used in a flexible manner, en-route between stations.

Additional activities were carried out at a few stations along the main transect. A test station was carried out on the leg from Stanley to R1 (at the site of the P1 bio-station rom previous cruises). All gear was deployed in the water to ensure it was working correctly. Moorings were deployed at P2 and P3. An extra RMT25 stratified haul was carried out at the end of the C4 occupation. Another was scheduled for D14 but the weather was not suitable at that site.

The work at the PF front was based around day time activities (CTD's, LHPR, acoustic surveys, bongos) and night time fishing with the RMT25. Station location and naming can be seen in Fig 2. Night time fishing with the RMT25 had the highest priority of the station activities. The scheduling of day time activities was dependent on weather conditions and time of arrival on stations.

Fig 1.2.1 location of the ice edge during the JR200 cruise

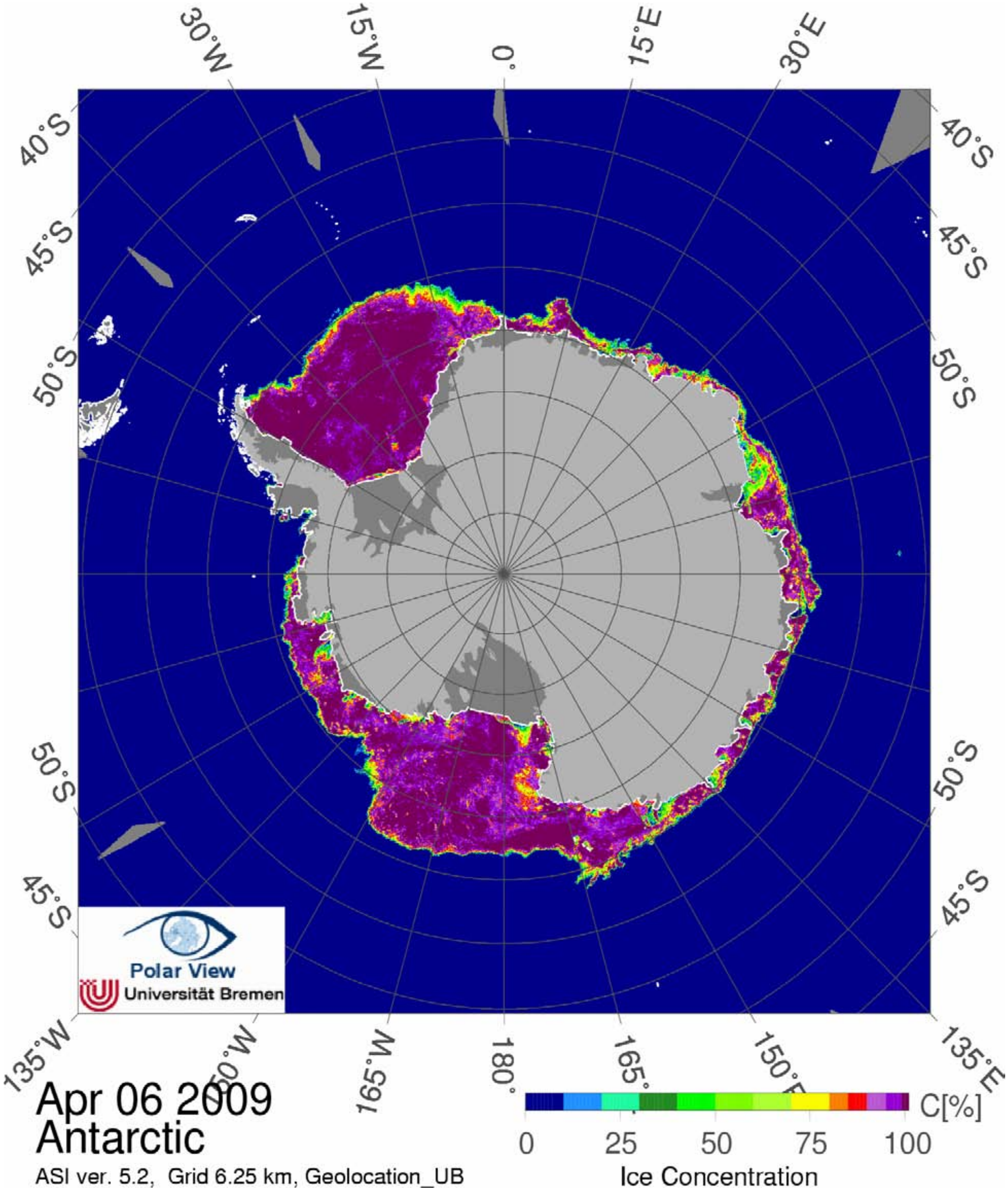


Fig 1.2.2 Proposed cruise track and station names

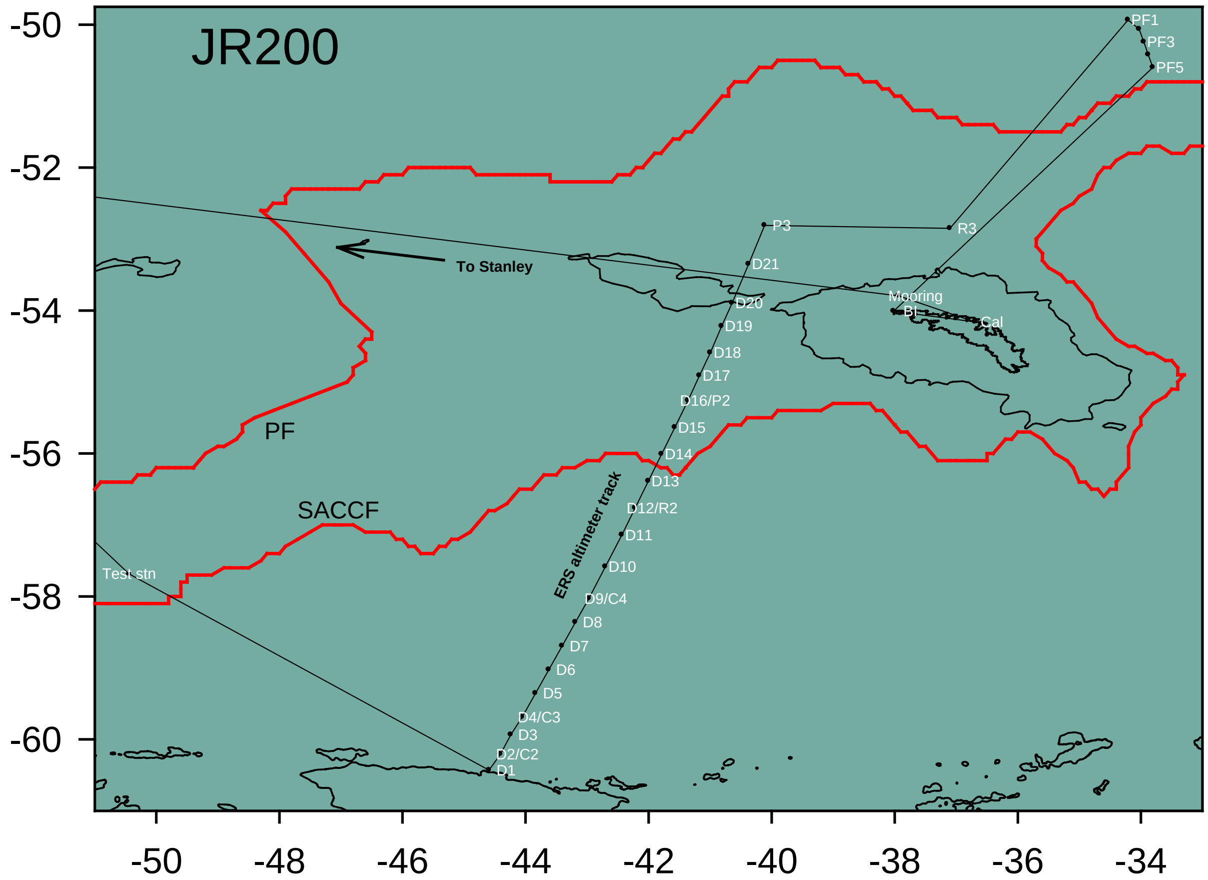
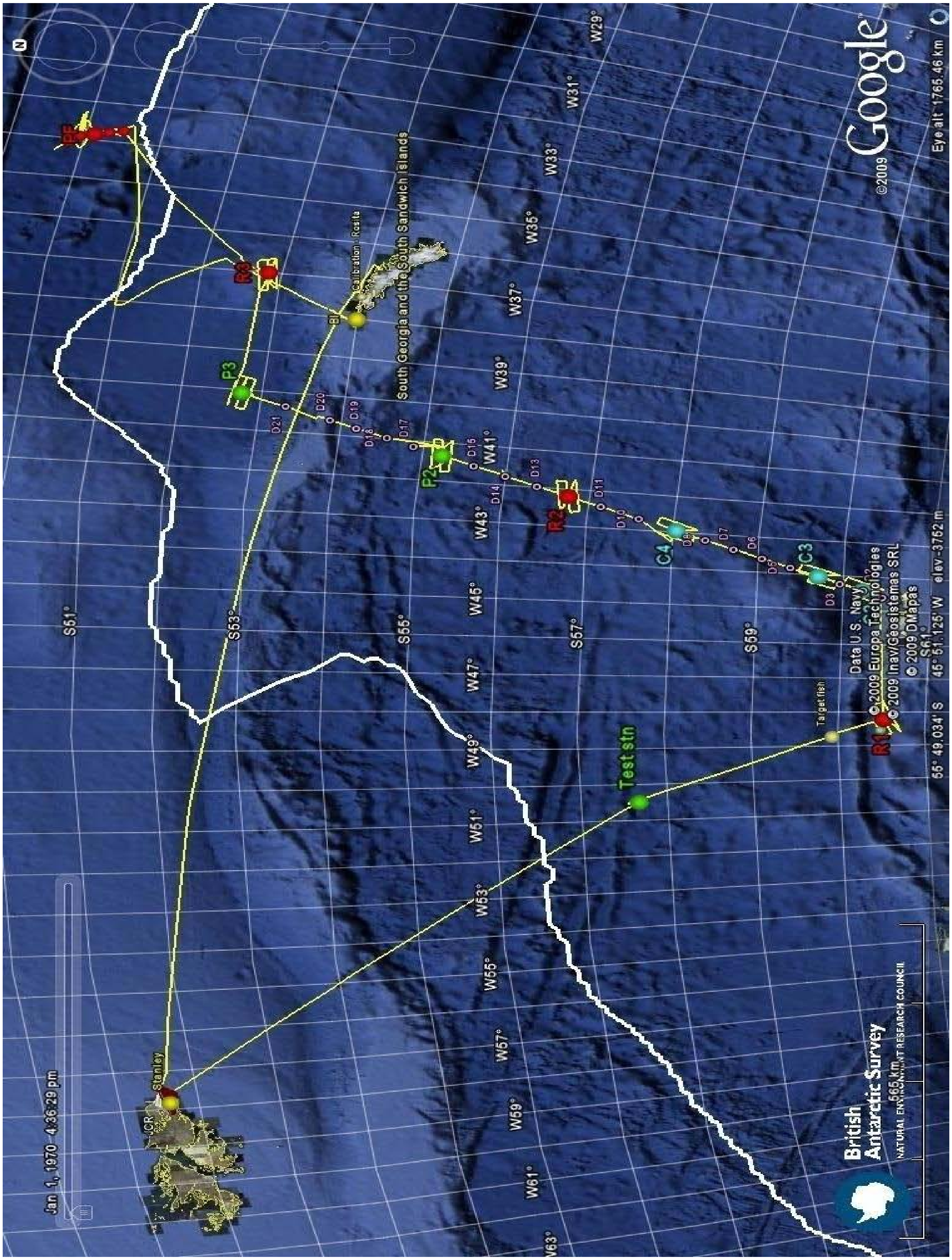


Fig 1.2.3 JR200 station activities plan

Local times	Day 1	Day 2	Day 3
22:00	RMT25 Stratified	MOCNESS	Krill target fishing
23:00		FRRF (night)	RMT8
00:00		LHPR (night)	************************
01:00			Flexible –
02:00			may be en-route along
03:00		CTD (full depth)	transect
04:00	Bongo+Minibongo		
05:00			
06:00	Acoustic survey	LHPR (day)	
07:00			
08:00			
09:00		Go-Flo	
10:00			
11:00		FRRF (day)	
12:00		Bongo + minibong0	
13:00			
14:00		MOCNESS (day)	
15:00			
16:00			
17:00		CTD (2000 m)	
18:00	Krill target fishing		
19:00	RMT8	CTD (400 m - Oithona)	
20:00		MOCNESS (night)	
21:00			

Fig 1.2.4 Actual JR200 Cruise Track



1.3 PSO Narrative

Rebecca Korb PSO

04/03/2009 MOBILISATION 16:30
Four of the JR200 science team (Enderlein, Fielding, Pond & Gordon) left for Stanley to begin mobilisation. The team travelled with the MOD from Brize Norton to Stanley.

08/03/2009 MOBILISATION 16:30
The PSO and the majority of the science team assembled at BAS HQ for trip South with the MOD. Spare parts for the ships winch, which will be used for RMT25, were carried down. At check-in MOD staff complained that zargie boxes were being checked in as luggage. Said they should be cargo.

09/03/2009 17:00 MOBILISATION Lat -51.69163 Lon -57.82414 19.78°C
Arrived at Stanley at ~2pm (27 hours after setting off from BAS). The 4 science crew members who arrived early had already unpacked the science equipment/gear containers. Nets had been sorted out ,boxes placed in the appropriate labs and chemicals located. A few of the labs had also been setup. This team did an excellent job which should enable us to leave on time /slightly ahead of schedule.

10/03/2009 11:00 MOBILISATION Lat -51.69162 Lon -57.82413 13.59°C
Collected kit bags 8 am (local). General cruise meeting at 8.30 am. Further meetings will be arranged once all gear has been setup. These include fishing group, CTD users, Fe AFI-CGS and producers of bio samples/waste. Points raised were: May sail evening of 11th so need to get gear sorted and lashed down by midday . People thought they would be ready to sail by this date. Jose wants to get dropped off at BI at end of cruise if possible ie to be included in PF work Johnnie to sort out laptops/ PC's, Nathan to set up L drive. Talked to Graham and Simon (2/0) and all of us happy with cruise track/plans. Sebastian complained about the state of the clean container. Very dirty inside, vents had not been shut. Also, no GoFlo rack in the container. Will call Jason Scott at NMF tomorrow. Towfish to go in at the test station.

11/03/2009 11:00 MOBILISATION/TRAVEL Lat -51.6916 -Lon 57.82414 12.46°C
It was confirmed that we would sail today so final preparations made in lab. All science groups are ready to go. Only problems with NOC group as they need water, supplies, etc sorted out once Simon Wright is available. GoFlo rack was not sent down by NMF. They said it was not requested. I have a document to show I asked for it. Seb made a makeshift rack. Lab inspection at 3pm (local)- all labs organised and lashed down. Only things to note were the waste from a previous cruise stored in the cold room and there were a number of chemicals left in the fume hoods from previous cruises. These were poorly labelled and potentially dangerous. Shore leave ended at 4pm followed by a safety briefing. Ship sailed at ~ 5 pm. Requested towfish to go into the water as soon as convenient. Graham said this would be tomorrow after emergency steering test.

12/03/2009 11:00 TRAVEL Lat -53.8101 Lon -55.20323 6.84°C

Emergency steering at 8:00 (local) was followed by deployment of the NOC Fe-towfish. A muster/lifeboat drill was carried out at 10.30. The –80°C contents from near cold room to be moved to –80°C in science hold (only 2 –80°C freezers available, one is near full capacity). A running order of equipment testing (for 13/03/09) was passed to Graham. It was suggested that the CTD and bio wire could be tested today, this did not occur in the end. A problem with the FRRF arose: the deck unit lead is missing. Peter to see if such a lead can be made up on the ship. Midnight meals to start Sat 14th. Weather has remained calm, warm and sunny all day.

12/03/2009 15:47 Lat -54.49264 Lon -54.39194 7.67°C
Set up cruise PSO narrative logsheet.

13/03/2009 22:45 TEST STATON Lat -57.80504 Lon -50.29578 4.25 °C
Ship made good time overnight and arrived at the test station (PS1) early (10:50 am originally estimated to arrive 13.00). Wind has freshened (27 knots) grey skies. After breakfast gear testing began starting with bongo nets then CTD to 150 m (sampled for chl, nutrients, FvFm), CTD for Oithona, LHPR, MOCNESS, RMT8. FRRF not tested as connector not available yet, although it looks promising. Problems with the RMT25 connector meant that this could not be tested in the water at this station. Plan to test this tomorrow a.m. en- route to R1. Go-Flo test aborted on deck as wire is too thick for bottles; this is the same problem as we had last year! Left test station to head to R1 at ~21:30. Weather on departure was calm and foggy. No target fishing carried out overnight.

14/03/2009 22:00 R1 Lat -60.49469 Lon -48.19047 0.93°C
Day started off clear and sunny. RMT25 connector fixed last night. At ~06:00 (local) targets were spotted and target fishing with RMT8 commenced. By 07:00 the net was back on deck. The catch was comprised of mainly krill and salps. Enough krill were caught to allow us to carry on to R1. Tested RMT25, worked fine and we set sail at 11.30 for R1. Around mid-day fog descended again and ships speed reduced. Station reached at around 16:00. Started activities with CTD to 2000 m (Pond), followed by Oithona CTD. A problem with the wire meant this CTD had to be abandoned. 250 m of wire needed to be removed and the CTD re-terminated. Moved on to finish the day with the MOCNESS followed by the FRRF. However during the night the weather deteriorated with up to 40-knot winds and a confused seastate. The FRRF drop was abandoned as well as the LHPR.

15/03/2009 22:00 R1 Lat -60.64355 Lon -48.39192 0.55 °C
At 04:30 local the winds were beginning to die down. Decision was made to get on station and carry out a deep CTD. However at the station there were still problems with the CTD (with the termination) and we decided to postpone this and start the acoustic survey. A revised plan of work activities was drawn up to fit in the CTD, FRRF and LHPR lost during the weather. By the afternoon the CTD was fixed and ready for use tomorrow. Acoustic survey ran until ~16:30 then target fishing was due to begin. A problem with the net monitor meant that neither the RMT8 nor RMT25 could be deployed. Target fishing was cancelled and whilst the monitor was being repaired, we re-located to station to deploy two bongos followed by a mini-bongo. When this had finished the RMT25 was ready to be deployed.

16/03/2009 22:00 R1 Lat -60.51984 Lon -48.17544 1.83 ^{o}C
Despite the initial setbacks at this station all events were carried out and the day ran fairly smoothly. RMT25 fishing finished around 04:00 local. 4 depths (nets) were fished for 30 mins. All nets were successful and caught fish. Relocated to station for the deep CTD followed by Oithona, CTD, LHPR, FRRF. GoFlos were cancelled, as they have not been drilled to fit the wire. Bongos, minibongos, MOCNESS, LHPR all deployed. Target fishing was successful. The last activity was the night-time FRRF and then the ship left to head towards D1.

17/03/2009 22:00 D1 &C2 Lat -60.20849 Lon -44.40803 1.13 ^{o}C
Steamed eastwards from R1 to the first station of the northbound transect, Dimes station 1 (D1). Poor visibility meant that we could barely see the South Orkneys. However as we steamed along the north of the South Orkney shelf there were plenty of fin whales, fur seals and chinstrap penguins around. Target fishing followed the CTD at D1, on way to C2. No targets were found to fish so went straight into station work starting with the MOCNESS, then CTD (Pond), CTD (Oithona) and the night-time MOCNESS. The bars on the mouth of the MOCNESS were bent and so the mouth did not open fully. However zooplankton were caught but the volume reduced due to the smaller net mouth size during fishing. The FRRF drop was the last activity of the day.

18/03/2009 22:00 C2 Lat -54.15665 Lon -40.78252 -3.42 ^{o}C
The sea remained calm today allowing work to proceed smoothly. The day's activities started with an LHPR followed by the deep CTD (>5000 m). The acoustic survey had a delayed start due to overrun of CTD time but ended at same time. During the acoustic survey the higher predator observer, Andy Black, remained outside despite the miserable rain/sleet! There were no/few targets around to fish but the RMT8 was deployed and a few of the hauls were successful in catching krill. The last activity of the day was fishing with the RMT25, both fish and many salps were caught.

19/03/2009 22:00 C2, D3, C3 Lat -59.93592 Lon -44.23926 -0.47 ^{o}C
After the RMT25 fishing finished, we relocated to C2 to finish off the stations activities. However, there was a problem with the bio wire which needs a chunk of wire removed and reterminated. We cancelled the remaining LHPR and will re-schedule tomorrows activities (at station C3) to give Peter Enderlein and Simon Wright plenty of time to fix the bio wire. This morning's activities included bongos, minibongos, GoFlos, FRRF, and another set of bongos. The GoFlo winch only had 540 m of wire on it, it was supposed to be 1000 m. It had also been in use by someone else as there were lengths of tape on it every 5m or so. This meant a lot of time had to be spent removing the tape to ensure the messengers slide down the wire. NMF made no mention of this to us and yet they must have known about it. Once again, a very poor service from NMF. Ended the station with FRRF and bongos, then moved to D3 for CTD. Next headed to C3, target fishing on the way. A small amount of krill was caught. At C3 the first activity was the RMT25 which ran overnight.

20/03/2009 22:00 C3 Lat -59.59004 Lon -44.1702 0.22 ^{o}C
Peter completed work on fixing the biowire. Completed RMT25 (a small amount of fish and more salps were caught) followed by bongos and then the acoustic survey. Scheduling of station activities (i.e. relocating to station for bongos) and the start point of the acoustic survey (x miles away from the station) mean this activity will almost always start late, perhaps something to bear

in mind for future cruises. Biowire was not ready for MOCNESS (epoxy on the termination needed more time to set) so MOCNESS will be postponed to tomorrow night. The rest of the evening was taken up with target fishing. Krill were caught in the 2nd net, fish caught in the 3rd net. The FRRF appeared to cut out during the night-time deployment.

21/03/2009 22:00 C3 Lat -59.68869 Lon -44.05392 0.05 °C
The biowire was tested and ready for use so started day with LHPR then moved on to deep CTD, LHPR and GoFlos. The FRRF does not appear to be working therefore cancelled. GoFlos were followed by bongos, MOCNESS, CTD's, another MOCNESS and then target fishing en route to the start of the DIMES stations. A number of cattle egrets looking the worse for wear landed on the JCR providing a talking point and distraction from the constant grey skies!

22/03/2009 22:00 D5, D6, D7, D8 &C4 Lat -58.35222 Lon -43.18088 1.82 °C
Another grey day with thick fog throughout the morning. No targets were found to fish in the night so started D5 CTD then D6 CTD. After this target fishing began and krill caught fairly soon after. Proceeded to CTDs 7 & 8 and then C4. The first activity was fishing with the RMT25. One net (400 to 200 m) was split along the side as it was brought to the surface. Believed to be due to the huge amount of salps in the net. The net was repaired and used again. This time there were few salps in the net.

23/03/2009 22:00 C4 Lat -57.88191 Lon -43.08753 0.7 °C
Yet another grey foggy start to the day! After completion of RMT25 headed back to the station for bongos & mongos then started the acoustic survey. Target fishing in the evening was largely unsuccessful. Although there was a few krill caught, the catch was mainly salps. A large fish target was seen but not fished, as the priority was krill and no time left for fishing. Finished the day with the night time MOCNESS. A brief glimpse of the sun was seen today but only as the sun was setting!

24/03/2009 22:00 C4 Lat -58.03005 Lon -42.97102 3.14 °C
The day started off even more miserable with heavy rain but then finally the sun came out for the rest of the day. The FRRF did not work again and will be removed from the schedule for the rest of the cruise. The LHPR (night), deep CTD, LHPR (day), MOCNESS deployed. Change in schedule to bring Oithona CTD forward. This was followed by bongos, GoFlos, CTD (Pond) and an extra RMT25 (1 of 2 allocated slots during the cruise survey). RMT25 criteria : to be placed before the SACCF & carried out at night. Our current location (C4) is the only place & time that the RMT25 can be carried out before we reach R2 tomorrow (where the approx position of the SACCF is). Min Gordon attended the ships health and safety meeting. The Chief Engineer requested a list of all chemicals in the outside chemical lockers.

25/03/2009 22:00 C4, D10, D11 & R2 Lat -56.9803 Lon -42.35203 0.6 °C
Last night's RMT25 fishing went fine but suffered from the huge quantity of salps around. This lead the decision to abandon the area and target fish for krill en-route to D10 and between CTD stations. No targets seen. CTD's carried out at D10 and D11. Targets were fished between D11 and R2 the first had no krill only salps second one was similar. Arrived at R2 at ~20.30 pm local so started with CTD Oithona then the MOCNESS.

26/03/2009 22:00 R2 Lat -56.74251 Lon -42.36308 3.12 °C
Started the day with the LHPR then deep CTD. The CTD was sounding an alarm on the way down. Decided to cancel the cast. CTD recovered and will be examined. On the previous 2 casts (D11 & Oithona CTD) data from the primary and then the secondary sensors looked odd. Station work was running late so we started the acoustic survey after the CTD was cancelled. At the end of the acoustic survey another CTD test was planned. It was ready to be deployed but in the CTD annex the pumps came on early (when there was tension in the wire) so we decided to cancel the cast and check out the CTD further. After this we went target fishing then RMT25 (shallow).

27/03/2009 22:00 R2 Lat -56.76589 Lon -42.15107 1.58 °C
The second RMT25 deep haul was cancelled as there was too much tension on the wire – result of strong currents, big swell and wind. The CTD was tested 3 times during the night/early morning and kept alarming. So deep CTD for the morning had to be cancelled. Having been up all night, Julian needed to get some rest and will work on the CTD later. In the meantime, all activities for the rest of the day were brought forward starting with bongos at ~4 am local time, then LHPR, MOCNESS. The afternoon bongos were reduced to just 1 instead of 2 as there is not much material in the bongos. GoFlos – shallow and deep separate casts. Test on CTD at 5 pm to ~300m . Alarming. Will reterminate (using potting compound instead of heat shrink) and change underwater unit. This will take about 12 hours to set and then CTD will be tested again. We will stay on station until this time. Time to be spent target fishing and fishing with RMT25.

28/03/2009 22:00 R2, D13 & D14 Lat -56.02681 Lon -41.79758 2.75 °C
The deep RMT25 haul from last night worked well and lots of interesting species were caught including squid. Target fishing on a supposed fish layer only caught lots of salps and very few fish. Target fishing for krill was also unsuccessful. After fishing, the ship headed back to the station and is waiting here until we can test out the CTD (need to ensure potting compound on the termination has set). The test failed so we decided to get a profile of nutrients, chl and Fv/Fm using Goflos. This was done using 5 bottles on 2 separate casts, the deepest depth being 120m. Remaining water of shallowest GoFlos used by Dave Pond. An XBT was also deployed as we left the station to head to D13. Tested out the CTD here and this worked fine, so carried on to a full deep, deployment. Fingers crossed it stays working! However, we had more bad luck as the wind increased during the afternoon/evening. Arrived at D14 at ~18.30 local and hove to as the rising wind/seastate were deemed unsuitable for RMT25 and CTD.

29/03/2009 22:00 D14, D15 & P2 Lat -55.25906 Lon -41.35809 3.38 °C
At ~6am the ship was brought back on station (D14) having drifted about 5 nm. The ship was drifting about 1knot and with the heavy swell and wind direction it was not possible to deploy the CTD. We decided to abandon the station and head to D15 where we will reassess the weather. It was fine so carried out CTD then moved on to P2 looking for targets along the way. None found. Arrived at P2 started with bongos & mongos, CTD (Pond), CTD Oithona, RMT25. This worked well and there were no salps in the net for a change!

30/03/2009 22:00 P2 Lat -55.28603 Lon -41.56541 4.07 °C
After RMT25 fishing ended we went into acoustic survey. Peter prepared moorings with aim of deployment tomorrow. No targets were seen during the survey so the target fishing time was spent as surface tows with the RMT8. A number of sub-Antarctic species were caught but no E.

superb. This agrees with the physical oceanography especially the warm water we are in, most likely a meander of the Polar Front. Last activity was the MOCNESS.

31/03/2009 22:00 P2 & D17 Lat -55.25843 Lon -41.35769 1.81 °C
Assessing weather throughout the day to see when schedule can be stopped to carry out mooring deployment. LHPR, CTD (deep), bongos, MOCNESS (day), LHPR(day), GoFlos all carried out as weather not suitable for deploying mooring. Plan is to put out mooring tomorrow starting at 6 a.m. Tonight will steam to D17 and carry out CTD. Nathan has organized a mid cruise quiz to keep us all happy!

01/04/2009 22:00 P2, D18 & D19 Lat -54.48241 Lon -40.945 1.69 °C
Work started on the mooring deployment at around 6 am and was completed by 12.30. All went smoothly even with the new method of deployment (buoy end first instead of weight end first). Moved on to D18 and D19. Target fishing along the way although no targets were seen.

02/04/2009 22:00 D19, D20, D21 & P3 Lat -52.80847 Lon -40.11512 1.49 °C
At D20 there was a heavy swell, which caused the shallow bottles of the CTD cast to misfire. A second shallow CTD cast was carried out with most bottles firing OK but a few missing. Moved off after this and decided to put the RMT8 into the water for half an hour even though no targets were seen. We placed an extra shallow CTD station in the middle of the transect between D20 and P3. This was called D21 and chl/nutrients sampled from it. The weather had not improved by lunchtime (gusty winds with heavy sleet) and decided to postpone mooring work until tomorrow. Started off station work with 1 bongo followed by MOCNESS, CTD (Pond), CTD (Oithona) and finished the day target fishing for krill. Lots of krill were caught when the ship moved to slightly cooler waters to the south of the station (currently temp is ~5.2 °C)

03/04/2009 22:00 P3 Lat -52.80853 Lon -40.1146 0.96 °C
Heavy swell through the night had eased by morning and winds were light. Day started with LHPR, deep CTD bongos and mongo then deployed mooring. All went well again and this work was finished by ~13:00. After the mooring work we did bongos again then LHPR (day), GoFlos, MOCNESS (night) and the RMT25.

04/04/2009 22:00 P3 Lat -52.68116 Lon -40.29946 2.14 °C
Finished the RMT25 and went into acoustic survey. The winds picked up during the morning and it is due to stay fresh for the next few days. At end of acoustic survey (6 pm) headed to R3, spotted a strong target on the way but nothing was caught. Due to weather ship can only steam at <7 knots, will cause a delay in arrival at station. There was no more target fishing as the weather had deteriorated with strong winds and swell.

05/04/2009 22:00 TRAVEL Lat -52.8433 -37.16214 0.65 °C
The storm intensified overnight to Gale force 8. The ship moved slowly towards R3 then hove to for the rest of the day. By the afternoon the storm had eased slightly to a gale force 7 but it was still too rough to carry out any science.

06/04/2009 22:00 R3 Lat -52.86569 Lon -36.83676 1.73 °C

The ship was still hove to in the early morning and had drifted about 20 miles away from R3. At around 4 am the ship turned and headed back towards R3. Waiting for daylight to assess swell and see if we can carry out some activities. If so, we no longer have the time at this station to carry out all station activities. At 6 am the ship was stopped and this new position became the R3 station. We started work there with a set of bongos and a mongo, CTD (deep), GoFlos, MOCNESS, LHPR. Tried to target fish in the evening. The RMT8 was deployed but the swell was too strong and the net brought back on deck. RMT25 fishing was cancelled also.

07/04/2009 22:00 R3 Lat -52.66819 Lon -36.96985 1.56 ^{o}C
The ship hove to for most of the night. In the early morning we slowly started heading back to R3. Quite a few icebergs around in this location. Acoustic survey began at 6 am and was originally due to end at midday. However the captain wanted to delay heading to the Polar Front as the weather was not looking good up there. So carried on with acoustic survey until 5 pm then headed to PF station. Had planned to target fish for krill over the NW Georgia Rise but the swell was too great and there were no targets. XBT's will be deployed every 2 hours from leaving R3 up to the PF station.

08/04/2009 22:00 TRAVEL Lat -49.86096 Lon -34.32356 3 ^{o}C
Proceeding to the PF station with XBT's every 2 hours. Arrived at ~13:00 and started deploying XBT's every half hour. A heavy swell meant that the ship's course was slightly altered (there were a few 30 degree roles through the day). The XBT section was complete and the ship turned course to move to the northern PF station (there will be 3 stations, one in the PF and one either side of the PF). Attempted to hold the ship on DP at the station but with the confused swell and wind it was not possible to hold position. In the end the ship hove to until the morning when conditions could be reassessed.

09/04/2009 22:00 PF Lat -50.05919 Lon -34.01376 1.89 ^{o}C
At 5 am conditions were moderating but still too severe to deploy CTD's etc. An acoustic survey was carried out which ran through the northern station (PFN). The transect direction had to be changed from the original plans due to the heavy swell still present. Also there are now only 2 stations not 3 and these have been named the PFN and PFS. A set of 6 CTD's will be carried out from north of PFN to south of PFS; they are to be called PF1 though to PF6. These CTD's run along the XBT transect. At ~3.30 pm the CTD was deployed to 500 m at PF1. Ship moved south to PF2 and CTD deployed to 1500 m. The current was strong at this site ~1.8 knots. RMT25 fishing was carried out throughout the night.

10/04/2009 22:00 PF Lat -50.60149 Lon -33.85679 3.19 ^{o}C
The weather today was good with calm seas and light winds. After the RMT25 fishing finished, the ship was quite a distance from the PFN station and it took ~2.5 hours to head back to station. At PFN a set of bongos & mongo were carried out. We then headed to PF3 for a shallow (500 m) CTD and to PF4 for a deep (1500 m) CTD. At PF4 the acoustic survey was cancelled and the time used to examine a problem with the RMT25 wire. The wire was hung over the back of the ship with a weight attached to remove torque and possible bird caging. This appeared to solve the problem. To fill in time before night-time target fishing an LHPR was deployed. Overnight the RMT25 was fished starting with shallow nets, deep nets, then target fishing.

11/04/2009 22:00 PF Lat -51.12071 Lon -36.04359 2.15 °C
The weather turned with the wind and swell picking up. A CTD was deployed and then bongo/mongo (by the time the last net was on deck conditions were marginal). Turned to start an acoustic survey around PFS. However the weather deteriorated to blizzard like conditions and the survey was abandoned. The weather continued to deteriorate with a heavy swell and gale force 10 gusting to 12. The ship proceeded towards South Georgia although had to take a westerly course.

12/04/2009 22:00 TRAVEL Lat -53.04477 Lon -37.35983 1.86 °C
Heavy rolling all night. At ~7 am the ship managed to turn and head south-eastwards to Bird Island. Throughout the day the wind eased but the heavy swell persisted for most of the morning but began to ease in the early afternoon. By 4 pm conditions had moderated enough to allow target fishing. However no targets were seen. In the evening the towfish was recovered on deck as there were worries it may become entangled in the kelp on the approach to Bird Island. The first mate Robert gave us a briefing about going ashore at Bird Island.

13/04/2009 22:00 BI Lat -54.01897 Lon -38.05439 2.97 °C
Arrived at Bird Island (BI) in the early hours of the morning. Conditions looked calm and good for a relief. The first group of scientists got ashore at ~7.30. This group consisted mainly of people who had not been on the island before. After lunch a second group of people got ashore. The base staff took ships people on various walks to see the local wildlife. This was greatly appreciated and everyone thoroughly enjoyed the chance to stretch their legs and work their cameras. At 5 pm all were back onboard with the exception of Jose who left the ship to overwinter at BI. Anton and the doc also stayed ashore.

14/04/2009 22:00 BI, WCB & STROMNESS Lat -54.1474 Lon -36.61914 1.07 °C

Anton, the doc and 5 BI people were picked up this morning and, once all were onboard, then the ship headed towards the WCB mooring. Once there, the conditions were not suitable for recovering the mooring. The towfish was re-deployed and then we headed inshore and towards Rosita Harbor for target fishing. This was very successful and by 3 pm the towfish was brought back onboard and we were able to head towards Rosita for the calibration. However, when we arrived at Rosita, another ship, the Faros, was already anchored there sheltering from the weather which had picked up, squalls and wind. We decided to head to Stromness for the acoustic calibration. Arrived at 8 pm and proceeded with CTD. A problem with the wire meant the CTD could not be deployed. Instead we used the CTD from the RMT8 net monitor. This failed on the first deployment but after swapping some of the sensors around it worked OK. The acoustic calibration could then proceed and was finished at ~4 am.

15/04/2009 22:00 STROMNESS & WCB Lat -53.76025 Lon -38.31859 2.74 °C
The morning started with glorious sunshine and the stunning scenery of Stromness and South Georgia surrounded us. It was the perfect setting for the cruise photo which all scientists turned up for though some were much more willing than others. The ship prepared to leave at 9 am and then we turned the corner and were treated to the beautiful site of Leith Harbour as the captain and the 3rd mate took the ship in for a closer view. After our site seeing trip we had to get back

to reality and proceeded to the WCB to recover/redeploy the shallow mooring, then the CPR and towfish were deployed and we headed back to Stanley.

16/04/2009 22:00 TRAVEL Lat -53.02606 Lon -44.94706   3.0^{o}C
On passage back to Stanley.

17/04/2009 22:00 TRAVEL Lat -52.23377 Lon -52.35999   6.16^{o}C
On passage to Stanley. In the evening we had the end of cruise dinner that consisted of a fantastic sit down meal, speeches and then horse racing in the bar. A great end to the cruise.

18/04/2009 13:22 TRAVEL Lat -51.73541 Lat -56.95660   4.12^{o}C
On passage to Stanley, arrival expected at ~2pm ship time. Demobilisation will begin.

1.4 Acknowledgments

Rebecca Korb PSO

Having spent many seasons on board the JCR, this was my first time as PSO. I found the experience both pleasant and relatively easy. However, all credit for this goes to the experts and professionals that I had the opportunity to work with, both on the cruise and back at BAS HQ. It is only now as PSO that I can appreciate the enormous network of people involved in putting together such a multidisciplinary cruise as JR200. I know there will be people I fail to name directly here but many, many thanks got out to all BAS operations and logistics staff for putting such a large science team in the field.

Despite an extremely tight schedule, almost all our science activities were achieved with only a few problems due to weather. Sincere thanks go to Captain Graham Chapman, his officers and crew, who guided our work through rough seas and were happy to accommodate our ever changing station schedules. Many thanks to our science support staff for their hard work, especially Julian Klepacki for working non stop during a mid cruise crisis, to fix a tired and emotional CTD. I am extremely grateful to the scientists (Peter Enderlein, Sophie Fielding, Min Gordon, David Pond) who arrived 3 days early on the ship to begin mobilization. Finally, I sincerely appreciate the hard work and professionalism of all scientists on board the ship who made my job as PSO a relatively easy one.

1.5 JR200 Scientists and Support Personnel

Angus **Atkinson**	Krill Ecology	BAS
Andy **Black**	At Sea Observations	BAS
Yves **Cherel**	Nekton	Centre d'Etudes Biologiques de Chizé
Nathan **Cunningham**	Data Management	BAS
Johnnie **Edmonston**	ICT Support	BAS
Peter **Enderlein**	Moorings & Sampling Gear	BAS
Sophie **Fielding**	Acoustics / Krill Ecology	BAS
Min **Gordon**	Phytoplankton	BAS
Ruth **Hicks**	Krill Diseases	AFI-CGS, CEFAS
Daria **Hinz**	Iron Chemistry	AFI-CSS, NOC
Julian **Klepacki**	AME Support	BAS
Rebecca **Korb**	PSO, Phytoplankton	BAS
Dave **Pond**	Biochemistry	BAS
Anton **van de Putte**	Nekton	Katholieke Universiteit Leuven
Sebastian **Steigenberger**	Iron Chemistry	AFI-CSS, NOC
James **Screen**	Oceanography	UEA
Gabi **Stowasser**	Nekton	BAS
Geraint **Tarling**	Mesozooplantkon	BAS
Hugh **Venables**	Oceanography	BAS
Pete **Ward**	Mesozooplantkon	BAS
Mick **Whitehouse**	Macronutrients	BAS
Jose **Xavier**	Nekton	University of Algarve

Fig 1.5.1 Cruise Photo

1.6 JCR Officers and Crew

CHAPMAN Graham P	Master
PATERSON Robert C	Chief Officer
EVANS Simon D	2nd Officer
SPOONER Alexander J	3rd Officer
SUMMERS John W	Deck Officer
WADDICOR Charles A	ETO (Comms)
CUTTING David J	Chief Engineer
COLLARD, Glynn	2nd Engineer
DITCHFIELD James C	3rd Engineer
EADIE Steven J	4th Engineer
WRIGHT Simon A	Deck Engineer
DUNBAR Nicholas J	ETO (Eng)
GIBSON James S	Purser
STEWART George M	Bosun
JENKINS Derek G	SG1
CAMPBELL Andrew C	SG1
MULLANEY Clifford	SG1
LEGGETT Colin J	SG1
O'DUFFY John P	SG1
MCILHATTON James F	SG1
ROBINSHAW Mark A	MG1
MOORE Carl J	MG1
WALKER Keith A	Cook
BALLARD Glen R 2nd	Cook
WESTON Kenneth	Steward
NEWALL James	Steward
LEE Derek W	Steward
MOTTE Colin	Steward

2. PHYSICAL OCEANOGRAPHY

Hugh Venables and James Screen

2.1 INTRODUCTION

Collection of physical oceanographic data throughout JR200 included the continuous logging of navigational, bathymetric, ocean current, surface ocean and meteorological parameters, in addition to water column profiling at specific locations using a Conductivity-Temperature-Depth (CTD) unit fitted with numerous sensors and Expendable Bathythermographs (XBTs).

2.1.1 Aim

The purpose of the physical oceanographic program was twofold: firstly, to complete a high resolution CTD section between South Orkneys and South Georgia as part of the DIMES project; and secondly, to support the work of the biologists and chemists aboard the JCR, and aid in the selection of suitable sampling locations.

2.1.2 Data acquisition

As previously stated, numerous instruments were employed in the collection of physical data. For ease of reading, each method of data collection will be discussed in a separate section, as follows:

2.2 Navigation
2.3 Underway (oceanlogger and meteorological data)
2.4 Vessel-mounted Acoustic Doppler Current Profiler (VM-ADCP)
2.5 CTD profiles
2.6 XBT profiles

Each of these sections will include a description of the instrumentation and any necessary configuration information; a description of the data collection; details of any processing carried out thus far; details of problems encountered (and solutions, if found!); some preliminary results, where available; and any recommendations for future work.

2.2 UNDERWAY NAVIGATIONAL DATA

James Screen & Hugh Venables

2.2.1 Instrumentation and data collection

Navigational data were collected continuously throughout the cruise. Instrumentation was as follows:

Ashtec ADU2 GPS: antenna 1 used to determine the ship's position; antennae 2-4 used to determine pitch, roll and yaw.

Ashtec GLONASS GG24 (accurate to ≈15m)

Sperry Mk 37 Model D Gyrocompass

Seatex GPS (Seapath 200)

GPS NMEA

Hull-mounted Simrad EA600 Hydrographic 12kHz Echosounder (transducers located approximately 5m below the water level). **It must be noted that the datastream is still called 'sim500', so all programs are named according to this, despite the instrument being an EA600!**

Navigational data were collected every second, whilst the bathymetric data were logged every 10 seconds.

2.2.2 Processing

Navigational data were processed in Unix and Matlab using modified versions of programs developed by Mike Meredith. Data were initially read into the Unix system, then transferred to Matlab, where the bulk of the processing was carried out.

Unix

get_nav Calls the scripts *get_gyro*, *get_bestnav*, *get_gpsash*, *get_gpsglos*, *get_gpsnmea*, *get_seatex* and *get_tsshrp*, which invoke the *listit* command to retrieve 24 hours of gyrocompass, bestnav, Ashtec (ADU2), Ashtec Glonass (GG24), GPS NMEA, Seatex and tsshrp (heave, pitch and roll) data. Data are saved in subdirectories 'gyro', 'bestnav', 'gpsash', 'gpsglos', 'gpsnmea', 'seatex', and 'tsshrp' as *gyro.NNN*, *bestnav.NNN*, *gpsash.NNN*, *gspglos.NNN*, *gpsnmea.NNN*, *seatex.NNN* and *tsshrp.NNN*, where NNN is the jday.

get_sim500 Invokes the *listit* command to retrieve 24 hours of EA600 data. Data are saved as *sim500.NNN*.

Matlab

load_daily.m Reads in navigation files output by the Unix processing (above) by calling the following functions:

- *load_daily_bestnav*: reads in text file *bestnav.NNN* and writes data to a Matlab structure array. Data are flagged, such that any variable with flag ≠ 50 are poor, and thus discarded. Output is *bestnav/bestnavNNN.mat*.
- *load_daily_gpsash*: reads in text file *gpsash.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag ≠ 50 are poor, and thus discarded. Output is *gpsash/gpsashNNN.mat*.
- *load_daily_gpsglos*: reads in text file *gpsglos.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag ≠ 50 are poor, and thus discarded. Output is *gpsglos/gpsglosNNN.mat*.

- *load_daily_gpsnmea*: reads in text file *gpsnmea.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag$\neq$ 50 are poor, and thus discarded. Output is *gpsnmea/gpsnmeaNNN.mat*.
- *load_daily_gyro*: reads in text file *gyro.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag$\neq$ 50 are poor, and thus discarded. Output is *gyro/gyroNNN.mat*.
- *load_daily_seatex*: reads in text file *seatex.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag$\neq$ 50 are poor, and thus discarded. Output is *seatex/seatexNNN.mat*.
- *load_daily_tsshrp*: reads in text file *tsshrp.NNN* and writes data to Matlab structure array. Data are flagged, such that any variable with flag$\neq$ 50 are poor, and thus discarded. Output is *tsshrp/tsshrpNNN.mat*.

For a quick visual check, the program then plots bestnav, gpsash, gpsglos, gpsnmea and seatex data over one another (after plotting each dataset the user must hit return to continue), gyrocompass heading, and pitch and roll.

plot_seatex_all Plots entire cruise track. Loads *seatexNNN.mat* for all jdays and GEBCO bathymetry data.

loadsim500 Reads in *sim500.NNN* and stores data in Matlab structure array. Saves *sim500_NNN.mat*

cleansim500 Loads *sim500_NNN.mat* and sets values $\leq$0 to NaNs, then uses 1D linear interpolation to fill data gaps. Data are then despiked by calling *dspike* and data gaps are filled by linear interpolation. Data are then cleaned using an interactive editor and gaps filled by linear interpolation. Output is *sim500_NNNclean.mat*. A slight change to the interactive editor was made to speed this process as some days (generally if water is deep and weather is rough) have a large scatter in the depths and a need for significant amounts of the data to be removed. The change was to allow the user to respond with ‘2’ when asked if finished editing, this returned the same axes as the previous edit, skipping setting them in figure 3.

2.2.3 Problems encountered

On two occassions, TSHRP had to be restarted due to the data storage disk filling up. This resulted in short periods when TSHRP data are missing. The cruise track produced from the Ashtec GPS sometimes had a few spurious points, which have not been removed; the Seatex GPS was used for navigational data for all oceanographic purposes.

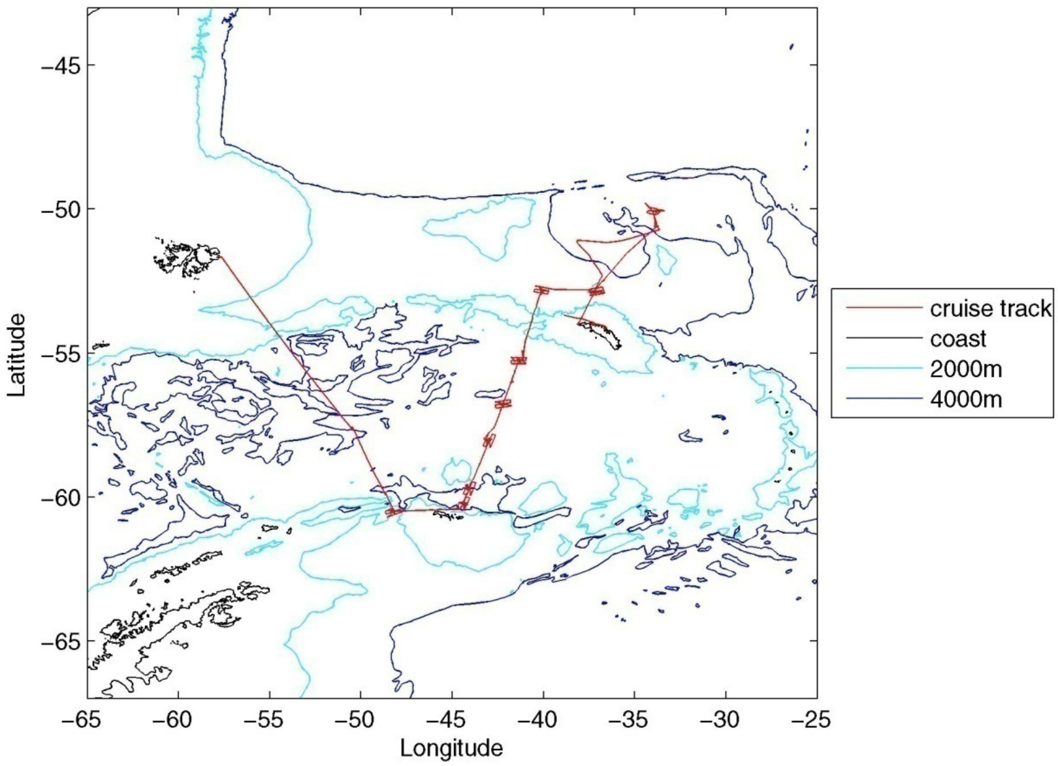


Fig 2.2.1: JR200 cruise track for jdays 70 to 105 from Seatex GPS. Coastline and bathymetry data are from the GEBCO dataset.

2.3 UNDERWAY OCEANLOGGER AND METEOROGICAL DATA

James Screen & Hugh Venables

2.3.1 Instrumentation and data collection

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

Oceanlogger

- SeaBird Electronics SBE45 CTD
- Turner Designs 10-AU Fluorometer

Meteorological data

- Photosynthetically Active Radiation (PAR) 1, Parlite Quanum Sensor, Kipp & Zonen
- Photosynthetically Active Radiation (PAR) 2, Parlite Quanum Sensor, Kipp & Zonen
- Solar Radiation 1, Proto1 SPLite, Kipp & Zonen
- Solar Radiation 2, Proto1 SPLite, Kipp & Zonen

- Air temperature/humidity 1, Chilled Mirror Hygrometer MBW, PM-20251/1, Temperature Sensor Pt100, PM-20252/1
- Anemometer (this logs wind speed relative to the ship. At this time there is no datastream for true wind, but this can be calculated from relative wind and navigational data, if required).

Both surface ocean and meteorological data were collected at 5 second intervals.

2.3.2 Processing

Initial processing was carried out in Unix, which generated files that could be further processed in Matlab.

Unix

get_underway	Calls the scripts *get_oceanlog*, *get_anemom* and *get_truewind*, which invoke the *listit* command to retrieve 24 hours of underway data. Output files are *oceanlog.NNN*, *anemom.NNN* and *truewind.NNN*, where NNN is the jday.

Matlab

loadunderway	Calls functions *loadoceanlog* and *loadanemom* to read *oceanlog.NNN* and *anemom.NNN*. Data are stored in structure arrays and saved as *oceanlogNNN.mat* and *anemomNNN.mat*. The program then calls the function *cleanoceanlog*, which sets unrealistic values to NaNs, uses *dspike* to remove large spikes in conductivity, housing (CTD) temperature and remote (hull) temperature. Linear interpolation is used to fill data gaps. Data from periods of flow >1.5 l/min or <0.4 l/min are also set to NaNs, as are data from 5 minutes after a drop in flow to allow variables to return to normal. Surface ocean data are further cleaned using an interactive editor, which allows manual removal of spikes and flier points. Salinity is then calculated using *ds_salt* and the interactive editor is used to remove spikes and flier points. The output is *oceanlogNNNclean.mat*.
plot_oceanlog_daily	Loads *oceanlogNNNclean.mat* and *seatexNNN.mat*, calculates 1 minute averages and plots maps of sea surface temperature, salinity and fluorescence. Bathymetry data from GEBCO are included in the plots. Output files are *oceanlog_navNNN.mat* and *oceanlog_navNNN_1minave.mat*.
plot_oceanlog_all	Loads *oceanlog_navNNN_1minave.mat* for all jdays and plots sea surface temperature, salinity and fluorescence for the entire cruise track. Bathymetry data from GEBCO are included in the plots.
underwayAll	Loads *oceanlogNNNclean.mat*, *anemomNNN.mat* and *oceanlog_navNNN.mat*, and appends all data to a master file *underwayAll_jr200.mat*.

2.3.3 Problems encountered

(1) Underway temperatures have previously been observed to be ≈0.3ºC too low. This was noted during JR165 (Feb-Apr 2007) and an attempt was made to fix the problem during that summer's refit period. However, the same problem was encountered on JR171 and JR193 (Nov-Dec 2007). During JR177 a concerted effort was made to monitor the problem, and comparisons have been made between CTD data from 6m and synchronous underway data. The code was used again on JR200. *check_oceanlog_ctd* loads *jr200ctdNNN.2db.mat*, *jr200ctdNNN.2db.up.mat* and *oceanlog_navNNN.mat*, and extracts underway temperature, salinity and fluorescence data from times corresponding with those at which the CTD is at 6m depth. Plots of CTD salinity minus underway salinity, CTD temperature minus underway temperature and time change against temperature change are output to the screen, and 6m values are saved in *ctdOceanlog.mat*.

The difference, CTD temperature minus underway temperature, has a scatter of points between -0.181 and 0.121ºC. There is a mean offset of 0.0028ºC. The standard deviation is 0.04ºC. This appears to be an improvement on previous seasons but an informal check of the data at the beginning of JR218 appeared to show the oceanlogger was 0.4ºC too warm.

2.3.4 Salinity samples

Throughout the cruise, water samples were collected for salinity analysis in order to calibrate the underway conductivity sensor. The water samples were collected in 200ml medicine bottles. Standard procedure was to rinse the bottle three times, before filling it to just below the neck to allow room for expansion during warming and to facilitate mixing of the bottle's contents prior to analysis. The rim of each bottle was wiped dry with a tissue, then a plastic seal inserted and the screw cap replaced. Ongoing crates of salt samples were kept in salinometer lab and allowed to equilibrate with ambient conditions for at least 24 hours prior to analysis.

The samples were analysed on one of the shipboard Guildline 8400B Autosal salinometers (s/n 68959), which had been standardised at the beginning of the cruise using Ocean Scientific International Ltd (OSIL) P146-series standard seawater. Prior to, and following, analysis of each water sample crate, a new bottle of standard seawater was analysed to ensure that the salinometer remained stable and in order to derive a calibration offset. In between batches of salinity analysis, the salinometer was flushed, and filled with, milliq. It was noted on JR193 that this led to dilution of (and thus low readings for) the standard prior to the first salinity crate, requiring another standard to be run before analysis of the collected water samples. This issue was resolved by means of flushing the salinometer several times with standard seawater left over from previous analyses before analysing the first standard associated with each crate.

Standard procedure was to invert each sample bottle a few times in order to mix the contents but avoid the introduction of a large number of air bubbles into the sample. The salinometer cell was then flushed three times with the sample, prior to taking the first reading. The cell was then flushed once between subsequent readings, with at least three readings being taken for each sample.

During the cruise the salinometer drifted slightly, with standards reading 1.99981 by the end (up from 1.99964). The offsets between measured salinities (after accounting for the offset in the standards) and the CTD salinities remained constant. It was therefore considered to be a drift that had been successfully accounted for rather than an issue with the standards.

Once analysed, the conductivity ratios were entered by hand into an Excel spreadsheet, *jr200_master.xls*, converted to salinities and transferred to the Unix system. They were then used to investigate a conductivity offset for the underway sensor along with 6m CTD values found as above for temperature.

2.3.5 Conductivity calibration

Times at which underway salts were collected were entered by hand into the Excel file *Salts underway.xls*. The Matlab script *underwaySaltsCal* reads in *Salts underway.xls*, loads *underwayAll_jr200.mat* and extracts data corresponding to the times at which underway samples were taken. The program assumes that the sample was taken at 30 seconds past the minute recorded in the underway salts log, then extracts the median value for that minute (i.e. the median value for salinity 30 seconds either side of the recorded time). These data are compared with salinity values from water sample analysis (stored in *jr200_master.xls*) and a plot of underway salinity minus sample salinity is plotted to the screen. The offset found relative to CTD 6m salinities shows a drift through the cruise from the oceanlogger being 0.025 too fresh to 0.07 too fresh. This will be investigated fully with the sample and an offset applied to the data.

2.3.6 Oxygen isotope samples

Water samples were collected for oxygen isotope analysis in areas close to/downstream of glacial landmasses. Samples were taken from CTD Niskin bottles and from the underway supply. Standard procedure was to rinse each bottle three times then fill it to the neck, before drying the bottle and sealing it with a rubber insert. A metal cap was then added to the bottle using crimpers. Samples were packed in boxes for transfer back to the UK and will be sent to the NERC Isotope Geosciences Laboratory (NIGL, Keyworth, U.K.) for analysis. Times were written onto a logsheet which was then typed into excel.

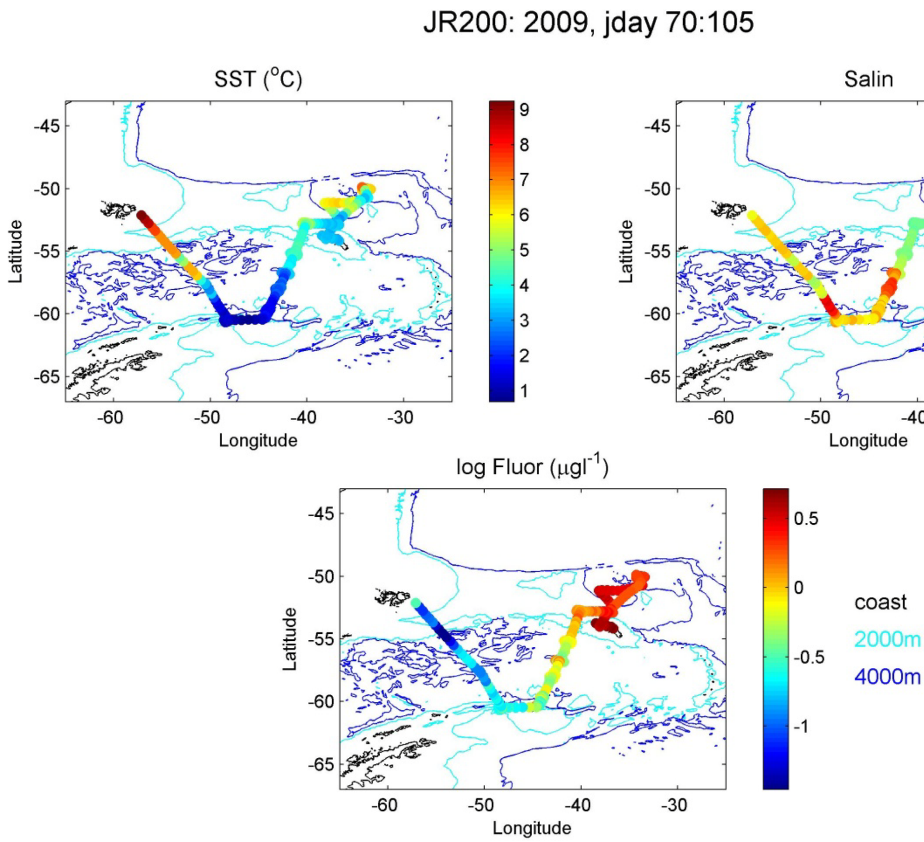


Fig 2.3.1: 1 minute averages of SST, salinity and log fluorescence from the oceanlogger for JR200

2.4 VESSEL-MOUNTED ACOUSTIC DOPPLER CURRENT PROFILER

Hugh Venables

2.4.1 Introduction

A 75 kHz RD Instruments Ocean Surveyor (OS75) ADCP was used during this cruise. This has also been used on JR139 (Stansfield 2006), JR161 (Hawker 2006), JR165 (Shoosmith/Renner 2007), JR193 (McCarthy and Venables 2007), JR177 (Venables 2008) and JR218 (Fielding and Venables 2008). The OS75 is capable of profiling to deeper levels in the water column than the previous 150kHz ADCP and can also be configured to run in either narrowband or broadband modes.

2.4.2 Instrumentation

The OS75 unit is sited in the transducer well in the hull of the *JCR*. This is flooded with a mixture of 90% de-ionised water and 10% monopropylene glycol. With the previous 150 kHz unit, the use of a mixture of water/antifreeze in the transducer chest required a post-processing correction to derived ADCP velocities. However, the new OS75 unit uses a phased array transducer that produces all four beams from a single aperture at specific angles. A consequence of the way the beams are formed is that horizontal velocities derived using this instrument are independent of the speed of sound (vertical velocities, on the other hand, are not), hence this correction is no longer required.

The OS75 transducer on the *JCR* is aligned at approximately 60 degrees relative to the centre line. This differs from the recommended 45 degrees. Shortly after sailing for JR139, the hull depth was measured by Robert Patterson (Chief Officer), and found to be 6.47m. Combined with a value for the distance of the transducer behind the seachest window of 100-200mm and a window thickness of 50mm, this implies a transducer depth of 6.3m. This is the value assumed for JR200, but note that the ship was very heavily laden during cruise JR139, and for other cruises it may be shallower.

During the trials cruise, it was noted that the OS75 causes interference with most of the other acoustic instruments on *JCR*, including the EM120 swath bathymetry system. To circumvent this, the ADCP pinging was synchronised with the other acoustic instruments using the SSU. This issue was investigated in detail on JR218 (which see for full details). On JR200 the Swath was not used (except briefly when deploying moorings) and the ADCP was synchronised with the EK60. The EK60 was master on a 2 second ping rate and the ADCP followed pinging every 4 seconds. When not sychronised (when swath was used briefly when deploying moorings) it would ping every approximately 3.1 seconds. In shallow water the ADCP was set in bottom track mode with varying depths (and therefore ping rates).

The heading feed to the OS75 is the heading from the Seapath GPS unit. This differs from the previous ADCP setup on *JCR*, which took a heading feed from the ship's gyrocompass and required correction to GPS heading (from Ashtech) in post-processing.

2.4.3 Configuration

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The logging PC also had Version 1.13 of the RDI WinADCP software installed. This can be run as a realtime monitor of data but the output bears little resemblance to the processed data so this was not used. The OS75 ran in two modes during JR200: narrowband with bottom-tracking on and narrowband with bottom-tracking off. While bottom tracking the maximum water depth was either set to 250m, 500m or 800m (30, 65 or 100 bins, each 8 metres). Water-tracking was always one hundred 8 metre bins. The matlab code can now (post-JR218) concatenate files with differing numbers of bins. Narrowband profiling was enabled with an 8 metre blanking distance (Note that this blanking distance is larger than the 2m initially used by the RDI technician during the trials cruise. This change was adopted following advice from Dr. Mark Inall and Dr. Deb Shoosmith, who voiced concerns over the quality of data in the top bin). Despite this, there were still periods, especially in bad weather, where the data in the top bin looked bad. The 'set modes' configuration files, as described in JR218 report, were used during the cruise.

Reducing the maximum water depth to less than twice the actual water depth (as measured by the EA600) has two significant advantages (see JR218 report for full details). Firstly it speeds up the ping rate as the instrument spends less time waiting for echoes. This means that at 250m it stays in sync with the EK60 at a two-second ping rate (one water track ping and one bottom track ping every four seconds, one with each of two EK60 pings). At 500m it manages the two pings in 6 seconds and at 800m it manages them in 8 seconds, which is slow for the water track data and so should be used sparingly in areas where water column data is wanted for science. The second advantage is that the instrument stops listening before it can hear double-bottom echoes (sounds that goes transducer-bottom-surface-bottom-transducer). This leads to cleaner plots of the water column velocities.

Salinity at the transducer was set to zero, and Beam 3 misalignment was set to 60.08 degrees (see above discussion). The full configuration files for each of the modes used are given at the end of this section.

2.4.4 Outputs

The ADCP writes files to a network drive that is samba-mounted from the Unix system. The raw data (.ENR and .N1R) are also written to the local PC hard drive. For use in the matlab scripts the raw data saved to the PC would have to be run through the VMDas software again to create the .ENX files. When the Unix system is accessed (via samba) from a separate networked PC, this enables post-processing of the data without the need to move files.

Output files are of the form JR200_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present filesize exceeds 10 Mbyte.

ZZZ are the filename extensions, and are of the form:-
.N1R (NMEA telegram + ADCP timestamp; ASCII)
.ENR (Beam co-ordinate single-ping data; binary). These two are the raw data, saved to both disks
.VMO (VmDas configuration; ASCII)
.NMS (Navigation and attitude; binary)
.ENS (Beam co-ordinate single-ping data + NMEA data; binary)
.LOG (Log of ADCP communication and VmDas error; ASCII)
.ENX (Earth co-ordinate single-ping data; binary). This is read by matlab processing
.STA (Earth co-ordinate short-term averaged data; binary)
.LTA (Earth co-ordinate long-term averaged data; binary).

The .N1R and .LTA files are streamed back to Cambridge for use in google earth real time plotting.

2.4.5 Post-processing of data

OS75 data were processed on JR200 using Matlab code originated by IFM Kiel. This was adapted by Dr. Mark Inall, Dr. Deb Shoosmith, Angelika Renner, Mark Brandon and Hugh Venables for use with the *JCR* system. The master file for the processing is "OS75_JCR _jr200.m", which calls a lengthy sequence of routines to execute the following steps. Angelika Renner made changes to the main program following JR165, to calibrate narrowband and broadband data separately. These changes are adopted, though no broadband data has been collected.

1) Read RDI binary file with extension .ENX and ASCII file with extension .N1R into Matlab environment.

2) Remove missing data and data with bad navigation

3) Merge Seapath attitude data with single-ping ADCP data.
The program read_nmea_att_jcr.m was modified to cope with a .N1R file where the first line was a PADCP line that was too short. The fix only works if it the first PADCP line that is broken.

4) Correct for transducer misalignment and velocity scaling error (calculated during first run-through of code, applied during second)

5) Derive ship velocity from Seapath navigation data

6) Perform quality control on data, such that four-beam solution is only permitted. Other screening is performed based on maximum heading change between pings, maximum velocity change between pings, and the error velocity. Angelika Renner, after JR165, added checks on the correlation and also removed data with very strong amplitudes, as this is a sign of interference. The latter check involves a large amount of processing time, which caused problems when ADCP data was wanted rapidly. To solve this the check was removed when data were processed initially (amplitude and misalignment as defaults) but included for post-processing. The filter length was reduced, or the filter removed completely for short files (including when data collection was stopped just after a new 10mb increment of the .ENX file). This stopped the processing stopping with an error.

7) Average data into ensembles of pre-defined length (120 seconds for JR200). The version of the function average_pings.m was modified slightly to cope with cases found during JR200 which initially caused the processing to crash. These were where there was less than 2 minutes data in the last .N1R file and where there was over two minutes of missing data near the end of a file but followed by good data in the period after the last full two-minute interval. Such cases made the code crash so it was adapted to cope with these eventualities.

8) Calculates transducer misalignment and velocity scaling error (computation done on first run-through of code, to be applied during second). The data filtering implemented for JR165 was relaxed for this cruise. In particular, heading and speed data outside one standard deviation of the mean were not removed, as it was not seen why these should necessarily be bad. The checks for rapid turning or accelerating were left in and these would catch any spikes in the velocity or heading data. Minor changes were made to calib_calc_bt.m and calib_calc_wt.m so that the trend line was not calculated if there was insufficient data. This allows short files to run successfully, after the above changes to the use of a filter in qual_control.m.

9) Velocities from depths deeper than 86% of the bottom-tracking depth are set to missing.

10) Determine absolute velocities from either bottom-track ship velocity or Seapath GPS (usually the latter).

11) Plots the eastward and northward velocities. Details of this plotting were tidied during JR193 and JR200. In particular, code was added to deal with plotting files that spanned the new year. There is still an issue that for short files too many times are plotted on the x axis, causing them to overlap.

2.4.6 Output Files

Final data are stored in Matlab format. Filenames are of the form:-

1) JR200_00A_00000B_raw.mat, where A is the highest number of the user-incremented files. This is the number that VmDas increments every time logging is stopped and restarted. The version number is B, which increments with the .ENX files, when they reach 10Mb. This contains structured arrays “c” (ensembled-averaged data), and “b” (absolute velocities). Initially the increment was accidentally left as 100Mb from the last cruise. This results in files that sometimes cause matlab to run out of memory. 10 Mb is therefore recommended. The code was changed to load this file if it existed rather than recreate it in post-processing. This is much faster and means that when the large file did process successfully the result could be used instead of trying again.

2) JR200_00A_00000Bd_att.mat, where A and B are as above. This contains the ship’s attitude data.

3) JR200_00A_00000B_sgl_ping.mat, where A is as above, and B is the number VmDas increments every time filesize exceeds 10 Mbyte. This contains single-ping data in structured array “d”.

4) JR200_00A_000000_ATT.mat. As (3), but for the whole section of data in the user-incremented series A

5) JR200_00A_00000B_bad_heading.mat. Record of the data points removed due to bad heading

6) JR200_00A_00000B_bad_nav.mat. Record of the data points removed due to bad navigation.

7) jr200_000_000000_A_ave_ping. Two minute averaged data, including ship velocity.

8) jr200_000_000000_A_abs. Two minute averaged data, water velocities.

9) adcp_vel_contours_A.ps Individual plots of data in jr200_000_000000_A_abs, “A” here is the first in any list of files given to OS75_JCR _jr200.m. This was introduced at A=43 so is only present before that if data has been reprocessed.

10) adcp_vel_contours.ps A file with each of the individual plots appended, each as an extra page when converted to pdf.

JR200 Data

The data were collected in a series of files for the section, due to the required changes in configuration file when the VM-ADCP needed to be changed from bottom-tracking to normal mode and also to allow processing of the data during the cruise.

The instrument stopped on one occasion but the reason is unknown. On another occasion all navigation data for a period of approximately four hours was rejected in the processing. These instances need to be investigated. During good weather good quality data were collected to approximately 800m. This depth reduced during bad weather, due to bubbles under the hull absorbing or scattering energy from the beams.

As noted on JR193 and JR177, the ADCP velocities can be contaminated by deployed instruments or the cable. This was linked to CTD deployments on JR193 and was seen again on JR200 for CTD and Bongo net deployments. The problem is that in medium to strong flows the instruments are pulled by the flow so that the cable velocity has a horizontal component, which is recorded by the ADCP. This component must only be in one beam so it should be possible to remove it, Indeed it is perhaps a flaw in the processing that it is not already. This will be further investigated in Cambridge. As calculated on JR193, the intersection should be below 40m (as found) as the beam angle of the ADCP is 30º and the transducer is 23m away from the CTD gantry.

2.4.7 Calibration

While the ship is steaming, the main signal that the ADCP instrument records is the ship speed – 12 knots (6 m/s) is 1-2 orders of magnitude greater than the water velocity. This velocity is removed using GPS derived ship velocities but there is clearly the potential for a significant error associated with this process as the output data is the small difference between two large numbers. To address this the velocity of the bottom can be measured and compared directly to the GPS velocity of the ship. This should give the amplitude error for the ADCP and the misalignment with the ship heading. This only works in water where the bottom track ping can reach the sea bed – 800m or shallower.

In deeper water the processing uses changes in the ship velocity to assess what proportion of the ship velocity is contaminating the calculated water velocity. This calculation necessarily invokes assumptions that the true water velocity is relatively constant in space (if slowing down) or time (if turning round) and is therefore considered less precise. Similarly to JR177, on JR200 a large number of water track data were collected, from slowing down and speeding up from CTD stations and from the procedure to deploy nets of steaming downwind, turning round and towing them along the same course upwind.

2.5 CTD DEPLOYMENT AND DATA ACQUISITION

Hugh Venables & James Screen

2.5.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. Fifty casts were carried out in total, including one test station, eight biological stations and thirty physics CTDs. Additional CTDs were also carried out to test the CTD and prior to the acoustics calibration. At each of the biological stations, at least three CTDs were carried out: one full depth CTD and two water sample CTDs to 400m and 2000m (or the seabed, if shallower than 2000m). CTD positions are included in Table 2.5.1. CTD profiles were numbered consecutively without discrimination between the different types of station. Thus, the CTD file numbers do not correspond with numbered station positions, and reference should be made to Table 2.5.1 when accessing CTD data.

2.5.2 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 SBE4 conductivity sensors and a *Paroscientific* pressure sensor. 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, an oxygen sensor, a photosynthetically active radiation (PAR) sensor and a transmissometer. 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 or reverts to default values (approximately multiples of 500m) and, in deep water, often returns depths that are several tens of metres different from the true bottom depth. 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 Win32 version 5.30 (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 consistently switched on 60 seconds after the instrument entered the water, as they should.

After the 10m soak, the CTD was typically raised to the surface 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 CTD was left at this depth for ≈15 seconds to allow the SBE35 temperature sensor to take readings over 8 data cycles. The sensor averages these readings to produce one value for each bottle fire. If duplicate bottles were fired at any depth the SBE35 does not take readings unless there is a 20 second gap between firings. The unit needs time to recharge between firings but can cope with two in succession. Bottles were generally fired in pairs as a compromise between speed and data collection. If the sea state was particularly rough, the CTD package was not raised fully to the surface prior to the downcast.

Bottle firing depths were largely determined by water sample and calibration requirements. Casts where phytoplankton and nutrients were sampled were set to a pattern of bottles fired at depths (metres) of 5, 10, 20, chl max, 30, 40, 50, 60, 80, 100, 120, 140, 160, 180, 200, 400, 600, 800, 1000, 1500, 2000, 2500*, 3000, bottom. *: or 4000m if bottom >4500m. If samples were taken for phytoplankton but not nutrients then only depths of 120m and shallower were required. O18 samples were taken at 5, 10, 30, 50 80, 120, 160, 200, 400, 600, 1000, 2000m and bottom. Any remaining bottles were fired for salinity calibration (small gradient of salinity) but generally salinity samples were taken from the above depths (generally 8 per cast). 300m bottles were added at some stations for stable isotope work in conjunction with the stratified fishing.

2.5.3 Instrumentation changes and problems encountered with CTD deployments

Details of instrumentation and configuration are included in Table 2.5.2. Some changes were made to the CTD instrumentation throughout the cruise, in most cases in response to failure of instruments and the casts on which particular instruments were used are stated in Table 2.5.2. Also worthy of note are the notes appended to Table 2.5.1, regarding issues associated with individual CTDs.

2.5.4 Data acquisition and preliminary processing

The CTD data were recorded using SeaSave Win32 version 5.28e, which created four files:

jr200_ctd[NNN].dat	binary data file
jr200_ctd[NNN].con	ascii configuration file containing calibration information
jr200_ctd[NNN].hdr	ascii header file containing sensor information
jr200_ctd[NNN].bl	ascii file containing bottle fire information

where NNN is the CTD number (column 1 in Table 2.5.1). These were immediately copied to the Unix system and the further files were copied over as they were created. The *.dat* file was then converted from binary to ascii using the SBE Data Processing software version 5.37b *Data Conversion* module. The output was a file named *jr200_ctd[NNN].cnv*. The *Data Conversion* module calculates parameters using the coefficients detailed in Table 2.5.2 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 in 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 detailed in Table 2.5.2, where U is the temperature in ˚C.

Conductivity: $$cond = \frac{\left(g + hf^2 + if^3 + jf^4\right)}{10\left(1 + \delta t + \varepsilon p\right)}$$

where *cond* is the conductivity in Sm^{-1}, *p* is pressure, *t* is temperature, *δ* = CTcor and *ε* = CPcor. All coefficients are included in Table 2.5.2.

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 detailed in Table 2.5.2 and *f* is the frequency output by the sensor.

Oxygen: $$oxy = \left(Soc(V + Voffset)\right)e^{Tcor.T}\,Oxsat(T,S)e^{Pcor.P}$$

where *oxy* is dissolved oxygen in ml/l, *V* is the voltage output from the SBE43 sensor, *Oxsat* is oxygen saturation (ml/l), a function of temperature, *T*, salinity, *S*, and pressure, *P*, and the remaining coefficients are detailed in Table 2.5.2.

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

where *V*, *B*, *M*, *offset*, *multiplier* and *C*, the calibration constant, can be found in Table 2.5.2.

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 and the remaining coefficients can be found in Table 2.5.2.

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 Table 2.5.2.

The SBE Data Processing *Align* was used to account for the time lag of the oxygen sensor, with data being advanceded by 5 seconds. *Wildedit* was then used to remove outlying values (pass 1: 2sd, 500 scans; pass 2: 10sd, 500 scans). *Cell thermal mass* module was then used to remove the conductivity cell thermal mass effects from the measured conductivity. This reads in the *jr200_ctd[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 as *jr200_ctd[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, T is temperature, ctm_0 is the uncorrected cell thermal mass, $\alpha = 0.03$ and $\beta = 7.0$. Finally *Translate* converts data to ascii, ready to be read into matlab.

2.5.5 SBE35 high precision thermometer

Data from the SBE35 thermometer were usually uploaded after every cast using the *SeaTerm* program. Once the readings had been written to an ascii file (named *jr200sbeNNN.asc*), the file was opened and the contents checked to make sure the correct number of readings had been stored. The memory of the SBE35 was then cleared using the '*samplenum=0*' command. To check that the memory was clear, the command '*ds*' was entered, which displays the number of data points stored in the instrument's memory. This number should be 0. The date and time are also shown by the *ds* command and these should be checked and corrected if needed.

2.5.6 Salinity samples

At each CTD station 24 niskin bottles were closed at selected depths. In general, eight of these on the full depth CTDs were sampled for salinity analysis, although if duplicate water samples were taken from one bottle, only six or seven bottles were sampled in total. Furthermore, at shallow CTD stations, fewer samples were taken. No salinity samples were collected on the water sample or mooring CTDs. Sampling, storage and analytical procedures were as per those described in Section 2.3.4 (Underway).

Once analysed, the conductivity ratios were entered by hand into *jr200_master.xls*, converted to salinities and used for further CTD data processing.

2.5.7 Oxygen isotope samples

Water samples were also collected for oxygen isotope analysis, as per Section 2.3.5. Samples were taken at 5, 10, 30, 50, 80, 120, 160, 200, 400, 600, 1000, 2000m and from the bottom CTD bottle if deeper. Samples were stored in cardboard boxes, along with photocopies of associated CTD logsheets. The depths and cast details were written into an excel spreadsheet.

2.5.8 CTD data processing

Further processing of CTD data was carried out in Matlab using existing programs, predominantly written by Mike Meredith and Karen Heywood, with modifications by numerous others, and further significant changes made on JR177. The processing routines were split into two subsets: those that could be carried out in the absence of salinity calibration data and those that required the *jr200_master.xls* file containing the salinometer readings. The first subset of programs was run following each CTD cast and allowed a visual check of the data to ensure that the instruments were working correctly and plots to be printed for inspection by others aboard within a few hours of the cast. The second subset was run for those CTDs for which salt samples had been collected, following the salinity analysis. The first subset of Matlab routines applied to the CTD data is as follows:

- *ctdread200* invokes the *cnv2mat* routine written by Rich Signell to read in the *jr200_ctdNNN_ctm.cnv* file. Data are stored in Matlab arrays and named accordingly. The event number was captured and added to the end of gtime (as a convenience to avoid adding it to all scripts as a separate variable to be resaved). Start, bottom and end times, latitudes and longitudes are entered manually. The start time is entered into t2pos in a jrua window (ssh pstar@jrua, password=pstar) using the syntax: t2pos –d seatex yydddhhmmss. This gives latitude and longitude, which are checked against the logsheet. This time, and the resulting position are then copied and pasted into the matlab window. A further check of the inputted data was added during JR200: the time of the downcast and whole cast, along with the distances covered are printed to the screen for comparison with the logsheet and a warning is issued if they are outside expected bounds. The output file is of the form *jr200_ctdNNN.cal*.
- *offpress200* reads in *jr200_ctdNNN.cal* and sets variables to NaN if pumps were off, and allows the application of an offset pressure. As yet, no offset has been applied to the data because the aim is to determine a single offset for the entire cruise, which will be determined once the CTDs have been completed. Output is *jr200_ctdNNN.wat*.
- *editctd200* reads in *jr200_ctdNNN.wat* and allows manual removal of both the 10m soak prior to the CTD cast, and any data collected at the end of the upcast when the CTD was out of the water. The selected data points are set to NaN for all variables. Primary and secondary conductivity and temperature are then despiked using the interactive editor, with selected data points being set to NaN. These points are also set to NaN for PAR, fluorescence, oxygen and transmission. Output is *jr200_ctdNNN.edt*.
- *interpol200* reads in *jr200_ctdNNN.edt* and uses linear interpolation to fill data gaps generated by *editctd200*. Output is *jr200_ctdNNN.int*.
- *salcalapp* checks whether bottle files have been generated from salinity samples (see the second subset of routines, below). If it does not find the required file, it loads *jr200_ctdNNN.int* and calculates salinity, potential temperature and σ_θ, σ_2 and σ_4 as per the UNESCO 1983 algorithms by invoking the routines *ds_salt*, *sw_ptmp* and *sw_pden*. θ and salinity are calculated for both the primary and secondary sensors, whilst σ is calculated using primary temperature and conductivity, except for casts 23 and 38 where the secondary sensors are used. Output is *jr200_ctdNNN.var*.
- *splitcast* reads in *jr200_ctdNNN.var* and splits the downcast and upcast into *jr200_ctdNNN.var.dn* and *jr200_ctdNNN.var.up*.
- *fallrate* was added on JR200 (after retrospectively being applied to JR161 and JR177 data). It is a matlab version of the seapath loopedit script. It has to be run after the initial soak is removed as it removes any datapoint on the downcast where pressure is less than one previously recorded or if the fall rate is <0.25 ms^{-1}. Loopedit flags such points (excluding the initial soak if set to) but these flags were not subsequently used in the processing and often did erroneously include the initial soak. This process results in smoother density profiles with fewer apparent overturns. Input and output is *jr200_ctdNNN.var.dn* – it is not run on the upcast as it will remove bottle stops.
- *gridctd* reads in both *jr200_ctdNNN.var.dn* and *jr200_ctdNNN.var.up*, and averages the data into 2dbar bins. Data are padded with NaNs to 5999dbar, thereby ensuring that

arrays for all CTDs are the same size. Outputs are *jr200_ctdNNN.2db.mat* and *jr200_ctdNNN.2db.up.mat*.

- *fill_to_surf* reads in *jr200_ctdNNN.2db.mat* and *jr200_ctdNNN.2db.up.mat* and allows any missing data at the surface to be filled with values from the next non-NaN line. This should only be carried out where the upper water column is well mixed. Missing values for the time stamp and PAR are left as NaNs. The output file is the same as the input file.
- *ctdplot200* reads in *jr200_ctdNNN.2db.mat* and plots profiles of θ and salinity (both primary and secdondary), σ_θ, fluorescence, transmission, oxygen and PAR. Plots are output for the entire CTD depth and for only the upper 200m of the cast. These plots are saved as png files and printed.

The second subset of Matlab programs is as follows:

- *makebot200* reads in *jr200_ctdNNN.ros*, *jr200_ctdNNN.BL* and *jr200_ctdNNN.int*, and extracts CTD pressure, temperature (1 & 2), conductivity (1 & 2), transmission, fluorescence, oxygen and PAR for each bottle fired. It also calculates the standard deviation for pressure, temperature and conductivity, and writes a warning to the screen if those for temperature and conductivity are greater than 0.001. Salinity and potential temperature are calculated from both primary and secondary temperature and conductivity using *ds_salt* and *ds_ptmp*. Results are saved in *jr200botNNN.1st*.
- *readsal200* extracts salinity calibration data from *jr200_master.xls* and reads in *jr200botNNN.1st*. Data from duplicate salinity samples are stored in *niskinsalts.mat*, and if the standard deviation of these samples is >0.002, a warning is written to the screen. Output is *jr200salNNN.mat*.
- *addsal200* reads in *jr200botNNN.1st* and *jr200salNNN.mat*, and stores all salinity information in *jr200botNNN.sal*.
- *setsalflag200* loads *jr200botNNN.sal* and flags those bottles with high standard deviations for temperature and conductivity. Output is *jr200botNNN.sal*.
- *salplot200* loads *jr200_ctdNNN.int* and *jr200botNNN.sal*, and plots sample salinities on top of the CTD salinity profiles, allowing a visual check of the data. Plots of conductivity and temperature standard deviations against CTD salinity minus sample salinity are also generated.
- *sb35read200* loads *jr200sbeNNN.asc*, *jr200botNNN.1st* and *jr200_ctdNNN.cal*, and plots SBE35 temperature minus CTD temperature (1 & 2) for a visual check. The SBE35 data are saved in *jr200botNNN.sb35* and SBE35 temperature minus CTD temperature is saved in *tempcals.all.mat*. This script must be run prior to *salcal200*.
- *salcal200* loads *jr200botNNN.sal*, *jr200_ctdNNN.int* and *tempcals.all.mat*, and uses sample salinities and SBE35 temperatures to calculate conductivity offsets for both CTD sensors. All offsets are stored in *salcals.all.mat*. Plots of temperature and conductivity offsets are output to the screen.
- *calibrations* reads in *tempcals.all.mat* and *salcals.all.mat*, and plots primary and secondary temperature and conductivity minus SBE35 temperature and conductivity calculated from the salinity samples. This allows determination of any offsets that should be applied to calibrate the CTD sensors.
- Once this second subset of programs has been run the offsets found in calibrations are entered into *salcalapp*, which is then run again. Any required temperature or conductivity

offset is applied here, and salinity, θ, and σ are recalculated. Offset data are saved in *jr200botNNN.cal*. All programs following *salcalapp* must then be re-run.

2.5.9 CTD calibration

In total, 792 SBE35 temperature data points were recorded, and 224 salinity samples analysed. Some SBE35 datapoints were lost due to the data not being checked for the first 6 casts and then finding the sensor to be full of previous cruises data. Data were also lost to the sensor failing partially or totally for casts 11-16, after which it was replaced. The offsets have not been finalised but the temp1 is about 0.005 too cold, both temp2s are too close for a non-zero offset to be needed and conductivity1, after accounting for the temperature offset, is approximately 0.003 at the surface with the difference reducing with depth. Conductivity will be calibrated to allow for the possibility of a new formula for calculating salinity in the future but this requires a further check that there are not residual offsets in salinity due to problems with the pressure sensor.

Table 2.5.1 : CTD Casts

'Wout' is the wireout at the bottom depth of the CTD. 'Type' refers to full depth (FD), Pond (Po; 2000m depth, water samples at 2000m and Chlorophyll maximum), Oithona (Oi; 400m depth, water samples at 400, 300, 200, 150, 100, 80, 60, 50, 40, 30, 20 and 10m), and shallow (S) CTDs. 'Station name' is the official name/number of the CTD station in the cruise plan and 'event' is the event number in the JR200 bridge science log. Numbered notes are found at the end of the table.

CTD #	Jday	Time (GMT)	Lat (deg, min)	Lon (deg, min)	Wout (m)	Type	Station name	Event	Note
001	072	12:21:31	57º 41.36'S	50º 26.05'W	150	S	Test	3	
002	072	13:21:20	57º 41.65'S	50º 25.52'W	400	Oi	Test	4	
003	073	19:09:02	60º 29.96'S	48º 11.65'W	1371	Po	R1	10	
004	073	20:33:30	60º 29.91'S	48º 11.58'W	191	Oi	R1	11	1
005	075	08:47:10	60º 29.90'S	48º 11.52'W	1371	FD	R1	19	
006	075	10:50:00	60º 29.91'S	48º 11.52'W	400	Oi	R1	20	
007	076	14:24:45	60º 25.87'S	44º 35.58'W	990	FD	D1	31	
008	076	20:21:40	60º 12.51'S	44º 24.48'W	2000	Po	C2/D2	33	
009	076	22:06:25	61º 12.50'S	44º 24.48'W	400	Oi	C2/D2	34	
010	077	07:31:10	60º 12.51'S	44º 24.50'W	5402	FD	C2/D2	37	
011	078	18:35:40	59º 56.09'S	44º 14.20'W	4674	FD	D3	52	
012	080	07:21:59	59º 41.32'S	44º 03.31'W	4085	FD	C3/D4	66	
013	080	21:26:56	59º 41.32'S	44º 03.24'W	2000	Po	C3/D4	73	
014	080	23:11:20	59º 41.32'S	44º 03.25'W	400	Oi	C3/D4	74	
015	081	05:15:28	59º 21.34'S	43º 50.19'W	3098	FD	D5	76	
016	081	10:00:40	59º 01.52'S	43º 37.27'W	3050	FD	D6	77	
017	081	15:23:30	58º 41.66'S	43º 24.26'W	2890	FD	D7	79	
018	081	19:43:18	58º 21.72'S	43º 11.32'W	2934	FD	D8	80	
019	083	09:10:22	58º 01.85'S	42º 58.27'W	2770	FD	C4/D9	92	
020	083	19:02:02	58º 01.80'S	42º 58.27'W	400	Oi	C4/D9	95	
021	083	22:36:17	58º 01.80'S	42º 58.27'W	2000	Po	C4/D9	99	
022	084	11:11:30	57º 35.12'S	42º 42.15'W	2969	FD	D10	102	
023	084	16:19:55	57º 08.41'S	42º 26.03'W	3628	FD	D11	104	2
024	084	23:35:31	56º 45.81'S	42º 13.29'W	400	Oi	R2/D12	107	3
025	085	08:09:57	56º 45.82'S	42º 13.05'W	388	Test	Extra	110	4
026	085	23:12:35	56º 44.39'S	42º 23.43'W	218	Test	Extra	113	4
027	086	00:58:10	56º 47.65'S	42º 11.03'W	317	Test	Extra	114	4
028	086	06:08:47	56º 45.78'S	42º 13.12'W	10	Test	Extra	116	4
029	086	19:42:18	56º 45.80'S	42º 13.13'W	408	Test	Extra	125	4
030	087	16:21:10	56º 23.24'S	42º 00.03'W	3868	FD	D13	134	
031	088	14:21:10	55º 38.06'S	41º 34.27'W	3420	FD	D15	135	
032	088	21:34:33	55º 15.53'S	41º 21.48'W	2000	Po	P2/D16	139	
033	088	23:22:45	55º 15.53'S	41º 21.48'W	400	Oi	P2/D16	140	
034	090	08:07:30	55º 15.53'S	41º 21.45'W	3528	FD	P2/D16	148	
035	091	01:50:12	54º 54.72'S	41º 10.44'W	3374	FD	D17	156	
036	091	18:44:25	54º 35.33'S	40º 59.67'W	3245	FD	D18	159	
037	092	00:42:10	54º 13.16'S	40º 48.80'W	2443	FD	D19	161	
038	092	04:49:35	53º 53.80'S	40º 38.63'W	1244	FD	D20	162	5
039	092	06:49:38	53º 53.86'S	40º 38.64'W	120	S	D20	163	5
040	092	12:00:17	53º 21.07'S	40º 22.46'W	120	S	Extra	165	
041	092	20:57:40	52º 48.51'S	40º 06.93'W	2000	Po	P3	168	
042	092	22:40:05	52º 48.52'S	40º 06.88'W	400	Oi	P3	169	
043	093	06:54:10	52º 48.47'S	40º 06.88'W	3729	FD	P3	173	

044	096	11:15:27	52º 51.05’S	37º 05.79’W	2210	FD	R3	191	
045	096	15:27:42	52º 51.05’S	37º 05.79’W	400	Oi	R3	194	
046	099	18:26:38	49º 56.15’S	34º 12.47’W	600	S	PF1	223	
047	099	20:46:65	50º 03.80’S	34º 01.73’W	1500	S	PF2 /PFN	224	
048	100	14:28:28	50º 14.57’S	33º 57.15’W	600	S	PF3	231	
049	100	16:28:20	50º 25.25’S	33º 52.81’W	600	S	PF4	232	
050	101	07:20:40	50º 36.00’S	33º 48.10’W	1500	S	PF5 /PFS	238	

Notes:

1) CTD aborted at 191m wireout due to wire damage.
2) Problem with primary sensors on down-cast. Disappeared with time. Data from secondary sensor selected during post processing.
3) Problem with secondary sensors on both up- and down-casts. Primary sensors working fine. New secondary sensors (see Table 2.5.2) and pumps cleaned following cast.
4) CTD aborted due to alarm sounding on deck unit. Temporary, and sometimes persistent, loss of communication between CTD and deck unit. No bottles fired, but data largely meaningful.
5) Large swell caused temporary loss of power to CTD. CTD reset itself – pumps switched off for a short period and bottle firing program reset making it impossible to fire all bottles.

Table 2.5.2: Details of instrumentation and configuration for SBE911Plus CTD.

Frequency channels suppressed: 0	**Channel 4, Temperature 2 (casts 25-50)**
Voltage words suppressed: 0	s/n: 2191
Computer interface: RS-232C	Calibrated: 13/07/07
Scans to average: 1	G: 4.31966392e-003
Surface PAR voltage added: No	H: 6.38833117e-004
NMEA position data added: No	I: 2.27889521e-005
Scan time added: No	J: 2.17620818e-006
	F0: 1000.000
Channel 1, Temperature 1	Slope: 1.00000000
s/n: 4302	Offset: 0.00000
Calibrated: 18/07/07	
G: 4.37269298e-003	**Channel 4, Temperature 2 (casts 1-24)**
H: 6.42004858e-004	s/n: 4235
I: 2.19025784e-005	Calibrated: 29/07/07
J: 1.81767398e-006	G: 4.3551464e-003
F0: 1000.000	H: 6.45183995e-004
Slope: 1.00000000	I: 2.21076034e-005
Offset: 0.0000	J: 1.74507310e-006
	F0: 1000.000
Channel 2, Conductivity 1	Slope: 1.00000000
s/n: 2875	Offset: 0.00000
Calibrated: 18/07/07	
G: -1.01634295e+001	**Channel 5, Conductivity 2 (casts 25-50)**
H: 1.40348275e+000	s/n: 1912
I: 8.99756645e-005	Calibrated: 17/07/07
J: 5.82471200e-005	G: -4.16283556e+000
CTcorr: 3.2500e-006	H: 5.36632788e-001
CPcorr: -9.57000000e-008	I: -7.06036394e-004
Slope: 1.00000000	J: 6.30610541e-005
Offset: 0.00000	CTcorr: 3.2500e-006
	CPcorr: -9.57000000e-008
Channel 3, Pressure	Slope: 1.00000000
s/n: 0541-75429	Offset: 0.00000
Calibrated: 18/07/07	
C1: -4.398881e+004	**Channel 5, Conductivity 2 (casts 1-24)**
C2: -5.551403e-001	s/n: 2813
C3: 1.279490e-002	Calibrated: 17/07/07
D1: 3.603000e-002	G: -9.75792279e+000
D2: 0.000000e+000	H: 1.45435632e+000
T1: 2.986716e+001	I: -5.07100074e-003
T2: -5.274889e-004	J: 4.16613153e-004
T3: 4.0929000e-006	CTcorr: 3.2500e-006
T4: 1.616590e-009	CPcorr: -9.57000000e-008
T5: 0.000000e+000	Slope: 1.00000000
Slope: 0.9994000	Offset: 0.00000
Offset: 0.52570	AD590B: -8.79339e+000
AD590M: 1.287420e-002	
Channel 6, PAR/Irradiance (Biospherical/Licor)	**Channel 10, Fluorometer**
	s/n: 088-249

s/n: 7235 Calibrated: 26/07/07 M: 1.00000000 B: 0.00000000 Calibration constant: 35335689045.0 Multiplier: 1.00000000 Offset: 0.00000000 **Channel 7, Free** **Channel 8, Oxygen (SBE43)** s/n: 0676 Calibrated: 14/08/07 Soc: 0.3914 Boc: 0.0000 Voffset: -0.4916 Tcor: 0.0023 Pcor: 1.35e-004 **Channel 9, Altimeter** s/n: 2130.27001 Calibrated: 11/10/06 Scale factor: 15.000 Offset: 0.000	Calibrated: 13/09/07 VB: 0.181700 V1: 2.097600 Vacetone: 0.202800 Scale factor: 1.000000 Slope: 1.000000 Offset: 0.000000 **Channel 11, Free** **Channel 12, Transmissometer** s/n: CST-527DR Calibrated: 14/08/07 M: 21.7287 B: -1.2735 Path length: 0.250 **Channel 13, Free**
SBE35, Temperature (casts 17-50) s/n: 0051 Calibrated: 27/9/07 A0: 3.92631784e-003 A1: -1.03622386e-003 A2: 1.63062788e-004 A3: -9.15190184e-006 A4: 1.97599859e-007 Slope: 1.000023 Offset: -0.001512	**SBE35, Temperature (casts 1-16)** s/n: 0047 Calibrated: 7/6/07 A0: 4.70995801e-003 A1: -1.29325515e-003 A2: 1.93550623e-004 A3: -1.07498200e-006 A4: 2.29058494e-007 Slope: 1.000049 Offset: -0.001758

2.6 *EXPENDABLE BATHYTHERMOGRAPHS (XBTs)*

Hugh Venables and James Screen with additional support from Nathan Cunningham, Data Manager

2.6.1 Introduction

A sequence of XBT drops were performed from RRS *James Clark Ross* during JR200 during the transect to and beyond the Polar Front station. The details of the XBT drops are listed in Table 2.6.1.

2.6.2 Deployment

Sippican T5 probes were used and launched using a launcher clamped to the rear of the aft deck. The ship speed was not decreased for deploying probes in order to save time. This led to them not reaching full depth but they did resolve 1400m (at 10 knots) or 1200m (at 11knots) which was sufficient for the work at the Polar Front. Data were logged by a Viglen IBM-type 486 PC running the Sippican WinMk12 software. Data were written directly to the unix system. Uncleaned data was also streamed back to Cambridge in real time.

2.6.3 Processing

Initial processing of the XBT using matlab scripts was carried out. This involved reading the ascii files into matlab (xbtascreadstruc.m) and then using the interactive editor program (same as used for CTD processing) to remove data at the end of the cast and that judged to be bad (xbtedit.m). A contour plot of the section was also produced (contourxbt.m).

2.6.4 Additional comments

The time stamp from the PC is in BST (GMT+1). This is not used in the processing but is in the header of the ascii file.

Table 2.6.1: JR200 XBT deployments

Time	Latitude	Longitude	Depth	Event number	XBT serial number	Filename	Comment
08/04/2009 21:08	-49.792	-34.423	1280m	221	338831	T5_00023	Successful
08/04/2009 20:29	-49.873	-34.301	1240m	220	338833	T5_00022	Successful, one big spike removed in post processing
08/04/2009 19:58	-49.937	-34.207	1340m	219	338829	T5_00021	Successful
08/04/2009 19:31	-49.994	-34.123	1250m	218	338830	T5_00020	Successful, one big spike removed in post processing
08/04/2009 18:58	-50.065	-34.026	1280m	217	338834	T5_00019	Successful
08/04/2009 18:15	-50.158	-33.981	1260m	216	338835	T5_00018	Successful
08/04/2009 17:45	-50.233	-33.937	1290m	215	338836	T5_00017	Successful
08/04/2009 17:15	-50.319	-33.885	1300m	214	338840	T5_00016	Successful
08/04/2009 16:45	-50.409	-33.837	1200m	213	338839	T5_00015	Successful
01/01/1998 16:15	-50.592	-33.799	1200m	212	338838	T5_00014	Successful
08/04/2009 15:45	-50.592	-33.799	1200m	211	338837	T5_00013	Successful
08/04/2009 14:08	-50.791	-34.123	1430m	210	338873	T5_00012	Successful
08/04/2009 12:12	-51.012	-34.517	1450m	209	338867	T5_00011	Successful, one big spike removed in post processing
08/04/2009 10:28	-51.209	-34.869	1450m	208	338869	T5_00010	Successful
08/04/2009 10:13	-51.236	-34.918		207	338870		No data collected – user error
08/04/2009 08:15	-51.460	-35.313	1450m	206	338874	T5_00009	Successful
08/04/2009 06:07	-51.725	-35.687	1440m	205	338871	T5_00008	Successful
08/04/2009 04:13	-51.965	-36.015	1340m	204	338868	T5_00007	Successful
08/04/2009 02:16	-52.207	-36.346	1525m	203	338872	T5_00006	Successful
08/04/2009 00:17	-52.466	-36.683	1490m	202	338875	T5_00005	Successful
07/04/2009 21:32	-52.729	-37.056	1443m	200	338876	T5_00004	Successful
07/04/2009 19:32	-52.984	-37.437	1400m	199	338866	T5_00003	Successful
28/03/2009 13:40	-56.779	-42.220	1700m	133	338865	T5_00002	Successful. There was no T5_00001

3. MOORING CRUISE REPORT

Peter Enderlein, David Pond, Hugh Venables & Sophie Fielding

3.1 Redeployment of both sediment trap moorings during JR 200:

During JR200 both Discovery2010 sediment trap moorings were successfully redeployed, having been recovered during JR187. After double checking with the manufacture Paraflux on deployment techniques regarding the Paraflux Sediment traps, the decision was made to deploy both moorings buoy first instead of weight first as it was done on previous cruises. By deploying buoy first, the tension on the rope is significantly less. This makes it a) easier to deploy, especially since the rope is not biting into the coil of rope on the rope drum b) more safe, as the risk that the mooring rope snags or parts is dramatically reduced. The only downside is that because of the pendulum effect of the mooring, the exact position of the mooring rig is difficult to determine. Therefore a triangulation was done after both deployments to determine the position of the moorings.

The 3200m mooring was redeployed on 01.04.09 @ 11:35 GMT with the buoy first. After the deployment of all the equipment the main weight was finally cut at 13:25 in 3213 m of water depth at 55.20875S and 41.12380W. To release, a sacrificial rope was used.
Because of the pendulum effect having deployed the mooring buoy first, the mooring was pinged after the deployment to determine its position by triangulation. The ship moved from its west position approx. ½ nm first E and then again ½ nm NW. The positions, water depth, acoustic distance and the calculated radius where:

Table 3.1.1. 3200m mooring triangulation

Position	Time	Triangulation		Latitude	Longitude
P1 (W)	14:21	Depth	3150	55.19973	41.12382
		Ping distance	3230		
		Radius	714		
P2 (E)	14:43	Depth	3160	55.19981	41.10817
		Ping distance	3340		
		Radius	1081		
P3 (NW)	15:07	Depth	3158	55.19352	41.11802
		Ping distance	3462		
		Radius	1081		

This gave the following triangulation, with a relatively precise position of **55^{o} 12.3757 S and 41^{o} 07.2568 W** where we believe the 3200m mooring is sitting:

Fig 3.1.1 Calculated 3200m mooring position on JCR micropolt with cruise track in purple.

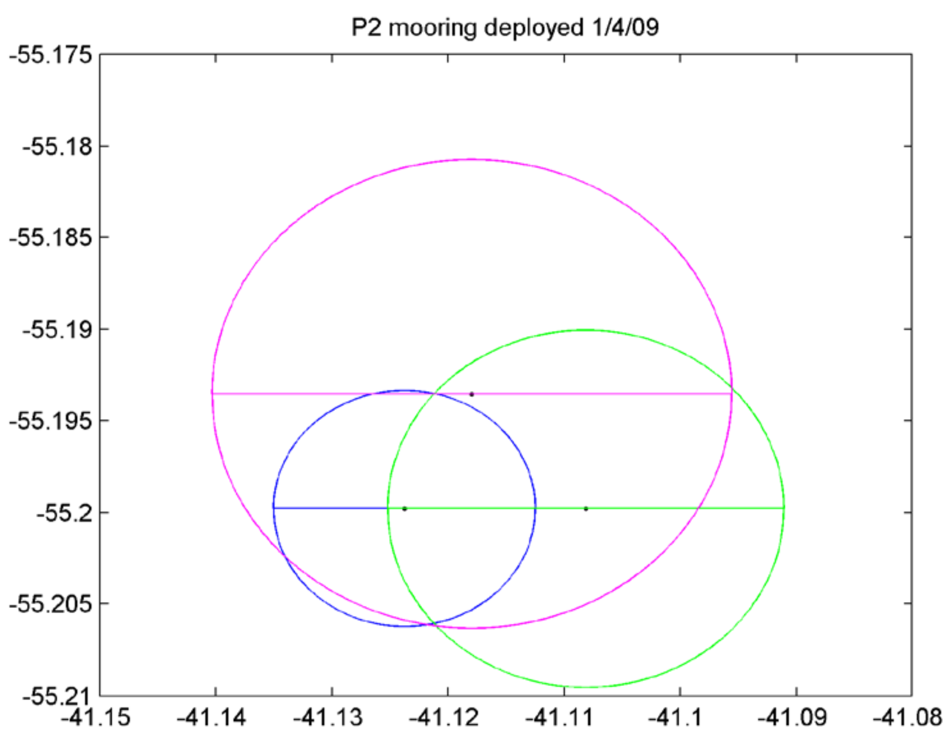


Fig 3.1.2 Calculated 3200m mooring position by triangulation.

The 3700 m mooring was redeployed on 03/04/2009 @ 14:04 GMT with the buoy first again. After the deployment of all the equipment the weight was finally released at 14:53:00 in 3850 m of water depth at 52.72335 W and 40.14901S

Again the mooring was pinged after the deployment to determine its position by triangulation. The ship moved from its east position approx. ½ nm first W and then again ½ nm NW. The positions, water depth, acoustic distance and the calculated radius where:

Table 3.1.2. 3700m mooring triangulation

Position	Time	Triangulation		Latitude	Longitude
P1 (E)	15:23	Depth	3790	52.72332	40.14853
		Ping distance	3829		
		Radius	545		
P2 (W)	15:52	Depth	3790	52.72333	40.16213
		Ping distance	3810		
		Radius	390		
P3 (NE)	16:24	Depth	3790	52.71757	40.15284
		Ping distance	3883		
		Radius	844		

This gave the following triangulation, with a relatively precise position of **52^{o} 43.4707 S and 40^{o} 09.3897 W** where we believe the 3800m mooring is sitting:

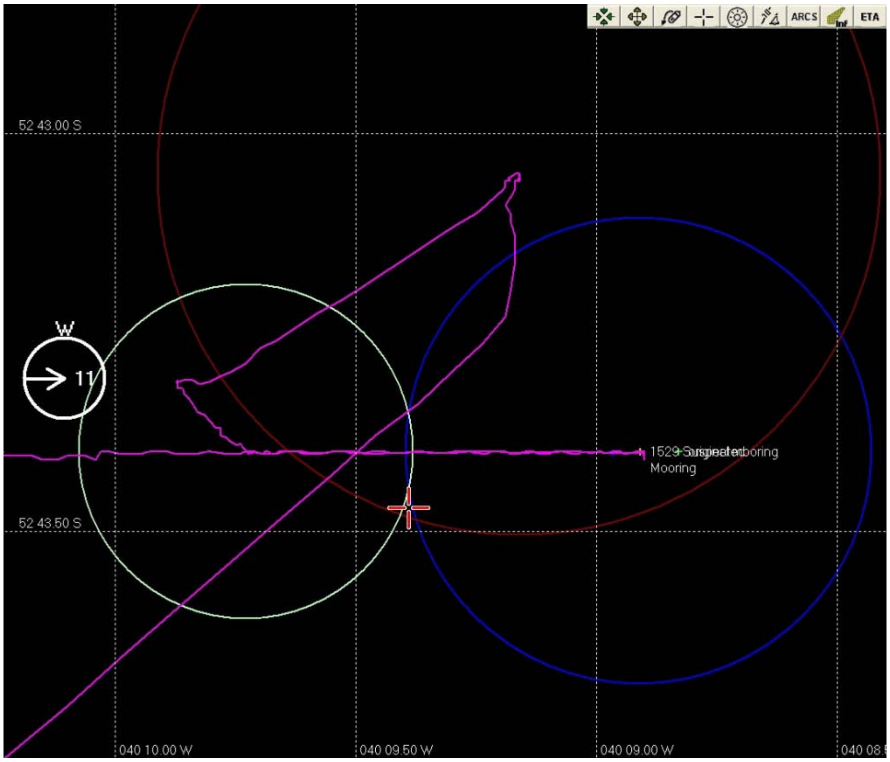


Fig 3.1.3 Calculated 3700m mooring position on JCR micropolt with cruise track in purple.

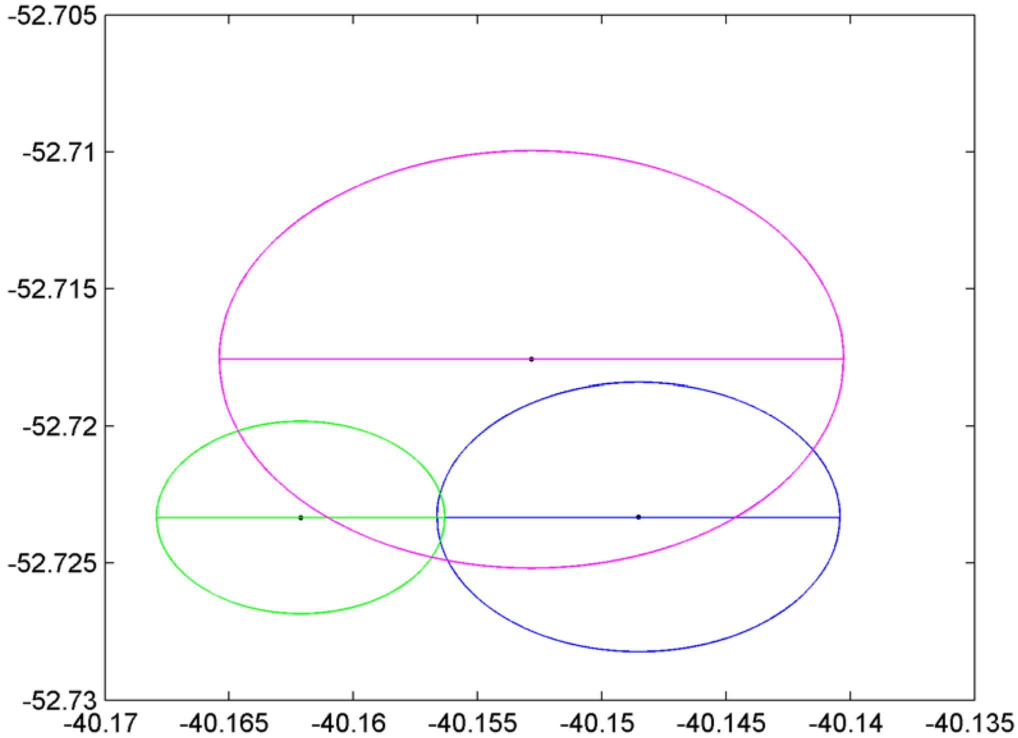


Fig 3.1.4 Calculated 3700m mooring position by triangulation.

Overall the mooring recoveries and redeployments were all very smooth operations so they took far less time then expected. For the next recoveries and redeployments however **12 hours for each operation** should be allocated to allow for any unexpected problems.

3.2 3200m Discovery2010 sediment trap mooring

NOVATEC beacon: R09, Ch B, 159.48 MHz

Acoustic Releases:
Deck unit mode: **B FR2 – FR2,** to release press: **safety + command**

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

Release No: 572	release code: **15E0 + 1555**
Release No: 573	release code: **15E1 + 1555**

Acoustic releases: 572 + 573
new batteries
tested

ARGOS beacon: ***35519***

new batteries
tested

NOVATEC Combo beacon: *R09-020*
new batteries
tested

CTD 37 SMP 29579: *2462 on main buoy*
data downloaded during JR187
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

ADCP *WHS300 – I – UG26: 2965*
data downloaded during JR187
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
start time: 00:01:00 01.04.09
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

Sediment trap: Parflux No: ML11966-02
data downloaded
new batteries (14x C – Cells + 1x 9V Block battery)
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
PS2 Sediment Trap Deployment April 2009 JR200

Enter the time and dates in this format MM DD YY HH MM SS
Event   1 of 22 = 04/01/2009 00:00:00
Event   2 of 22 = 05/01/2009 00:00:00
Event   3 of 22 = 06/01/2009 00:00:00
Event   4 of 22 = 07/01/2009 00:00:00
Event   5 of 22 = 08/01/2009 00:00:00
Event   6 of 22 = 09/01/2009 00:00:00
Event   7 of 22 = 10/01/2009 00:00:00
Event   8 of 22 = 11/01/2009 00:00:00
Event   9 of 22 = 12/01/2009 00:00:00
Event 10 of 22 = 12/15/2009 00:00:00
Event 12 of 22 = 01/15/2010 00:00:00
Event 13 of 22 = 02/01/2010 00:00:00
Event 14 of 22 = 02/15/2010 00:00:00
Event 15 of 22 = 03/01/2010 00:00:00
Event 16 of 22 = 04/01/2010 00:00:00
Event 17 of 22 = 05/01/2010 00:00:00
Event 18 of 22 = 06/01/2010 00:00:00
Event 19 of 22 = 07/01/2010 00:00:00
Event 20 of 22 = 08/01/2010 00:00:00
Event 21 of 22 = 09/01/2010 00:00:00
Event 22 of 22 = 10/01/2010 00:00:00

Current meter: Aquadopp No A2L - 1792
data downloaded
new batteries
The current meter batteries (lithium) are extremely expensive and those batteries deployed during last season will be returned to the UK with the view to finding a local manufacturer.

PS2 CURRENT METER SETTINGS

```
User setup
--------------------------------------------------------------
Measurement interval                  900 sec
Sampling rate                         NORMAL
Average interval                      60 sec
Measurement load                      4 %
Transmit pulse length                 0.75 m
Blanking distance                     0.37 m
Compass update rate                   900 sec
Diagnostics measurements              DISABLED
Diagnostics - Interval                43200 sec
Diagnostics - Number of samples       20
Diagnostics - Cell number             1
Diagnostics - Number of pings         20
Analog input 1                        NONE
External input 2                      NONE
Powerlevel                            HIGH
Coordinate system                     ENU
Sound speed                           MEASURED
Salinity                              34.0 ppt
Distance between pings                10.00 m
Number of beams                       3
Number of pings per burst             1
Software version                      1.28
Deployment name                       dstm47
Wrap mode                             OFF
Deployment time                       01/04/2009
Comments                              deep water sediment trap
     mooring, deployed south
     west of SG at PS2
```

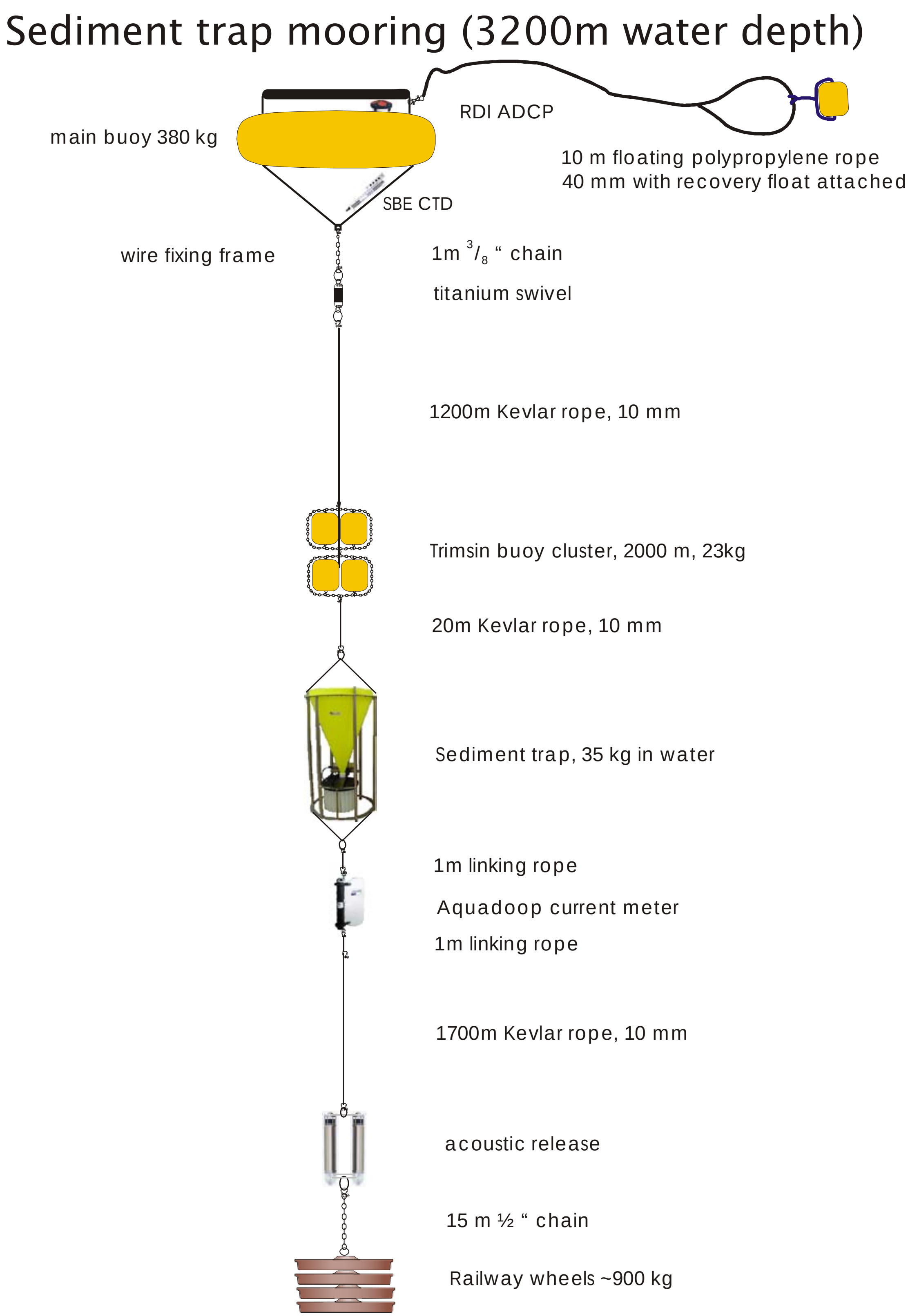


Fig 3.2.1 Diagram of 3200m Mooring

3.3 3700m Discovery2010 sediment trap mooring

NOVATEC beacon: U07-029, Ch A, 154.585 MHz

Acoustic Releases:
Deck unit mode: **B FR2 – FR2,** to release press: s**afety + command**

Codes:
Release No: 290
On FR1 FR2 : B637
Release: B639
Diagnostic: B640
Pinger: B636 + B694

Release No: 1022
ARM, Ranging: 1890
Release code: 1890 + 1855
Release + Pinger: ARM + 1856
Pinger on: ARM + 1847
Pinger of: ARM + 1848
Diagnostic: ARM + 1849

Acoustic releases: 290 + 1022
new batteries
tested
original part to hold hock in place was not in box, coming from HQ last minute. Simon DE made a new out of stainless steel. Has to be replaced next turnaround.

ARGOS beacon: ***SN 280, ID 60210***
new batteries
tested

NOVATEC Combo beacon: ***U07-029***
new batteries
tested

CTD 37 SMP 43742: ***4852 on main buoy***
data downloaded during JR187
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

CTD 37 SMP 43742: ***4855 at estimated 500 m***
data downloaded during JR187
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

ADCP ***WHS300 – I – UG26: 7522***
data downloaded during JR187
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

Sediment trap: Parflux No: ML11966-01

- new batteries (14x C – Cells + 1x 9V Block battery)
    - 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 April 2009 JR200

Enter the time and dates in this format  MM DD YY HH MM SS

Event   1 of  22 = 04/04/2009 00:00:00
Event   2 of  22 = 05/01/2009 00:00:00
Event   3 of  22 = 06/01/2009 00:00:00
Event   4 of  22 = 07/01/2009 00:00:00
Event   5 of  22 = 08/01/2009 00:00:00
Event   6 of  22 = 09/01/2009 00:00:00
Event   7 of  22 = 10/01/2009 00:00:00
Event   8 of  22 = 11/01/2009 00:00:00
Event   9 of  22 = 12/01/2009 00:00:00
```

```
Event  10 of  22 = 12/15/2009 00:00:00
Event  11 of  22 = 01/01/2010 00:00:00
Event  12 of  22 = 01/15/2010 00:00:00
Event  13 of  22 = 02/01/2010 00:00:00
Event  14 of  22 = 02/15/2010 00:00:00
Event  15 of  22 = 03/01/2010 00:00:00
Event  16 of  22 = 04/01/2010 00:00:00
Event  17 of  22 = 05/01/2010 00:00:00
Event  18 of  22 = 06/01/2010 00:00:00
Event  19 of  22 = 07/01/2010 00:00:00
Event  20 of  22 = 08/01/2010 00:00:00
Event  21 of  22 = 09/01/2010 00:00:00
Event  22 of  22 = 10/01/2010 00:00:00
```

Current meter: Aquadopp No A2L - 1792 at estimated 2000 m water depth
data downloaded
new batteries
The current meter batteries (lithium) are extremely expensive and those batteries deployed during last season will be returned to the UK with the view to finding a local manufacturer.

Aquadopp current meter deployment settings

```
PS3 CURRENT METER SETTINGS

User setup
--------------------------------------------------------------
Measurement interval                  900 sec
Sampling rate                         NORMAL
Average interval                      60 sec
Measurement load                      4 %
Transmit pulse length                 0.75 m
Blanking distance                     0.37 m
Compass update rate                   900 sec
Diagnostics measurements              ENABLED
Diagnostics - Interval                43200 sec
Diagnostics - Number of samples       20
Diagnostics - Cell number             1
Diagnostics - Number of pings         20
Analog input 1                        NONE
External input 2                      NONE
Powerlevel                            HIGH
Coordinate system                     ENU
Sound speed                           MEASURED
Salinity                              34.0 ppt
Distance between pings                10.00 m
Number of beams                       3
Number of pings per burst             1
Software version                      1.28
Deployment name                       dstm49
Wrap mode                             OFF
Deployment time                       03/04/2009 00:00:00
Comments                             deep water sediment trap
                                     mooring, deployed North
                                     West of SG at Station PS3
```

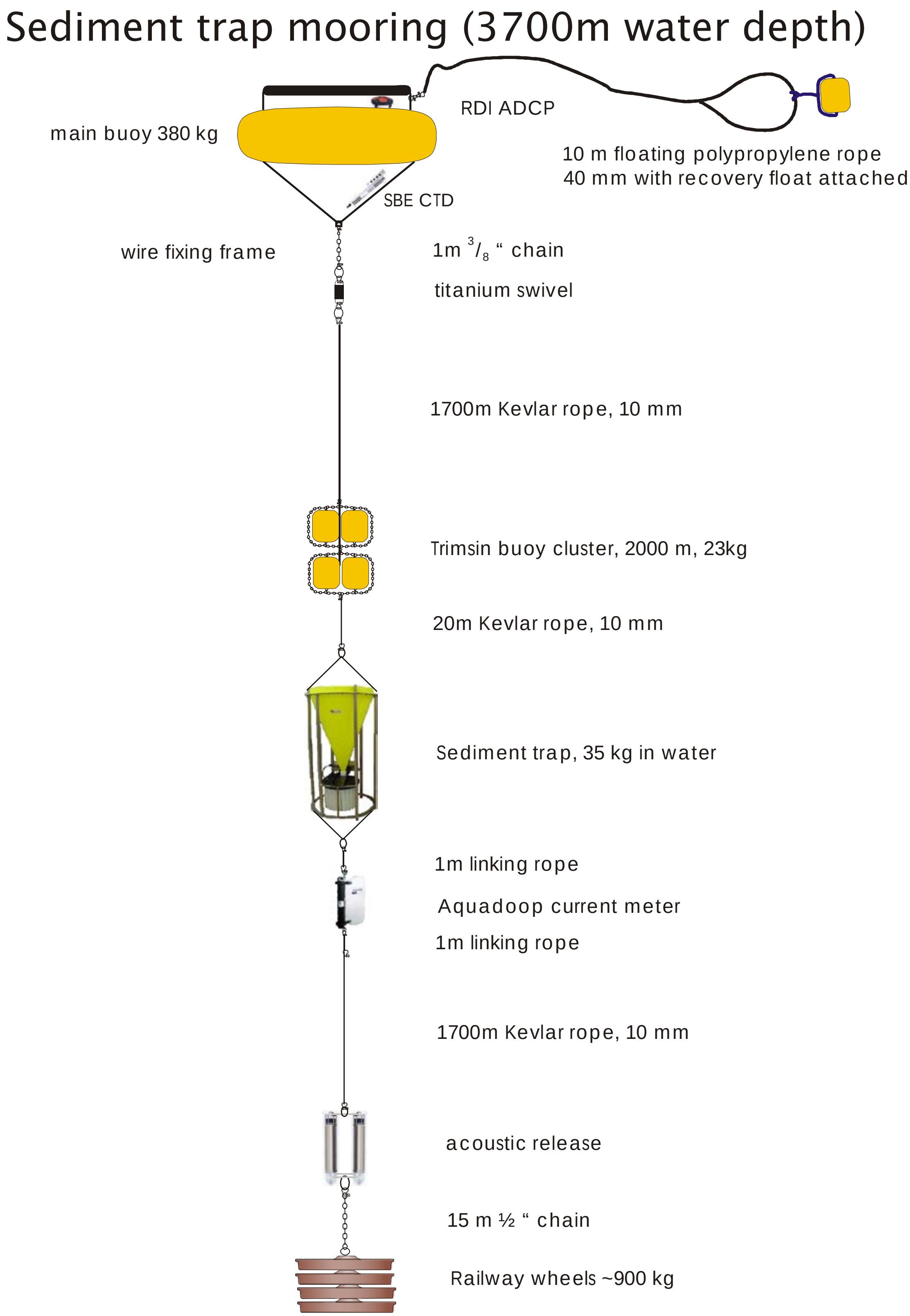


Fig 3.3.1 Diagram of 2700m Mooring

3.4 shallow water WCB mooring

The shallow water WCB mooring was recovered to put the WCP on for the coming winter period. Therefore maintenance was kept to a minimum and the whole mooring was just checked for any visible damage. The batteries where changed in the release which was fired and in the ARGOS beacon. After the battery change and the fitting of the WCP to the main frame, the mooring was redeployed 2 hours after recovery.

The buoy was released at 18:23 GMT and surfaced just 3 minutes later. At 18:58 the whole mooring was successfully recovered. Just an hour later all maintenance was finished and the mooring was redeployed. The weight was released at **20:13 GMT** on the **15/04/2009** @ **53.79515S and 37.93578W**

NOVATEC beacon: Ch. C.: **160.725 MHz**

Acoustic Releases:
Deck unit mode: **B FR2 – FR2,** to release press: s**afety + command**

Codes shallow water mooring:

New release:	No: 217	release code: **04FB + 0455**
Old release:	No: 218	release code: **04FC + 0455**

Work after recovery on mooring:
Acoustic releases 217 + 218
batteries replaced in releases 217 (C-cells & 9V block)

ARGOS beacon ***35520***
batteries replaced
check instrument (ARGOS beeper) and switch it on

WCP ***004***
opened instrument and connected battery
set-up instrument for deployment
set real time clock to PC clock [shift F7] (p.48)
check for correct time [shift F1]
run RAM & Memory Test to check instrument and erase all data
set-up instrument (p.15 pp)
Burst Resolution (sec): 1
Burst Interval (sec): 240
Burst counts (pings): 18
Ping length (micro sec): 600
Max range (m): 200
Bin size: 8
Gain: 1
Start time: 15.04.2009
Stop time: 15.04.2010
Save deployment settings as .dpl file in prepared folder

shallow water mooring (300m water depth)

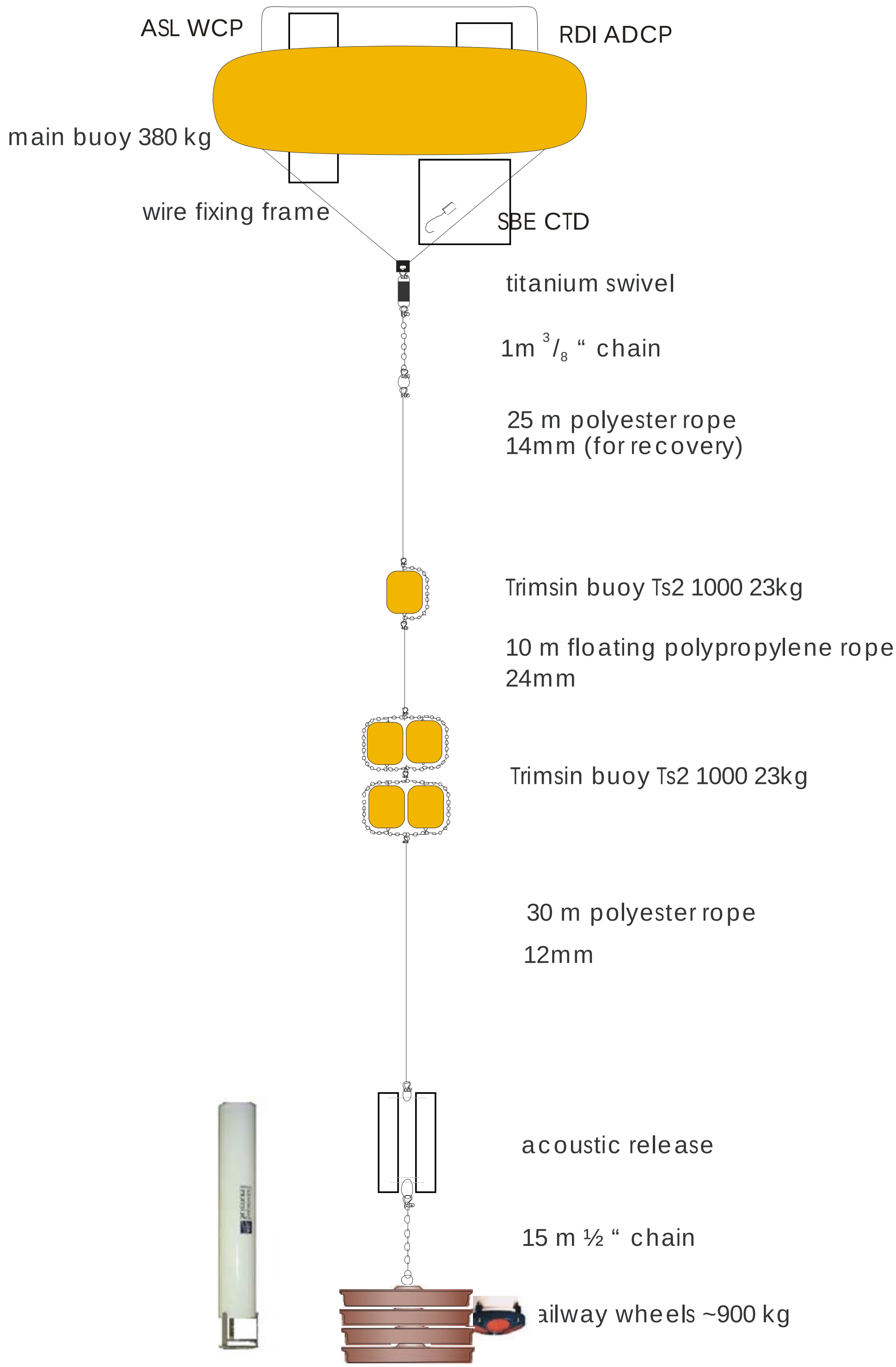


Fig 3.4.1 Diagram of Shallow Water Mooring

4. MACRONUTRIENT ANALYSIS

Mick Whitehouse and Min Gordon

4.1 Introduction

The Southern Ocean is rich in macronutrients that are generally underutilized by phytoplankton. However, there are a number of exceptions to this generalization, particularly in the Scotia Sea and to the north of the North Scotia Ridge. For instance, the abundant phytoplankton growth downstream of South Georgia is well documented (Atkinson et al. 2001, Korb and Whitehouse 2004, Korb et al. 2004). These long lasting blooms benefit from natural Fe fertilization. Likewise the Antarctic Peninsula is probably an Fe source for the central Scotia Sea and the South Orkneys a source for the south to some extent.

Additional controls on phytoplankton growth include light and grazing; the latter both stimulating growth through the remineralisation of nutrients as well as cropping the standing stock. Also the Southern Ocean's latitudinal silicic acid gradient imposes limitations on diatom growth in the northernmost reaches of the Scotia Sea, such as in the vicinity of South Georgia. The three cruises conducted in the present study allow the examination of macronutrient variability, as a proxy for phytoplankton growth, over temporal and spatial scales against the backdrop of differing micronutrient and light availability, and changes in grazing pressure.

4.2 Aims

Data collection falls into three categories: fine-scale underway measurements, CTD profiles, and onboard experiments. Onboard experiments will be detailed elsewhere and are not discussed in this report.

Underway measurements, both along the major south-north transect and on the "acoustic" surveys, will allow an unprecedented view of nutrient variability across the Scotia Sea. The analysis would best be undertaken in tandem with physical, phytoplankton and acoustic data collected at a similar resolution, thus allowing most of the major controls to be considered. Unfortunately micronutrient data cannot be collected so frequently but Fe control may be predicted by NO_3 utilisation and N:P depletion ratios.

CTD profiles will be used to verify underway measurements and to identify gross watermass characteristics. They will also allow comparison with previous studies that have been restricted to meso-large scale measurements.

4.3 Sample collection and analytical methods

Along the major south-north transect and during mesoscale (acoustic) surveys, near-surface water (7 m depth) pumped through the ship's non-toxic seawater supply was monitored for macronutrient levels. Full depth profiles were measured at all major stations where samples were taken from the main CTD cast (see physical oceanography section for depths), and additional profiles were obtained at intervening "Dimes" stations when possible.

When Go-flo bottle casts were successful, samples were obtained for macronutrient analysis. Onboard experiments (a bioassay manipulating Fe and light conditions, and another considering krill remineralisation – both detailed elsewhere) were also monitored for changes in macronutrient concentrations.

All samples were filtered through a cellulose nitrate membrane (Whatman WCN, pore size 0.45 μm), and the filtrate was analysed colorimetrically for dissolved nitrate+nitrite (NO_3+NO_2-N), ammonium (NH_4-N), silicic acid ($Si(OH)_4$-Si) and phosphate (PO_4-P) using a Technicon-based segmented-flow analyser (Whitehouse 1997). Data were logged to a PC using a LabVIEW 6i (National instruments) acquisition programme and to a Kipp and Zonen BD300 data acquisition recorder.

4.4 Data analysis

Full data analysis and verification will be undertaken with subsidiary programmes (Whitehouse and Preston 1997) on our return to the UK. The data are subject to a variety of analytical corrections (eg. saline-freshwater RI adjustments), and the underway data require time-lag adjustments to individual chemistry lines. Additionally, for full verification of the vertical nutrient profiles the contemporaneous physical oceanographic measurements from the CTD are required.

4.5 Problems

There were a number of analytical problems that need to be considered for the present dataset and future BAS chemical oceanography. The one major problem is the age of the detection systems on the nutrient analyzer – obsolete for the last 15 years or so. A retinue of faults from temperature-warped filter holders to antiquated optics and a transformer that regularly trips the laboratory's power supply conspire to complicate the analytical procedure and inevitably will detract from data quality. All this and more were documented in a report last year and do not need to be repeated here. Essentially, if macronutrients are to be measured by BAS in the future, the instruments used will require serious attention and drastic renewal.

In addition, two more problems are of note. The speedy turn around times for equipment in the UK between cruises allow little time for method testing and optimization. So the switch a couple of years ago to "Pharmed" tubing on the main drive pumps of the analyzer was a mixed blessing. This new, "rubberized" tubing extends working life by a factor of ten or more but the physical specifications of this type of tube are different to those of the traditional PVC with which standard methods have been developed historically. Thus the BAS chemistry's are all slightly different and the hydraulics of the segmenting air and the process timings are also changed with this switch in tubing use. This has caused a number of problems with some methods, e.g. susceptibility to violent ship's movement and reduced analytical sensitivity. Once the equipment shortfalls detailed above have been resolved then a comprehensive optimization of methods should be undertaken at Cambridge before further shipboard analysis is considered.

A further analytical problem to be reconciled is the sporadic occurrence of spuriously high NH_4 concentrations in samples taken in the water-bottle annex and filtered in the chemistry laboratory. This problem does not occur with samples prepared elsewhere (e.g. the cool room) and analysed in the chemistry laboratory, which indicates that the analytical system itself is not at fault. Which leaves either the present filtering system (new two years ago thus unlikely) or the environment in which sample preparation takes place as the likely source of contamination. With sufficient time, this problem could be identified in the Cambridge laboratory. However, if it is the environment to blame then resolving the problem will be difficult. To this end, the chemistry laboratory (and probably others) requires thorough cleaning. In addition, the air supply to the laboratory should be re-evaluated and modified if required.

4.6 References

Atkinson A, Whitehouse MJ, Priddle J, Cripps GC, Ward P, Brandon MA (2001) South Georgia, Antarctica: a productive, cold water, pelagic ecosystem. Mar. Ecol. Prog. Ser. 216: 279-308.

Korb R, Whitehouse M (2004) Contrasting primary production regimes around South Georgia, Southern Ocean: large blooms versus high nutrient, low chlorophyll waters. Deep-Sea Res. I, 51:721-738.

Korb RE, Whitehouse MJ, Ward P (2004) SeaWiFS in the southern ocean: spatial and temporal variability in phytoplankton biomass around South Georgia. Deep-Sea Res. II, 51, 99-116.

Whitehouse MJ (1997) Automated seawater nutrient chemistry. British Antarctic Survey, Cambridge, 14 pp.

Whitehouse MJ, Preston M (1997) A flexible computer-based technique for the analysis of data from a sea-going nutrient autoanalyser. Analytica chimica Acta 345: 197-20.

5. PARTICULATES

Dave Pond

5.1 Introduction

Particulate material was collected from the chlorophyll maxima to determine the food availability, quality and trophic level (stable isotope) for meso- and macro-zooplankton communities at each site. Additional large volume samples of particulate material were collected from dedicated CTDs to provide sufficient material for the analysis of a wide suit of lipid biomarkers

5.2 Data Coverage

Table 5.2.1 Samples taken from bottle 21 of the full depth CTD. The downcast fluorescence trace was used to establish depth of the chlorophyll maxima.

Event	Date	Depth	Fatty acid (litres)	Stable isotope (litres)	POC, PON (litres)
E19	16/03/09	20	3	2.5	2.5
E37	18/03/09	20	5.2	2	2
E66	21/03/09	30	3	2.5	2.5
E92	24/03/09	10	4.4	2.5	2.5
E132	28/03/09	20+30	6.4	2	2
E148	31/03/09	20	4.2	2	2
E173	03/04/09	20	4.2	2	2
E191	06/04/09	20	4.2	2	2

Table 5.2.2 Large volume water collections from the chlorophyll maxima and 2000m to correspond with the depth of the sediment traps deployed at process stations 2 and 3.

Event	Date	Litres filtered	Depth
E10	14/03/09	125	1371
		75	15
E33	18/03/09	100	2000
		75	20
E73	21/03/09	100	2000
		75	30
E99	26/03/09	100	2000
		75	40
E139	29/03/09	100	2000
		100	20
E168	02/04/09	100	2000
		100	20
E199	06/04/09	100	2000
		75	20

6. IRON CHEMISTRY

6.1 A study of the iron biogeochemistry in the Scotia Sea

Sebastian Steigenberger, Daria Hinz, Tom Bibby, Eric Achterberg, Mick Whitehouse & Rebecca Korb

6.1.1 Introduction

Iron is an essential trace element for all living organisms and is of major importance for aquatic photosynthetic organisms. Due to the very low solubility of Fe(III) hydrolysis products the concentration of dissolved iron in the oxygenated upper ocean is extremely low (<0.5 nM in the open ocean). Iron is supplied to the surface ocean via atmospheric transport of dust and its wet and dry deposition (Jickells 2005), as well as via upwelling, entrainment, or mixing of deeper waters relatively rich in nutrients and metals (Johnson 1997, Bowie 2005). Furthermore sea ice and brine has been found to contribute to the iron budget in higher latitudes (Lannzuel 2007).

Since iron deficiency was reported to limit primary production in High Nutrient Low Chlorophyll (HNLC) regions (Martin and Fitzwater 1988; Martin et al. 1990) extensive research has been carried out in the Subarctic Pacific, the Equatorial Pacific and the Southern Ocean (Martin and Fitzwater 1988; Martin et al. 1990).

During JR200 the aim was to sample a series of profiles down to 1000 m depth from the open ocean onto the shelf near South Georgia. In a multi-element approach these samples will be analysed for a range of trace metals, e.g. Mn as a tracer for the influence of the sediment and Ti and Al as aerosol tracers. This should give show the sources of iron in the Scotia Sea.

6.1.2 Sample Methods

Underway

Samples were taken from a steel torpedo fish that was towed at the stern on the starboard side of the ship. Tubing went from the fish into the clean container where it was pumped with a peristaltic pump. Underway samples were filtered online through a 0.2 um Sartobran filter cartridge. All underway samples were acidified to a pH~1.8 with ultra pure HNO_3.

Profiles

Water samples from six depth horizons (10-500 m) were obtained at the last 5 biostation. Samples were taken with 3 General Oceanic (GO-FLO) bottles. The bottles were attached to a plastic coated metal wire and the bottles were released with plastic coated messengers weights.

Initially all 10 GO-FLO bottles were acid washed with 10% HCl 2 times, 1% HCl 2 times, 2% Decon90 and 2 times with acidified seawater (0.1% HCl). However, this only helped to remove the Fe contamination from 3 bottles, which were then deployed in two casts at each biostation.

All samples were acidified to pH~2 with ultra pure HNO_3 for subsequent analysis for several metals (e.g. Fe, Al, Mn, Co, Ti) on an ICP-MS some time in the future.

In addition to dissolved iron samples, unfiltered, samples were taken and acidified for total dissolvable Fe to be analysed back at NOC.

6.1.3 Method of analysis

Dissolved iron was measured using the flow-injection chemiluminescence method by Obata (1993). Samples were buffered with ammonium acetate to pH 4 and pre-concentrated on a 8 HQ resin column. The samples were then eluted off the column with HCl and mixed with Luminol, H_2O_2 and NH_4OH to create a blue light detected by a photomultiplier as a voltage signal. Concentrations were determined according to standard addition calibration carried out before analysis and comparison with SAFe and samples.

6.1.4 Results

5 GO-FLO profiles (Tab. 6.1.1) were sampled and 65 underway samples (Table 6.1.2) with the tow fish. The majority of the samples will be analysed at NOC.

Table 6.1.1 : Date, position and depth of sampled GO-FLOs during JR200

Event	Name	Start Time	End Time	Start Lat	Start Lon	End Lat	End Lon	depths [m]
47	GO-FLO	19/03/2009 11:33:00	19/03/2009 14:12:00	-60.20819	-44.40805	-60.20817	-44.40796	(contaminated)
68	GO-FLO	21/03/2009 14:05:00	21/03/2009 15:27:00	-59.68859	-44.05515	-59.68842	-44.05462	(contaminated)
98	GO-FLO	24/03/2009 21:02:00	24/03/2009 22:20:00	-58.03005	-42.97104	-58.03003	-42.97100	(contaminated)
124	GO-FLO	27/03/2009 18:00:00	27/03/2009 19:17:00	-56.76343	-42.21861	-56.76342	-42.21860	500, 300, 200
126	GO-FLO	27/03/2009 20:16:00	27/03/2009 20:54:00	-56.76815	-42.21556	-56.76556	-42.21289	100, 50, 20
131	GO-FLO	28/03/2009 12:27:00	28/03/2009 12:36:00	-56.77002	-42.21881	-56.76802	-42.21877	500, 300, 200
132	GO-FLO	28/03/2009 13:00:00	28/03/2009 13:26:00	-56.78104	-42.22177	-56.77534	-42.21998	100, 50, 20
154	GO-FLO	31/03/2009 20:38:00	31/03/2009 21:45:00	-55.25847	-41.35762	-55.25843	-41.35762	500, 300, 150
155	GO-FLO	31/03/2009 22:18:00	31/03/2009 22:46:00	-55.25847	-41.35769	-55.25843	-41.35768	80, 40, 10
181	GO-FLO	03/04/2009 20:57:00	03/04/2009 22:02:00	-52.80854	-40.11459	-52.80847	-40.11455	500, 300, 150
182	GO-FLO	03/04/2009 22:31:00	03/04/2009 22:58:00	-52.80856	-40.11458	-52.80851	-40.11457	60, 40, 20
192	GO-FLO	06/04/2009 13:10:00	06/04/2009 13:40:00	-52.85077	-37.09675	-52.85074	-37.09668	60, 40, 20
193	GO-FLO	06/04/2009 14:11:00	06/04/2009 15:17:00	-52.85077	-37.09670	-52.85072	-37.09666	500, 300, 150

Table 6.1.2 : Date and position of underway samples during JR200

Sample	Date	Time	Lat	Lon
U1	13/03/2009	07:09	-57.1296	-51.1574
U2	13/03/2009	10:09	-57.6177	-50.5297
U3	14/03/2009	07:39	-59.2155	-49.2436
U4	14/03/2009	08:39	-59.37	-49.1163
U5	14/03/2009	11:09	-59.6172	-48.9018
U6	14/03/2009	17:25	-60.2674	-48.3628
U7	17/03/2009	07:09	-60.4754	-47.1008
U8	17/03/2009	10:19	-60.4583	-45.9939
U9	17/03/2009	13:09	-60.4337	-44.99
U10	18/03/2009	12:29	-60.3501	-44.3832
U11	19/03/2009	17:59	-59.9966	-44.2774
U12	20/03/2009	00:14	-59.8569	-44.1734
U13	22/03/2009	09:24	-59.0896	-43.6644
U14	22/03/2009	12:49	-58.9593	-43.5828
U15	22/03/2009	18:44	-58.5013	-43.2788
U16	25/03/2009	10:04	-57.7048	-42.8791
U17	25/03/2009	14:39	-57.4144	-42.5992
U18	25/03/2009	20:31	-57.0367	-42.3815
U19	28/03/2009	14:19	-56.6851	-42.1714
U20	28/03/2009	15:54	-56.4269	-42.0282
U21	28/03/2009	20:59	-56.1414	-41.8638
U22	29/03/2009	13:19	-55.7114	-41.6137
U23	29/03/2009	18:26	-55.4188	-41.4508
U24	01/04/2009	16:44	-54.9211	-41.0644
U25	01/04/2009	18:09	-54.6505	-41.0124
U26	02/04/2009	00:06	-54.259	-40.832
U27	02/04/2009	08:09	-53.8045	-40.596
U28	02/04/2009	09:24	-53.742	-40.6337
U29	02/04/2009	13:04	-53.2715	-40.3514
U30	02/04/2009	14:39	-53.0038	-40.2158
U31	04/04/2009	22:19	-52.6842	-40.2377
U32	05/04/2009	04:15	-52.795	-39.2321
U33	05/04/2009	08:49	-52.8016	-38.3399
U34	05/04/2009	11:26	-52.8018	-37.8752
U35	07/04/2009	21:15	-52.7646	-37.1151
U36	07/04/2009	23:09	-52.5078	-36.7858
U37	08/04/2009	02:09	-52.222	-36.3662
U38	08/04/2009	05:09	-51.8474	-35.8547
U39	08/04/2009	08:09	-51.4733	-35.3362
U40	08/04/2009	11:19	-51.1144	-34.7002
U41	08/04/2009	13:14	-50.8954	-34.3102
U42	08/04/2009	15:19	-50.6502	-33.8829
U43	08/04/2009	17:11	-50.3325	-33.8786
U44	08/04/2009	19:14	-50.0319	-34.0721
U45	08/04/2009	21:13	-49.7823	-34.4392
U46	12/04/2009	14:19	-51.8865	-37.2219
U47	12/04/2009	16:25	-52.1757	-36.9033
U48	12/04/2009	18:26	-52.4819	-36.9517
U49	12/04/2009	20:24	-52.8149	-37.183

U50	14/04/2009	14:29	-53.8615	-37.6276
U51	14/04/2009	15:29	-53.9221	-37.3597
U52	15/04/2009	21:14	-53.7848	-38.1092
U53	15/04/2009	22:14	-53.7516	-38.3834
U54	15/04/2009	23:14	-53.7097	-38.653
U55	16/04/2009	00:14	-53.6689	-38.9204
U56	16/04/2009	01:17	-53.6396	-39.2029
U57	16/04/2009	02:14	-53.6165	-39.4651
U58	16/04/2009	03:14	-53.592	-39.732
U59	16/04/2009	06:14	-53.5063	-40.5069
U60	16/04/2009	09:15	-53.4185	-41.2764
U61	16/04/2009	11:15	-53.357	-41.8144
U62	16/04/2009	13:24	-53.2945	-42.4158
U63	16/04/2009	15:29	-53.2302	-43.0029
U64	16/04/2009	17:29	-53.1706	-43.5737
U65	16/04/2009	19:54	-53.0953	-44.2915

6.1.5 Recommendations and future work

For the future, it would be a great help to send one more person on the cruise to give a hand with the iron work and the bioassays and also to improve the coverage of underway sampling.

6.1.6 Equipment

The clean container: The annex and also the lab area and the laminar flow bench of the clean container provided by NMF were covered in dust due to unsealed ventilation openings, which were then closed with tape before cleaning the whole inside of the container (~1.5 days). The MQ system in the clean container worked well even though the tube connecting to the ship's freshwater line inside the lab had a hole and needed fixing. The plumbing of the sink was leaking into the annex because the pipes of the AC were not properly connected. The laminar flow bench did not have a front cover to keep the inside clean while turned off. Switching the main switch of the clean bench blows the fuses for the whole container and needs to be fixed. The only power socket in the container annex to plug in the peristaltic pump is a Euro socket and not compatible with the British plug of the pump, this needs to be exchanged. The container was lacking a rack for the GO-FLO bottles what made the handling of the bottles more difficult and time consuming.

The GO-FLO bottles: The wire provided for the GO-FLOs was surprisingly too thick so deck engineer Simon Wright had to cut out deeper grooves in to the plastic holders and the titanium screws (~2 days) as he had done already during JR177. Several of the bottles were missing the rubber springs, leaked badly and some were unable to close properly and had to be fixed and adjusted. On the wire there were tape marks stopping the messengers weights to slide down. The winch was provided with only 500 m of wire although the original plan was to sample down to 1000 m depth.

To avoid the hassle of contamination the GO-FLO bottles should be stored in strong sealable bags not only bin bags. The majority of these bottles need to be replaced or their Teflon coating needs to be renewed.

6.1.7 Acknowledgements

I would like to thank S. Wright and J. Klepacki for their help with the GO-FLOs, as well as M.J. Whitehouse, who did the macronutrient analyses of the GO-FLO samples. Also, I would like to thank the captain, officers and crew of the JCR for all their help and patience. The work carried out on cruise JR200 was funded by an AFI-CGS collaboration awarded to Dr. Rebecca Korb. [CGS10/48]. See: http://www.antarctica.ac.uk/afi/awards_round10.php#1048

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6.2 Study of phytoplankton response to naturally iron enriched regions of the Scotia Sea

Daria Hinz[1], Sebastian Steigenberger[1], Mick Whitehouse[2], Rebecca Korb[2], Tom Bibby[1], Eric Achtenberg[1]

[1]National Oceanography Centre, Southampton, [2]British Antarctic Survey

6.2.1 Overview

Iron is an essential component of the photosynthetic electron transfer chain and as such iron abundance and phytoplankton abundance are positively correlated. Iron concentrations in the Southern Ocean are generally low owing to the lack of continental derived Aeolian dust inputs. There are however, potential sources of iron into this system – including; seasonal melting sea ice, upwelling, and run-off / dust deposition from islands. The aim of this work, as part of JR200, is to correlate natural iron abundance with phytoplankton abundance, speciation and productivity with respect to the rest of the Scotia Sea food chain.

6.2.2 Phytoplankton physiology

Active chlorophyll *a* fluorescence is a non-invasive method of probing phytoplankton photophysiology by providing information on the functioning of photosystem II within the photosynthetic apparatus (Kolber et al. 1998; Suggett et al. 2005). Changes in biophysical parameters measured by active fluorescence techniques can then be used to infer the factors influencing phytoplankton growth in situ, including nutrient and light availability/stress (e.g. Greene et al. 1994).

During JR200, a Fast Repetition Rate (FRR) fluorometer was used to record continuous underway measurements from the ship's non-toxic supply, discrete measurements from CTD casts, and discrete measurements from bioassay experiments. The machine used was a bench top FIRe™ system (Fluorescence Induction and Relaxation of Emission Spectrometer) manufactured by Satlantic (Canada).

*6.2.3 Underway measurements on ship's non-toxic supply, D*aria Hinz

The bench top FIRe™ FRRf was connected to the ship's non-toxic supply within the main lab in order to monitor the physiological state of photosystem II (PSII) within the surface phytoplankton population throughout the study area.

Underway sampling was carried out using a flow-through cuvette, which was cleaned daily. Sampling was stopped for discrete measurements, but otherwise ran continuously for the entire cruise. The data will be analyzed at a later date using manufacturer-provided software.

6.2.4 Discrete measurements of samples from 5-day bioassays, Daria Hinz, Sebastian Steigenberger

A series of on-deck bioassay incubation experiments was conducted at four stations (Table 6.2.1). The aim of these experiments was to identify the factors limiting phytoplankton growth. Trace metal clean surface water was collected using the Tow-Fish during the station's acoustic survey, between about 5am and 6am ship's time. 2 litre sample bottles were subjected to varying nutrient and light conditions (Table 6.2.2). Sub-samples from the four Fe addition bioassays were collected at one or two day intervals (Table 6.2.3) and were run through the FIRe™ FRRf after being allowed to relax in the dark for >30 minutes before analysis. Data will be analyzed later using manufacturer-provided software (FIRe™).

These experiments will be important demonstrations of conclusions drawn from the sampling of the natural phytoplankton community and nutrient availability in the Scotia Sea.

	Sampling location	Sampling method	Start date	End date
BIO1	Test station (low chl.)	Tow Fish	13/3/09	18/3/09
BIO2	C3 (moderate chl.)	Tow Fish	20/3/09	25/3/09
BIO3	P2 – S.SG (moderate chl.)	Tow Fish	30/3/09	4/4/09
BIO4	P3 – N.SG (high chl.)	Tow Fish	4/4/09	9/4/09

Table 6.2.1. Sampling method, location, and dates for bioassay experiments.

	15% of Surface PAR	15% of Surface PAR + Fe addition	2.5% of Surface PAR	2.5% of Surface PAR + Fe addition
Bottle Number	1-5	6-10	11-15	16-20

Table 6.2.2 . Conditions for bioassay experiments.

Sub-samples	Days 0 and 5	Days 1 and 3
Fe	Yes	Yes
FRRF	Yes	Yes
Chl	Yes	Yes
Nutrients	Yes	Yes
Lugols	Yes	No
Protein	Yes	No
SEM	Yes	No

Table 6.2.3 . Sub-samples taken and on which day.

6.2.5 Discrete measurements of samples from 24-hour bioassays, Daria Hinz, Sebastian Steigenberger

Two additional, short duration bioassays experiments were run for 24-hours total and sub-sampled as often as possible (between 1 and 10 hour intervals) (Table 6.2.4). 2 replicates of control (bottles A, C) and Fe added (bottles B, D) conditions were all placed in one incubator. The goal of these experiments was to collect high-resolution data on diel cycles within the bioassay experiments.

	Sampling location	Sampling method	Start date	End date	Comments
Experiment 1	C2 (moderate chl.)	Tow Fish	19/3/09	20/3/09	Used 15% PAR incubator
Experiment 2	P2 (moderate chl.)	Tow Fish	31/3/09	1/4/09	Used 2.5% PAR incubator

Table 6.2.4 . Sampling method, location, and dates for 24-hour bioassay experiments.

6.2.6 CTD casts, Daria Hinz

Discrete samples were collected from the niskin rosette during deep station casts and dimes station casts in dark 500 ml bottles and analyzed using the bench top FIRe™ FRRf (Table 6.2.6). Samples were taken from 10 shallow depths (Table 6.2.5) and in addition, the chlorophyll maximum sample was size fractionated using 3, 5, 10 and 20 µm poly-carbonate membrane filters. The data will be analyzed at a later date using software mentioned previously to provide vertical profiles of the abundance and physiology of the phytoplankton community throughout the study area, as well as the physiology and abundance associated with each size fraction.

Date	Event number	Station
12/3/09	3	Test Stn
16/3/09	19	R1
17/3/09	31	Dimes 1
18/3/09	38	C2
21/3/09	66	C3
22/3/09	77	Dimes 6
22/3/09	79	Dimes 7
24/3/09	92	C4
25/3/09	102	Dimes 10
25/3/09	104	Dimes 11
28/3/09	131	R2
29/3/09	134	Dimes 13
29/3/09	135	Dimes 15
31/3/09	148	P2
1/4/09	159	Dimes 18
2/4/09	165	Dimes 21
3/4/09	173	P3
6/4/09	191	R3
10/4/09	231	PF3
10/4/09	232	PF4
11/4/09	238	PF5

Table 6.2.5 . Record of CTD casts.

Depths sampled (m)
120
100
80
60
50
40
30
20
10
5

Table 6.2.6. Depths sampled on CTD casts.

6.2.7 SEM, Daria Hinz

In addition to physiological measurements, samples were taken underway for later analysis using Scanning Electron Microscopy (SEM), to investigate coccolithophore abundance. Water was taken from the non-toxic supply and vacuum filtered through 0.4 µm nucleopore poly-carbonate filters (Whatman) both underway and on station.

6.2.8 Acknowledgements

Funding for this work was provided by an AFI-CGS grant (a NOCS/BAS collaboration) awarded to Dr. Rebecca Korb. [CGS10/48], http://www.antarctica.ac.uk/afi/awards_round10.php#1048. Special thanks to Min Gordon for her help with chlorophyll analysis & Lugols samples, Dave Pond for the use of his filter rig, and Simon Wright for his technical expertise in altering equipment.

6.2.9 References

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7. PHYTOPLANKTON BIOMASS & PRODUCTIVITY

Rebecca Korb & Min Gordon

7.1 Introduction

Although the Southern Ocean is the largest, high-nutrient, low chlorophyll (HNLC) region in the global ocean, there are areas where phytoplankton blooms occur regularly. Elevated chlorophyll and primary production are typically observed downstream of oceanic islands during the austral summer (e.g. Blain et al 2007). These blooms are generally dominated by diatoms, and potentially represent "hotspots" of carbon export.

In the northern Scotia Sea, large and intense blooms may at times be dominated by non-siliceous species such as dinoflagellates (Korb et al 2008), which could have important implications for carbon export in the region. Key abiotic factors controlling phytoplankton growth are light, iron and silicic acid. In this study, we examine how these environmental conditions (or indices of them) related to the phytoplankton communities over a productivity gradient across the Scotia Sea. In addition, we will compare the results of this autumn cruise to previous cruises carried out in the spring and in the summer to gain a seasonal perspective to phytoplankton community composition.

7.2 Aims

We will measure primary production, phytoplankton biomass and species composition and relate to environmental parameters, across a latitudinal gradient covering both areas of open ocean and shelf waters.

7.3 Methods and data coverage

7.3.1 Primary production

Primary production was measured using the radioisotope 14C following the standard methods of Korb. This method basically follows the JGOFS protocol and uses an on deck incubator with incubations lasting 24 hours in tubes with100, 77, 54, 30, 10, 6, 1, and 0% surface irradiance. Trace metal clean techniques were followed for sample collection. Bottles for incubations were cleaned at BAS (using HCl) and shipped south in plastic bags. Clean water samples were collected from the NOC towfish. However, all radioisotope work was carried out in the radioisotope lab and not in the clean container.

Primary production was measured at all the major biology stations (see Table 7.1)

7.3.2 Chlorophyll a

Chl a profiles were measured on water collected from all major biology stations as well as at a number of physics CTD stations (see Table 7.1). When a full profile was not measured, a sample was collected from the surface and from 20 m. Bottles were fired at nominal depths of 5, 10, 20, 30, 40, 50, 60, 80, 100 and 120 m and at a floating depth determined to be the chlorophyll maxima (from examination of fluorescence data on the downcast). Fluorescence data from the

CTD will be examined back at Cambridge and calibrated against the chlorophyll samples collected. PAR data from the shallow CTD cast will also be examined to determine euphotic depths.

In addition, size fractionated chlorophyll *a*, from 20 m, was measured at all main CTD stations. Chlorophyll samples, from the ships non-toxic seawater supply, were taken whilst the ship was underway. For coverage see Fig 7.1. These samples will be used to calibrate the Oceanlogger fluorescence.

All chlorophyll samples were filtered and then frozen at –20 ºC and stored for at least a day until it was convenient to extract and analyse them on the ship.

7.3.3 Species composition

Lugols samples were collected at most stations at a depth of 20 m (see Table 7.1)

7.3.4 Photosynthetic physiology

The BAS FRRF could not be deployed on this trip as the lead connecting the FRRF to its deck unit was missing (it was taken out of the box last year for repair and not replaced before the FRRF was packed south).

7.3.5 Additional

At some stations (see Table 7.1) water samples were taken from the CTD for Si isotope analysis (for Kate Hendry, University of Oxford).

7.4 Results

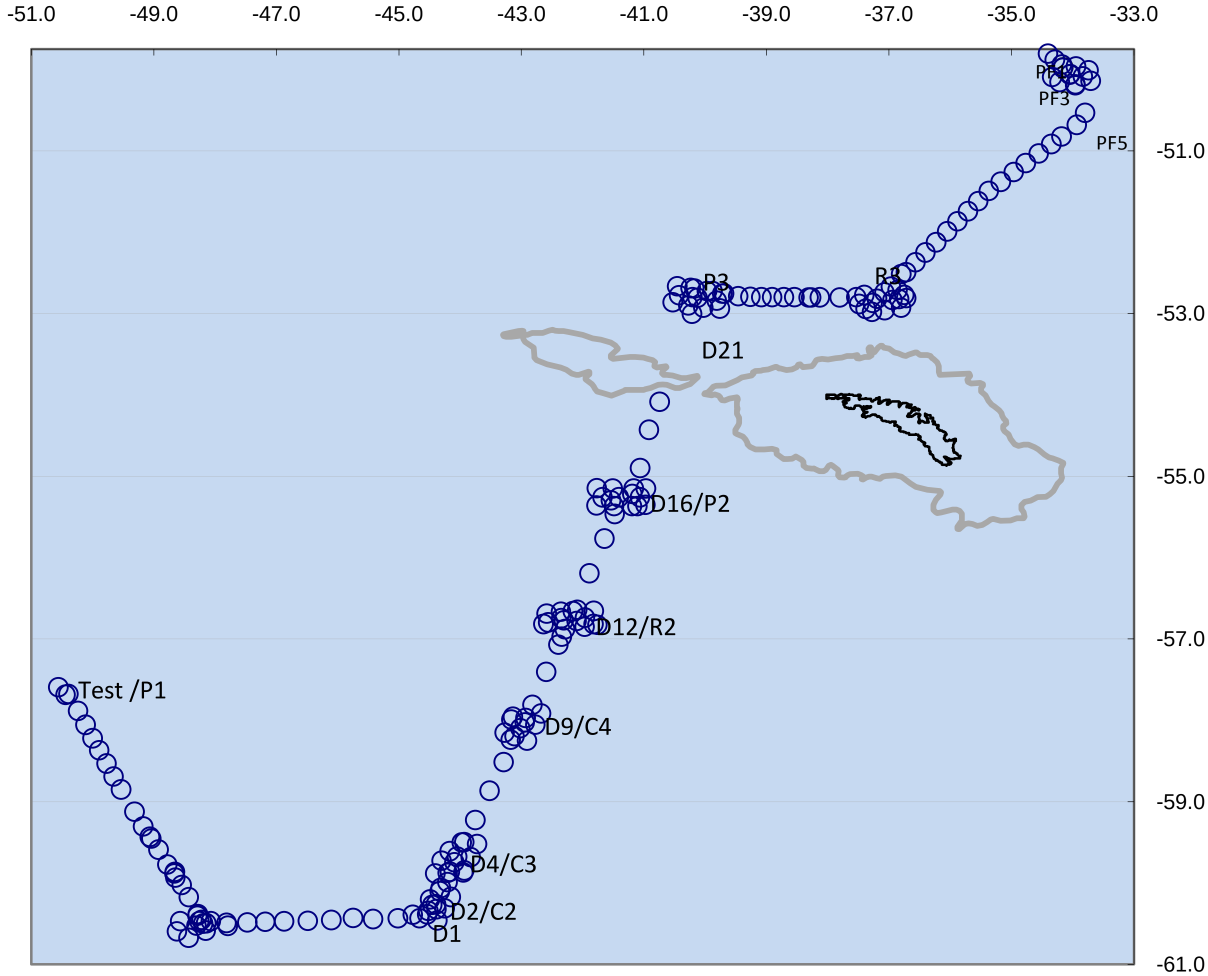
Full data analysis will be performed back at BAS, Cambridge as many of the data sets are subject to a variety of correction factors, e.g. the chlorophyll standard needs to be calibrated on a spectrophotometer. Additionally, the data can only be fully interpreted with the contemporaneous physical oceanographic measurements from the CTD and Oceanlogger. A full evaluation of all the data should be completed during summer 2008.

Table 7.1. Phytoplankton samples collected during JR200.

* No CTD due to bad weather.

Station names(s)		Prim prod	Chl profile/SF	Chl 20 m	Lugols 20 m	Si isotopes	POC
	Test	y	y		y		y
	R1		y		y	y	y
D1			y		y		y
D2	C2	y	y		y	y	y
D3				y	y		y
D4	C3	y	y		y	y	y
D5				y	y		y
D6			y		y		y
D7			y		y		y
D8				y	y		y
D9	C4	y	y		y	y	y
D10			y		y		y
D11			y		y		y
D12	R2	y	y		y		y
D13			y		y		y
D14	*	*	*	*	*	*	*
D15			y		y		y
D16	P2	y	y		y	y	y
D17				y	y		y
D18			y		y		y
D19				y	y		y
D20			y		y		y
D21			y		y		y
	P3	y	y		y	y	y
	R3	y	y		y	y	y
	PF				y		

Fig 7.1 Coverage of underway Chl samples on JR200



8. MESOZOOPLANKTON SAMPLING

8.1 Longhurst Hardy Plankton Recorder (LHPR) studies

Peter Ward, Geraint Tarling

8.1.1 Background

As on the two previous cruises (JR161 & 177) LHPR sampling was undertaken at each station to describe the fine-scale (~25 m resolution) of mesozooplankton within the top 1000 m. This year the LHPR had its own dedicated Down-Wire Net Monitor which obviated the need to take the instrument on and off the net frame for each haul. This probably contributed to the greater reliability and freedom from communication problems that we encountered on cruise JR161 and to a lesser extent on JR177.

8.1.2 Method

We wished to undertake 2 deployments at each station; a night-time and a daytime haul to1000 m with a sampling resolution of around 25 m. To achieve this the gauze advance was set to 2 minutes and the net deployed to 1000 m. By paying out cable at around 40-50 m per minute at a ships speed of 2.-2.5kts, one thousand meters net depth was achieved when approximately 2000 m of wire had been paid off the winch drum, a ratio of ~2:1. The LHPR was then allowed to settle at depth and once stable at 1000m the open/close mechanism was switched to the open position, ie in line with the cod-end, and the gauze advance activated. A couple of advances were allowed to clear the net of any material carried down on the descent before hauling to the surface at ~25 m per minute. In this way the depth resolution of each patch of gauze was around 25 m and around 20 m^3 of water was swept.
Gauzes were cut into respective patches onboard ship and frozen at –20°C to await analysis in the UK.

A total of 14 hauls were undertaken at 8 stations (Table 8.1). At 5 stations both hauls were successfully carried out, although at CS2 the daytime haul was cancelled due to the sea cable needing re-termination and at CS3 the feedback mechanism was found not to be operating on the ascent (E067). This was due to the plug to the motor being partially disengaged. Addition of a cable tie prevented this happening again.

Stations only 1 haul was taken: At R3 only one haul was carried out due to the station being shortened as a result of bad weather. No sampling was undertaken at the Polar Front station (R4) due to poor weather conditions.

Table 8.1 LHPR. Summary of hauls

Station	Event	Patches	Comments
R1	E21 (Day)	42	OK
	E27 (Night)	43	OK
CS2	E37 (Night)	41	OK
CS3	E065 (Night)	43	OK
	E067 (Day)		No feedbacks
CS4	E91 (Night)	45	OK
	E93 (Day)	45	OK
R2	E109 (Night)	46	OK
	E120 (Day)	47	OK
P2	E147 (Night)	44	OK
	E153 (Day)	50	OK
P3	E172 (Night)	43	OK
	E180 (Day)	44	OK
R3	E196 (Day)	46	OK Recovered in darkness

8.2 Oithona similis (Copepoda:Cyclopoida): lifecycles and population dynamics

Peter Ward and Andrew Hirst*(Queen Mary College, University of London)*

8.2.1 Introduction

Work has continued throughout JR200 on elaborating the lifecycle of this, the most abundant copepod in the Southern Ocean, and probably elsewhere in the world ocean (Gallienne and Robins 2001).

Previous work in the Scotia Sea has focussed on abundance and distribution in relation to temperature (Ward and Hirst 2007) and an assessment of mortality during spring (Hirst and Ward 2008).

Our aim during Q4 cruises, has been, and is, to investigate population structure, recruitment and mortality with regard to prevailing conditions across the Scotia Sea in relation to season.

8.2.2 Method

At all stations sampled we used a variety of methods to capture *Oithona* spp. A motion compensated paired bongo net (0.62m mouth dia) equipped with 100 and 200 micron mesh nets was deployed to 400 m and hauled vertically to the surface, as was a 53micron mesh paired (minibongo) net (0.18 m mouth dia). Additionally a CTD rosette equipped with 24 x 10 l bottles was also deployed to 400 m and 2 bottles sampled each of the following depths, 400, 300, 200, 150, 100, 80, 60, 50, 40, 30, 20 and 10m. Bottle contents were passed through a 53 micron filter and back-washed into 4% formalin preservative. The close spacing of bottle depths in the surface 100 m was based on the results from the spring cruise (JR161) which suggested that the majority of the population was resident in this part of the water column (Hirst and Ward 2008). In the UK, following sample analysis, data on stage abundance from all nets and water bottles will be standardised and compared to assess their relative sampling efficiency. The water bottle samples will also provide fine-scale information on the distribution of life-stages of this and its less abundant congener *Oithona frigida* in relation to physical and environmental variation.

8.2.3 Carbon analysis

Two hundred and fifty adult female *O.similis* were picked from samples obtained at 4 of thestations sampled. Individuals were placed in filtered sea-water in a watch glass and adhering phytoplankton detritus was removed from aliquots of 20 animals at a time. Animals were bulked up and retained on a 25 mm pre-ashed GFF filter which was frozen at –80$_o$C to await carbon analysis. At two of the stations *O. frigida* was also sufficiently abundant to allow the same procedure to take place.

8.2.4 Bongo Net samples

The bongo samples taken at each station were preserved in 4% sea-water formalin for analysis in the UK. Data will be used to determine community structure across the Scotia Sea and compared with similar data collected during the two previous cruises of this seasonal series.

8.2.5 References

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8.3 MOCNESS sampling

Geraint Tarling, David Pond, Peter Ward

8.3.1 Background

The principal aim of sampling with the MOCNESS net during the DISCOVERY 2010 cruises was to obtain mesozooplankton specimens from different parts of the water column in a condition suitable for determination of body condition indices such as carbon, nitrogen, lipids and stable isotopes. The MOCNESS is equipped with 9 nets that open in a sequential manner.

Opening and closing of the nets during a double oblique deployment results in a set of depth discrete samples over the sampled water column. Our working hypothesis is that certain developmental stages may occupy different parts of the water dependent on (1) their body condition (2) the stage in the life-cycle and (3) the time of year. The present cruise, carried out in the austral autumn, is the final of a set of three cruises covering also spring (JR161) and summer (JR177).

FIG 8.3.1 1M^2 MOCNESS NET BEING DEPLOYED

8.3.2 Method

A $1m^2$ MOCNESS (300µm mesh) was deployed at each core sampling station, one deployment during daylight and one during nighttime. Deployments were made to a depth of 1000 m with net 1 opened (wire-out rate of 30 m/min). It was then hauled back in at an average rate of 20 m/min, incrementing regularly through remaining 8 nets. The depth interval were as follows: (Net 2) 1000 to 875 m, (Net 3) 875 to 750 m, (Net 4) 750 to 625 m, (Net5) 625 to 500 m, (Net 6) 500 to 375 m, (Net 7) 375 to 250 m, (Net 8) 250 to 125 m, (Net 9) 125 to 5 m. We aimed to cover the each depth interval over a 10 minute period.

When the nets were aboard, they were sampled by Tarling and Pond to extract small numbers of calanoid copepods (see below). Hicks occasionally took out some euphausiids, mainly *Euphausia triacantha* and Cherel occasionally took out some myctophid fish. Any specimens extracted by Hicks or Cherel were noted on the back of the sample labels.

After sampling, all daytime catches (net 2 to 9) were preserved in 95% Ethanol. All nighttime catches (net 2 to 9) were preserved in Formalin. Net 1 was mostly discarded from day and nighttime catches although some were preserved in 95% Ethanol.

Problems encountered: (1) some twisting during deployment ended up with kinks in the towing bridle. This will need replacing (2) two buckets were lost (3) the stainless steel runner bars became bent and required replacement (4) tow cable damaged

Time (GMT)	Latitude	Longitude	Event Number	Station Name	Water Depth (m)	Relative Wind Speed	Haul Rate	Wire Out	Ship Speed	Net Number	Open Net Depth	Close Net Depth	Volume Filtered	Duration	Comment
06/04/2009 18:39	-52.84045	-36.9901	195	R3_DAY	2153.3	26.7	-16	194	1.75	9	125	5	628	11.6	
06/04/2009 18:31	-52.84152	-36.99659	195	R3_DAY	2250	27.1	-30	378	1.85	8	250	125	487	9.6	
06/04/2009 18:16	-52.84223	-37.00768	195	R3_DAY	2250	23.4	-5	668	2.21	7	375	250	729	14	
06/04/2009 18:08	-52.84258	-37.0158	195	R3_DAY	2179.37	20.8	-21	755	2.17	6	500	375	413	8	
06/04/2009 17:59	-52.84236	-37.02215	195	R3_DAY	2250	24.8	-30	975	1.32	5	625	500	400	9	
06/04/2009 17:46	-52.84188	-37.03099	195	R3_DAY	2187.56	20.8	-20	1343	1.68	4	750	625	660	13	
06/04/2009 17:35	-52.84206	-37.04102	195	R3_DAY	2200.94	26.9	-15	1547	2.72	3	875	750	565	11	
06/04/2009 17:26	-52.84331	-37.04879	195	R3_DAY	2250	30.5	0	1667	2.54	2	1000	875	450	9	
06/04/2009 16:30	-52.85013	-37.09244	195	R3_DAY	2258.92	28.5	27	-4	2.25	1	0	1000	2131	55	
04/04/2009 01:56	-52.81443	-39.95011	183	P3_NITE	3792.01	13.4	-32	295	2.38	9	125	5	583	9.4	
04/04/2009 01:44	-52.81551	-39.96307	183	P3_NITE	3788.65	16	-26	612	2.59	8	250	125	781	12.1	
04/04/2009 01:19	-52.8182	-39.9909	183	P3_NITE	3798	16.9	-21	1189	2.59	6	500	375	726	11.7	
04/04/2009 01:06	-52.81966	-40.00495	183	P3_NITE	3798.22	14	-21	1461	2.57	5	625	500	812	13	
04/04/2009 00:55	-52.82092	-40.01713	183	P3_NITE	3795.2	16.5	-20	1690	2.54	4	750	625	bad	11.7	Flow kicked in after 6.6 minutes - read 359 at end of net.
04/04/2009 00:43	-52.82189	-40.02985	183	P3_NITE	3789.31	15	-20	1931	2.39	3	875	750	bad	11.2	No flow
04/04/2009 00:32	-52.82207	-40.04091	183	P3_NITE	3797.77	13.9	20	2046	2.29	2	1000	875	bad	11.6	Flowmeter not working
03/04/2009 23:21	-52.81025	-40.10642	183	P3_NITE	3797.08	12.8	20	23	2.12	1	0	1000	2530	73	Comms stopped once at 150m wd
02/04/2009 19:22	-52.87687	-40.03131	167	P3_DAY	3000.7	25.8	-25	250	2.1	9	125	5	571	9.6	
02/04/2009 19:11	-52.87078	-40.0369	167	P3_DAY	3001.11	27.5	-25	545	2.09	8	250	125	658	11	
02/04/2009 18:58	-52.86353	-40.04413	167	P3_DAY	4501.68	28.5	-15	794	2.76	7	375	250	726	12.6	
02/04/2009 18:54	-52.86067	-40.04692	167	P3_DAY	4501.96	29.5	-25	890	1.77	6	500	375	314	4	
02/04/2009 18:40	-52.8552	-40.05372	167	P3_DAY	4501.96	29.1	-25	1207	2.07	5	625	500	720	13	Full flow for this net
02/04/2009 18:31	-52.85087	-40.05837	167	P3_DAY	4501.96	28	-25	1428	1.95	4	750	625	bad	9	Flow resumed part way thru
02/04/2009 18:20	-52.84565	-40.06402	167	P3_DAY	4501.96	27.4	-25	1712	2.06	3	875	750	bad	11	
02/04/2009 18:06	-52.84005	-40.0714	167	P3_DAY	4501.96	26.9	0	1991	2.15	2	1000	875	bad	14	
02/04/2009 17:04	-52.81215	-40.11167	167	P3_DAY	3981.73	28.3	30	1	2.35	1	0	1000	bad	61	bad flow some comms probs at start
31/03/2009 15:27	-55.34609	-41.25082	152	P2_DAY	3001.73	27.4	-25	264	2.07	9	125	5	758	10.4	
31/03/2009 15:18	-55.34018	-41.25802	152	P2_DAY	3002.18	24.7	-26	482	2.41	8	250	125	bad	11	
31/03/2009 15:16	-55.33898	-41.25946	152	P2_DAY	3002.18	24.5	-26	528	2.15	7	375	250	520	9	
31/03/2009 14:59	-55.32798	-41.27288	152	P2_DAY	3002.18	25	-31	1047	1.52	6	500	375	bad	8.8	
31/03/2009 14:50	-55.32273	-41.27869	152	P2_DAY	3002.18	29.9	-30	1310	2.32	5	625	500	501	8	
31/03/2009 14:43	-55.31848	-41.28271	152	P2_DAY	3002.18	26.2	-30	1497	2.13	4	750	625	bad	7	
31/03/2009 14:35	-55.3134	-41.28754	152	P2_DAY	3002.18	30.9	-30	1741	2	3	875	750	bad	7	
31/03/2009 14:18	-55.30382	-41.29585	152	P2_DAY	3002.18	24.8	0	2242	2.21	2	1000	875	bad	18	
31/03/2009 13:02	-55.26149	-41.35323	152	P2_DAY	3002.18	29.3	30	15	2.73	1	0	1000	2484	75	
31/03/2009 03:33	-55.2116	-41.439	146	P2_NITE	3489.36	15.3	-30	250	2.03	9	125	5	550	9.7	
31/03/2009 03:22	-55.21604	-41.42998	146	P2_NITE	3489.36	15.2	-31	573	2.53	8	250	125	697	11.5	
31/03/2009 03:09	-55.22165	-41.41982	146	P2_NITE	3476.71	16.3	-20	892	2.26	7	375	250	660	11.4	
31/03/2009 02:56	-55.22716	-41.40962	146	P2_NITE	3002.17	14.1	-21	1144	2.11	6	500	375	744	12.5	
31/03/2009 02:46	-55.23188	-41.40088	146	P2_NITE	3498.89	16.3	-30	1375	2.63	5	625	500	547	9.6	
31/03/2009 02:39	-55.23459	-41.39594	146	P2_NITE	3508.2	16.1	-30	1565	1.03	4	750	625	436	7.5	
31/03/2009 02:26	-55.23964	-41.38637	146	P2_NITE	3541.34	18	-20	1909	2.16	3	875	750	747	13	
31/03/2009 02:14	-55.24474	-41.37774	146	P2_NITE	3564.56	14.3	0	2145	1.05	2	1000	875	719	12	
31/03/2009 00:53	-55.27885	-41.32012	146	P2_NITE	4000	18.3	13	4	2.82	1	0	1000	3781	81	
27/03/2009 15:21	-56.75022	-42.35773	121	R2_DAY	4000	26.3	-30	304	1.46	9	125	0	557	11	
27/03/2009 15:11	-56.75138	-42.3461	121	R2_DAY	4000	20.4	-29	604	1.17	8	250	125	599	10	
27/03/2009 15:02	-56.75225	-42.33526	121	R2_DAY	4000	25.3	-29	877	1.36	7	375	250	532	9	
27/03/2009 14:54	-56.75308	-42.32616	121	R2_DAY	4000	25	-30	1110	1.37	6	500	375	447	8	
27/03/2009 14:44	-56.75429	-42.31579	121	R2_DAY	4000	24.3	-30	1412	1.37	5	625	500	568	10	
27/03/2009 14:35	-56.75512	-42.30637	121	R2_DAY	4000	26.2	-31	1671	1.43	4	750	625	491	8	
27/03/2009 14:25	-56.75634	-42.2961	121	R2_DAY	4000	24.3	-31	1964	1.4	3	875	750	560	10	
27/03/2009 14:17	-56.75745	-42.28796	121	R2_DAY	4000	27.1	0	2182	1.73	2	1000	875	456	8	
27/03/2009 13:02	-56.76625	-42.2137	121	R2_DAY	4000	33.7	30	25	-0.11	1	0	1000	3601	76	Lost comms at 900 m. Pressed OK and it went through re
26/03/2009 03:12	-56.76001	-42.37869	108	R2_NITE	4081.31	12.5	-21	231	0.85	9	125	5	627	10.7	
26/03/2009 02:56	-56.76115	-42.36079	108	R2_NITE	4081.31	12	-22	564	0.72	8	250	125	1001	16.8	
26/03/2009 02:45	-56.76207	-42.34823	108	R2_NITE	4081.31	11.2	-21	789	2.34	7	375	250	590	10.9	
26/03/2009 02:32	-56.76336	-42.33417	108	R2_NITE	4081.31	10.5	-22	1054	2.56	6	500	375	651	12.2	
26/03/2009 02:24	-56.76417	-42.32442	108	R2_NITE	4081.31	14.4	-21	1236	2.29	5	625	500	487	9	
26/03/2009 02:15	-56.76484	-42.31446	108	R2_NITE	4081.31	14.1	-21	1419	2.21	4	750	625	423	8.2	
26/03/2009 02:06	-56.76522	-42.30561	108	R2_NITE	4081.31	15.6	-20	1601	1.66	3	875	750	490	9	
26/03/2009 01:55	-56.76528	-42.296	108	R2_NITE	4081.31	11.7	0	1817	1.04	2	1000	875	545	10.5	
26/03/2009 00:49	-56.76512	-42.2283	108	R2_NITE	4081.31	7.6	10	3	2.74	1	0	1000	2856	66	
24/03/2009 17:34	-58.03842	-43.11978	94	C4_DAY	2955.26	29.3	-21	555	1.87	8	250	125	803	14	
24/03/2009 17:21	-58.03852	-43.10189	94	C4_DAY	3001.76	26.1	-21	825	1.86	7	375	250	755	13	
24/03/2009 17:06	-58.03868	-43.08147	94	C4_DAY	3001.76	25.1	-19	1117	2.15	6	500	375	836	14	
24/03/2009 16:54	-58.03848	-43.0644	94	C4_DAY	3001.76	22.3	-20	1365	1.61	5	650	500	692	13	
24/03/2009 16:42	-58.03881	-43.04805	94	C3_DAY	3001.76	26.8	-20	1611	1.69	4	750	625	702	12	
24/03/2009 16:29	-58.03903	-43.0315	94	C4_DAY	3001.76	25.9	-22	1872	1.68	3	875	750	725	13	
24/03/2009 16:19	-58.0389	-43.01821	94	C4_DAY	3001.76	22.1	-19	2081	1.92	2	1000	875	597	10	
24/03/2009 15:07	-58.03705	-42.92555	94	C4_DAY	3001.54	26	25	16	1.42	1	0	1000	3332	70	18.9V
24/03/2009 03:51	-58.0121	-43.1467	89	C4_NITE	2943.3	10.3	-31	567	2.17	8	259	125	505	8.3	
24/03/2009 03:42	-58.01414	-43.13571	89	C4_NITE	2931.53	11.3	-30	835	2.33	7	375	250	521	8.8	
24/03/2009 03:32	-58.01654	-43.12289	89	C4_NITE	2926.9	11.4	-30	1136	2.15	6	500	375	619	10.3	
24/03/2009 03:17	-58.01947	-43.10376	89	C4_NITE	2918.46	9.6	-20	1478	2.19	5	625	500	955	15.4	

24/03/2009 03:02	-58.02094	-43.08211	89	C4_NITE	2899.18	8.9	-20	1791	2.4	4	750	625	897	14.4	
24/03/2009 02:50	-58.02214	-43.06618	89	C4_NITE	2895.19	9.3	-20	2021	2.27	3	875	750	726	12.1	
24/03/2009 02:39	-58.02355	-43.04981	89	C4_NITE	2884.87	8.2	27	2202	2.41	2	1000	875	598	10	
24/03/2009 01:20	-58.0327	-42.94849	89	C4_NITE	2817.1	13.4	15	1	2.54	1	0	1000	3957	79.6	
22/03/2009 03:08	-59.58462	-44.01637	75	C3_nite	3002.48	12.2	-29	366	0.87	9	125	5	719	10.46	
22/03/2009 02:57	-59.59506	-44.02053	75	C3_nite	3003.43	11.2	-31	696	1.44	8	250	125	732	10.36	
22/03/2009 02:45	-59.6073	-44.02568	75	C3_nite	3001.27	13.2	-21	1059	1.31	7	375	250	758	12.3	
22/03/2009 02:30	-59.58313	-44.01574	75	C3_nite		13.1	-29	320	1.38	6	500	375	956.6	15.21	Slowed down again!
22/03/2009 02:22	-59.62933	-44.03479	75	C3_nite	3001.32	10.7	-21	1469	1.03	5	625	500	471.8	8.02	Net slowing down
22/03/2009 02:18	-59.63341	-44.03619	75	C3_nite	3002.28	11.6	-22	1549	2.55	4	750	625	212	3.51	Very fast still - hauling in at 15!
22/03/2009 02:14	-59.63736	-44.03779	75	C3_nite	0	11	-29	1658	0.65	3	875	750 ?		4.03	Now coming up far toek60
22/03/2009 01:48	-59.65256	-44.04394	75	C3_nite	3001.86	9	0	2214	-2.02	2	1000	875	1487	25.5	Difficult currents - MOCNESS coming up very slowly
22/03/2009 00:29	-59.71431	-44.03656	75	C3_nite	3002.39	10.4	17	-16	2.41	1	0	1000	3632	79	
21/03/2009 20:17	-59.72475	-44.18956	72	C3_DAY	4502.21					9	125	0	765	13	
21/03/2009 20:07	-59.72475	-44.18956	72	C3_DAY	4502.21					8	250	125	600.8	10	
21/03/2009 19:54	-59.72475	-44.18956	72	C3_DAY	4502.21	6.1	-20	737	2.39	7	375	250	704	13	
21/03/2009 19:42	-59.72173	-44.1776	72	C3_DAY	4501.99	4.8	-20	995	2.33	6	500	375	717	13	
21/03/2009 19:29	-59.71849	-44.16523	72	C3_DAY	4165.18	4.8	-20	1263	2.16	6	625	500	723	13	
21/03/2009 19:17	-59.71532	-44.15346	72	C3_DAY	4500	3.9	-20	1513	2.1	4	750	625	689	12	
21/03/2009 19:04	-59.71198	-44.14158	72	C3_DAY	4502.6	4.9	-20	1764	2.1	3	875	750	684	12	
21/03/2009 18:52	-59.70873	-44.13068	72	C3_DAY	4502.16	3.5	0	1986	2.15	2	1000	875	614	12	
21/03/2009 17:44	-59.68896	-44.06113	72	C3_DAY	4500	8.8	28	20	1.48	1	0	1000	3150	66	1970 m cable out
18/03/2009 01:37	-60.1377	-44.34489	35	C2nite	4550.97	22.3	-31	269	1.25	9	125	5	526	9	
18/03/2009 01:27	-60.14453	-44.35084	35	C2nite	4501.34	19.9	-31	569	-0.01	8	250	125	584	9.7	
18/03/2009 01:18	-60.15093	-44.35625	35	C2nite	4501	23.6	-31	849	0.08	7	375	250	519	9.1	
18/03/2009 01:08	-60.15716	-44.36183	35	C2nite	4501	24.8	-31	1147	0.64	6	500	375	567	10	
18/03/2009 01:00	-60.16236	-44.36661	35	C2nite	4501.75	22.2	-30	1387	0.35	5	625	500	465	8.3	
18/03/2009 00:59	-60.16283	-44.36704	35	C2nite	4502	19.9	-30	1409	0.66	4	625	500	498	9	no feedback
18/03/2009 00:50	-60.16888	-44.37277	35	C2nite	4502	20.3	-31	1689	-0.34	3	875	750	581	10.7	No feedback still - hope that the feedback is taped back!
18/03/2009 00:39	-60.1758	-44.37927	35	C2nite	4502	22.1	-31	2022	-0.32	2	1000	875	407	7.9	no feedback
17/03/2009 23:15	-60.22919	-44.4252	35	C2nite	5459.25	22.9	21	22	2.51	1	0	1000	3716	76	No feedback on increment of net
17/03/2009 19:44	-60.22965	-44.42936	32	C2day	4502.23	20.9	-31	232	1.58	9	125	4	388	7	
17/03/2009 19:36	-60.23383	-44.42918	32	C2day	4501.64	18.4	-30	462	2.26	8	250	125	434	8.2	
17/03/2009 19:29	-60.23776	-44.42888	32	C2day	4501	21.7	-30	662	2.18	7	375	250	382	7.2	
17/03/2009 19:21	-60.24216	-44.42926	32	C2day	4501.93	20.6	-31	900	1.84	6	500	375	400	7.5	
17/03/2009 19:14	-60.24609	-44.42914	32	C2day	4500.86	21	-31	1118	2.05	5	625	500	355	7	
17/03/2009 19:08	-60.24951	-44.42879	32	C2day	4501.87	20.4	-31	1301	1.83	4	750	625	304	6	
17/03/2009 19:02	-60.25292	-44.42866	32	C2day	4500	20.4	-29	1488	2.22	3	875	750	305	7	
17/03/2009 18:53	-60.25763	-44.42857	32	C2day	4500	20.5	0	1642	1.15	2	1000	875	442	9	
17/03/2009 17:57	-60.2858	-44.42501	32	C2day	4500	20.8	20	-1	1.81	1	0	1000	1980	55	1642 m cable out
16/03/2009 20:21	-60.43108	-48.2977	26	R1_day	1502.27	22.5	-20	178	1.88	9	125	5	470	8.8	
16/03/2009 20:08	-60.43642	-48.28937	26	R1_day	1515.26	26.1	-19	430	1.63	8	250	125	670	12	
16/03/2009 19:57	-60.44148	-48.28173	26	R1_day	1515.26	23.9	-21	663	1.75	7	375	250	648	11.6	
16/03/2009 19:45	-60.44647	-48.27331	26	R1_day	1489	26.3	-19	899	1.97	6	500	375	649	11.7	
16/03/2009 19:34	-60.45126	-48.26492	26	R1_day	1475	21.7	-20	1124	1.9	5	625	500	608	11.4	
16/03/2009 19:21	-60.45683	-48.25565	26	R1_day	1400	23.7	-20	1385	1.76	4	750	625	683	12.4	
16/03/2009 19:07	-60.46302	-48.24643	26	R1_day	1458.91	24.6	-20	1672	2.26	3	875	750	771	15	
16/03/2009 18:56	-60.46802	-48.23867	26	R1_day	1458.91	25	0	1852	2.12	2	1000	875	600.1	11	
16/03/2009 17:51	-60.49608	-48.19476	26	R1_day	1458.91	23.3	29	6	0.78	1	0	1000	2762	64	
15/03/2009 01:12	-60.55116	-48.187	12	R1_nite	1913.46	35.7	-21	12	0.99	9	125	7	494.8	9.7	
15/03/2009 01:02	-60.5464	-48.18658	12	R1_nite	1903.34	33.2	-20	207	0.9	8	250	125	503.4	9.6	
15/03/2009 00:53	-60.54157	-48.18551	12	R1_nite	1880.32	27.3	-21	404	0.7	7	375	250	687.8	12.7	
15/03/2009 00:40	-60.53531	-48.185	12	R1_nite	1717.33	31.7	-20	669	1.22	6	500	375	580.8	10.5	
15/03/2009 00:29	-60.52974	-48.18362	12	R1_nite	1475.38	30.3	-20	883	0.73	5	625	500	882.9	15.9	
15/03/2009 00:13	-60.52239	-48.18217	12	R1_nite	1432.98	34.1	-20	1212	0.63	4	750	625	807.6	14.5	Wind picking up and up!
14/03/2009 23:58	-60.51475	-48.18099	12	R1_nite	1421.35	33.3	-22	1520	0.86	3	875	750	557.4	10.1	
14/03/2009 23:49	-60.51	-48.17967	12	R1_nite	1417.53	26.6	-21	1708	0.26	2	1000	875	419.3	8.2	
14/03/2009 19:36	-60.49868	-48.19314	12	R1_nite	1417.54	1.2	0	1371	0.52	1	0	1000	2969	64	MOCNESS deployed

Table 8.3.1 : MOCNESS deployments, showing a record for each net during each deployment

8.3.3 Samples collected

<u>Condition factors of *Calanoides acutus*</u>

Following the protocol of JR177, individuals of stage CV *Calanoides acutus* were picked from all depth-discrete MOCNESS and placed in individual tin-foil capsules.

It was aimed to obtain between 10 and 12 individuals from each depth-discrete net. This was not achieved for some nets either because of a lack of individuals or because of the dominance of salps which made sorting difficult and left the copepods in poor condition. More than 12 individuals were taken from some nets to use up spare capsules.

The capsules were placed in 96 well plates (one capsule per well) and placed immediately within -80oC freezer. The plates were not dried on board as in JR177 but will be dried back at Cambridge prior to analysis.

[Nb. Unlike JR177, none of the capsules was pre-weighed given that this is not necessary to obtain carbon and nitrogen weights]

MOCNESS depth interval (m)	Net number	R1 (E26)	C2 (E32)	C3 (E72)	C4 (E94)	R2 (E121)	P2 (152)	P3 (E167)	R3 (E195)
1000-875	2	10	10	10	1	5	12	12	15
875-750	3	10	10	10	0	12	10	12	15
750-625	4	10	10	10	6	0	11	12	15
625-500	5	10	10	8	12	10	12	12	15
500-375	6	5	10	10	8	10	11	14	15
375-250	7	10	10	10	12	9	13	12	15
250-125	8	10	10	10	0	2	1	10	14
125-0	9	10	9	10	0	0	3	11	18

Table 8.3.2: The number of *Calanoides acutus* CV individuals taken from each depth-discrete MOCNESS net

Additional samples of C. acutus, R. gigas, C. simillliums and C. propinquus were frozen in solvent (chloroform:methanol) and will be analysed individually for their total lipid, lipid class, fatty acid and fatty alcohol signatures. Prosome length of each copepod was also determined.

Table 8.3.3 Samples of C. acutus, R. gigas, C. simillium s and C. propinquus

#	Station	Date	Event	Net	Net Number	Deth range	Stage	Number	Microscope units	Prosome (mm)	notes
1	Test	13/03/2009	E2	Bongo		0-400	F	1	47	3.92	
2	Test	13/03/2009	E2	Bongo		0-400	F	2	51	4.25	
3	Test	13/03/2009	E2	Bongo		0-400	V	3	43	3.58	
4	Test	13/03/2009	E2	Bongo		0-400	V	4	43	3.58	
5	Test	13/03/2009	E2	Bongo		0-400	V	5	3	0.25	
6	Test	13/03/2009	E2	Bongo		0-400	VI	6	32	2.67	
7	Test	13/03/2009	E2	Bongo		0-400	V	7	42	3.50	
8	Test	13/03/2009	E2	Bongo		0-400	VI	8	30	2.50	
9	Test	13/03/2009	E2	Bongo		0-400	V	9	42	3.50	
10	Test	13/03/2009	E2	Bongo		0-400	V	10	42	3.50	
11	R1	14/03/2009	E12	Mocness	2	875-1000	F	1	56	4.67	
12	R1	14/03/2009	E12	Mocness	2	875-1000	F	2	55	4.58	
13	R1	14/03/2009	E12	Mocness	2	875-1000	F	3	56	4.67	
14	R1	14/03/2009	E12	Mocness	2	875-1000	F	4	55	4.58	
15	R1	14/03/2009	E12	Mocness	2	875-1000	F	5	49	4.08	
16	R1	14/03/2009	E12	Mocness	2	875-1000	F	6	55	4.58	
17	R1	14/03/2009	E12	Mocness	2	875-1000	F	7	51	4.25	
18	R1	14/03/2009	E12	Mocness	2	875-1000	F	8	55	4.58	
19	R1	14/03/2009	E12	Mocness	2	875-1000	F	9	53	4.42	
20	R1	14/03/2009	E12	Mocness	2	875-1000	F	10	53	4.42	
21	R1	14/03/2009	E12	Mocness	2	875-1000	V	1	46	3.83	
22	R1	14/03/2009	E12	Mocness	2	875-1000	V	2	44	3.67	
23	R1	14/03/2009	E12	Mocness	2	875-1000	V	3	44	3.67	
24	R1	14/03/2009	E12	Mocness	2	875-1000	V	4	46	3.83	
25	R1	14/03/2009	E12	Mocness	2	875-1000	V	5	44	3.67	
26	R1	14/03/2009	E12	Mocness	2	875-1000	V	6	49	4.08	
27	R1	14/03/2009	E12	Mocness	2	875-1000	V	7	47	3.92	
28	R1	14/03/2009	E12	Mocness	2	875-1000	V	8	45	3.75	
29	R1	14/03/2009	E12	Mocness	2	875-1000	V	9	47	3.92	
30	R1	14/03/2009	E12	Mocness	2	875-1000	V	10	45	3.75	
31	R1	14/03/2009	E12	Mocness	4	625-750	F	1	56	4.67	
32	R1	14/03/2009	E12	Mocness	4	625-750	F	2	56	4.67	
33	R1	14/03/2009	E12	Mocness	4	625-750	F	3	57	4.75	
34	R1	14/03/2009	E12	Mocness	4	625-750	F	4	55	4.58	
35	R1	14/03/2009	E12	Mocness	4	625-750	F	5	55	4.58	
36	R1	14/03/2009	E12	Mocness	4	625-750	F	6	5	0.42	
37	R1	14/03/2009	E12	Mocness	4	625-750	F	7	55	4.58	
38	R1	14/03/2009	E12	Mocness	4	625-750	F	8	56	4.67	
39	R1	14/03/2009	E12	Mocness	4	625-750	F	9	53	4.42	
40	R1	14/03/2009	E12	Mocness	4	625-750	F	10	55	4.58	
41	R1	14/03/2009	E12	Mocness	4	625-750	V	1	43	3.58	
42	R1	14/03/2009	E12	Mocness	4	625-750	V	2	44	3.67	
43	R1	14/03/2009	E12	Mocness	4	625-750	V	3	43	3.58	
44	R1	14/03/2009	E12	Mocness	4	625-750	V	4	44	3.67	
45	R1	14/03/2009	E12	Mocness	4	625-750	V	5	46	3.83	
46	R1	14/03/2009	E12	Mocness	4	625-750	V	6	45	3.75	

47	R1	14/03/2009	E12	Mocness	4	625-750	V	7	45	3.75
48	R1	14/03/2009	E12	Mocness	4	625-750	V	8	44	3.67
49	R1	14/03/2009	E12	Mocness	4	625-750	V	9	47	3.92
50	R1	14/03/2009	E12	Mocness	4	625-750	V	10	43	3.58
51	R1	14/03/2009	E12	Mocness	5	500-625	F	1	53	4.42
52	R1	14/03/2009	E12	Mocness	5	500-625	F	2	54	4.50
53	R1	14/03/2009	E12	Mocness	5	500-625	F	3	5	0.42
54	R1	14/03/2009	E12	Mocness	5	500-625	F	4	57	4.75
55	R1	14/03/2009	E12	Mocness	5	500-625	F	5	54	4.50
56	R1	14/03/2009	E12	Mocness	5	500-625	F	6	57	4.75
57	R1	14/03/2009	E12	Mocness	5	500-625	F	7	54	4.50
58	R1	14/03/2009	E12	Mocness	5	500-625	F	8	56	4.67
59	R1	14/03/2009	E12	Mocness	5	500-625	F	9	57	4.75
60	R1	14/03/2009	E12	Mocness	5	500-625	F	10	57	4.75
61	R1	14/03/2009	E12	Mocness	5	500-625	V	1	43	3.58
62	R1	14/03/2009	E12	Mocness	5	500-625	V	2	46	3.83
63	R1	14/03/2009	E12	Mocness	5	500-625	V	3	41	3.42
64	R1	14/03/2009	E12	Mocness	5	500-625	V	4	47	3.92
65	R1	14/03/2009	E12	Mocness	5	500-625	V	5	45	3.75
66	R1	14/03/2009	E12	Mocness	5	500-625	V	6	46	3.83
67	R1	14/03/2009	E12	Mocness	5	500-625	V	7	45	3.75
68	R1	14/03/2009	E12	Mocness	5	500-625	V	8	45	3.75
69	R1	14/03/2009	E12	Mocness	5	500-625	V	9	45	3.75
70	R1	14/03/2009	E12	Mocness	5	500-625	V	10	47	3.92
71	R1	14/03/2009	E12	Mocness	8	125-250	F	1	49	4.08
72	R1	14/03/2009	E12	Mocness	8	125-250	F	2	53	4.42
73	R1	14/03/2009	E12	Mocness	8	125-250	F	3	53	4.42
74	R1	14/03/2009	E12	Mocness	8	125-250	F	4	59	4.92
75	R1	14/03/2009	E12	Mocness	8	125-250	F	5	55	4.58
76	R1	14/03/2009	E12	Mocness	8	125-250	F	6	53	4.42
77	R1	14/03/2009	E12	Mocness	8	125-250	F	7	55	4.58
78	R1	14/03/2009	E12	Mocness	8	125-250	F	8	57	4.75
79	R1	14/03/2009	E12	Mocness	8	125-250	F	9	53	4.42
80	R1	14/03/2009	E12	Mocness	8	125-250	F	10	52	4.33
81	R1	14/03/2009	E12	Mocness	8	125-250	V	1	45	3.75
82	R1	14/03/2009	E12	Mocness	8	125-250	V	2	45	3.75
83	R1	14/03/2009	E12	Mocness	8	125-250	V	3	45	3.75
84	R1	14/03/2009	E12	Mocness	8	125-250	V	4	45	3.75
85	R1	14/03/2009	E12	Mocness	8	125-250	V	5	46	3.83
86	R1	14/03/2009	E12	Mocness	8	125-250	V	6	47	3.92
87	R1	14/03/2009	E12	Mocness	8	125-250	V	7	42	3.50
88	R1	14/03/2009	E12	Mocness	8	125-250	V	8	44	3.67
89	R1	14/03/2009	E12	Mocness	8	125-250	V	9	42	3.50
90	R1	14/03/2009	E12	Mocness	8	125-250	V	10	46	3.83
91	R1	14/03/2009	E12	Mocness	9	0-125	F	1	55	4.58
92	R1	14/03/2009	E12	Mocness	9	0-125	F	2	52	4.33
93	R1	14/03/2009	E12	Mocness	9	0-125	F	3	53	4.42
94	R1	14/03/2009	E12	Mocness	9	0-125	V	1	43	3.58

95	R1	14/03/2009	E12	Mocness	9	0-125	V	2	43	3.58	
96	R1	14/03/2009	E12	Mocness	9	0-125	V	3	4	0.33	
97	R1	14/03/2009	E12	Mocness	9	0-125	V	4	46	3.83	
98	R1	14/03/2009	E12	Mocness	9	0-125	V	5	44	3.67	
99	R1	16/03/2009	E23	Mocness	Bongo	0-400	F	1	52	4.33	
100	R1	16/03/2009	E23	Mocness	Bongo	0-400	F	2	53	4.42	
101	R1	16/03/2009	E23	Mocness	Bongo	0-400	F	3	51	4.25	
102	R1	16/03/2009	E23	Mocness	Bongo	0-400	F	4	54	4.50	
103	R1	16/03/2009	E23	Mocness	Bongo	0-400	F	5	52	4.33	
104	R1	16/03/2009	E23	Mocness	Bongo	0-400	V	1	45	3.75	
105	R1	16/03/2009	E23	Mocness	Bongo	0-400	V	2	46	3.83	
106	R1	16/03/2009	E23	Mocness	Bongo	0-400	V	3	45	3.75	
107	R1	16/03/2009	E23	Mocness	Bongo	0-400	V	4	41	3.42	
108	R1	16/03/2009	E23	Mocness	Bongo	0-400	V	5	46	3.83	
109	R1	16/03/2009	E26	Mocness	6	375-500	F	1	51	4.25	
110	R1	16/03/2009	E26	Mocness	6	375-500	F	2	55	4.58	
111	R1	16/03/2009	E26	Mocness	6	375-500	F	3	55	4.58	
112	R1	16/03/2009	E26	Mocness	6	375-500	F	4	55	4.58	
113	R1	16/03/2009	E26	Mocness	6	375-500	F	5	53	4.42	
114	R1	16/03/2009	E26	Mocness	6	375-500	F	6	54	4.50	
115	R1	16/03/2009	E26	Mocness	6	375-500	F	7	52	4.33	
116	R1	16/03/2009	E26	Mocness	6	375-500	F	8	55	4.58	
117	R1	16/03/2009	E26	Mocness	6	375-500	F	9	57	4.75	
118	R1	16/03/2009	E26	Mocness	6	375-500	F	10	55	4.58	
119	R1	16/03/2009	E26	Mocness	6	375-500	V	1	41	3.42	
120	R1	16/03/2009	E26	Mocness	6	375-500	V	2	45	3.75	
121	R1	16/03/2009	E26	Mocness	6	375-500	V	3	47	3.92	
122	R1	16/03/2009	E26	Mocness	6	375-500	V	4	42	3.50	
123	R1	16/03/2009	E26	Mocness	6	375-500	V	5	45	3.75	
124	R1	16/03/2009	E26	Mocness	7	250-375	F	1	56	4.67	
125	R1	16/03/2009	E26	Mocness	7	250-375	F	2	50	4.17	
126	R1	16/03/2009	E26	Mocness	7	250-375	F	3	54	4.50	
127	R1	16/03/2009	E26	Mocness	7	250-375	F	4	56	4.67	
128	R1	16/03/2009	E26	Mocness	7	250-375	F	5	55	4.58	V ?
129	R1	16/03/2009	E26	Mocness	7	250-375	F	6	47	3.92	
130	R1	16/03/2009	E26	Mocness	7	250-375	F	7	55	4.58	ovary 2/3
131	R1	16/03/2009	E26	Mocness	7	250-375	F	8	52	4.33	
132	R1	16/03/2009	E26	Mocness	7	250-375	V	1	45	3.75	
133	R1	16/03/2009	E26	Mocness	7	250-375	V	2	47	3.92	
134	R1	16/03/2009	E26	Mocness	7	250-375	V	3	44	3.67	
135	R1	16/03/2009	E26	Mocness	7	250-375	V	4	44	3.67	
136	R1	16/03/2009	E26	Mocness	7	250-375	V	5	44	3.67	
137	R1	16/03/2009	E26	Mocness	7	250-375	V	6	48	4.00	
138	R1	16/03/2009	E26	Mocness	7	250-375	V	7	44	3.67	
139	R1	16/03/2009	E26	Mocness	7	250-375	V	8	45	3.75	
140	R1	16/03/2009	E26	Mocness	7	250-375	V	9	45	3.75	
141	R1	16/03/2009	E26	Mocness	7	250-375	V	10	42	3.50	
142	C2	17/03/2009	E32	Mocness	3	750-875	F	1	54	4.50	

143	C2	17/03/2009	E32	Mocness	3	750-875	F	2	52	4.33	
144	C2	17/03/2009	E32	Mocness	3	750-875	F	3	55	4.58	
145	C2	17/03/2009	E32	Mocness	3	750-875	F	4	53	4.42	
146	C2	17/03/2009	E32	Mocness	3	750-875	F	5	55	4.58	
147	C2	17/03/2009	E32	Mocness	3	750-875	F	6	57	4.75	
148	C2	17/03/2009	E32	Mocness	3	750-875	F	7	53	4.42	
149	C2	17/03/2009	E32	Mocness	3	750-875	F	8	55	4.58	
150	C2	17/03/2009	E32	Mocness	3	750-875	F	9	52	4.33	ovary
151	C2	17/03/2009	E32	Mocness	3	750-875	F	10	56	4.67	
152	C2	17/03/2009	E32	Mocness	3	750-875	V	1	47	3.92	
153	C2	17/03/2009	E32	Mocness	3	750-875	V	2	47	3.92	
154	C2	17/03/2009	E32	Mocness	3	750-875	V	3	45	3.75	
155	C2	17/03/2009	E32	Mocness	3	750-875	V	4	47	3.92	
156	C2	17/03/2009	E32	Mocness	3	750-875	V	5	45	3.75	
157	C2	17/03/2009	E32	Mocness	3	750-875	V	6	45	3.75	
158	C2	17/03/2009	E32	Mocness	3	750-875	V	7	45	3.75	
159	C2	17/03/2009	E32	Mocness	3	750-875	V	8	46	3.83	
160	C2	17/03/2009	E32	Mocness	3	750-875	V	9	45	3.75	
161	C2	17/03/2009	E32	Mocness	3	750-875	V	10	47	3.92	
162	C2	17/03/2009	E32	Mocness	6	375-500	F	1	55	4.58	
163	C2	17/03/2009	E32	Mocness	6	375-500	F	2	53	4.42	
164	C2	17/03/2009	E32	Mocness	6	375-500	F	3	52	4.33	
165	C2	17/03/2009	E32	Mocness	6	375-500	F	4	52	4.33	
166	C2	17/03/2009	E32	Mocness	6	375-500	F	5	51	4.25	
167	C2	17/03/2009	E32	Mocness	6	375-500	F	6	51	4.25	
168	C2	17/03/2009	E32	Mocness	6	375-500	F	7	52	4.33	
169	C2	17/03/2009	E32	Mocness	6	375-500	V	1	45	3.75	
170	C2	17/03/2009	E32	Mocness	6	375-500	V	2	47	3.92	
171	C2	17/03/2009	E32	Mocness	6	375-500	V	3	47	3.92	
172	C2	17/03/2009	E32	Mocness	6	375-500	V	4	47	3.92	
173	C2	17/03/2009	E32	Mocness	6	375-500	V	5	46	3.83	
174	C2	17/03/2009	E32	Mocness	6	375-500	V	6	45	3.75	
175	C2	17/03/2009	E32	Mocness	6	375-500	V	7	46	3.83	
176	C2	17/03/2009	E32	Mocness	6	375-500	V	8	46	3.83	
177	C2	17/03/2009	E32	Mocness	6	375-500	V	9	45	3.75	
178	C2	17/03/2009	E32	Mocness	6	375-500	V	10	46	3.83	
179	C2	17/03/2009	E32	Mocness	8	125-250	F	1	52	4.33	
180	C2	17/03/2009	E32	Mocness	8	125-250	F	2	52	4.33	
181	C2	17/03/2009	E32	Mocness	8	125-250	F	3	48	4.00	
182	C2	17/03/2009	E32	Mocness	8	125-250	V	1	45	3.75	
183	C2	17/03/2009	E32	Mocness	8	125-250	V	2	47	3.92	
184	C2	17/03/2009	E32	Mocness	8	125-250	V	3	46	3.83	
185	C2	17/03/2009	E32	Mocness	8	125-250	V	4	44	3.67	
186	C2	17/03/2009	E32	Mocness	8	125-250	V	5	45	3.75	
187	C2	17/03/2009	E32	Mocness	8	125-250	V	6	43	3.58	
188	C2	17/03/2009	E32	Mocness	8	125-250	V	7	44	3.67	
189	C2	17/03/2009	E32	Mocness	8	125-250	V	8	44	3.67	
190	C2	17/03/2009	E32	Mocness	8	125-250	V	9	45	3.75	

191	C2	17/03/2009	E32	Mocness	8	125-250	V	10	45	3.75	
192	C2	17/03/2009	E32	Mocness	8	125-250	VI	1	34	2.83	
193	C2	17/03/2009	E32	Mocness	8	125-250	VI	2	35	2.92	
194	C2	17/03/2009	E32	Mocness	8	125-250	VI	3	35	2.92	
195	C2	17/03/2009	E32	Mocness	8	125-250	VI	4	32	2.67	
196	C2	17/03/2009	E32	Mocness	8	125-250	VI	5	32	2.67	
197	C2	17/03/2009	E32	Mocness	2	875-1000	V	1	44	3.67	
198	C2	17/03/2009	E32	Mocness	4	625-750	F	1	55	4.58	
199	C2	17/03/2009	E32	Mocness	4	625-750	F	2	56	4.67	
200	C2	17/03/2009	E32	Mocness	4	625-750	F	3	53	4.42	
201	C2	17/03/2009	E32	Mocness	4	625-750	F	4	55	4.58	
202	C2	17/03/2009	E32	Mocness	4	625-750	F	5	54	4.50	
203	C2	17/03/2009	E32	Mocness	4	625-750	F	6	57	4.75	
204	C2	17/03/2009	E32	Mocness	4	625-750	F	7	56	4.67	
205	C2	17/03/2009	E32	Mocness	4	625-750	F	8	56	4.67	
206	C2	17/03/2009	E32	Mocness	4	625-750	F	9	55	4.58	
207	C2	17/03/2009	E32	Mocness	4	625-750	V	1	50	4.17	Large V's
208	C2	17/03/2009	E32	Mocness	4	625-750	V	2	50	4.17	Large V's
209	C2	17/03/2009	E32	Mocness	4	625-750	V	3	45	3.75	Large V's
210	C2	17/03/2009	E32	Mocness	4	625-750	V	4	50	4.17	Large V's
211	C2	17/03/2009	E32	Mocness	4	625-750	V	5	49	4.08	Large V's
212	C2	17/03/2009	E32	Mocness	4	625-750	V	6	46	3.83	Large V's
213	C2	17/03/2009	E32	Mocness	4	625-750	V	7	45	3.75	Large V's
214	C2	17/03/2009	E32	Mocness	4	625-750	V	8	48	4.00	Large V's
215	C2	17/03/2009	E32	Mocness	4	625-750	V	9	47	3.92	Large V's
216	C2	17/03/2009	E32	Mocness	4	625-750	V	10	49	4.08	Large V's
217	C2	17/03/2009	E32	Mocness	5	500-625	F	1	56	4.67	
218	C2	17/03/2009	E32	Mocness	5	500-625	F	2	57	4.75	
219	C2	17/03/2009	E32	Mocness	5	500-625	F	3	55	4.58	
220	C2	17/03/2009	E32	Mocness	5	500-625	V	1	47	3.92	
221	C2	17/03/2009	E32	Mocness	5	500-625	V	2	45	3.75	
222	C2	17/03/2009	E32	Mocness	5	500-625	V	3	51	4.25	
223	C2	17/03/2009	E32	Mocness	5	500-625	V	4	46	3.83	
224	C2	17/03/2009	E32	Mocness	5	500-625	V	5	48	4.00	
225	C2	17/03/2009	E44	Bongo		0-400	F	1	53	4.42	
226	C2	17/03/2009	E44	Bongo		0-400	F	2	52	4.33	
227	C2	17/03/2009	E44	Bongo		0-400	IV	1	34	2.83	
228	C2	17/03/2009	E44	Bongo		0-400	IV	2	35	2.92	
229	C2	17/03/2009	E44	Bongo		0-400	IV	3	33	2.75	
230	C2	17/03/2009	E44	Bongo		0-400	IV	4	33	2.75	
231	C2	17/03/2009	E44	Bongo		0-400	IV	5	6	0.50	
232	C2	17/03/2009	E44	Bongo		0-400	V	1	43	3.58	
233	C2	17/03/2009	E44	Bongo		0-400	V	2	45	3.75	
234	C2	17/03/2009	E44	Bongo		0-400	V	3	45	3.75	
235	C2	17/03/2009	E44	Bongo		0-400	V	4	43	3.58	
236	C2	17/03/2009	E44	Bongo		0-400	V	5	43	3.58	
237	C2	17/03/2009	E44	Bongo		0-400	V	6	44	3.67	
238	C2	17/03/2009	E44	Bongo		0-400	V	7	44	3.67	

239	C2	17/03/2009	E44	Bongo		0-400	V	8	43	3.58		
240	C2	17/03/2009	E44	Bongo		0-400	V	9	43	3.58		
241	C3	19/03/2009	E54	Bongo		0-400	F	1	55	4.58		
242	C3	19/03/2009	E54	Bongo		0-400	F	2	53	4.42		
243	C3	19/03/2009	E54	Bongo		0-400	F	3	50	4.17		
244	C3	19/03/2009	E54	Bongo		0-400	IV	1	32	2.67		
245	C3	19/03/2009	E54	Bongo		0-400	IV	2	31	2.58		
246	C3	19/03/2009	E54	Bongo		0-400	IV	3	32	2.67		
247	C3	19/03/2009	E54	Bongo		0-400	IV	4	32	2.67		
248	C3	19/03/2009	E54	Bongo		0-400	IV	5	30	2.50		
249	C3	19/03/2009	E54	Bongo		0-400	V	1	48	4.00		
250	C3	19/03/2009	E54	Bongo		0-400	V	2	47	3.92		
251	C3	19/03/2009	E54	Bongo		0-400	V	3	46	3.83		
252	C3	19/03/2009	E54	Bongo		0-400	V	4	44	3.67		
253	C3	19/03/2009	E54	Bongo		0-400	V	5	46	3.83		
254	C3	19/03/2009	E54	Bongo		0-400	V	6	46	3.83		
255	C3	19/03/2009	E54	Bongo		0-400	V	7	45	3.75		
256	C3	19/03/2009	E54	Bongo		0-400	V	8	44	3.67		
257	C3	19/03/2009	E54	Bongo		0-400	V	9	44	3.67		
258	C3	19/03/2009	E54	Bongo		0-400	V	10	42	3.50		
259	C3	21/03/2009	E72	Mocness	2	875-1000	F	1	58	4.83		
260	C3	21/03/2009	E72	Mocness	2	875-1000	F	2	55	4.58		
261	C3	21/03/2009	E72	Mocness	2	875-1000	F	3	55	4.58		
262	C3	21/03/2009	E72	Mocness	2	875-1000	F	4	53	4.42		
263	C3	21/03/2009	E72	Mocness	2	875-1000	F	5	56	4.67		
264	C3	21/03/2009	E72	Mocness	2	875-1000	F	6	55	4.58		
265	C3	21/03/2009	E72	Mocness	2	875-1000	F	7	55	4.58		
266	C3	21/03/2009	E72	Mocness	2	875-1000	V	1	45	3.75		
267	C3	21/03/2009	E72	Mocness	2	875-1000	V	2	47	3.92		
268	C3	21/03/2009	E72	Mocness	2	875-1000	V	3	47	3.92		
269	C3	21/03/2009	E72	Mocness	2	875-1000	V	4	48	4.00		
270	C3	21/03/2009	E72	Mocness	2	875-1000	V	5	46	3.83		
271	C3	21/03/2009	E72	Mocness	2	875-1000	V	6	45	3.75		
272	C3	21/03/2009	E72	Mocness	2	875-1000	V	7	47	3.92		
273	C3	21/03/2009	E72	Mocness	3	750-875	F	1	53	4.42	ovary I/II	high lipid
274	C3	21/03/2009	E72	Mocness	3	750-875	F	2	53	4.42		high lipid
275	C3	21/03/2009	E72	Mocness	3	750-875	F	3	57	4.75		high lipid
276	C3	21/03/2009	E72	Mocness	3	750-875	F	4	49	4.08	propinquus?	high lipid
277	C3	21/03/2009	E72	Mocness	3	750-875	F	5	57	4.75		high lipid
278	C3	21/03/2009	E72	Mocness	3	750-875	F	6	59	4.92		high lipid
279	C3	21/03/2009	E72	Mocness	3	750-875	F	7	54	4.50		high lipid
280	C3	21/03/2009	E72	Mocness	3	750-875	V	1	45	3.75		low lipid
281	C3	21/03/2009	E72	Mocness	3	750-875	V	2	46	3.83		low lipid
282	C3	21/03/2009	E72	Mocness	3	750-875	V	3	43	3.58		low lipid
283	C3	21/03/2009	E72	Mocness	3	750-875	V	4	43	3.58		low lipid
284	C3	21/03/2009	E72	Mocness	3	750-875	V	5	47	3.92		low lipid
285	C3	21/03/2009	E72	Mocness	3	750-875	V	6	47	3.92		low lipid
286	C3	21/03/2009	E72	Mocness	3	750-875	V	7	44	3.67		low lipid

287	C3	21/03/2009	E72	Mocness	4	625-750	F	1	55	4.58		
288	C3	21/03/2009	E72	Mocness	4	625-750	F	2	56	4.67		
289	C3	21/03/2009	E72	Mocness	4	625-750	F	3	57	4.75		
290	C3	21/03/2009	E72	Mocness	4	625-750	F	4	52	4.33		
291	C3	21/03/2009	E72	Mocness	4	625-750	F	5	51	4.25		
292	C3	21/03/2009	E72	Mocness	4	625-750	V	1	43	3.58		
293	C3	21/03/2009	E72	Mocness	4	625-750	V	2	45	3.75		animal lost
294	C3	21/03/2009	E72	Mocness	4	625-750	V	3	44	3.67		
295	C3	21/03/2009	E72	Mocness	4	625-750	V	4	43	3.58		
296	C3	21/03/2009	E72	Mocness	5	500-625	F	1	53	4.42		
297	C3	21/03/2009	E72	Mocness	5	500-625	F	2	57	4.75		
298	C3	21/03/2009	E72	Mocness	5	500-625	F	3	50	4.17		
299	C3	21/03/2009	E72	Mocness	5	500-625	F	4	54	4.50		
300	C3	21/03/2009	E72	Mocness	5	500-625	F	5	51	4.25		
301	C3	21/03/2009	E72	Mocness	5	500-625	V	1	46	3.83		
302	C3	21/03/2009	E72	Mocness	5	500-625	V	2	44	3.67		
303	C3	21/03/2009	E72	Mocness	5	500-625	V	3	50	4.17		
304	C3	21/03/2009	E72	Mocness	5	500-625	V	4	47	3.92		
305	C3	21/03/2009	E72	Mocness	5	500-625	V	5	47	3.92		
306	C3	21/03/2009	E72	Mocness	5	500-625	V	6	45	3.75		
307	C3	21/03/2009	E72	Mocness	5	500-625	V	7	45	3.75		
308	C3	21/03/2009	E72	Mocness	6	375-500	F	1	53	4.42		
309	C3	21/03/2009	E72	Mocness	6	375-500	F	2	51	4.25		
310	C3	21/03/2009	E72	Mocness	6	375-500	F	3	54	4.50		
311	C3	21/03/2009	E72	Mocness	6	375-500	F	4	51	4.25		
312	C3	21/03/2009	E72	Mocness	6	375-500	F	5	52	4.33		ovary 1/2
313	C3	21/03/2009	E72	Mocness	6	375-500	V	1	48	4.00		
314	C3	21/03/2009	E72	Mocness	6	375-500	V	2	47	3.92		
315	C3	21/03/2009	E72	Mocness	6	375-500	V	3	46	3.83		
316	C3	21/03/2009	E72	Mocness	6	375-500	V	4	46	3.83		
317	C3	21/03/2009	E72	Mocness	6	375-500	V	5	47	3.92		
318	C3	21/03/2009	E72	Mocness	7	250-375	V	1	43	3.58		
319	C3	21/03/2009	E72	Mocness	7	250-375	V	2	44	3.67		
320	C3	21/03/2009	E72	Mocness	7	250-375	V	3	45	3.75		
321	C3	21/03/2009	E72	Mocness	7	250-375	V	4	46	3.83		
322	C3	21/03/2009	E72	Mocness	7	250-375	V	5	46	3.83		
323	C3	21/03/2009	E72	Mocness	8	125-250	V	1	47	3.92		
324	C3	21/03/2009	E72	Mocness	8	125-250	V	2	46	3.83		
325	C3	21/03/2009	E72	Mocness	8	125-250	V	3	45	3.75		
326	C3	21/03/2009	E72	Mocness	8	125-250	V	4	44	3.67		
327	C3	21/03/2009	E72	Mocness	8	125-250	V	5	43	3.58		
328	C3	21/03/2009	E72	Mocness	9	0-125	V	1	44	3.67		
329	C3	21/03/2009	E72	Mocness	9	0-125	V	2	44	3.67		
330	C3	21/03/2009	E72	Mocness	9	0-125	V	3	45	3.75		
331	C3	21/03/2009	E72	Mocness	9	0-125	V	4	44	3.67		
332	C3	21/03/2009	E72	Mocness	9	0-125	V	5	44	3.67		
333	C4	23/03/2009	E84	Bongo		0-400	F	1	54	4.50	V low production site	
334	C4	23/03/2009	E84	Bongo		0-400	F	2	55	4.58		

335	C4	23/03/2009	E84	Bongo		0-400	F	3	54	4.50	
336	C4	23/03/2009	E84	Bongo		0-400	F	4	56	4.67	
337	C4	23/03/2009	E84	Bongo		0-400	F	5	53	4.42	ovary I
338	C4	23/03/2009	E84	Bongo		0-400	F	6	55	4.58	
339	C4	23/03/2009	E84	Bongo		0-400	V	1	45	3.75	
340	C4	23/03/2009	E84	Bongo		0-400	V	2	43	3.58	
341	C4	23/03/2009	E84	Bongo		0-400	V	3	47	3.92	
342	C4	23/03/2009	E84	Bongo		0-400	V	4	45	3.75	
343	C4	23/03/2009	E84	Bongo		0-400	V	5	45	3.75	
344	C4	23/03/2009	E84	Bongo		0-400	V	6	46	3.83	
345	C4	24/03/2009	E94	Mocness	3	750-875	F	1	51	4.25	
346	C4	24/03/2009	E94	Mocness	3	750-875	F	2	51	4.25	
347	C4	24/03/2009	E94	Mocness	3	750-875	F	3	53	4.42	
348	C4	24/03/2009	E94	Mocness	3	750-875	F	4	53	4.42	
349	C4	24/03/2009	E94	Mocness	3	750-875	F	5	52	4.33	
350	C4	24/03/2009	E94	Mocness	3	750-875	V	1	41	3.42	
351	C4	24/03/2009	E94	Mocness	3	750-875	V	2	45	3.75	
352	C4	24/03/2009	E94	Mocness	4	625-750	F	1	56	4.67	
353	C4	24/03/2009	E94	Mocness	4	625-750	F	2	56	4.67	
354	C4	24/03/2009	E94	Mocness	4	625-750	F	3	55	4.58	
355	C4	24/03/2009	E94	Mocness	4	625-750	F	4	55	4.58	
356	C4	24/03/2009	E94	Mocness	4	625-750	F	5	53	4.42	
357	C4	24/03/2009	E94	Mocness	4	625-750	F	6	50	4.17	
358	C4	24/03/2009	E94	Mocness	4	625-750	F	7	53	4.42	ovary I
359	C4	24/03/2009	E94	Mocness	4	625-750	V	1	47	3.92	
360	C4	24/03/2009	E94	Mocness	4	625-750	V	2	47	3.92	
361	C4	24/03/2009	E94	Mocness	4	625-750	V	3	46	3.83	
362	C4	24/03/2009	E94	Mocness	4	625-750	V	4	45	3.75	
363	C4	24/03/2009	E94	Mocness	4	625-750	V	5	5	0.42	
364	C4	24/03/2009	E94	Mocness	4	625-750	V	6	48	4.00	
365	C4	24/03/2009	E94	Mocness	4	625-750	V	7	44	3.67	
366	C4	24/03/2009	E94	Mocness	5	500-625	F	1	54	4.50	
367	C4	24/03/2009	E94	Mocness	5	500-625	F	2	55	4.58	
368	C4	24/03/2009	E94	Mocness	5	500-625	F	3	56	4.67	
369	C4	24/03/2009	E94	Mocness	5	500-625	F	4	53	4.42	
370	C4	24/03/2009	E94	Mocness	5	500-625	F	5	54	4.50	
371	C4	24/03/2009	E94	Mocness	5	500-625	V	1	47	3.92	
372	C4	24/03/2009	E94	Mocness	5	500-625	V	2	45	3.75	
373	C4	24/03/2009	E94	Mocness	5	500-625	V	3	47	3.92	
374	C4	24/03/2009	E94	Mocness	5	500-625	V	4	49	4.08	
375	C4	24/03/2009	E94	Mocness	5	500-625	V	5	47	3.92	
376	C4	24/03/2009	E94	Mocness	6	375-500	F	1	52	4.33	ovary I
377	C4	24/03/2009	E94	Mocness	6	375-500	F	2	56	4.67	
378	C4	24/03/2009	E94	Mocness	6	375-500	F	3	53	4.42	
379	C4	24/03/2009	E94	Mocness	6	375-500	F	4	50	4.17	
380	C4	24/03/2009	E94	Mocness	6	375-500	F	5	50	4.17	
381	C4	24/03/2009	E94	Mocness	6	375-500	V	1	47	3.92	
382	C4	24/03/2009	E94	Mocness	6	375-500	V	2	47	3.92	

383	C4	24/03/2009	E94	Mocness	6	375-500	V	3	46	3.83	dead/almost dead?
384	C4	24/03/2009	E94	Mocness	6	375-500	V	4	45	3.75	dead/almost dead?
385	C4	24/03/2009	E94	Mocness	7	250-375	V	1	46	3.83	
386	C4	24/03/2009	E94	Mocness	7	250-375	V	2	47	3.92	
387	C4	24/03/2009	E94	Mocness	7	250-375	V	3	45	3.75	
388	C4	24/03/2009	E94	Mocness	7	250-375	V	4	46	3.83	
389	C4	24/03/2009	E94	Mocness	8	125-250	V	1	46	3.83	
390	C4	24/03/2009	E94	Mocness	8	125-250	V	2	46	3.83	
391	C4	24/03/2009	E94	Mocness	8	125-250	F	1	57	4.75	
392	R2	27/03/2008	E121	Mocness	2	875-1000	V	1	43	3.58	C. propinquus
393	R2	27/03/2008	E121	Mocness	2	875-1000	V	2	44	3.67	C. propinquus
394	R2	27/03/2008	E121	Mocness	2	875-1000	V	3	44	3.67	C. propinquus
395	R2	27/03/2008	E121	Mocness	2	875-1000	V	4	43	3.58	C. propinquus
396	R2	27/03/2008	E121	Mocness	2	875-1000	V	5	43	3.58	C. propinquus
397	R2	27/03/2008	E121	Mocness	2	875-1000	V	6	43	3.58	C. propinquus
398	R2	27/03/2008	E121	Mocness	7	250-375	V	1	43	3.58	C. propinquus
399	R2	27/03/2008	E121	Mocness	7	250-375	V	2	44	3.67	C. propinquus
400	R2	27/03/2008	E121	Mocness	7	250-375	V	3	42	3.50	C. propinquus
401	R2	27/03/2008	E121	Mocness	7	250-375	V	4	42	3.50	C. propinquus
402	R2	27/03/2008	E121	Mocness	7	250-375	V	5	43	3.58	C. propinquus
403	R2	27/03/2008	E121	Mocness	7	250-375	V	6	41	3.42	C. propinquus
404	R2	27/03/2008	E121	Mocness	7	250-375	V	7	41	3.42	C. propinquus
405	R2	27/03/2008	E121	Mocness	2	875-1000	V	1	44	3.67	
406	R2	27/03/2008	E121	Mocness	2	875-1000	V	2	42	3.50	
407	R2	27/03/2008	E121	Mocness	2	875-1000	V	3	43	3.58	
408	R2	27/03/2008	E121	Mocness	2	875-1000	V	4	41	3.42	
409	R2	27/03/2008	E121	Mocness	2	875-1000	V	5	39	3.25	
410	R2	27/03/2008	E121	Mocness	2	875-1000	V	6	43	3.58	
411	R2	27/03/2008	E121	Mocness	2	875-1000	F	1	55	4.58	
412	R2	27/03/2008	E121	Mocness	5	500-625	F	1	85	7.08	R.gigas
413	R2	27/03/2008	E121	Mocness	5	500-625	F	2	87	7.25	R.gigas
414	R2	27/03/2008	E121	Mocness	5	500-625	F	3	88	7.33	R.gigas
415	R2	27/03/2008	E121	Mocness	5	500-625	F	4	92	7.67	R.gigas
416	R2	27/03/2008	E121	Mocness	5	500-625	F	5	95	7.92	R.gigas
417	R2	27/03/2008	E121	Mocness	5	500-625	F	6	85	7.08	R.gigas
418	R2	27/03/2008	E121	Mocness	5	500-625	F	7	85	7.08	R.gigas
419	R2	27/03/2008	E121	Mocness	5	500-625	F	8	77	6.42	R.gigas
420	R2	27/03/2008	E121	Mocness	5	500-625	V	9	78	6.50	R.gigas
421	R2	27/03/2008	E121	Mocness	5	500-625	V	10	72	6.00	R.gigas
422	R2	27/03/2008	E121	Mocness	5	500-625	V	11	75	6.25	R.gigas
423	R2	27/03/2008	E121	Mocness	5	500-625	V	1	42	3.50	
424	R2	27/03/2008	E121	Mocness	5	500-625	V	2	43	3.58	
425	R2	27/03/2008	E121	Mocness	5	500-625	V	3	41	3.42	
426	R2	27/03/2008	E121	Mocness	5	500-625	V	4	44	3.67	
427	R2	27/03/2008	E121	Mocness	5	500-625	V	5	45	3.75	
428	R2	27/03/2008	E121	Mocness	5	500-625	V	6	44	3.67	
429	R2	27/03/2008	E121	Mocness	5	500-625	V	7	46	3.83	
430	R2	27/03/2008	E121	Mocness	5	500-625	V	8	41	3.42	

431	R2	27/03/2008	E121	Mocness	5	500-625	V	9	41	3.42	
432	R2	27/03/2008	E121	Mocness	5	500-625	F	1	46	3.83	
433	R2	27/03/2008	E121	Mocness	5	500-625	F	2	56	4.67	
434	R2	27/03/2008	E121	Mocness	5	500-625	F	3	54	4.50	
435	R2	27/03/2008	E121	Mocness	6	375-500	V	1	42	3.50	
436	R2	27/03/2008	E121	Mocness	6	375-500	V	2	43	3.58	
437	R2	27/03/2008	E121	Mocness	6	375-500	V	3	45	3.75	
438	R2	27/03/2008	E121	Mocness	6	375-500	V	4	45	3.75	
439	R2	27/03/2008	E121	Mocness	6	375-500	V	5	47	3.92	
440	R2	27/03/2008	E121	Mocness	6	375-500	V	6	42	3.50	
441	R2	27/03/2008	E121	Mocness	6	375-500	V	7	42	3.50	
442	R2	27/03/2008	E121	Mocness	6	375-500	F	1	52	4.33	
443	R2	27/03/2008	E121	Mocness	6	375-500	F	2	55	4.58	
444	R2	27/03/2008	E121	Mocness	6	375-500	F	3	57	4.75	
445	R2	27/03/2008	E121	Mocness	6	375-500	F	4	6	0.50	
446	R2	27/03/2008	E121	Mocness	6	375-500	F	5	52	4.33	Ovary II
447	R2	27/03/2008	E121	Mocness	6	375-500	F	6	50	4.17	Ovary II
448	R2	27/03/2008	E121	Mocness	6	375-500	F	7	53	4.42	Ovary II
449	R2	27/03/2008	E121	Mocness	7	250-375	V	1	39	3.25	
450	PS2	31/03/2009	E152	Mocness	3	750-875	V	1	41	3.42	
451	PS2	31/03/2009	E152	Mocness	3	750-875	V	2	43	3.58	
452	PS2	31/03/2009	E152	Mocness	3	750-875	V	3	44	3.67	
453	PS2	31/03/2009	E152	Mocness	3	750-875	V	4	43	3.58	
454	PS2	31/03/2009	E152	Mocness	3	750-875	V	5	43	3.58	
455	PS2	31/03/2009	E152	Mocness	3	750-875	V	6	46	3.83	
456	PS2	31/03/2009	E152	Mocness	3	750-875	V	7	42	3.50	
457	PS2	31/03/2009	E152	Mocness	3	750-875	V	8	42	3.50	
458	PS2	31/03/2009	E152	Mocness	3	750-875	V	9	41	3.42	
459	PS2	31/03/2009	E152	Mocness	3	750-875	V	10	43	3.58	
460	PS2	31/03/2009	E152	Mocness	3	750-875	V	1	42	3.50	C. propinquus
461	PS2	31/03/2009	E152	Mocness	3	750-875	V	2	44	3.67	C. propinquus
462	PS2	31/03/2009	E152	Mocness	3	750-875	V	3	44	3.67	C. propinquus
463	PS2	31/03/2009	E152	Mocness	3	750-875	V	4	43	3.58	C. propinquus
464	PS2	31/03/2009	E152	Mocness	3	750-875	V	5	43	3.58	C. propinquus
465	PS2	31/03/2009	E152	Mocness	3	750-875	V	6	42	3.50	C. propinquus
466	PS2	31/03/2009	E152	Mocness	3	750-875	V	7	43	3.58	C. propinquus
467	PS2	31/03/2009	E152	Mocness	3	750-875	V	8	44	3.67	C. propinquus
468	PS2	31/03/2009	E152	Mocness	3	750-875	V	9	43	3.58	C. propinquus
469	PS2	31/03/2009	E152	Mocness	3	750-875	V	10	43	3.58	C. propinquus
470	PS2	31/03/2009	E152	Mocness	3	750-875	F	1	87	7.25	R. gigas
471	PS2	31/03/2009	E152	Mocness	3	750-875	F	2	87	7.25	R. gigas
472	PS2	31/03/2009	E152	Mocness	3	750-875	F	3	80	6.67	R. gigas
473	PS2	31/03/2009	E152	Mocness	3	750-875	F	4	73	6.08	R. gigas
474	PS2	31/03/2009	E152	Mocness	3	750-875	F	5	83	6.92	R. gigas
475	PS2	31/03/2009	E152	Mocness	3	750-875	V	6	70	5.83	R. gigas
476	PS2	31/03/2009	E152	Mocness	3	750-875	V	7	70	5.83	R. gigas
477	PS2	31/03/2009	E152	Mocness	3	750-875	F	8	81	6.75	R. gigas
478	PS2	31/03/2009	E152	Mocness	3	750-875	V	9	68	5.67	R. gigas

479	PS2	31/03/2009	E152	Mocness	3	750-875	F	10	63	5.25	R. gigas
480	PS2	31/03/2009	E152	Mocness	3	750-875	V	1	29	2.42	C. simillimus
481	PS2	31/03/2009	E152	Mocness	3	750-875	V	2	27	2.25	C. simillimus
482	PS2	31/03/2009	E152	Mocness	3	750-875	V	3	27	2.25	C. simillimus
483	PS2	31/03/2009	E152	Mocness	3	750-875	V	4	30	2.50	C. simillimus
484	PS2	31/03/2009	E152	Mocness	3	750-875	V	5	27	2.25	C. simillimus
485	PS2	31/03/2009	E152	Mocness	3	750-875	V	6	29	2.42	C. simillimus
486	PS2	31/03/2009	E152	Mocness	3	750-875	V	7	29	2.42	C. simillimus
487	PS2	31/03/2009	E152	Mocness	3	750-875	V	8	29	2.42	C. simillimus
488	PS2	31/03/2009	E152	Mocness	3	750-875	V	9	29	2.42	C. simillimus
489	PS2	31/03/2009	E152	Mocness	3	750-875	V	10	29	2.42	C. simillimus
490	PS2	31/03/2009	E152	Mocness	3	750-875	F	1	35	2.92	C. simillimus
491	PS2	31/03/2009	E152	Mocness	3	750-875	F	2	35	2.92	C. simillimus
492	PS2	31/03/2009	E152	Mocness	5	500-625	V	1	73	6.08	R. gigas
493	PS2	31/03/2009	E152	Mocness	5	500-625	F	2	83	6.92	R. gigas
494	PS2	31/03/2009	E152	Mocness	5	500-625	F	3	91	7.58	R. gigas
495	PS2	31/03/2009	E152	Mocness	5	500-625	F	4	85	7.08	R. gigas
496	PS2	31/03/2009	E152	Mocness	5	500-625	F	5	82	6.83	R. gigas
497	PS2	31/03/2009	E152	Mocness	5	500-625	F	6	85	7.08	R. gigas
498	PS2	31/03/2009	E152	Mocness	5	500-625	V	7	68	5.67	R. gigas
499	PS2	31/03/2009	E152	Mocness	5	500-625	V	8	69	5.75	R. gigas
500	PS2	31/03/2009	E152	Mocness	5	500-625	V	9	66	5.50	R. gigas
501	PS2	31/03/2009	E152	Mocness	5	500-625	V	10	68	5.67	R. gigas
502	PS2	31/03/2009	E152	Mocness	5	500-625	V	1	29	2.42	C.simillimus
503	PS2	31/03/2009	E152	Mocness	5	500-625	V	2	29	2.42	C.simillimus
504	PS2	31/03/2009	E152	Mocness	5	500-625	V	3	28	2.33	C.simillimus
505	PS2	31/03/2009	E152	Mocness	5	500-625	V	4	28	2.33	C.simillimus
506	PS2	31/03/2009	E152	Mocness	5	500-625	V	5	29	2.42	C.simillimus
507	PS2	31/03/2009	E152	Mocness	5	500-625	V	6	30	2.50	C.simillimus
508	PS2	31/03/2009	E152	Mocness	5	500-625	V	7	29	2.42	C.simillimus
509	PS2	31/03/2009	E152	Mocness	5	500-625	V	8	28	2.33	C.simillimus
510	PS2	31/03/2009	E152	Mocness	5	500-625	V	9	30	2.50	C.simillimus
511	PS2	31/03/2009	E152	Mocness	5	500-625	V	10	28	2.33	C.simillimus
512	PS2	31/03/2009	E152	Mocness	5	500-625	V	1	42	3.50	C. acutus
513	PS2	31/03/2009	E152	Mocness	5	500-625	V	2	44	3.67	C. acutus
514	PS2	31/03/2009	E152	Mocness	5	500-625	V	3	44	3.67	C. acutus
515	PS2	31/03/2009	E152	Mocness	5	500-625	V	4	43	3.58	C. acutus
516	PS2	31/03/2009	E152	Mocness	5	500-625	V	5	44	3.67	C. acutus
517	PS2	31/03/2009	E152	Mocness	5	500-625	V	6	45	3.75	C. acutus
518	PS2	31/03/2009	E152	Mocness	5	500-625	V	7	43	3.58	C. acutus
519	PS2	31/03/2009	E152	Mocness	5	500-625	V	8	43	3.58	C. acutus
520	PS2	31/03/2009	E152	Mocness	5	500-625	V	9	42	3.50	C. acutus
521	PS2	31/03/2009	E152	Mocness	5	500-625	V	10	43	3.58	C. acutus
522	PS2	31/03/2009	E152	Mocness	8	125-250	V	1	67	5.58	R. gigas
523	PS2	31/03/2009	E152	Mocness	8	125-250	V	2	72	6.00	R. gigas
524	PS2	31/03/2009	E152	Mocness	8	125-250	VI	3	56	4.67	R. gigas
525	PS2	31/03/2009	E152	Mocness	8	125-250	V	4	69	5.75	R. gigas
526	PS2	31/03/2009	E152	Mocness	8	125-250	V	5	66	5.50	R. gigas

527	PS2	31/03/2009	E152	Mocness	8	125-250	V	6	68	5.67	R. gigas
528	PS2	31/03/2009	E152	Mocness	8	125-250	V	7	71	5.92	R. gigas
529	PS2	31/03/2009	E152	Mocness	8	125-250	V	8	66	5.50	R. gigas
530	PS2	31/03/2009	E152	Mocness	8	125-250	V	9	74	6.17	R. gigas
531	PS2	31/03/2009	E152	Mocness	8	125-250	V	10	67	5.58	R. gigas
532	PS2	31/03/2009	E152	Mocness	8	125-250	V	1	42	3.50	C. propinquus
533	PS2	31/03/2009	E152	Mocness	8	125-250	V	2	40	3.33	C. propinquus
534	PS2	31/03/2009	E152	Mocness	8	125-250	V	3	39	3.25	C. propinquus
535	PS2	31/03/2009	E152	Mocness	8	125-250	V	4	43	3.58	C. propinquus
536	PS2	31/03/2009	E152	Mocness	8	125-250	V	5	43	3.58	C. propinquus
537	PS2	31/03/2009	E152	Mocness	8	125-250	V	6	40	3.33	C. propinquus
538	PS2	31/03/2009	E152	Mocness	8	125-250	V	7	41	3.42	C. propinquus
539	PS2	31/03/2009	E152	Mocness	8	125-250	V	8	42	3.50	C. propinquus
540	PS2	31/03/2009	E152	Mocness	8	125-250	V	9	41	3.42	C. propinquus
541	PS2	31/03/2009	E152	Mocness	8	125-250	V	10	41	3.42	C. propinquus
542	PS2	31/03/2009	E152	Mocness	8	125-250	V	1	27	2.25	C. simillimus
543	PS2	31/03/2009	E152	Mocness	8	125-250	V	2	29	2.42	C. simillimus
544	PS2	31/03/2009	E152	Mocness	8	125-250	V	3	29	2.42	C. simillimus
545	PS2	31/03/2009	E152	Mocness	8	125-250	V	4	29	2.42	C. simillimus
546	PS2	31/03/2009	E152	Mocness	8	125-250	V	5	28	2.33	C. simillimus
547	PS2	31/03/2009	E152	Mocness	8	125-250	V	6	29	2.42	C. simillimus
548	PS2	31/03/2009	E152	Mocness	8	125-250	V	7	28	2.33	C. simillimus
549	PS2	31/03/2009	E152	Mocness	8	125-250	V	8	27	2.25	C. simillimus
550	PS2	31/03/2009	E152	Mocness	8	125-250	V	9	28	2.33	C. simillimus
551	PS2	31/03/2009	E152	Mocness	8	125-250	V	10	29	2.42	C. simillimus
552	PS3	02/04/2009	E167	Mocness	2	875-1000	V	1	47	3.92	
553	PS3	02/04/2009	E167	Mocness	2	875-1000	V	2	47	3.92	
554	PS3	02/04/2009	E167	Mocness	2	875-1000	V	3	46	3.83	
555	PS3	02/04/2009	E167	Mocness	2	875-1000	V	4	46	3.83	
556	PS3	02/04/2009	E167	Mocness	2	875-1000	V	5	47	3.92	
557	PS3	02/04/2009	E167	Mocness	2	875-1000	V	6	46	3.83	
558	PS3	02/04/2009	E167	Mocness	2	875-1000	V	7	42	3.50	
559	PS3	02/04/2009	E167	Mocness	2	875-1000	V	8	47	3.92	
560	PS3	02/04/2009	E167	Mocness	2	875-1000	V	9	47	3.92	
561	PS3	02/04/2009	E167	Mocness	2	875-1000	V	10	45	3.75	
562	PS3	02/04/2009	E167	Mocness	3	750-875	V	1	45	3.75	
563	PS3	02/04/2009	E167	Mocness	3	750-875	V	2	46	3.83	
564	PS3	02/04/2009	E167	Mocness	3	750-875	V	3	45	3.75	
565	PS3	02/04/2009	E167	Mocness	3	750-875	V	4	46	3.83	
566	PS3	02/04/2009	E167	Mocness	3	750-875	V	5	44	3.67	
567	PS3	02/04/2009	E167	Mocness	4	625-750	V	1	46	3.83	
568	PS3	02/04/2009	E167	Mocness	4	625-750	V	2	47	3.92	
569	PS3	02/04/2009	E167	Mocness	4	625-750	V	3	48	4.00	
570	PS3	02/04/2009	E167	Mocness	4	625-750	V	4	45	3.75	
571	PS3	02/04/2009	E167	Mocness	4	625-750	V	5	45	3.75	
572	PS3	02/04/2009	E167	Mocness	5	500-625	V	1	42	3.50	
573	PS3	02/04/2009	E167	Mocness	5	500-625	V	2	45	3.75	
574	PS3	02/04/2009	E167	Mocness	5	500-625	V	3	46	3.83	

575	PS3	02/04/2009 E167 Mocness	5	500-625	V	4	47	3.92	
576	PS3	02/04/2009 E167 Mocness	5	500-625	V	5	42	3.50	
577	PS3	02/04/2009 E167 Mocness	6	375-500	V	1	47	3.92	
578	PS3	02/04/2009 E167 Mocness	6	375-500	V	2	45	3.75	
579	PS3	02/04/2009 E167 Mocness	6	375-500	V	3	46	3.83	
580	PS3	02/04/2009 E167 Mocness	6	375-500	V	4	46	3.83	
581	PS3	02/04/2009 E167 Mocness	6	375-500	V	5	45	3.75	
582	PS3	02/04/2009 E167 Mocness	7	250-375	V	1	47	3.92	
583	PS3	02/04/2009 E167 Mocness	7	250-375	V	2	46	3.83	
584	PS3	02/04/2009 E167 Mocness	7	250-375	V	3	44	3.67	
585	PS3	02/04/2009 E167 Mocness	7	250-375	V	4	44	3.67	
586	PS3	02/04/2009 E167 Mocness	7	250-375	V	5	45	3.75	
587	PS3	02/04/2009 E167 Mocness	8	125-250	V	1	45	3.75	
588	PS3	02/04/2009 E167 Mocness	8	125-250	V	2	44	3.67	
589	PS3	02/04/2009 E167 Mocness	8	125-250	V	3	42	3.50	
590	PS3	02/04/2009 E167 Mocness	8	125-250	V	4	45	3.75	
591	PS3	02/04/2009 E167 Mocness	8	125-250	V	1	42	3.50	C. propinquus full guts
592	PS3	02/04/2009 E167 Mocness	8	125-250	V	2	43	3.58	C. propinquus full guts
593	PS3	02/04/2009 E167 Mocness	8	125-250	V	3	38	3.17	C. propinquus full guts
594	PS3	02/04/2009 E167 Mocness	8	125-250	V	4	41	3.42	C. propinquus full guts
595	PS3	02/04/2009 E167 Mocness	8	125-250	V	5	40	3.33	C. propinquus full guts
596	PS3	02/04/2009 E167 Mocness	8	125-250	V	6	41	3.42	C. propinquus full guts
597	PS3	02/04/2009 E167 Mocness	8	125-250	V	7	45	3.75	C. propinquus full guts
598	PS3	02/04/2009 E167 Mocness	2	875-1000	V	1	45	3.75	C. propinquus full guts
599	PS3	02/04/2009 E167 Mocness	2	875-1000	V	2	45	3.75	C. propinquus full guts
600	PS3	02/04/2009 E167 Mocness	2	875-1000	F	3	55	4.58	female
601	PS3	02/04/2009 E167 Mocness	2	875-1000	V	4	45	3.75	C. propinquus full guts
602	PS3	02/04/2009 E167 Mocness	2	875-1000	V	5	45	3.75	C. propinquus full guts
603	PS3	02/04/2009 E167 Mocness	2	875-1000	V	6	44	3.67	C. propinquus full guts
604	PS3	02/04/2009 E167 Mocness	2	875-1000	V	7	44	3.67	C. propinquus full guts
605	PS3	02/04/2009 E167 Mocness	2	875-1000	F	1	94	7.83	R. gigas
606	PS3	02/04/2009 E167 Mocness	2	875-1000	F	2	90	7.50	R. gigas
607	PS3	02/04/2009 E167 Mocness	2	875-1000	F	3	4	0.33	R. gigas
608	PS3	02/04/2009 E167 Mocness	2	875-1000	V	4	74	6.17	R. gigas
609	PS3	02/04/2009 E167 Mocness	2	875-1000	V	5	79	6.58	R. gigas
610	PS3	02/04/2009 E167 Mocness	5	500-625	F	1	84	7.00	R. gigas
611	PS3	02/04/2009 E167 Mocness	5	500-625	F	2	89	7.42	R. gigas
612	PS3	02/04/2009 E167 Mocness	5	500-625	F	3	87	7.25	R. gigas
613	PS3	02/04/2009 E167 Mocness	5	500-625	V	4	71	5.92	R. gigas
614	PS3	02/04/2009 E167 Mocness	5	500-625	F	5	93	7.75	R. gigas
615	PS3	02/04/2009 E167 Mocness	5	500-625	F	6	93	7.75	R. gigas
616	PS3	02/04/2009 E167 Mocness	8	125-250	V	1	75	6.25	R. gigas
617	PS3	02/04/2009 E167 Mocness	8	125-250	V	2	75	6.25	R. gigas
618	PS3	02/04/2009 E167 Mocness	8	125-250	IV	3	59	4.92	R. gigas
619	PS3	02/04/2009 E167 Mocness	8	125-250	IV	4	55	4.58	R. gigas
620	PS3	02/04/2009 E167 Mocness	8	125-250	V	5	73	6.08	R. gigas
621	PS3	02/04/2009 E167 Mocness	8	125-250	V	6	75	6.25	R. gigas
622	PS3	02/04/2009 E167 Mocness	8	125-250	V	7	74	6.17	R. gigas

623	PS3	02/04/2009	E167	Mocness	8	125-250	V	8	76	6.33	R. gigas
624	PS3	02/04/2009	E167	Mocness	8	125-250	IV	9	57	4.75	R. gigas
625	PS3	02/04/2009	E167	Mocness	8	125-250	V	10	75	6.25	R. gigas
626	R3	06/04/2009	E195	Mocness	3	750-875	F	1	96	8.00	R.gigas
627	R3	06/04/2009	E195	Mocness	3	750-875	F	2	93	7.75	R.gigas
628	R3	06/04/2009	E195	Mocness	3	750-875	V	3	79	6.58	R.gigas
629	R3	06/04/2009	E195	Mocness	3	750-875	F	4	82	6.83	R.gigas
630	R3	06/04/2009	E195	Mocness	3	750-875	V	5	82	6.83	R.gigas
631	R3	06/04/2009	E195	Mocness	3	750-875	V	6	75	6.25	R.gigas
632	R3	06/04/2009	E195	Mocness	3	750-875	V	1	45	3.75	C. propinquus
633	R3	06/04/2009	E195	Mocness	3	750-875	V	2	45	3.75	C. propinquus
634	R3	06/04/2009	E195	Mocness	3	750-875	V	3	45	3.75	C. propinquus
635	R3	06/04/2009	E195	Mocness	3	750-875	V	4	45	3.75	C. propinquus
636	R3	06/04/2009	E195	Mocness	3	750-875	V	5	45	3.75	C. propinquus
637	R3	06/04/2009	E195	Mocness	3	750-875	V	1	47	3.92	C.acutus
638	R3	06/04/2009	E195	Mocness	3	750-875	V	2	45	3.75	C.acutus
639	R3	06/04/2009	E195	Mocness	3	750-875	V	3	46	3.83	C.acutus
640	R3	06/04/2009	E195	Mocness	3	750-875	V	4	45	3.75	C.acutus
641	R3	06/04/2009	E195	Mocness	3	750-875	V	5	43	3.58	C.acutus

9. KRILL ECOLOGY

9.1 Krill length Frequency

Sophie Fielding

Introduction

Antarctic krill (*Euphausia superba*) were sampled to determine variation in the structure of the population across the Scotia Sea ecosystem.

Methods

Samples were taken from the targeted RMT8 net hauls that were either directed at acoustic targets or hauled obliquely through shallow depth horizons to find dispersed krill. For all hauls where krill were caught, where the primary aim was to capture live krill for experiments, a random sample was taken from all the remaining krill once the required number of live krill had been extracted.

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 by Morris et al. (1988). Fig 9.1.1 shows the krill length frequency for all measured krill during JR200 (Ev8_2, Ev28_2, Ev29_1, Ev41_2, Ev62_1, Ev78_1, Ev112_2, Ev171_2, Ev242_2). Once measured the sample was discarded.

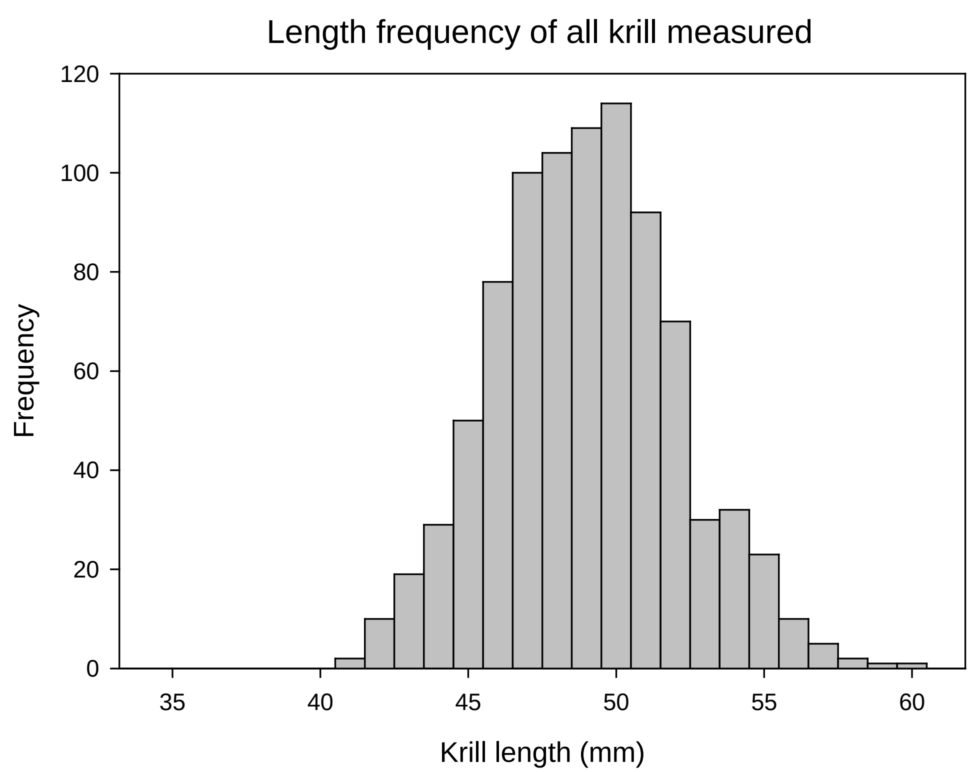

FIG 9.1.1 LENGTH FREQUENCY OF ALL KRILL CAUGHT DURING JR200

9.2 Feeding Ecology of Antarctic krill

Angus Atkinson

I had three separate objectives for JR200. The first was to determine fecal egstion rates of *Euphausia superba*, in a similar way to that on the previous cruise in summer, JR177. The second objective was to do a pilot study to measure iron excretion by krill and the third was to filter large volume water samples to determine how much sediment there is in the upper mixed layer at varying distances downstream of South Georgia. I describe these in turn.

9.2.1 OBJECTIVE 1: FECAL EGESTION BY ANTARCTIC KRILL

Introduction

Antarctic krill, *Euphausia superba*, are an important species within Scotia Sea food webs, and potentially also in biogeochemical export of carbon via their sinking fecal pellets. The species has been experimented on repeatedly in the past, but we are still some way from understanding its energy budget. This is because this mobile, schooling species does not appear to behave naturally under laboratory confinement, making the rates obtained open to question.

One approach to this problem has been to measure rate processes immediately after capture, before the animal adapts to confinement. This method is now generally considered as the best to assess feeding rate, by measuring fecal pellet production over the first few hours after capture (Clarke et al. 1988). It has been also been adopted to measure growth, by measuring moulting over the first few days after capture (Quetin et al. 1994). Measuring the rate of fecal pellet production on the one hand gives an insight into the feeding rate (by converting from egestion to ingestion via assimilation efficiency). On the other hand it gives a direct estimate of the rate of material processed by krill and repackaged into fecal pellets. These pellets are then either consumed within the mixed layer or sink to depth.

There is interest among both food web ecologists and biogeochemists in the production and sinking rates of zooplankton fecal pellets. Large grazers with rapidly sinking fecal pellets such as salps or krill can contribute directly to the “biological pump” of carbon and other important elements to the deep ocean. This flux of sinking pellets depends on a suite of factors, including the rate of pellet production, pellet composition and sinking rate.

There have been less than a dozen published measurements of egestion rates of krill. These are characterised by high variability and, surprisingly, none has measured carbon egestion rate directly, the results usually being presented in terms of dry mass. Likewise published data on the composition and sinking rates of the krill fecal pellets are scarce.

Aims

A: Measure egestion rate of freshly caught krill

1. To collect krill of a range of sizes from a wide a variety of sites, depths, times of day and food environments across the Scotia Sea.
2. To freeze part of the catch as soon as possible for gut contents analysis, for comparison with ambient chl *a* concentration and food composition.
3. To incubate a sample of the freshly caught krill for 3-4 hours to measure the hourly rate of fecal carbon and nitrogen production.

This will provide insights into the variability of the rates of fecal egestion, and, if sufficient swarms are sampled, an overview of the amount of C and N egested by the krill population.

B: Measure potential sinking rates of krill fecal pellets

1. Determine the sinking velocities of pellets from a wide variety of Scotia Sea environments.
2. Relate these to pellet dimensions, krill size and their diets and egestion rates.

The aim of these lab determinations is to examine what factors lead to high potential export fluxes of krill fecal pellets, in addition to the production rate of pellets.

C: Determine the elemental composition of krill fecal pellets

1. Analyse relative amounts of C and N as a proportion of dry mass in pellets from freshly caught krill

The aim of this is firstly to determine the nutritional value of pellets produced under different conditions. Second it will provide insights into assimilation efficiency, to test the idea that when feeding rates are high, assimilation efficiency decreases.

Methods

Objective 1A: fecal egestion rates.
As soon as a krill catch came aboard, a random sub-sample of 50 krill, where possible, were frozen immediately at –80^{o}C for laboratory determination of gut fullness and diet back in Cambridge. Undamaged animals in good condition were then transferred to a 20L bucket of filtered seawater (fsw), provided by Dave Pond and a bucket of water from the non-toxic supply filtered through 60 micron mesh. At hourly intervals for the first 4h after capture the krill were transferred to fresh 10L buckets of the respective filtered waters. This allowed all pellets to settle, allowing them to settle, whence they were pipetted to watch glasses. Pellets were rinsed in fsw, cleaned of any adhering debris under a binocular microscope, and transferred gently to ashed 25 mm GF/F filters. These were frozen at –80^{o}C for analysis of CHN in Cambridge. All filters were photographed for future record of pellet dimensions and quantities as a guide for CHN analysis.

These rates of fecal egestion will be compared with in situ gut contents of krill, which will be analysed on the krill samples frozen immediately after capture. I took water from the non-toxic supply at target fishing sites which was kindly processed for chl *a* by Min. These, in conjunction with their hourly- and CTD-derived chl *a* data will provide information on the food environment to help interpret the egestion rate data.

Objective 1B: pellet sinking rates
Concurrently with the krill incubated for fecal egestion rate measurements, I also incubated larger numbers, where available, in two to four 20L buckets of fsw. Fifty of these pellets were used for determinations of pellet sinking velocity. This was done in a 1L glass measuring cylinder filled with water of known salinity and temperature (Thanks to Hugh for salinity determination). Only intact, regular shape pellets with no adhering debris or protruding hairs were used for these experiments. Potentially suitable pellets were picked at random, without regard to dimensions in order to provide a reasonable representation of the pellet size produced by the krill. Pellets were introduced gently into the top of the cylinder without inducing turbulence and allowed to settle. Once they had attained uniform velocity, their time to sink a given distance was determined. Pellets hitting the sides or sinking vertically were attributed as questionable data.

Objective 1C: pellet composition.
I attacked this objective as follows:

1.Concurrently with the krill incubated for fecal egestion rate measurements, I also incubated larger numbers of animals, where available, in two 20L buckets of fsw. The pellets of these were harvested at hourly intervals for up to 3.5 h, rinsed in fsw and cleaned carefully of any debris, before a brief final rinse in deioinised water and transfer to 2ml micro-centrifuge tubes. These larger volume samples were frozen (-80^{o}C) for later analysis of dry mass and elemental content. For three of these experiments, I divided the pellest in two batches, purified and froze one immediately as normal and did the same for the other half after a day at ambient temperature in the cold room. This is to tests whether the elemental composition of pellets changes over time, reflecting possible degradation.

Data coverage and Preliminary Results

Table 9.2.1 shows the experiments and preservation of freshly caught krill completed for Objectives A, B and C.

Objective 1A: fecal egestion rates
Krill were caught by RMT8, providing 13 catches with freshly frozen krill for gut contents analysis and fecal egestion analysis. These were caught throughout the cruise from a variety of conditions, spanning a range of swarm depths and times of day. I incubated variable numbers of krill per time-point, based on visual assessment of gut fullness of freshly caught krill. This was to attempt to obtain sufficient fecal material for measurement on the CHN analyser. Krill size was remarkably uniform, typically 45-55 mm with no gravid females or young krill in their second year of life.

Overall, fecal egesting rate was highly variable, reflecting the complex feeding behaviour of this species. Fecal egestion rates did not appear to be noticeably lower than those measured in summer on JR177. There was no noticeable day-night difference in egestion rates, although a layer-type feature sampled at 200m at South Georgia 50 m above the seabed had lower egestion rates. There appeared from first impressions to be only a very weak relationship between fecal egestion rate and ambient chl *a* concentration. I found little decrease in egestion rate over the first two hours of the incubation, like in JR177 but in contrast to some earlier studies. There was no difference in egestion rates whether the krill were in GF/F –fileted water or 60 micron-filtered seawater.

With 9 egestion rate determinations it would be ambitious to attempt a functional analysis of egestion rate against krill size, food quantity and quality, time of day, temperature, swarm depth etc. However the methods were very similar to those from the previous cruise, JR177 done in summer, so the results will be combined in a single paper. We have sampled across sufficient variation to maybe draw some conclusions about overall fecal egestion rates expected for krill in the Scotia Sea and the degree of variation in this.

Objective 1B: pellet sinking rates
I determined the sinking rate of 491 individual pellets across 11 experiments (see Table 9.2.1). The sinking rate of the fecal pellets varied over 40-fold, from 0.031 cm s^{-1} to1.28 cm s^{-1} (corresponding to an equivalent theoretical sinking rate of 26 to 1105 m d^{-1} in motionless water column of equivalent density to the incubation water). Sinking rate depended mainly on pellet width, but also increased with pellet length. However there were clear differences between experiments in the sinking rate of pellets of the same dimensions, which I will relate to diet and feeding rate. There was also inter-swarm variation in the widths of pellets of krill of equivalent size.

Objective 1C: pellet composition
There were sufficient krill caught to obtain bulk samples of fecal pellets from 12 of the catches (Table 9.2.1). In conjunction with the pellets from the freshly caught krill it should give some insights into the digestion processes and into the composition of the pellets.

Problems encountered/recommendations

None. Thanks to great efforts from Peter Enderlein, Sophie Fielding and the whole of the night-time netting team, we managed to catch krill surprisingly frequently in what was apparently a “poor krill year”.

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9.2.2 OBJECTIVE 2: PILOT STUDY OF IRON EXCRETION BY KRILL

Angus Atkinson, Sophie Fielding, Seb Steigenberger, Mick Whitehouse

Introduction

A recent paper suggests that krill are an important species in recycling dissolved iron via their excretion process. A forthcoming AFI9 project aims to examine the role of krill in recycling iron and other elements. The plan is to examine whether krill have roles in excreting, assimilating or repackaging iron into their fecal pellets. This is slightly ambitious for a single field season, so we wanted to benefit on this cruise from having both krill and iron scientists on board to do some pilot studies. This would give time to re-jig methods if there were problems, e.g with contamination.

Method

a. Fill 20 L aspirator from ironfish supply, filtered through 1.2 micron (3 micron for last expt). Also fill first 2 rinsing buckets (5L)
b. Mix and pour from carboy into 7 polycarbonate bottles – fill to 2.35 L to bottom of neck.
c. Fill 3rd acid-washed 5L rinsing buckets with remaining water and secure lids.
d. Bag these in resealables and place in coldroom (2^{o}C). Store for up to 3-4 days before use.
e. During krill fishing, take a 1 L sample of non-toxic supply and store for Min to filter for Chl a concentration
f. When a krill catch comes in, empty catch into big bucket as normal, then transfer 15 ish healthy krill (preferably of similar size) to a 5L bucket of freshly-collected non-toxic water. This done with an acid-washed spoon.
g. Transfer to Main Lab, and under cover of a plastic "tent" spoon the krill into 1st then 2nd rinsing bucket and then the 9 healthiest into the 3rd with the acid-washed spoon.
h. Meanwhile, the other person has selected 20ish random other krill from catch if available (dead/dying OK) and placed them in resealable with label on outside. Then double bag and into minus 80 as the "t-nought" sample.
i. Take krill plus all the 2L bottles into clean container.
j. Transfer 3 krill (if average size of ~ 40 mm) to each of 3 bottles with same spoon stowed in resealable when not in use. Other 3 bottles are controls with no krill, and the 7th is only sampled at final timepoint.
k. Immediately subsample each by mixing, allowing 1 min for any pellets to sink and after 3 small vol rinses, pour 125 ml into a plastic subsample bottle. (Leave all bottles in fridge while not used). If one of the subsample bottles has any pellets (a problem in 3rd expt when pellests were numerous and slow sinking) subsampling is repeated.
l. for macronut subsampling pour into barrel of a syringe to its brim, use top bit for a single rinsed (they're already rinsed with MQ) and inject 60 ml through filter into Mick's nutrient bottle. Filters changed every 3rd sample.
m. store 125 ml subsample bottle in fridge, pending dissolved iron determiunation by flow injection, whereby they are first filtered through 0.2 micron for dissolved iron determination.
n. Return all bottles to cold room between subsamples.

o. Subsampling of all 6 bottles is on set-up and after 2h and 4h.
p. At end of expt final volumes remaining in bottles recorded. Krill are checked to see whether they are swimming freely, temperature measured also.
q. To get the krill and fecal pellets, all 3 experimental bottles were emptied into the empty 3rd rinsing bucket, (use a control sample for rinsing water) and krill spooned out and frozen separately in batches of 3 in resealables in minus 80. Pellets pipetted off with new plastic sterile pipette (first rinsed briefly with MQ) and put in one of the 125 ml sample bottles. These pellets (with about 20 ml of water) then frozen at minus 80, for later analysis of particulate metals.

Future improvements on this:

1. Use a big coolbox to store all bottles to keep temp more constant
2. Buy more Sartobran 1 micron filters to use once-only.
3. Use clear polycarbonate subsampling 125 ml bottles so it is easier to see if pellets have inadvertantly been subsampled

Results

Four experiments were conducted, from events 40,87,171 and 242. Preliminary results from first three experiments were that we did not introduce contamination, and that excretion rates of dissolved iron were very low or zero, in contrast to the findings of the single previous study. From macronuteint analysis of the first experiment, excretion rates of ammonium were comparable to our previous findings.

OBJECTIVE 3: WATER FILTRATION FOR SEDIMENT ANALYSIS

Introduction

I wanted to do some work that links a previous AFI looking at krill diets to a forthcoming one looking at their role in nutrient recycling. The previous AFI found that krill fed on surprisingly high amounts of lithogenic sediment, either derived from surface waters or from the seabed. I therefore wanted to check what the ambient sediment loads were in the waters close to and downstream of South Georgia, since krill could potentially transform the nutrients in this sediment as it passed through their possibly acidic digestive systems**.**

Methods

Water samples of 10 L were obtained either from the ironfish or the non-toxic supply in the prep lab and filtered onto 2 micron polycarbonate filters, taking care to mix the water thouroughly and ensure that either filters or water had minimal exposure to ship-born dust. Filters were stored in petrislides and placed in the minus 80. 3 replicates were taken from each sample.

Results

Table 9.2.2 describes the 30 samples taken.

Table 9.2.1. A summary of RMT 8 net catches used for krill fecal pellet experiments

Event	Date (2008)	Net no.	Freshly frozen (t_o) krill		Fecal egestion measurement			Bulk pellets (no. h after t_o	Incubation Temp (^oC)	No. of pellets settled	Fecal decay expt?
			Time frozen (GMT-3)	Approx no. frozen	No. replicate buckets	No. time-points	No. krill per bucket				
8	14/3	2	07:05	20	2	3	20	3.5	1.5	41	-
28	16/3	2	21:52	30	2	3	21	3.5	0.0	25	-
29	16/3	1	22:49	35	1	3	25	3.5	0.5	25	-
41	18/3	1	22:10	100	-	-	-	3	0.5	50	-
54	19/3	1	20:51	30	2	4	23	2.5	1	50	-
61	20/3	2	19:23	25	-	-	-	3.5	1	-	-
62	20/3	1	20:39	30	2	4	19	3.25	1.3	50	Yes
78	22/3	1	11:14	50	2	4	25	3.5	1	50	Yes
88	23/3	1	21:40	25	-	-	-	2.5	1	50	-
105	25/3	2	17:15	10	1	2	5	-	1.5	-	-
112	26/3	2	20:00	30	2	4	15	3.5	2	50	-
171	¾	2	22:55	30	-	-	-	3.25	2	50	Yes
242	14/4	2	15:00	25	2	4	35	3.5	3.5	50	-

Table 9.2.2. **Collection of water samples onto 2 micron polycarbonate filters.**
NT = non-toxic supply, IF = ironfish, NQ = possibly non-quantitative. Positions recorded here are for the endpoint of sampling – my notebook has start positions. Ship speed was around 10 knots unless stated otherwise.

No.	Depth (m)	Date	Time(local) GMT-3	Water source	Latitude S,decimal minutes	Longitude W, decimal minutes	Filter no. (L filtered)			Notes
							Rep 1	Rep 2	Rep 3	
1	>1000	1/4	1315-1323	IF	52, 50.00	40, 5.00	54(3)	55(3)	56(3)	At P3 mooring
2	>1000	2/4	1600-1604	IF	52,52.40	40,02.02	57(3)	58(3)	59(3)	Water collected during MOCNESS
3	>1000	4/4	2259-2302	IF	52,45.90	39,38.28	60(3)	61(3)	62(3)	7 knots during gale
4	>1000	6/4	1411-1414	IF	52,50.51	37,02.32	63(2)	64(2)	65(2)	After gale, during Mocness
5	>1000	7/4	1805-1809	IF	52,46.05	37,07.12	66(2)	67(2)	68(2)	
6	>1000	7/4	2130-2132	IF	52,24.02	36,36.26	69(2.5)	70(2.5)	71(2.5)	
7	>1000	7/4	2323-2326	IF	52,10.62	36,18.22	75(2)	76(2)	77(2)	Filter74 is an NQ crumpled spare
8	>1000	8/4	0124-0127	IF	51,55.43	35,57.41	72(2.5)	73(2.5)	78(2.5)	
9	>1000	8/4	0325-0329	IF	51,40.17	35,36.78	79(3)	80(3)	81(3)	
10	>1000	12/4	0808-0811	IF	51,30.26	37,38.57	85(3)	86(3)	87(3)	6 knots, calming after gale. No.87 NQ
11	>1000	12/4	1110-1113	IF	51,53.07	37,13.41	88(3)	89(3)	90(3)	Still big swell but 10 knots now
12	>1000	12/4	1739-1743	IF	52,52.64	37,13.71	91(2.5)	92(2.5)	93(2.5)	Filtered at 1830
13	>1000?	12/4	1923-1940	NT	53,08.82	37,26.19	94(2.5)	95(2.5)	96(2.5)	8 knots
14	3153-1924	12/4	2143-2302	NT	53,25.17	37,39.24	97(2.5)	98(2.5)	99(2)	7 knots
15	1024-171	12/4	2325-2345	NT	53,37.45	37,48.72	100(2.5)	101(2)	102(2)	7 knots (100 is NQ)
16	111-136	13/4	0335-0357	NT	53,45.44	37,54.47	103(2)	104(2)	105(2)	7 knots
17	22-88	14/4	0752-0814	NT	53,57.12	38,04.29	106(2)	107(1.5)	108(1.5)	Stewart Strait
18	151	14/4	1036-1040	IF	53,48.86	37,50.64	109(2)	110(2)	111(2)	110 possibly NQ
19	98-150	15/4	1000-1029	NT	54,06.35	36,35.22	122(1.5)	123(1)	124(1)	8 knots as leaving Leith, calm after
20	250-175	15/4	1258-1324	NT	53,54.29	37,25.14	125(1.5)	126(1)	127(1)	126 NQ
21	141-277	15/4	1442-1509	NT	53,47.61	37,55.60	128(2)	129(2)	130(2)	128 NQ
22	352	15/4	1811-1815	IF	53,47.07	38,06.82	131(2)	132(2)	133(2)	
23	326-546	15/4	1946-2012	NT	53,42.83	38,37.43	134(2.5)	135(2.5)	136(2.5)	
24	945-992	15/4	1955-1958	IF	53,40.73	38,51.77	137(2.5)	138(2)	139(2)	
25	2051-1797	16/4	0502-0530	NT	53,26.36	41,05.07	140(2.5)	141(2.5)	142(2.5)	Slight dust on no. 140?
26	1407	16/4	0716-0730	IF	53,23.05	41,34.85	143(2.5)	144(2.5)	145(2.5)	Slight dust on no.144?
27	530-565	16/4	0904-0925	NT	53,19.26	42,09.13	146(2.5)	147(2.5)	148(2.5)	
28	688	16/4	1105-1110	IF	53,16.14	42,38.75	149(2.5)	150(2.5)	151(2.5)	Kelp on ironfish for these last 2 tows
29	1558-1710	16/4	1248-1312	NT	53,12.75	43,10.94	152(3)	153(3)	154(3)	
30	2197	16/4	1640-1643	IF	53,05.96	44,15.29	155(3)	156(3)	157(3)	

10. KRILL DISEASES

Ruth Hicks

Sampling of krill to screen for disease in the Southern Ocean: effects on standing stock and implications of changing climates

10.1 Background

Antarctic krill, *Euphausia superba,* are a keystone species in the Antarctic aquatic environment. Recent studies have reported a significant decline in krill stocks in the Southern Oceans (Atkinson, 2005). While the driving factor behind such declines is proposed as a temperature regime shift associated with global climate pattern change, the cause of the increased mortality (or reduction in recruitment) is currently unknown. Studies on the diseases of wild crustaceans are severely lacking. Despite their importance as key components of the global food chain, krill are no exception to this, with very few studies carried out on their pathogen fauna. Most of those studies that have been carried out to date have investigated the presence of ectoparasites and metazoan endoparasites (Komaki 1970, Shimazu 1971, 1972a, 1975a, 1975b, Shimazu & Oshima 1972, Kagei et al. 1978). In all of these cases, prevalence has been reported as low, with little inference made as to the potential population-level impact of these infections. More recent studies have demonstrated the presence of ciliates (Tarling & Cuzin-Roudy, 2007), some of which may be implicated in mass mortalities of krill (Gomez-Gutierrez et al., 2003). Also krill have been found to have bacterial infections probably as a result of environmental bacteria entering cavities made by earlier damage from parasitization, (Miwa et al. 2008).

While these studies provide a useful starting point for disease research in these species, a more detailed histopathological and ultrastructural assessment is required to study the potential range of protistan, bacterial, fungal and viral endoparasites potentially present. Since krill spend the majority of their lives in large ‘swarms’ that presumably aid the transmission and maintenance of micropathogen fauna within their populations, studies on these pathogens using approaches based upon histology and electron microscopy, will likely lead to the generation of disease profiles for krill within different parts of their natural range. It is important to note that as for the diseases of cultured shrimp, these micro-endoparasites are likely to have a greater impact on population dynamics in wild populations and as such, it is timely that their profile be studied in hosts such as krill.

By studying pathogen profiles in krill from across their natural range in the Southern Ocean we will contribute significantly to knowledge on mortality drivers in these populations. Furthermore, by combining disease data with oceanographic and fisheries data for these species may allow for further refinement of stock assessment models for krill and to comment on potential impact of further climate change on disease related mortality across their natural range.

Further to this, few studies have investigated pathogens of the smaller euphausiid species including *Euphausia triacantha, Euphausia valentini* and *Thysanoessa* spp. So as a caveat to the main project mentioned above, opportunistic samples of these smaller species will be collected and preserved, with a view to investigating what pathogens, if any, they are susceptible to and, if present, providing some information as to their pathogen profiles.

10.2 Sampling

Whole, live krill were collected from the RMT-8 net during both day and night hauls. Animals were maintained alive in 10L buckets of seawater, in the cold room prior to preparation for histology, electron microscopy (EM) and molecular diagnostics. Before dissection/fixation all krill were measured using standard BAS protocol, taking total length measurements (from the anterior edge of the eye to the tip of the telson, rounding down to the nearest mm). For histology whole krill were injected directly and subsequently placed within 10 % Davidson's seawater fixative for at least 24 hours before transfer to 70 % industrial methylated spirit (IMS) for storage and transport back to the Cefas laboratory, Weymouth UK. Specific fresh samples were dissected with removal of hepatopancreas tissue for EM and molecular. In these cases, the carcass was then placed into pre-labelled histology cassettes and fixed in the same way as above. Samples analysed for histology will be cross-referred to those collected for electron microscopy and molecular techniques. Pathogens or pathologies identified using histology will be subsequently analysed using electron microscopy (e.g. for identification of viruses or microparasites). Selected samples (e.g. from patently infected krill) were preserved in ethanol for molecular diagnostics on any emerging pathogens discovered. All downstream analyses will occur at the Cefas laboratories in the UK.

An atlas of pathology and pathogens of krill from across the range of sites visited will be generated. In addition, apparent prevalence of individual pathogens at different field sites will be reported to krill population biologists at BAS.

Whole, live specimens of smaller Euphausiid species, were collected opportunistically from the MOCNESS, RMT8 and RMT25 nets during both day and night hauls. They were maintained alive in buckets of fresh seawater prior to dissection/fixation. For the most part they were injected with Davidson's seawater fixative and fixed whole, as described above. However, some of the *E. triacantha* samples were dissected out, with extra hepatopancreas samples taken for EM, as outlined above. Where there was confusion at the time of sampling as to the correct identification of these species, e.g. between similar species such as *E. frigida* and *E. valentini*, ID keys will be consulted to clarify species back at the lab before processing.

10.3 Acknowledgements

This project has only been made possible thanks to a proposal by Geraint Tarling. On not only my behalf, but on that of Cefas in general, I would like to thank Geraint for putting the whole thing together and being a great source of advice/help/knowledge whilst at sea. Also thanks to Beki Korb and Min Gordon for much help with all things health and safety. Last but not least thanks to the awesome fishing team, for catching all the krill!

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Table 10.1 A SUMMARY OF NET CATCHES USED & SPECIES SAMPLED FOR DISEASE SCREEN. SGS = SOUTH GEORGIA SHELF

					Species			
Date	Station	Event	Gear	Net	*Euphausia superba*	*Euphausia triacantha*	*Euphausia valentini*	*Thysanoessa sp.*
14/03/2009	R1	8	RMT8		225			
17/03/2009	R1	29	RMT8		225			
18/03/2009	C2	39, 40, 41	RMT8		225			
19/03/2009	C2	54	RMT8	1	150			
20/03/2009	C3	62	RMT8	1	225			
22/03/2009	D7	78	RMT8	1	225			
23/03/2009	C4	87, 88	RMT8	1	105			
26/03/2009	R2	112	RMT8	2	50			
27/03/2009	R2	121	MOCNESS			54		
31/03/2009	P2	152	MOCNESS			15	10	
02/04/2009	P3	167	MOCNESS	6		23	25	24
03/04/2009	P3	171	RMT8	2	163			
03/04/2009	P3	183	MOCNESS	8	1	11	10	20
07/04/2009	PF	201	RMT8	1		78		
10/04/2009	PF5	235	RMT25	1		147		
14/04/2009	SGS	242	RMT8	1+2	400			

11. KRILL CONDITION: GENOMICS, POPULATION GENETICS AND MATURITY ANALYSIS

Geraint Tarling

11.1 Background

The distribution and state of krill through the Scotia Sea is subject to a number of influences. New techniques are being developed to assess krill state and its influence on distribution, particularly with regards genomic and population genetics. Our aim in the DISCOVERY 2010 cruises was to collect krill from a number of different environments and seasons so that specimens covered a range of states with regards life-cycle stage, moult stage and maturity. We also aimed to collect krill from a number of different times of day to examine genomic expression over the diel cycle. The brains of some krill were dissected and preserved to determine the site from which clock genes are controlled. Between 100 to 200 krill were preserved in 95% Ethanol, so that the population genetic diversity of krill could be assessed over the study region. Another 100 to 200 were preserved in formalin to examine maturity status, particularly of the ovaries.

11.2 Methods

11.2.1 Genomic expression analysis

30 to 40 live krill were extracted from a holding tank. Their total length and maturity were assessed before the two end abdominal segments (including telson and uropods) of the krill were removed and placed into a numbered well-tray. The remainder of the krill was placed either immediately into an individually labelled vial containing ~10 ml of RNA later or into a labelled bag and immersed immediately into super-cooled 95%ethanol (the ethanol having been cooled in the -80°C freezer before being placed in a Duran flask, within which the bags were immersed). The krill (minus abdominal segments) were stored in the -80°C freezer. The abdominal segments were analysed under a microscope for moult stage.

A high abundance of krill larvae were encountered in the early part of the cruise (calyptopes and early furcilia stages). Some were preserved in RNA later and stored in -80°C freezer.

11.2.2 Dissection of the brain, optic lobes and eyes of krill

The heads of between 20 and 30 live *Euphausia superba* were dissected and placed immediately in ZnFA solution for approximately 20 h. They were then washed in HBS and the connective tissue subsequently removed, also under HBS. The dissected brains, optic lobes and eyes were washed further in HBS and then placed in 80%Methanol:20% DMSO for 2 h before being finally preserved in 100% Methanol. Specimens were stored at -80°C.
A diagram of the dissection technique is shown below:

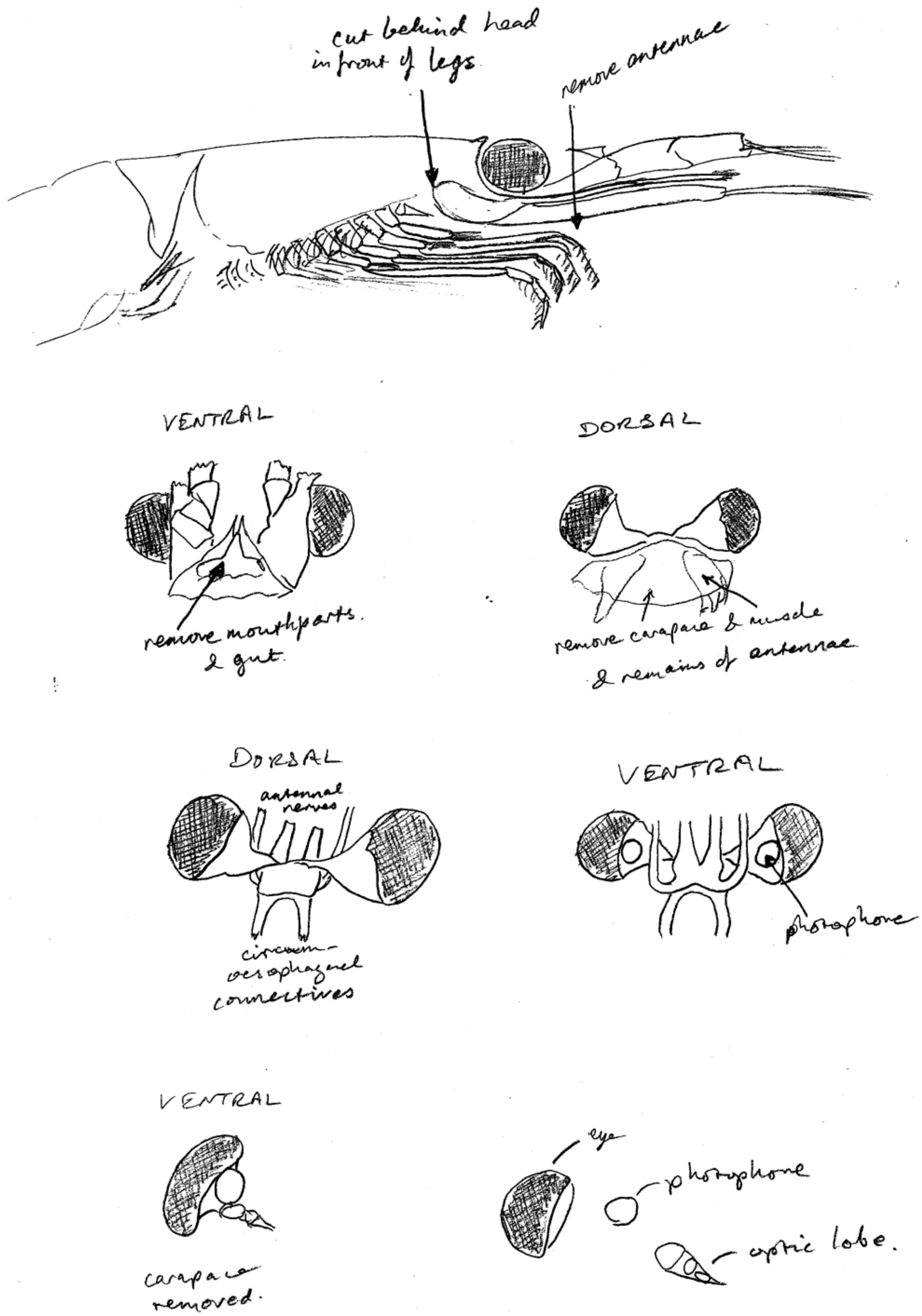

Fig. 11.2.1 Dissection technique for krill brains, optic lobes and eyes.

A high abundance of krill larvae were encountered in the early part of the cruise (calyptopes and early furcilia stages). Some were preserved as for krill brain preservation (ie ZnFA to 80:20 MetOH:DMSO, 100% MetOH) and stored in -80°C freezer.
In addition, live krill were extracted from holding tanks and placed into a plastic bag before being immersed into super-cooled 95% ethanol (see above). These will be used for DNA analysis of clock gene diversity.

11.3 Results

The following tables list the samples that were collected for each of the above objectives

Population genetics

Time (GMT)	Latitude	Longitude	Event Number	Station Name	Net Type	Number of Krill
14/03/2009 09:34	-59.4727	-49.04204	8	En route to R1	RMT8	100
17/03/2009 01:22	-60.4398	-48.22243	29	R1	RMT8	100
20/03/2009 21:38	-59.6058	-44.16973	61	C3	RMT8	100
22/03/2009 13:50	-58.8684	-43.51	78	C4	RMT8	100
03/04/2009 01:27	-52.9264	-40.14797	171	P3	RMT8	200
14/04/2009 16:59	-53.9207	-37.29464	242	South Georgia	RMT8	200

Table 11.3.1 Samples collected for population genetics. All were preserved in 95% Ethanol

Ovarian analysis

Time	Latitude	Longitude	Event Number	Station Name	Net Type	Number of Krill
14/03/2009 09:34	-59.4727	-49.042	8	En route to R1	RMT8	100
17/03/2009 01:22	-60.4395	-48.2224	29	R1	RMT8	100
20/03/2009 21:38	-59.6057	-44.1697	61	C3	RMT8	100
22/03/2009 13:50	-58.8683	-43.5099	78	C4	RMT8	100
26/03/2009 22:20	-56.7481	-42.337	112	R2	RMT8	100
03/04/2009 01:27	-52.9264	-40.148	171	P3	RMT8	100
14/04/2009 16:59	-53.9207	-37.2946	242	South Georgia	RMT8	100

Table 11.3.2 Samples collected for ovarian analysis. All were preserved in formalin.

RNA analysis

Table 11.3.3 Samples collected for RNA analysis

Time	Latitude	Longitude	Event Number	Station Name	Net Type	Number of Krill	Preservation Method	BOL
13/03/2009 11:20	-57.6854	-50.4415	2	P1 (test)	Bongo	10 larvae	RNA later -80°C	JS/C/09/4810
13/03/2009 16:35	-57.6573	-50.4481	6	P1 test	MOCNESS	~30 larvae	RNA later -80°C	JS/C/09/4810
14/03/2009 09:34	-59.4727	-49.042	8	En route to R1	RMT8	40 adults	RNA later -80°C	JS/C/09/4810
17/03/2009 01:22	-60.44	-48.2225	29	R1	RMT8	40 adults	RNA later -80°C	JS/C/09/4811
18/03/2009 23:51	-60.2129	-44.348	41	C2	RMT8	40 adults	RNA later -80°C	JS/C/09/4812
19/03/2009 23:30	-59.8795	-44.21	54	C2	RMT8	40 adults	RNA later -80°C	JS/C/09/4812
20/03/2009 21:38	-59.6053	-44.1697	61	C3	RMT8	40 adults	RNA later -80°C	JS/C/09/4813
22/03/2009 13:50	-58.8682	-43.5098	78	C4	RMT8	30 adults	Rapid freezing in ethanol then -80°C	JS/C/09/4813
03/04/2009 01:27	-52.9264	-40.148	171	P3	RMT8	30 adults	Rapid frozen in ethanol then -80°C	JS/C/09/4815
14/04/2009 16:59	-53.9207	-37.2946	242	South Georgia	RMT8	30 adults	Rapid frozen in ethanol then -80°C	JS/C/09/4816

All samples were measured for total length, maturity stage and moult stage. Note that uropod length rather than total length was measured in Event 8. Method of preservation differs between events in the first half compared with the second half of the cruise. Note that the first two entries concern krill larvae rather than adults

Brain Dissections

Time	Latitude	Longitude	Event Number	Station Name	Net Type	Number of Krill
13/03/2009 16:35	-57.6573	-50.4481	6	P1 test	MOCNESS	~30 krill larvae
14/03/2009 09:34	-59.4727	-49.042	8	En route to R1	RMT8	22 adults
17/03/2009 01:22	-60.4395	-48.2224	29	R1	RMT8	30 adults
18/03/2009 23:51	-60.2129	-44.3471	41	C2	RMT8	14 adults
20/03/2009 21:38	-59.6056	-44.1697	61	C3	RMT8	26 adults
22/03/2009 13:50	-58.8686	-43.5102	78	C4	RMT8	20 adults
03/04/2009 01:27	-52.9264	-40.148	171	P3	RMT8	20 adults

Table 11.3.4 Samples collected for brain dissections.

Dissected brains were preserved in 100% Methanol and stored at -20°C (having first being dehydrated through ZnFA and 80%:20% Methanol:DMSO). Note that krill larvae were collected for Event 2 and preserved whole using the same dehydration technique and stored in 100% Methanol at -20°C.

Time	Latitude	Longitude	Event Number	Station Name	Net Type	Number of Krill	BOL
26/03/2009 22:20	-56.7479	-42.3374	112	R2	RMT8	30 krill	JS/C/09/4814
03/04/2009 01:27	-52.9264	-40.148	171	P3	RMT8	95 krill	JS/C/09/4815
14/04/2009 16:59	-53.9207	-37.2946	242	South Georgia	RMT8	100 krill	JS/C/09/4816

Table 11.3.5 Krill collected for clock gene DNA analysis.

Events 112 and 171 were immersed into supercooled 95% Ethanol for rapid freezing before being stored at -80°C. In Event 242, the krill were placed directly into the -80°C freezer.

12. ACOUSTICS

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12.1 Acoustic instrumentation

Introduction

JR200 is the third of three Discovery 2010 cruises running two transects (Stanley to Signy and Signy to South Georgia) across the Scotia Sea. Within these transects there are a series of stations (C, P and R). At each station dedicated acoustic transects were run within mesoscale surveys (of two different styles depending on station, although acoustic data were collected continuously during the cruise.

Aim

Collection of acoustic data to accompany all transects, acoustic surveys, and net tows during the Scotia Sea survey.
Backup and process the acoustic data

Methods/System specification

Software versions
Simrad ER60 v. 2.0
Sonardata Echolog 60 v 4.05.6208
Sonardata Echoview v 4.0.75.6342 Live viewing
Sonardata Echoview v 4.20.59.8698 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 AP10 and the EK60 workstation 2 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 1000 m. Echolog was run on workstation 2 and wrote compressed files also directly to the Sun workstation via a Samba connection.

Echolog compression settings
Final compression settings used in Echolog for all frequencies were:

1) Power data only (angle data is still available from the raw files)
2) From 0 - 500 m (38 kHz), 0 – 500 (120 kHz) and 0 – 500 (200 kHz) data only (data from greater depths are available from the raw files)
3) Average samples where both Sv below –100 dB and TS below –20 dB
4) Maximum number of samples to average: 50
5) DO NOT use average samples below echosounder detected bottom unless sure of bottom detection

During the acoustic surveys, when the EK60 was stopped and restarted to mark the beginning and end of a transect, the Echolog programme would occasionally stop logging. As a result the raw files were compressed using Echozip on a local pc and the subsequent .ek60 files were saved to the L drive. The Echozip command to compress a folder of files is (directory has to be c:\program files\sonardata\echoview4):
C:> Echozip_60 –Z L:\science\acoustics\data\ek60\fishing_echolog\holding

File locations
All raw data were saved in a general folder JR200, all echolog data were saved in the folder JR200\echolog. All files were prefixed with JR200. Calibration data were additionally saved to the calibration folder.

EK60 (ER60) settings
The EK60 was only calibrated at the end of the cruise hence it was run throughout JR200 on the most recent settings. Table Acoustics_1 lists the settings the EK60 was run with during JR200. It was noted that the TS gain setting for the 38 kHz has been set (by someone in a previous cruise) to 22.03 – this is 2 dB higher than last years cruise. There is no documentation as to why. It was decided to leave it at these settings since the power into water and pulse length were correct. Finally at the end of the cruise it was found that someone had previously set the 38 kHz 2-way beam angle and TS gain parameters to that of the 200 kHz transducer. The noise on all frequencies was greater than the previous cruises and it is noted that the JCR has not been into the ice this year and there may be a large amount of fouling on the hull as a result. The EK60 settings were not updated following calibration – it is assumed that calibrated settings will be used in post-processing only, although the 38 kHz transducer 2-way beam angle was set to the correct value (-20.70 for the 2-way beam angle and 24.07 for TS gain and -0.63 for the Sa correction).

Table 12.1.1 EK60 settings

Variable	38 kHz	120 kHz	200 kHz
Ping interval (per sec)	2	2	2
Salinity (PSU)	34	34	34
Temperature (°C)	1	1	1
Sound velocity (m/s)	1471	1471	1471
Mode	Active	Active	Active
Transducer type	ES38	ES120-7	ES200-7
Transceiver Serial no.	009072033fa5	00907203422d	009072033f91
Transducer depth (m)	0	0	0
Absorption coef. (dB/km)	10.0967	30.8582	43.9717
Pulse length (ms)	1.024	1.024	1.024
Max Power (W)	2000	500	300
2-way beam angle (dB)	-19.60	-20.70	-19.60
Sv transducer gain (dB)	22.03	21.38	22.03
Sa correction (dB)	-0.31	-0.39	-0.31
Angle sensitivity along	23	21	23
Angle sensitivity athwart	23	21	23
3 dB Beam along	0.17	-0.12	0.17
3 dB Beam athwart	-0.24	-0.07	-0.24
Along offset	6.44	7.48	6.44
Athwart offset	6.43	7.48	6.43

The EK60 was controlled through the SSU, under a group EK60&EA600&ADCP. The EK60 was the master, with a ping rate set to 2 seconds. The ADCP was run in water column mode (as a slave with an external trigger). Within this setup the ADCP only pings every other trigger, therefore its resolution is slightly reduced at 1 ping every 4 seconds. In order to calibrate the ADCP, it is important for the ADCP to be run in bottom tracking mode in on-shelf waters as much as possible. This was achieved, either running the ADCP on its internal trigger in waters around the Falklands, or running the ADCP in bottom-tracking mode in the shallow water around South Georgia.

SSU settings

EA600 external trigger Tx pulse
EK60 external trigger Calculated (Set to 2 seconds in ER60 software)
ADCP external trigger Tx pulse (this setting only works if the bottom tracking mode is off)

12.2 EK60 Calibration

An acoustic calibration was carried out in Stromness Harbour, South Georgia on 15/04/2009. The ship was anchored, its movement balanced by minimal DP usage. The EK60 and EA600 were triggered through the SSU and the 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 was undertaken immediately prior to calibration, in this case using the Down Wire Net Monitor (RMT25) system since the mid-ship CTD was unworkable. Temperature and salinity were averaged from 6 (depth of the transducers) to 27 m (depth of the calibration sphere) and were 3.52°C and 33.49 PSU resulting in a speed of sound constant of 1462 m/s (Francois and Garrison, 1982). The speed of sound was updated into the ER60 software.

Each transducer was calibrated at the settings used throughout the cruise. In addition the 38 kHz transducer was calibrated a second time having reset the transducers parameters to manufacturers settings.
Parameters following two different procedures for calibrating are given in Table 12.2.1 and Table 12.2.2.

Table 12.2.1 Echoview calibration

Parameter	38kHz	38 kHz	120 kHz	200 kHz
Alpha (dB/km)	10.02	10.02	28.61	41.65
Theoretical TS (dB)	-33.70	-33.70	-40.30	-44.90
TS gain	23.74	23.72	22.14	23.88
Sa correction	0.06	-0.14	-0.08	0.03

Table 12.2.2 ER60 Calibration

Date	dd/mm/yyyy	15/04/2009	15/04/2009	15/04/2009	15/04/2009
Location		Stromness	Stromness	Stromness	Stromness
Time	hh:mm GMT				
Frequency	kHz	38	38	120	200
Cruise ID		JR200	JR200	JR200	Jr100
Calibrators		SF,PEND	SF,PEND	SF,PEND	
Transducer type		ES38	ES38	ES120-7	ES200-7
Transducer serial no		23080	23080	29471	24574
GPT serial no		009072033fa5	009072033fa5	00907203422d	9072033f91
Comments		Calibrate at wrong 2 waybeam angle			
Environmental parameters					
Water temperature	°C	3.52	3.52	3.52	3.52
Salinity	psu	33.49	33.49	33.49	33.49
Sound velocity*	m/s	1462	1462	1462	1462
Absorption coefficient	dB/km	10.02	10.02	28.61	41.65
Echosounder parameters					
Ping rate	Sec	1	1	1	1
Transmit power	W	2000	2000	500	300
Pulse length	msec	1.024	1.024	1.024	1.024
Bandwidth	kHz	2.43	2.43	3.03	3.088
Sample interval	m	0.187	0.187	0.187	0.187
Original gain	dB	22.03	24.07	21.38	-22.03
Original Sa correction	dB	-0.31	-0.63	-0.39	-0.31
Two-way beam angle	dB	-19.6	-20.7	-20.7	-19.6
Angle sens along		23	22	21	23
Angle sens athwart		23	22	21	23
Angle offset along		0.17	0	-0.12	0.17
Angle offset athwart		-0.24	0	-0.07	-0.24
3dB beamwidth along		6.44	7	7.48	6.44
3dB beamwidth athwart		6.43	7.1	7.48	6.43
Background noise	dB	-129	-127	-157	-140
Reference target					
Theoretical TS of sphe	dB	-33.7	-33.7	-40.3	-44.9
TS deviation allowed	dB	6	3	3	6
Depth of target	m	26.5	26.5	26.5	27
Min distance layer	m	22	22	22	24.5
Max distance layer	m	31	31	29	29
TS detection parameters					
Min value	dB	-50	-50	-50	-50
Max gain compensati	dB	6	6	6	6
Max phase deviation		8	8	8	8
Min echolength	%	0.8	0.8	0.8	0.8
Max echolength	%	1.8	1.8	1.8	1.8
Calibration/Beam model results					
Transducer gain	dB	23.85	23.89	22.16	23.83
Sa Correction	dB	-0.59	-0.6	-0.39	-0.25
Athwart Beam Angle	°	6.74	6.9	7.53	6.53
Along Beam Angle	°	6.68	7	7.63	6.59
Athw offset angle	°	0.03	-0.01	-0.03	-0.14
Along offset angle	°	-0.06	-0.04	-0.08	0.03
RMS of beam model	dB	0.14	0.13	0.17	0.21
Max model result	dB	0.56	0.39	0.43	0.61
Max no. of points		129	117	125	153
Min model result	dB	-0.62	-0.47	-0.52	-0.8
Min no. of points		117	52	103	160
Calibration applied		no	no	no	no

12.3 Data processing

Post-processing was undertaken in Echoview. One template EV file was set up using the compressed data files. Since files were created before calibration

Table 12.3.1 Data processing structure

VV name	Operator	Operand1	Operand2
Freq resampled even	Resample by number of pings	Fileset1: Sv raw pings T?	
Freq bad data	Region bitmap	Freq resampled even	
Freq surface bottom	Line bitmap	Freq resampled even	
Freq all bad	And	Freq bad data	Freq surface bottom
Freq bad masked	Mask	Freq resampled even	Freq all bad
Freq resample 1ping	Resample by number of pings	Freq bad masked	
Freq resample original	Resample by number of pings	Freq resample 1ping	
Freq dropout range	Data range bitmap	Freq resample original	
Freq no dropout	Mask	Freq bad masked	Freq dropout range
Freq noise	Data generator	Freq no dropout	
Freq-noise	Linear minus	Freq no dropout	Freq noise
Freq convolute	3x3 convolution	Freq-noise	
Freq spike detect	Minus	Freq-noise	Freq convolute
Freq spike mask	Data range bitmap	Freq spike detect	
Freq-noise-spike	Mask	Freq-noise	Freq spike mask
Freq-500m	Resample by distance interval	Freq-noise-spike	

12.4 Acoustic surveys

Acoustic transects were run at each station. Twelve hours were dedicated to all permanent stations (identified as C, R and P stations). Three transects of 50 km length and 12 km spacing were undertaken at each of the stations (Fig 12.4.1), the direction in which they were run was dependant on weather, sun and current conditions. At the Polar Front station (PFn) the transect lengths were reduced to 30 km to fit into the available time. Unfortunately, due to weather, acoustic transects were not run at PFs. Transect times and names are given in Table 12.4.1.

FIG 12.4.1 MESOSCALE SURVEY DESIGN

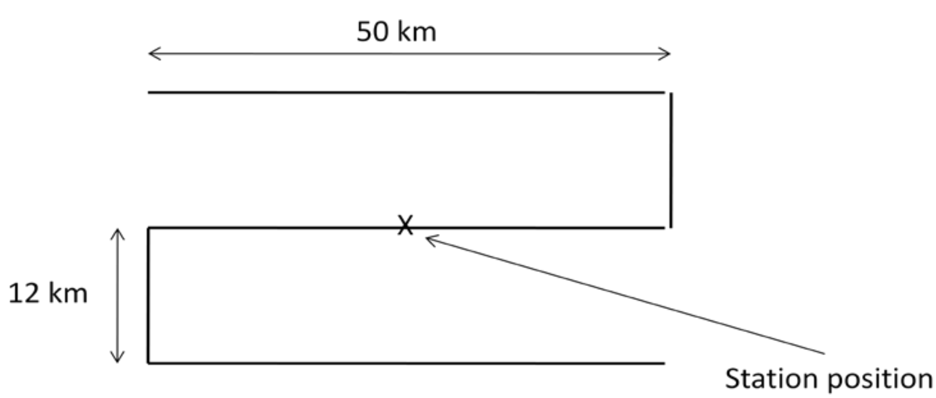

Table 12.4.1 Transect times, directions and speeds.

Date	Transect	Start time (GMT)	Stop time (GMT)	Bearing	Speed (knots)	Comments
15/03/09	R1_T1	10:54	12:23	240	8.5	Into wind
15/03/09	R1_T2	13:02	15:45	60	10	Down wind through station
15/03/09	R1_T3	16:29	19:18	240	9	Into wind, deviate for iceberg
18/03/09	C2_T1	13:11	15:51	20	10	
18/03/09	C2_T2	16:32	19:14	200	10	
18/03/09	C2_T3	19:56	21:00	20	10	
20/03/09	C3_T1	12:19	15:01	20	10	
20/03/09	C3_T2	15:43	18:24	200	10	
20/03/09	C3_T3	19:03	21:01	20	10	
23/03/09	C4_T1	11:38	14:19	20	10	
23/03/09	C4_T2	15:02	17:44	200	10	
23/03/09	C4_T3	18:28	21:10	20	10	
25/03/09	R2_T1	10:17	13:01	260	10	
25/03/09	R2_T2	13:36	16:27	80	10	
25/03/09	R2_T3	17:11	20:02	260	10	
28/03/09	P2_T1	10:05	12:47	270	10	
28/03/09	P2_T2	13:39	16:20	90	10	
28/03/09	P2_T3	17:06	19:49	270	10	
04/04/09	P3_T1	09:38	12:21	280	10	
04/04/09	P3_T2	13:08	15:52	100	10	
04/04/09	P3_T3	17:13	19:56	280	10	
07/04/09	R3_T1	09:07	11:49	260	10	
07/04/09	R3_T2	12:35	15:23	80	10	
07/04/09	R3_T3	16:40	19:22	260	10	
09/04/09	PFn_T1	10:01	11:37	280	10	
09/04/09	PFn_T2	12:38	14:19	100	10	
09/04/09	PFn_T3	16:20	17:58	280	10	

12.5 Target fishing

A degree of RMT8 and 25 target fishing was allowed for at each station and was primarily for krill for live incubation experiments (and for fish with the RMT25). Two strategies for target fishing were employed. The first, traditional, strategy was to head downwind searching for targets. Once found, the ship sails on for ½ to 1 mile more (depending on target depth) and then turns ready to shoot the net. This strategy worked well when there were targets and it was found useful to leave the RMT net fully cocked whilst searching to enable a prompt deployment. The second strategy was to do a night-time surface trawl whether there were targets or not. This strategy worked occasionally, on the whole it was normal to bring up empty nets. Ev files were created for each target net, each ev file is listed with event number.ev (e.g. ev1.ev).

Table 12.5.1 RMT8 target hauls times and comments.

Event no	Net	Date open	Time open	Depth open	Date closed	Time closed	Depth closed	Comments
028	1	17/03/09	00:35	50	17/03/09	00:38	45	Target marks surface to 60m
	2	17/03/09	00:40	30	17/03/09	00:43	22	
029	1	17/03/09	01:31	37	17/03/09	01:33	36	Target mark 25-50m
	2	17/03/09	01:39	10	17/03/09	01:40	10	
039	1	18/03/09	22:11	106	18/03/09	22:27	50	Targetless
	2	18/03/09	22:31	16	18/03/09	22:46	4	
040	1	18/03/09	23:09	25	18/03/09	23:19	16	Targetless
	2	18/03/09	23:20	20	18/03/09	23:30	14	
041	1	18/03/09	23:56	20	19/03/09	00:11	14	Targetless
	2	19/03/09	00:12	18	19/03/09	00:27	4	Two targets
053	1	19/03/09			19/03/09			No target seen net aborted
	2	19/03/09			19/03/09			
054	1	19/03/09	23:33	25	19/03/09	23:37	15	Target swarm
	2	19/03/09	23:38	20	19/03/09	23:38	20	
061	1	20/03/09	21:49	16	20/03/09	21:59	5	Target swarm 25m
	2	20/03/09	22:01	20	20/03/09	22:11	8	
062	1	20/03/09	23:22	7	20/03/09	23:26	12	Target swarm near surface
	2	20/03/09	23:27	16	20/03/09	23:27	18	
063	1	21/03/09	00:23	200	21/03/09	00:43	215	Target fish layer
	2	21/03/09	00:44	219	21/03/09	00:59	235	
078	1	22/03/09	13:55	50	22/03/09	13:58	20	Target krill swarm
	2	22/03/09	13:59	30	22/03/09	14:04	32	
087	1	23/03/09	22:50	55	23/03/09	23:01	7.5	Targetless
	2	23/03/09	23:02	17	23/03/09	23:12	10	
088	1	24/03/09	00:18	23	24/03/09	00:21	10	Target, mark 10-30m
	2	24/03/09	00:22	19	24/03/09	00:23	14	
105	1	25/03/09	19:37	22	25/03/09	19:44	12	Target very small surface marks
	2	25/03/09	19:45	19	25/03/09	19:45	21	
106	1	25/03/09	21:25	13	25/03/09	21:36	9	Target small swarms at 8m
	2	25/03/09	21:36	15	25/03/09	21:45	7	
112	1	26/03/09	22:40	15	26/03/09	22:45	8	Targetless
	2	26/03/09	22:46	15	26/03/09	22:51	16	
129	1	28/03/09	06:02	20	28/03/09	06:07	15	Targetless
	2	28/03/09	06:10	12	28/03/09	06:15	7	
130	1	28/03/09	06:39	22	28/03/09	06:44	22	Targetless
	2	28/03/09	06:45	30	28/03/09	06:50	38	
144	1	30/03/09	21:41	75	30/03/09	21:51	75	Targetless

	2	30/03/09	22:00	15	30/03/09	22:10	15	
145	1	30/03/09	22:28	53	30/03/09	22:38	53	Targetless
	2	30/03/09	22:44	25	30/03/09	22:54	22	
160	1	01/04/09	23:15	54	01/04/09	23:25	53	Targetless
	2	01/04/09	23:31	12	01/04/09	23:46	5	
164	1	02/04/09	08:45	65	02/04/09	08:55	20	Targetless
	2	02/04/09	08:56	25	02/04/09	09:06	5	
170	1	03/04/09			03/04/09			Net aborted, no targets seen
	2	03/04/09						
171	1	03/04/09	01:40		03/04/09	01:40		Suspect net had opened on own
	2	03/04/09	01:40	46	03/04/09	01:44	47	Fishing on target – caught krill
187	1	04/04/09	22:46	35	04/04/09	22:52	31	Fishing on surface mark – Protomyctophum tenisoni
	2	04/04/09	22:53	32	04/04/09	22:58	26	
197	1	07/04/09	01:40	55	07/04/09	01:42	50	Targetless. Net aborted due to tension on wire > 4 tonnes
	2	07/04/09			07/04/09			
201	1	07/04/09	23:26	80	07/04/09	23:34	53	Targetless. Net aborted due to tension on wire > 4 tonnes
	2	07/04/09			07/04/09			

Table 12.5.2 RMT25 target hauls times and comments.

Event no	Net	Date open	Time open	Depth open	Date closed	Time closed	Depth closed	Comments
128	1	28/03/09	02:49	271	28/03/09	03:10	252	Fish layer
	2	28/03/09	03:10	254	28/03/09	03:30	250	
227	1	10/04/09	06:41	553	10/04/09	07:11	550	Fish layer 500-600m
	2	10/04/09	07:36	319	10/04/09	08:01	300	Fish layer 300m
237	1	11/04/09	04:41	586	11/04/09	05:06	602	Fish layer 500-600m
	2	11/04/09	05:30	323	11/04/09	05:55	301	Fish layer 300m

12.6 Problems encountered

Apart from the incorrect parameters, no problems were encountered with the EK60. Interference from other acoustic instruments was rare due to all instrumentation being correctly interfaced by the SSU. Use of the bow thrusters was kept at a minimum during all trawling times to prevent noise at the surface. When weather picked up there were periods of increased dropout and higher noise but these are unavoidable. It was however noted that these seemed greater than on previous cruises.

13. PREDATOR OBSERVATIONS

Andrew Black

13.1. Introduction

As a continuation of the predator observations conducted during JR161 (Wakefield 2007) and JR177 (Black and Briggs 2008), the systematic surveys of air breathing predators (seabirds, seals and cetaceans) was carried out throughout the JR200 cruise. Presented here is a brief summary of the data collected.

13.2. Aims

The survey aims to establish the relative abundance of higher predators at each of the mesoscale stations and on passage between stations throughout the JR200 cruise. Along with data collected in previous years, this will help to characterise the higher predator assemblages encountered throughout the Scotia Sea.

The simultaneous recording of higher predator observations and acoustically detected aggregations of prey species will enable an investigation of the spatial cross correlations between these data.

13.3. Methods

The methodology used to record seabird and marine mammal distributions is comprehensively reviewed in Wakefield (2007). The survey technique used during this cruise was consistent with the methodology used during the two previous Discovery 2010 cruises (JR161 and JR177). All surveys were conducted by a single observer (Andrew Black).

In brief, standard seabirds at sea methodology was used to record seabirds and pinnipeds (Tasker et al. 1984, Webb and Durinck 1992, Camphuysen *et al*. 2004). Essentially, all seabirds and marine mammals on the water within a 300-m strip transect on one side of the vessel (the side offering the better viewing conditions) were counted. The 300-m transect limit was defined using a rangefinder, which was determined using Heinemann's (1981) formula. Seabirds and marine mammals recorded sitting on the water were assigned to one of five distance bands (A 0-50m, B 50-100m, C 100-200m, D 200-300m, E >300m), which run parallel to the ships track and are measured from the side of the ship (see Wakefield 2007 Figure pred 1).

In addition to the continuous strip transect for birds on the water, a second set of counts of flying birds were made using a 'snapshot' technique. The 'snapshot' is designed primarily to determine which of the birds flying through the surveyed area should be classed as 'in transect' thus ensuring that the density of flying birds is not over estimated. A 'snapshot' is taken at 300m intervals along the vessels track, the timing of which is determined by the vessel's speed. For example, a vessel travelling at 10knots travels 300m every 60 seconds and therefore 'snapshots' are taken at 60 second intervals. Any birds flying through the transect at the time of the 'snapshot' are classed as 'in transect'. Birds flying through the transect between 'snapshots' are also recorded but these records should not be used when calculating the density of birds recorded.

All animals were initially detected with the naked eye and if necessary the species identification was confirmed with the aid of binoculars. In some cases specific identification was not possible and species such as prions (*Pachyptila spp*.) and diving-petrels (*Pelecanoides spp*.) were generally only identified to genus level. For each observation, the time, species, age, plumage, number, distance or direction of flight, feeding behaviour, inter-specific association and whether 'in transect' was recorded on paper forms (see Appendix Pred 1) to be transcribed to an excel spreadsheet when time allowed. All codes used were the same as those described in Black and Briggs (2008). At the start of each observation period, weather information (wind speed and direction, swell height and direction, cloud cover and precipitation) was recorded.

Additions to standard methodology (followed on all Discovery 2010 cruises)

• In order to link observations with other sources of underway data, especially acoustics, the time, synchronised to the ships UTC chronometer, of each individual observation was recorded. For animals recorded on the water, the time at which the animals passed abeam of the bridge wing was recorded.

• Whenever weather conditions allowed, cetaceans out with the transect but on the observed side of the vessel were recorded. These observations are recorded with a bearing and approximate distance from the vessel when first sighted.

• During mesoscale surveys, if visibility fell below 300m the transect width was reduced to 200m or 100m when necessary. At such times, the timing of the 'snapshot' was also correspondingly reduced to ensure the distance travelled between snapshots was the same as the transect width.

13.4 Data coverage

Priority was given to record the distribution of higher predators during mesoscale acoustic surveys. In total 1,220 km of survey track was achieved during nine acoustic surveys.

The full acoustic survey track consisted of three 50km transects running in parallel, spaced at 12km intervals, with the centre of the middle transect passing through the station position. The direction of the acoustic transects was dependent on the wind direction at the start of the survey.

• At five stations (C4, R2, P2, P3 and R3) the entire 150km track was completed during daylight.
• At three stations (R1, C2 and C3) the survey was cut short due to limited daylight.
• The acoustic survey at the Polar Front station (PF) was shorter by design and consisted of three 30km transects run in parallel at 12km intervals.

Whenever daylight and sea state permitted, surveys were conducted as the vessel steamed between stations and on passage to and from the Falkland Islands.

13.5 Preliminary results

In total, 9,297 animals of at least 39 species were recorded between 12 March and 16 April 2009. The data collected during each mesoscale acoustic survey and the total number of each species recorded is summarised in Table Pred1. The total column includes animals recorded on passage between stations.

Table 13.1 Summary of the species observed during mesoscale acoustic surveys and the total number of each species recorded.

	Date		15/03	18/03	20/03	23/03	26/03	30/03	04/04	07/04	09/04
	Survey effort (km travelled)		125	120	135	150	150	150	150	150	90
	Station	Total	**R1**	**C2**	**C3**	**C4**	**R2**	**P2**	**P3**	**R3**	**PF**
Species	***Scientific name***										
Penguin species		10									1
King penguin	*Aptenodytes patagonicus*	117				1	5	4	10	8	1
Gentoo penguin	*Pygoscelis papua*	97									
Chinstrap penguin	*P. antarctica*	1,158	11	119	446	40	9				
Macaroni penguin	*Eudyptes chrysolophus*	289				25	3	3	2	6	
Great albatross species	*Diomedea spp*	2									
Wandering albatross	*D. exulans*	31			1			1	4	3	1
Southern royal albatross	*D. epomophora*	5									
Black-browed albatross	*Thalassarche melanophrys*	220	7	6	4	8	6	7	10	9	1
Grey-headed albatross	*T. chrysostoma*	113	6		3	4	8	4	12	1	3
Sooty albatross	*Phoebetria fusca*	13									1
Light-mantled albatross	*P. palpebrata*	27	1	2		2		4	1		
Giant petrel species	*Macronectes spp*	28	3	2					1	1	
Southern giant petrel	*M. giganteus*	77	4	5	2	3		1	7	8	
Northern giant petrel	*M. halli*	65	5	2	1	1		2	13		
Antarctic fulmar	*Fulmarus glacialoides*	184	44	9	4		1				
Antarctic petrel	*Thalassoica antarctica*	2	2								
Cape petrel	*Daption capense*	91	36	1	15	2	1		4	3	1
Soft-plumaged petrel	*Pterodroma mollis*	256	3				7	23	22	18	21
Great-winged petrel	*P. macroptera*	1									
White-headed petrel	*P. lesson*	2									
Kerguelen petrel	*Lugensa brevirostris*	162		5	4	7	7	6	21	44	3
Blue petrel	*Halobaena caerulea*	474		8		57	108	109	40	34	1
Prion species	*Pachyptila spp.*	2,646	476	108	24	123	445	101	56	12	10
Fairy prion	*P. turtur*	22	1					6	6	1	1
Grey petrel	*Procellaria cinerea*	20							1	1	1
White-chinned petrel	*P. aequinoctialis*	593	29	19	12	17	9	18	148	104	2

Table 13.1 Cont.

	Date		15/03	18/03	20/03	23/03	26/03	30/03	04/04	07/04	09/04
	Survey effort (km travelled)		125	120	135	150	150	150	150	150	90
	Station	Total	**R1**	**C2**	**C3**	**C3**	**C4**	**P2**	**P3**	**R3**	**PF**
Species	***Scientific name***										
Great shearwater	*Puffinus gravis*	3									1
Sooty shearwater	*P. griseus*	11					2	1			
Little shearwater	*P. assimilus*	1									
Wilson's storm-petrel	*Oceanites oceanicus*	377	28	6	13	2	1	9	134	21	2
Grey-backed storm-petrel	*Garrodia nereis*	3						1			
Black-bellied storm-petrel	*Fregetta tropica*	648	36	59	44	17	31	13	65	52	46
Diving-petrel species	*Pelecanoides spp.*	631			1	11	25	12	16	5	16
South Georgia shag	*Phalacrocorax georgicanus*	4									
Tern species	*Sterna spp.*	9									
Antarctic tern	*S. vittata*	7							1		
Franklin's gull	*Larus pipixcan*	1								1	
Catharacta skua species	*Catharacta spp.*	12	1	1	1		1	1	1		
Large whale species		15	7	1			3				
Fin whale	*Balaenoptera physalus*	269	93	3	63	2	3				
Southern right whale	*Eubalaena australis*	1			1						
Sperm whale	*Physeter macrocephalus*	1									
Beaked whale species		3			3						
Southern bottlenose whale	*Hyperoodon planifrons*	3				2				1	
Hourglass dolphin	*Lagenorhynchus cruciger*	131			9		6	28	10	5	
Fur seal species	*Arctocephalus spp*	462	41	26	47	16	2	7	38	11	8

The two most numerous 'species' recorded were prions (*Pachyptila spp*.) and chinstrap penguins (*Pygoscelis antarctica*) with 2,646 and 1,158 birds recorded respectively. Although the density of animals recorded throughout the cruise was generally low, there were some notable exceptions.

• At station R1, a large number of fin whales (*Balaenoptera physalus*) was encountered (at a rate of 0.74 animals per km travelled).

• At station C3, fin whales were again frequently sighted, at a rate of 0.47 animals per km travelled, along with significant numbers of chinstrap penguins (*Pygoscelis antarctica*), recorded at a rate of 3.3 birds per km travelled.

13.6 Problems and recommendations

• At the time of this cruise (March and April) the maximum day-length is approximately 12 hours. It was therefore possible for a single observer to cover all mesoscale acoustic surveys and obtain good coverage between stations.

• As noted following both JR161 and JR177, there are some issues regarding the associations between flying birds and the survey base. It is relatively easy to disregard those species that persistently form close associations with the vessel, Cape and giant petrels (*Daption capense* and *Macronectes spp*.) are particularly notable ship associates. However, most species of flying birds will associate with the vessel to some extent and whether a bird is recorded or not can become subjective. Throughout the series of Discovery 2010 cruises, an effort has been made to use consistent methodology and observers to standardise the recording procedure. A detailed description of the method used will help to maintain consistency on future cruises.

• Certain species of seabird (notably penguins and diving-petrels in the Scotia Sea) and marine mammals spend much of the time below the surface and can be difficult to detect. It is therefore important to consider sea state and visibility (for cetaceans) when analysing sightings of these species. With sufficient data, more than 1,000 animals recorded, species specific correction factors can be calculated to compensate for the lower detection rates in the outer bands of the transect. Assuming that seabirds and marine mammals do not alter their behaviour in response to the survey vessel and all animals in bands A and B are detected, the number of animals recorded in each transect band should occur in the ratio of 1:1:2:2 (A:B:C:D). However, in practice fewer than expected birds are generally recorded in the outer bands (C and D). Species specific correction factors can be calculated using the following formula.

$$\text{Correction factor} = \frac{3(A+B)}{A+B+C+D}$$

Where A, B, C and D represent the total number of birds recorded in each band.

• Throughout the cruise, the density of higher predators encountered was generally low. It was therefore possible for a single observer to individually record and time stamp each observation. However, on one occasion, while steaming through Stewart Strait (between the Willis Islands and Bird Island) a high density of birds was encountered and the method had to be adjusted to record only those birds ‘in transect’.

Some consideration should be given to the scale at which predator observation data can be analysed and whether it is necessary to time stamp each individual observation. At times when seabird and marine mammal densities are high it would be advantageous to group observations into five minute periods. This would allow the tallying of like observations and allow more time to be spent observing and less recording data. Alternatively, a scribe would be useful, however, the unpredictable nature of predator observations is not always compatible with the voluntary assistants.

13.7 Acknowledgements

For their assistance, patience, understanding and interest, and for providing cups of coffee, we would especially like to thank Captain Graham Chapman, Chief Officer Robert Patterson, the officers of the watch and watch keepers.

13.8 References

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Fig 13.2 **Species data recording form.**

JR200 Higher Predator Obs. Observer: Andy Black

Date: 12 / 03 / 09 Page 1 of 8

Time	Species	Age	Plu.	No.	Dist.	Dir.	Tran.	Ass.	Notes
09,20,00	Start								
23,10	WCP	U		1		S			
24,10	MAC	U		4	C		/		
25,00	WA	A	6	1		NE	/		
25,30	BBA	A		1		N			
26,20	SPP	U		1		O			
27,00	WCP	U		1	B		/		
etc									

14. FISH AND MACROZOOPLANKTON

Gabriele Stowasser, Yves Cherel, Anton van de Putte, José Xavier, Sophie Fielding, Geraint Tarling

14.1 Introduction

The mesopelagic fish and macro-zooplankton are an important part of the Southern Ocean foodweb. In particular mesopelagic myctophid fish are part of an important krill independent pathway linking secondary producers (such as copepods) to higher predators. During JR200 there were three key objectives associated with the Scotia Sea Foodwebs project:

1. To investigate the distribution of the mesopelagic fish community from Signy to the Polar Front to a depth of 1000 m, linking the distribution patterns to the oceanographic features identified during the cruise.

2. Investigate the diet and life-history of key myctophid fish across the latitudinal gradient.

3. Link the distribution of myctophids to the foraging areas of king penguins at the Polar Front. King penguins, which are primarily myctophid eaters, undertake long (2-3 weeks) foraging trips to the Polar Front, but the precise target of these foraging trips is still unknown. Penguins were satellite-tracked in previous seasons to identify key foraging locations and time-depth recorders provided information about diving depth. By fishing in their foraging areas, the aim is to determine the fish resources and biomass targeted by the king penguins and hence to understand why they undertake such long foraging trips.

14.2 Gear

During the cruise the RMT25 was used to characterise the fish and macrozooplankton community at each station from the surface to 1000 m. In response to unsuccessful fishing during daylight hours in the two previous seasons all catches were carried out during the night. The RMT25 was rigged with 2 new nets, with the release mechanism and downwire net-monitor with flow, temperature, salinity and PAR sensors.

14.3 Catch sorting and processing

Depth stratified hauls (1000-700 m; 700-400; 400-200 & 200-surface) were conducted at the majority of stations (21 hauls) (see Table 1), with each net open for 30-45 minutes. In addition 4 hauls (3 RMT25, 1 RMT8) were undertaken at stations targeting fish marks identified on the EK60 echosounder. For all hauls of both the RMT8 and RMT25 the total catch was sorted and quantified. Numbers caught and total weight (when > 1 g) was obtained for each species. For some groups specific identification was not possible and identification will be verified through re-examination in the laboratory in either Cambridge or by consulting colleagues specializing in these taxa outside BAS. Samples were collected from key species for stable isotope analysis and the remainder of the RMT25 catches, with the exception of the large jellies, was preserved in formalin or ethanol. If not sampled for stable isotope analysis or collaborative projects the remainder of RMT8 catches was discarded. Samples of amphipods, decapods and pteropods were preserved separately for further use in related studies within BAS and outside collaborators. All data were recorded in an Excel database. Fish were separated from the rest of the catch and were measured and sexed (using external sexual characters where present). Otoliths were extracted for identification purposes where external identification was difficult. The majority of fish were measured, sexed and frozen whole. Unusual specimens were fixed in formalin.

14.4 Preliminary results

In general sufficient data was collected to achieve objectives 1 & 2 above, although no samples were obtained from one of the stations north of South Georgia (R3), due to poor weather. In contrast to previous years objective 3 was achieved and we were able to fish both to the South and North end of the Polar Front in cold and warm waters respectively.

Over 2700 fish, belonging to 36 species were caught during this cruise (Table 2) with catches dominated by the myctophids (lantern fish) and bathylagids (deep-sea smelts) with the most abundant species being *Electrona antarctica, Gymnoscopelus braueri, Bathylagus antarcticus, Protomyctophum bolini, Krefftichthys anderssoni,* and *Cyclothone* sp.

97 invertebrate species (predominantly crustacea and gelatinous zooplankton) were identified. Catches were clearly dominated by *Salpa thompsoni* from the most Southern station up to Responsive Station 2 (R2). From the station south of South Georgia (P2) onwards catch composition changed significantly, with euphausids (e.g. *Euphausia triacantha*) and the amphipod *Themisto gaudichaudii* dominating the catches in numbers (net information see Chapter S. Fielding).

Table 14.1 : RMT25 Stations during JR200

Event	Net	Start time	End time	Start Lat.	Start Long.	End Lat.	End Long.	Water Depth	Net depth min.	Net depth Max.	SST mean
9	Both nets	14/03/2009 13:38	14/03/2009 14:26	-59.9007	-48.6542	-59.8662	-48.6695	4318	10	20	
17	Net 1	16/03/2009 02:52	16/03/2009 03:22	-60.4935	-48.2280	-60.4886	-48.2654	1508	196	405	1.1
17	Net 2	16/03/2009 03:23	16/03/2009 03:57	-60.4885	-48.2663	-60.4848	-48.3124	1656	12	202	1.1
18	Net 2	16/03/2009 05:49	16/03/2009 06:20	-60.4687	-48.4455	-60.4644	-48.4838	1700	400	703	1.1
42	Net 1	19/03/2009 02:43	19/03/2009 03:28	-60.2182	-44.2891	-60.2518	-44.2633	5458	200	401	1.7
42	Net 2	19/03/2009 03:28	19/03/2009 04:13	-60.2522	-44.2630	-60.2834	-44.2347	4615	11	208	1.7
43	Net 1	19/03/2009 06:26	19/03/2009 06:57	-60.2671	-44.3072	-60.2860	-44.3156	5409	695	1002	1.7
43	Net 2	19/03/2009 06:57	19/03/2009 07:29	-60.2865	-44.3159	-60.3075	-44.3251	5277	400	702	1.7
55	Net 1	20/03/2009 02:29	20/03/2009 03:14	-59.6883	-44.0670	-59.7223	-44.0908	4284	200	401	1.6
55	Net 2	20/03/2009 03:14	20/03/2009 03:47	-59.7226	-44.0910	-59.7464	-44.1045	4379	15	208	1.6
56	Net 1	20/03/2009 06:03	20/03/2009 06:50	-59.6980	-44.0847	-59.7221	-44.1407	4210	698	1002	1.7
56	Net 2	20/03/2009 06:51	20/03/2009 07:36	-59.7224	-44.1413	-59.7469	-44.1908	4247	397	704	1.6
81	Net 1	23/03/2009 00:48	23/03/2009 01:36	-58.0339	-42.9856	-58.0142	-42.9473	2892	203	409	2.5
81	Net 2	23/03/2009 01:40	23/03/2009 02:11	-58.0125	-42.9437	-58.0014	-42.9193	2842	12	220	2.4
82	Net 1	23/03/2009 05:07	23/03/2009 05:52	-58.0502	-42.9666	-58.0258	-42.9186	2947	688	1003	2.5

Event	Net	Start time	End time	Start Lat.	Start Long.	End Lat.	End Long.	Water Depth	Net depth min.	Net depth Max.	SST mean
82	Net 2	23/03/2009 05:53	23/03/2009 06:38	-58.0251	-42.9173	-57.9989	-42.8674	2911	400	696	2.4
100	Net 1	25/03/2009 01:14	25/03/2009 01:44	-58.0230	-43.0152	-58.0161	-43.0520	2921	198	401	2.4
100	Net 2	25/03/2009 01:45	25/03/2009 02:18	-58.0158	-43.0534	-58.0071	-43.0934	2920	25	205	2.4
101	Net 1	25/03/2009 05:12	25/03/2009 05:57	-58.0173	-43.0670	-58.0103	-43.1268	2933	698	1000	2.4
101	Net 2	25/03/2009 05:58	25/03/2009 06:45	-58.0100	-43.1281	-57.9966	-43.1944	2971	400	704	2.2
115	Net 1	27/03/2009 02:37	27/03/2009 03:08	-56.8063	-42.2328	-56.7999	-42.2620	3003	201	406	2.9
115	Net 2	27/03/2009 03:09	27/03/2009 03:31	-56.7997	-42.2627	-56.7947	-42.2833	3004	52	211	2.9
127	Net 1	27/03/2009 23:04	27/03/2009 23:49	-56.7653	-42.2254	-56.7630	-42.2714	3036	693	1002	2.8
127	Net 2	27/03/2009 23:50	28/03/2009 00:36	-56.7629	-42.2729	-56.7612	-42.3204	3447	399	701	2.8
128	Net 1	28/03/2009 02:49	28/03/2009 03:10	-56.7683	-42.1803	-56.7678	-42.1963	3565	245	274	2.4
128	Net 2	28/03/2009 03:10	28/03/2009 03:30	-56.7678	-42.1967	-56.7665	-42.2137	4067	247	270	2.5
141	Net 1	30/03/2009 01:51	30/03/2009 02:22	-55.2654	-41.3479	-55.2465	-41.3638	3572	202	402	4.3
141	Net 2	30/03/2009 02:22	30/03/2009 02:53	-55.2462	-41.3641	-55.2274	-41.3816	3495	35	209	4.3
142	Net 1	30/03/2009 05:00	30/03/2009 05:45	-55.2434	-41.3659	-55.2205	-41.3885	3415	696	1005	4.3
142	Net 2	30/03/2009 05:46	30/03/2009 06:31	-55.2199	-41.3891	-55.1972	-41.4117	3259	400	701	4.3
185	Net 1	04/04/2009 06:49	04/04/2009 07:34	-52.8156	-39.9519	-52.8220	-39.9033	3792	699	1001	5.2

Event	Net	Start time	End time	Start Lat.	Start Long.	End Lat.	End Long.	Water Depth	Net depth min.	Net depth Max.	SST mean
185	Net 2	04/04/2009 07:35	04/04/2009 08:21	-52.8221	-39.9025	-52.8295	-39.8506	3794	401	704	5.2
225	Net 1	09/04/2009 23:32	10/04/2009 00:15	-50.0474	-33.9001	-50.0419	-33.8302	5041	699	1000	6.3
225	Net 2	10/04/2009 00:16	10/04/2009 01:03	-50.0418	-33.8288	-50.0383	-33.7431	5058	400	705	6.3
226	Net 1	10/04/2009 03:25	10/04/2009 04:11	-50.0473	-33.7431	-50.0447	-33.6677	5026	202	402	6.3
226	Net 2	10/04/2009 04:11	10/04/2009 04:56	-50.0447	-33.6666	-50.0441	-33.5871	5048	31	209	6.3
227	Net 1	10/04/2009 06:41	10/04/2009 07:11	-50.0496	-33.6124	-50.0496	-33.5581	5035	518	554	6.3
227	Net 2	10/04/2009 07:36	10/04/2009 08:01	-50.0502	-33.5120	-50.0510	-33.4669	5021	285	321	6.3
235	Net 1	10/04/2009 22:18	10/04/2009 23:05	-50.6004	-33.8398	-50.5982	-33.7948	4859	201	409	3.8
235	Net 2	10/04/2009 23:06	10/04/2009 23:49	-50.5982	-33.7943	-50.5957	-33.7586	4825	10	212	3.7
236	Net 1	11/04/2009 01:18	11/04/2009 02:03	-50.5965	-33.8068	-50.5900	-33.7735	4802	700	1010	3.7
236	Net 2	11/04/2009 02:03	11/04/2009 02:48	-50.5899	-33.7732	-50.5855	-33.7393	4756	397	702	3.7
237	Net 1	11/04/2009 04:41	11/04/2009 05:06	-50.5998	-33.8235	-50.6035	-33.8015	4891	543	603	3.7
237	Net 2	11/04/2009 05:30	11/04/2009 05:55	-50.6058	-33.7811	-50.6078	-33.7609	4937	286	325	3.7

Table 14.2 : Fish caught in RMT25 Net hauls during JR200

Species	N caught
Bathylagus sp.	429
Benthalbella elongate	4
Benthalbella macropinna	11
Borostomias antarcticus	6
Electrona carlsbergi	91
Electrona Antarctica	697
Electrona subaspera	1
Gymnoscopelus bolini	1
Gymnoscopelus fraseri	61
Gymnoscopelus hintonoides	1
Gymnoscopelus nicholsi	12
Gymnoscopelus opisthopterus	2
Gymnoscopelus braueri	562
Krefftichthys anderssoni	236
Lampanyctus (=Nannobrachium) achirus	28
Lampadena sp.	1
Lampanyctus sp.	2
Macrouridae sp.	2
Cynomacrurus piriei	4
Muraenolepis sp.	6
Nansenia sp.	1
Nemichthyidae sp.	2
Notolepis sp.	22
Notothenia rossii	1
Nansenia Antarctica	2
Notolepis coatsi	18
Paradiplospinus gracilis	13
Poromitra crassiceps	8
Protomyctophum andriashevi	3
Protomyctophum tension	102
Protomyctophum bolini	259
Protomyctophum parallelum	1
Protomyctophum choriodon	24
Stomias gracilis	2
Stomias sp.	3
unknown fish species	1
Cyclothone sp.	150
Total fish	**2769**

14.5 Collaboration Projects: Dr Geraint Tarling – British Antarctic Survey

Hyperiid amphipods (Table 3) were sampled and preserved in 95% Ethanol by Geraint Tarling for a collaboration project with Lisa Bryant, Victoria University Wellington, New Zealand, for future examination of population genetics of Southern Ocean hyperiid species. Furthermore shelled pteropods species (Table 4) were collected over the course of the cruise (preserved in 95% alcohol) for future examination of their shell ultrastructure in collaboration with Nina Bednarsek (BAS FAASIS fellow).

Table 14.5.1: Hyperiid amphipod species sampled for genetic analysis during cruise JR200

Event	Species	N	Gear type	Depth intervals
7	*Themisto gaudichaudii*	20	RMT8	Depth
7	*Cyllopus magellanicus*	20	RMT8	top 100 m
7	*Vibilia cf antarctica*	10	RMT8	top 100 m
7	*Primno macropa*	1	RMT8	top 100 m
18	*Cyphocaris richardii*	8	RMT25	top 100 m
141	*Themisto gaudichaudii*	200	RMT25	1000 to 400 m
142	*Themisto gaudichaudii*	71	RMT25	0 to 200 m
142	*Cyphocaris richardii*	15	RMT25	700 to 400 m
160	*Themisto gaudichaudii*	200	RMT25	700 to 400 m
184	*Paradania boecki*	30	RMT25	0 to 200 m
184	*Themisto gaudichaudii*	200	RMT25	400 to 200 m
185	*Cyphocaris richardii*	20	RMT25	200 to 0 m
227	*Themisto gaudichaudii*	150	RMT25	700 to 400 m
227	*Cyphocaris richardii*	15	RMT25	500 to 300 m
227	*Paradania boecki*	30	RMT25	500 to 300 m
235	*Themisto gaudichaudii*	100	RMT25	500 to 300 m
235	*Paradania boecki*	20	RMT25	400 to 200 m
236 & 237	*Cyphocaris richardii*	20	RMT25	400 to 200 m

Table 14.5.2: Shelled Pteropds sampled for the examination of shell ultrastructure during cruise JR200

Event	Net	Species	N	Sampling gear	Depth interval (m)
82	1	*Clio pyramidata*	1	RMT25	1000-690
127	1	*Clio pyramidata*	1	RMT25	1000-694
142	1	*Clio pyramidata*	2	RMT25	1000-695
160	1	*Clio pyramidata*	1	RMT8	0-54
171	2	*Clio pyramidata*	1	RMT8	0-47
185	1	*Clio pyramidata* and *Limacina helicina* (large)	10	RMT25	1000-699
226	2	*Clio pyramidata*	3	RMT25	200-30
226	1	*Clio pyramidata*	4	RMT25	400-200
227	2	*Clio pyramidata*	3	RMT25	319-300
235	2	*Clio pyramidata*	~20	RMT25	206-12
235	1	*Clio pyramidata*	3	RMT25	407-201
236	1	*Clio pyramidata*	~3	RMT25	1000-700
237	1	*Clio pyramidata*	1	RMT25	586-602
237	2	*Clio pyramidata*	2	RMT25	323-301

14.6 Collaboration Projects: Dr José Xavier – University of Coimbra, Portugal

José Xavier will work on data collected during the three bio-cruises incorporated into Discovery 2010. His focus will be on investigating the biology, distributional patterns and abundance of fish species that are important in the marine ecosystem of the Southern Ocean (e.g. Bathylagus sp.) and other species that play an important role in the diet of top predators (such as myctophids, squid and macrozooplankton).

14.7 Collaboration Projects: `Dr Anton van de Putte - Katholieke Universiteit Leuven, Belgium

Within the framework of the collaboration between BAS and the Universiteit of Leuven samples of various fish species will be subsampled (tissue samples) upon their arrival in Cambridge. These tissue samples will be used for two projects.

The first project is a population genetic study on *Electrona antarctica* for which samples have been exchanged previously. For this tissue samples will be taken from sampling locations where more than 50 individuals have been collected. Sampling populations in the same area can study temporal genetic patterns, allowing estimates of effective populations sizes within the Scotia Sea.

A second project will focus on the molecular barcoding of mesopelagic fish in the Southern Ocean. For this purpose, tissue samples of one to five individuals will be collected, preferable with a photographic record of the specimen. Special attention will be paid to the myctophids for which a more extensive phylogenetic study will be carried out comparing species from the South and North Atlantic. This will allow a better understanding of the mechanisms underlying the colonization of the Southern Ocean by myctophid fish.

14.8 Collaboration Projects: Dr Yves Cherel – Centre d'Etudes Biologiques de Chizé, France

Three main investigations in isotopic ecology will be achieved using specimens/tissue samples collected both at sea and on land (Bird Island) during the duration of the cruise.

Isoscapes (isotopic gradients) within the Scotia Sea will be estimated using spatial variations of the isotopic niches of a few selected species (e.g. *Salpa thompsoni, Euphausia superba, Themisto gaudichaudii, Electrona antarctica, Gymnoscopelus braueri*) collected at various stations within different water masses.

The isotopic niches and trophic levels of the main myctophid fishes collected at the Polar Front will be compared with those from the assemblage of myctophids living in the vicinity of the front in Kerguelen waters (Indian Ocean).

The prey-predator relationships of some selected seabirds and marine mammals (fur seals) will be investigated by comparing their isotopic niches with those of their main prey collected at different stations (e.g. myctophids, *Euphausia superba, Themisto gaudichaudii*).

Finally, a few specimens collected during the cruise (e.g. *Cynomacrurus piriei*, *Benthalbella elongate and macropinna*) will be used to complete the reference collection of the CEBC (France).

14.9 Tissue sampling for stable isotope analysis

Study: Trophic relationships and carbon flow in the Scotia Sea food web

14.9.1 Background

This project targets key components within the food webs of the Scotia Sea. This area is of special importance since not only does it currently support the most valuable fishery in the Southern Ocean but it is also part of one of the fastest warming areas on the planet. In order to understand the impact commercial exploitation and climate change the Scotia Sea ecosystem we need to first understand the temporal and spatial functioning of trophic pathways in the system. The aim is to quantify regional and seasonal diets of key species and map the distribution and abundance of these species from phytoplankton and zooplankton groups up to higher predators.

The use of stable isotopes as dietary tracers is based on the principle that isotopic concentrations of consumer diets can be related to those of consumer tissues in a predictable fashion. It has been extensively applied in the investigation of trophic relationships in various marine ecosystems and has been used to determine feeding migrations in numerous species. The stepwise enrichment of both carbon and nitrogen in a predator relative to its prey suggests that the predator will reflect the isotopic composition in the prey and isotope values can be used to identify the trophic position of species in the food web investigated. Additionally ^{13}C values can successfully be used to identify carbon pathways and sources of primary productivity.

Together with results gathered from fatty acid and conventional gut content studies, stable isotope analysis will allow us to quantify spatial and temporal variability in resource use and energy flow within the Scotia Sea food web. The research will identify key trophic linkages both seasonally and geographically, and will contribute to the development of sustainable management policies for the natural resources in this region.

14.9.2 Sampling

Whole specimens of invertebrate species were collected from the RTM 25, RMT 8 Bongo and MOCNESS nets during both day and night hauls. Animals were identified, bagged, labeled and frozen at – 80°C (species catalogue see Table 6). Fish samples were frozen whole and tissue samples will be taken at BAS at the time when samples are returned to Cambridge and the fish will be processed for stomach content analysis. Particulate organic matter (POM) was filtered onto ashed glass fibre filters sampled from shallow CTDs at chlorophyll maximum depth all stations and from depth (100m, 300m, 600m and 1000m) at stations C2, P2, P3 and the Polar Front. Samples were again stored at – 80°C prior to analysis in the laboratory.

To gain insight into the feeding of higher predators both blood and feather samples of penguins and flying birds as well as blood and skin samples of fur seals, were collected at Bird Island and Signy parallel to the timing of the cruise. All biochemical analysis will be carried out at BAS, Cambridge and the NERC Mass-spectrometry facility in East Kilbride.

Table 14.9.1: Species collected for stable isotope analysis

Process (P), condensed (C) and responsive (R) stations during cruise JR 177. T = test station), sh = shelf station, PF=Polar Front.

Species	**T**	**R1**	**C2**	**C3**	**C4**	**R2**	**P2**	**P3**	**PF**	**SH**
POM	x	x	x	x	x	x	x	x	x	x
Calycopsis borgrevichi	x	x	x	x	x	x		x	x	x
Diphyes sp.1	x	x	x	x	x	x		x	x	
Atolla wyvillei		x	x	x	x	x	x	x	x	
Periphylla periphylla			x	x	x	x		x	x	
Stygiomedusa gigantea					x					
Metridia sp.			x							
Calanoides acutus		x	x	x						
Calanus propinquus		x	x	x						
Calanus simillimus							x	x		
Pareuchaeta sp.								x		
Rhincalanus gigas		x	x	x						
Themisto gaudichaudii				x	x	x	x	x	x	x
Euphausia frigida		x	x	x			x	x	x	x
Euphausia triacantha				x	x	x	x		x	
Euphausia superba	x	x		x	x	x	x	x	x	x
Euphausia vallentini							x	x	x	
Thysanoessa sp.				x		x		x	x	x
Galiteuthis glacialis		x		x		x	x	x	x	
Slosarczykovia circumantarctica						x	x	x	x	
Sagitta sp.		x				x	x	x	x	
Salpa thompsoni	x	x	x		x	x	x	x	x	

15 POLAR FRONT WORK

Sophie Fielding, Hugh Venables, Peter Enderlein, Gabi Stowasser, Yves Cherel, Anton Van de Putte, Jose Xavier, Pete Ward

15.1 Introduction

JR200 represented the third attempt to assess the foodweb structure at and just south of the Polar Front, in particular to understand why King Penguins from South Georgia forage at the Polar Front. During the previous Scotia Sea cruises (JR161 and JR177) King Penguins were simultaneously tracked, using geolocators and argos transmitters, from South Georgia and the Polar Front station work on the ship was positioned according to the King Penguin positions. As no King Penguins were tracked in the 2008/9 season the sampling area had to be chosen based on the foraging areas of King Penguins in previous years relative to the Polar Front, and satellite data on the location of the Polar Front.

15.2 Finding the Polar Front

The two main sources of satellite data are AVISO absolute dynamic height and OSTIA sea surface temperature (SST). Contours of dynamic height are streamlines of geostrophic flow, the flow being proportional to the gradient in dynamic height. This has the advantage of showing where the strong flow of the Polar Front is located but has the disadvantage of being delayed 7 days and not being directly measurable from the ship. The file size at download is 1.5Mb. SST data (file size 7Mb on download, which occasionally failed) are available 1 day delayed and can be measured by the ship's underway oceanlogger (which had been calibrated against the CTD surface temperatures during the cruise).

The disadvantage of SST data is that there is considerable surface heating during the season (from 2°C to 7°C) so it is only possible to define a surface temperature for the Polar Front for a particular area (the magnitude of the surface heating is dependent on latitude and variability is probably decorrelated at some longitudinal separation) at a particular time of year for a particular year. This can be achieved by defining the bounding dynamic heights of the Polar Front (using Elephant Seal transects courtesy of Lars Boehme) and then cross referencing different dynamic height levels to SST through 2007-2009 (the period of OSTIA SST availability). The appropriate dynamic height was chosen by the behaviour of tagged King Penguins in 2007/8 and the SST at that time. The SST for early April 2009 was then found for this dynamic height.

Assessing SST and dynamic height images from the beginning of the cruise allowed a section of the Polar Front to be identified. It was considered suitable for sampling as it was in a similar location to that visited in previous years by tagged penguins and was narrow, allowing a rapid survey across the gradient. It also appeared stable in location. The area to the west, which was closer, was wide with dynamic height contours doubling back on themselves within so it would have been harder and more time consuming to survey. An inevitable consequence of choosing a narrow section of Polar Front was the strong currents, which reached 2 knots in ADCP data.

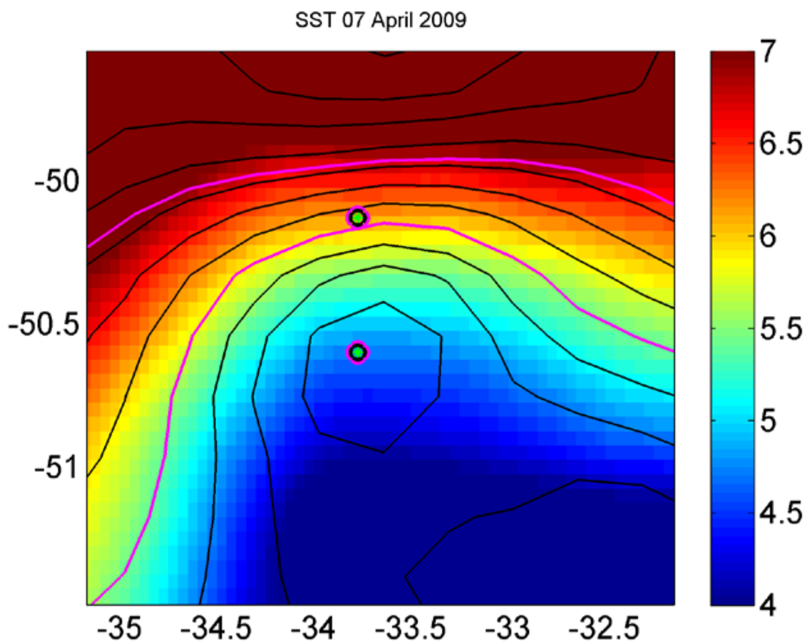

FIG 15.2.1 OSTIA SST image with overlain dynamic height contours

The magenta contours are the 40 and 65dyn cm contours that were taken as the approximate south and north edges respectively of the Polar Front. The dynamic height contours are a week older than the SST image so the agreement in the structure is due to the location of the feature being relatively stable. This was produced the day we were steaming towards the area on the 8th April.

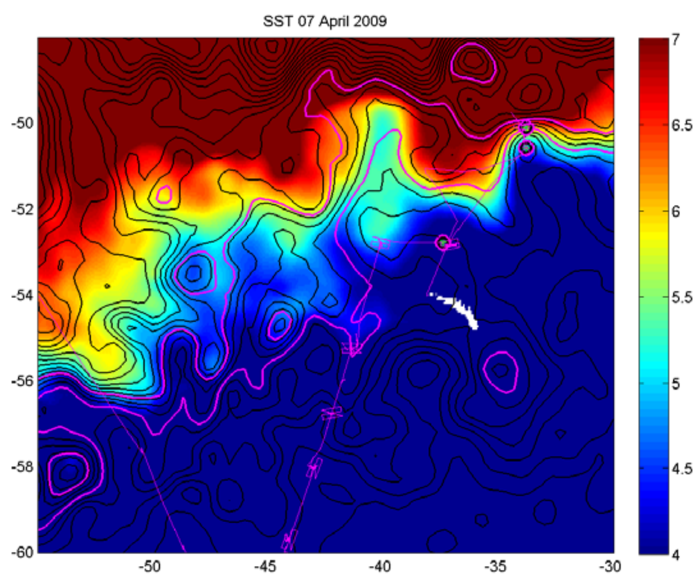

FIG 15.2.2 Dynamic height contours over OSTIA SST.

The contours picked out in magenta show the path of the Polar Front with the changing SST signature with latitude and varying width evident.

15.3 Polar Front Station strategy

In order to assess the difference in ecosystem structure at the Polar Front, two survey sites were identified. Polar Front north (PFn - 50° 03.79''S and 34° 01.40''W) was in the Polar Front, identified through SST, dynamic height and the occurrence of a temperature minimum at ~200m depth – identified from XBTs deployed on transit from R3 to the Polar front (Fig 16.3.1). PFn was positioned 33 nmiles north of the nominally identified Polar Front station position (used as Polar Front south PFs 50° 35.99'' and 33° 48.11''W – to represent south of the Polar Front conditions). In addition, throughout the 3 days allocated, 6 CTDs were planned in a transect across the Polar Front, connecting the two stations PFn and PFs.

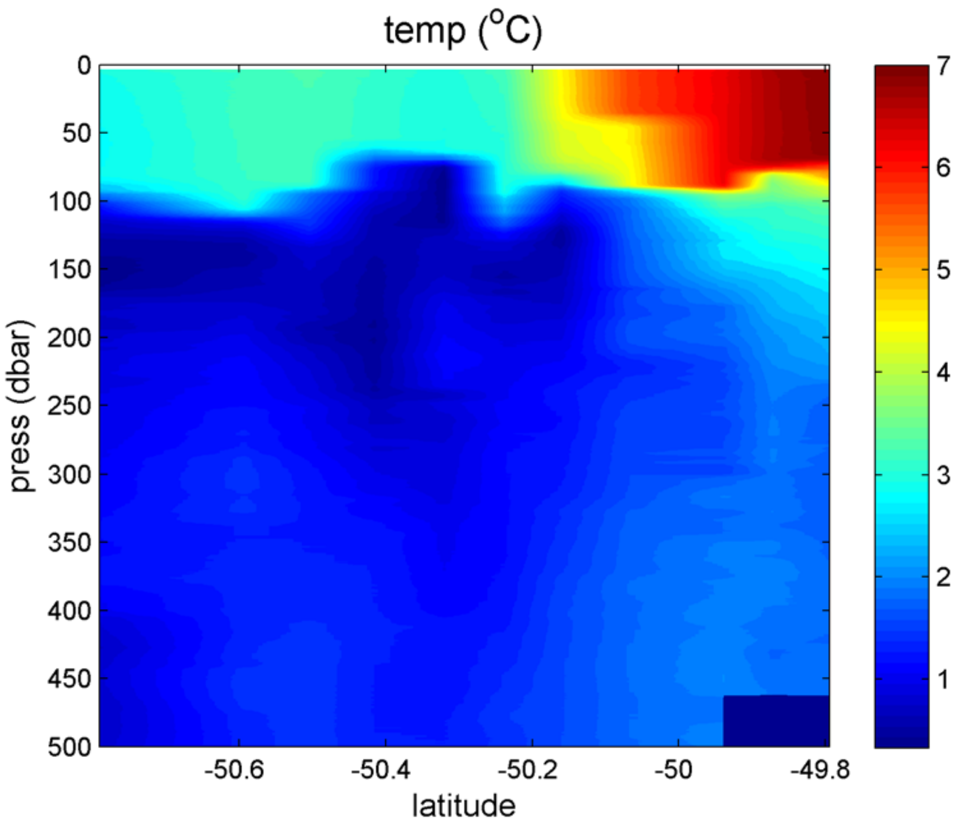

Fig 15.3.1 XBT section across Polar Front.

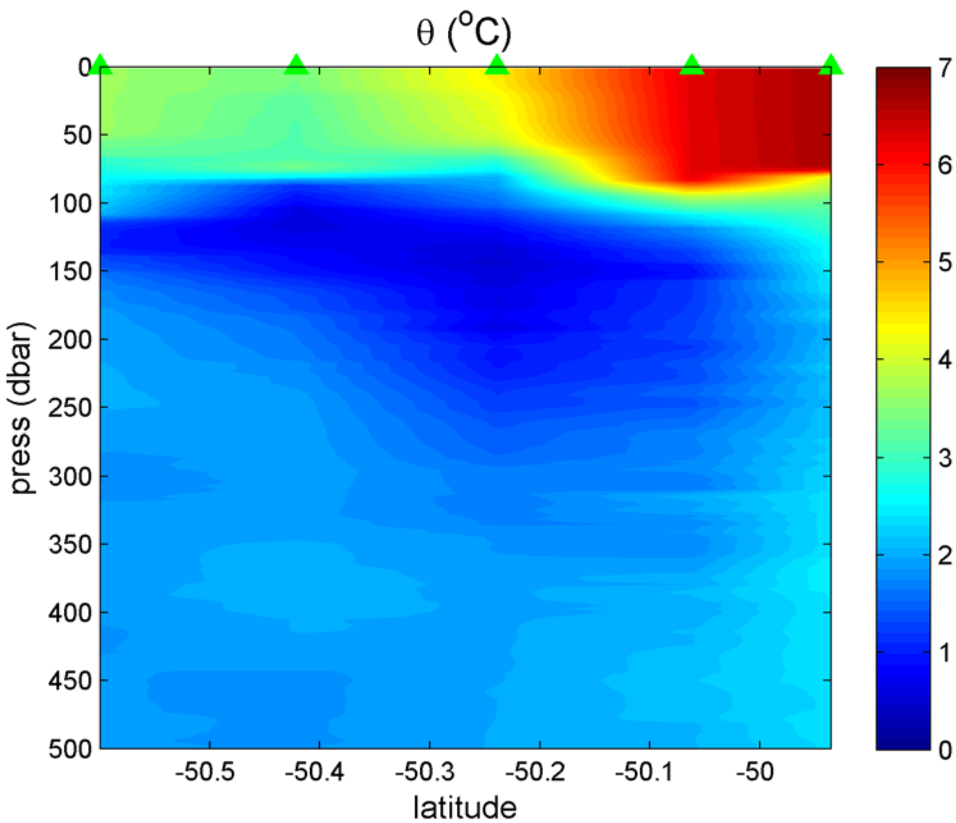

Fig15.3.2 Shallow CTD section across Polar Front.

15.3.1 PFn

On arrival at PFn the weather was not favourable to undertake any science and the vessel spent the night hove-too. During the following day an acoustic survey (3 times 30 km transects) was undertaken around the station (see section 12). A CTD (Ev_223) to 600m was completed at the end of the last acoustic transect marking the most northerly end of the CTD transect across the front. A second CTD (1500m) was undertaken at the PFn position. It was noted that there were strong currents (2 knots) in the area that caused difficulty for the vessel to stay on station, as well as concerns for getting nets – particularly the light LHPR – to the target 1000m. Later it was decided not to deploy the LHPR (since we were fishing with the current due to wind direction) as it may have caught up with the towfish. Three RMT25s (Ev_225-227) were undertaken, two sets of stratified nets (1000-700, 700-400 and 400-200, 200-near surface) and 1 targetted trawl (550m and 300m). In order to sample available mesozooplankton the Bongo net (Ev_228-230) was used. After completion, the vessel headed south to undertake the PFs station work, undertaking two 600m CTDs (Ev_231-232) on the way to continue the CTD transect across the Polar front.

15.3.2 PFs

During transit towards PFs it was noticed that the RMT25 17mm wire had bird-caged, which could prevent fishing that evening. Instead of heading to the first leg of the acoustic survey the ship was stopped and the 17mm wire dangled in the water with a weight on the end to tighten up the wire. This was successful, although there was not enough daylight left to undertake the acoustic survey. It was decided to run an LHPR (Ev_234) prior to the evenings RMT25 fishing.

The RMT25 (Ev_235-237) fishing was undertaken successfully at PFs, in the same fashion as at PFn (2 sets of stratified hauls 400-200,200-near surface and 1000-700, 700-400m and 1 targetted trawl at 550 and 300m), in increasing weather conditions. These were significantly easier without the strong current found at PFn. A CTD to 1500m (Ev_238) and a Bongo (Ev_239) and minibongo (Ev_240) were undertaken before the ship had to become hove-too in worsening weather. As a result an acoustic survey could not be undertaken at PFs, although it should be noted that the station was run through several times with the echosounder running continuously.

15.4 Comments, Problems and future suggestions

First and foremost the Polar front work was completed because of a small weather window and the willing of the ship's personnel and scientific personnel to work in difficult conditions and to optimise opportunities as they arose. Thanks to all.

The strong current, of up to two knots, produced some trouble with getting the RMT25 to the correct depth. It was also fortunate that sea condition meant that the net could be towed along the current (though against would have been faster). Towing across the current could have proved difficult with the wire angle and crossing into different water masses. It would therefore have been better overall to have been in a slightly wider section, with slower currents, if a suitable section was available.

16. SCIENTIFIC SUPPORT

16.1 Gear Report

Peter Enderlein

16.1.1 General

This was the third cruise with a high number of deployments of towed gear. There where over 83 deployments over the stern and more than 50 deployments over the side. Because of the number of different towed gears and their different requirements the cables needed lots of swapping over. At one point the “biowire” was reterminated because the cables electrical termination became unreliable (it was still the termination from last season). The intensive use of the equipment always causes certain wear and tear to the equipment. But everything worked very well with a problem rate of less than 10 %. All equipment was deployed to the maximum depth of 1000 m.

16.1.2 Down Wire Net Monitor

During this cruise the DWNM had been used on the ‘Biological wire’ for the RMT8 and the LHPR, and on the 17mm co-ax cable (ROV Cable) for towing the RMT25.

This was the first season of the new developed DWNM system. All the equipment was not in water tested and had not been tested on JCR before. Therefore there were a few problems in the beginning but after the initial problems where solved it worked very reliable. The new improved electronics, deck unit, connectors, cables, sensors, and the new software interface are a huge improvement compared to the old system. Having had 3 fully independent systems, to eliminate the swapping over, improved the reliability of the system even further. Also having the batteries from the RMT25 release into the DWNM housing is a big improvement as these batteries are now gets charged automatically by the system. The implementation of the three new DWNM systems is a big step forward regarding workload, reliability and quality.

Having also spares for everything and proper documentation helps a lot. For next season a new set of cables, a spare PC, a spare serial card and 3 more depth sensors should be purchased. That would finish the DWNM system replacement and only “normal” maintenance should be required thereafter.

16.1.3 RMT25

This net was used to make 23 hauls, for stratified hauls and target fishing at the polar front. The new net type where used this year and due to the high number of salps found on the south stations the nets filled up with them on several occasion. This needed the use of the Gilson winch to get the heavy net on deck. This also caused the net to get some damage during these recoveries. The nets need some minor repairs as they have been used now for two seasons in a row. General they are still in good conditions but repairs should be done before they got used again to prevent major damage. The padding put into the mouth layers are not staying in there over time and will be pulled out during deployments so they can be found in the net afterwards. A new way of some moth protection should be found, probably by using a different type. Also we should look in how to keep the towing loops in place so the nets cannot move inwards. But in general they are very good. Due to the number of deployments and the wear and tear in sometimes not ideal conditions the side wires were worn out and the starboard needed replacing with the spare.

The swivels on top of the side wires prevented them from twisting and in the future we should continue to use swivels so the side wires so they can turn freely. Also the reinforced non-filtering cod-ends proved to be reliable, compared with the once used last year. Only one got damaged slightly and need minor repairs.

16.1.4 RMT8

The RMT8 was used 28 times for target fishing for krill. It worked very well and caught krill in good conditions for live experiments, using the non-filtering cod-ends. At one point one old net was ripped apart which was not spotted in the first instance by the recovery crew. The net was swapped with a new one. Two more new nets should be purchased for next season.

16.1.5 LHPR

The LHPR was used 16 times and worked very well. With the new DWNM system there is now a separate channel given for the Opening Closing mechanism, so it can be turned in the open, closed position as often as required. The LHPR was deployed with the Opening Closing mechanism in the closed position, then opened at 1000 m and left open until it was back on deck. With the given towing speed and ship speed the LHPR made about 40 advances at a 120 sec. interval. Also there where no mismatches between the Gauze advances and the advances given by the software. In the beginning a connector came lose which forced water inside the DWNM housing destroying the electronics.

16.1.6 MOCNESS Net

The MOCNESS Net was deployed 16 times and it worked very well. Only the flowmeter seem to be a little bit sticky on a few occasions, so it was replaced with a spare one. During one deployment the nets got jammed on the feedback system bending the two stainless steel bars, these where replaced by the spare once. A spare PC should be bought to increase backup. Also the towing bridles needs replacing. Additionally we should look in replacing the original connector with the same Micro Wetcon connector used on all other gear.

16.1.7 Bongo and Mini-Bongo Net

The Bongo and Mini-Bongo net were deployed 50 times and worked very well. The new bars, and cod-ends were used on the new spring mechanism and the new top and old bottom ring frame. The cod-ends are a clear improvement to the old ones. During one deployment the spring wire got a little bit damaged and the damage was monitored during the following deployments. As no deterioration happened the spring unit was not replaced as the damage was a one off and not constant.

16.1.8 Recommendations

On a more general note mobilisation this time went very well having had 4 people flying south 4 days ahead of the main team. This allowed a proper mobilisation and reduced pressure during the first few days dramatically.

Demobilisation again relied on good weather condition during passage from and to the Falklands.

Time should be allocated for future cruises especially if the same amount of gear will be used.

We should keep in mind that we need 3 days for mobilisation and 2 day for demobilisation as long as we use the same amount of gear.

16.2 AME Report

Julian Klepacki

FAO:
The BAS AME (electronics) marine scientific instrumentation support engineers

Cruise Report Instructions

Richard Bridgeman (RIBR) is the first point of contact for marine scientific instrumentation – any questions email (ribr@bas.ac.uk) or phone him (01223 221407); try Steve Bremner (sfbr, 01223 221416) when Richard not available.

Before you leave HQ for cruise support obtain an up to date DVD image of the JCR directories from the M: drive. The database for locating incidentals and spares is now maintained on the JCR by AME and a copy for reference should be sent back to the UK each year. Please contact RIBR if you are unfamiliar with this database. A list of spares/stock required should be included at the end of this report. However critical items must be ordered immediately.

A brief cruise report checklist is required for every cruise AME are responsible for supporting. Include pertinent notes on fault history and diagnosis at the end of the report even if you have already discussed via email. This information will be added to the instrumentation database maintained in the UK.

Please log all problems or changes made to systems in use while the cruise is underway to your own logbook.

At the end of the cruise, please fill in the simple checklist attached, briefly describing any problems or changes made to the instrumentation (including intermittent problems, repairs, expansion, changes to software, etc). Tick ‘Used?’ against all instruments which were used or logged. This is so we can follow up these issues and keep a good history of our instruments.

In order to help us with calibrations and repairs, please note the serial numbers of the instruments actually used (as listed on the checklist), and also serial numbers of any spares which you swapped or tested due to a fault or fault-finding. Enter any details on the checklist. We now have many spare sensors that are identical except for serial number.

Please leave a copy of the cruise report on the ship in the electronics workshop for the next support engineer and email a copy to RIBR & SFBR.

Cruise: JR200 Start date: 09/03/2009 Finish date: 21/04/2009
Name of AME engineer: Julian Klepacki
Name of principle scientist (PSO): Beki Korb

Instrument	Used?	Comments
XBT (aft UIC) (PC, I/F box, handgun)	Y	O.K
Scintillation counter (prep lab)		
AutoSal (labs on upper deck) S/N 63360		
AutoSal (labs on upper deck) S/N 65763		
AutoSal (labs on upper deck) S/N 68533		
AutoSal (labs on upper deck) S/N 68959	Y	O.K
Portasal S/N 68164		
Magnetometer STCM1 (aft UIC)	Y	O.K
AME workshop PC	Y	O.K

16.2.1 GPS, MRU, Gyro

GPS Furuno GP32 (bridge – port side)	Y	O.K
DGPS Ashtec ADU5 (bridge – port side)	Y	Needs episodic reset
DGPS, MRU Seatex Seapath (UIC – swath suite)	Y	O.K
DGPS Ashtec Glonass GG24 (bridge – starboard side)	Y	O.K
Gyro synchro to RS232 Navitron NT925HDI (UIC – aft)	Y	O.K
TSS HRP (UIC repeater)	Y	O.K

16.2.2 ACOUSTIC

Instrument	Used?	Comments
ADCP (aft UIC)	Y	O.K
PES (aft UIC)		
EM120 (for'd UIC)	Y	O.K
TOPAS (for'd UIC)		
EPC plotter (used with TOPAS)		
EK60 (mid UIC)	Y	O.K
HP deskjet 1 (used with EK)		
HP deskjet 2 (used with EK)		
SSU (for'd UIC)	Y	O.K - Trigger input still 'grounded' internally via jumpers
SVP S/N3298 (cage when unused)		
SVP S/N3314 (cage when unused)		
10kHz IOS pinger		
Benthos 12kHz pinger S/N 1316 + bracket		
Benthos 12kHz pinger S/N 1317 + bracket		
MORS 10kHz transponder		
Sonardyne USBL (aft UIC)		
Sonardyne 7970 SSM Beacon cupboard 709 (by pes)		
Sonardyne 7971 SSM Beacon cupboard 709 (by pes)		

16.2.3 OCEANLOGGER

Instrument	Used?	Comments
Main logging PC hardware and software	Y	O.K
Barometer (back of logger rack) #V145002 (7/03)	Y	O.K
Barometer #V145003 (7/03)	Y	O.K
Barometer #Y2610005		
Barometer #W4620001		
Air humidity & temp (for'd mast) #15619015	Y	O.K
Air humidity & temp (for'd mast) #60000120	Y	Erroneous data, awaiting opportunity for ADC module replacement
Air humidity & temp (Drawer No. 907 aft UIC) #60000119		
Air humidity & temp #15619025		
Air humidity & temp #28552023 (HT1, 7/03)		
Air humidity & temp #18109036 (HT2, 7/03)		
Thermosalinograph SBE45 (prep lab) #4524698-0016		
Thermosalinograph SBE45 # 4532920-0072		
Thermosalinograph SBE45 #4524698-0018 (7/04)	Y	O.K
Fluorometer (prep lab)	Y	O.K
TIR sensor (pyranometer) (for'd mast) #990684	Y	O.K
TIR sensor		

#32374 (TIR1, 7/03)		
TIR sensor #990685		
TIR sensor #011403 (TIR2, 7/03)		
PAR sensor (for'd mast) #990069	Y	O.K
PAR sensor #990070		
PAR sensor #30335 (PAR1, 7/03)		
PAR sensor # 010224 (PAR2, 7/03)		
Flow meter (prep room) #45/59462		
Uncontaminated seawater temp (transducer space)	Y	O.K

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

Instrument	Used?	Comments
Deck unit 1 SBE11plus S/N 11P15759-0458		
Deck unit 2 SBE11plus S/N 11P20391-0502	Y	O.K. Patch lead BNC connection to Sci-wiring failed. BNC replaced.
Underwater unit SBE9plus #09P15759-0480 Press #67241	Y	Deck unit error when connected.
Underwater unit SBE9plus #09P20391-0541 Press #75429	Y	O.K, swopped with 0480, but re-fitted due to 0480 error
Underwater unit SBE9plus #09P30856-0707 Press #89973		
Underwater unit SBE9plus #09P35716-0771 Press #93686		
Carousel & pylon SBE32 #3215759-0173		
Carousel & pylon SBE32 #0248		
Carousel & pylon 24 Bottle	Y	O.K
CTD swivel linkage	Y	O.K
CTD swivel S/N196115	Y	O.K, changed, but not faulty, back in case in cage
CTD swivel S/N196111	Y	O.K, presently fitted to CTD

CTD contd – C & T & pumps – please state which primary and secondary

Temp sensor SBE3plus #03P2191	Y	O.K, secondary T2
Temp sensor SBE3plus #03P2307		
Temp sensor SBE3plus #03P2366		
Temp sensor SBE3plus #03P2679		
Temp sensor SBE3plus #03P2705		
Temp sensor SBE3plus #03P2709		
Temp sensor SBE3plus #03P4235	Y	Secondary T2, changed, erroneous data
Temp sensor SBE3plus #03P4302	Y	O.K, Primary T1
Cond sensor SBE4C #041912	Y	O.K, secondary C2
Cond sensor SBE4C #041913		
Cond sensor SBE4C #042222		
Cond sensor SBE4C #042248		
Cond sensor SBE4C #042255		
Cond sensor SBE4C #042289		
Cond sensor SBE4C #042813	Y	Secondary C2, changed, erroneous data
Cond sensor SBE4C #042875	Y	O.K, Primary C1
Pump SBE5T # 51807	Y	Changed, erroneous T1 and C1
Pump SBE5T # 51813		
Pump SBE5T # 52371	Y	O.K, P1
Pump SBE5T # 52395	Y	O.K, P2

Pump SBE5T # 52400		
Pump SBE5T # 53415	Y	Changed; job lot with T2 and C2

CTD contd

Instrument	Used?	Comments
Fluorometer Aquatracka MkIII #088216		
Fluorometer Aquatracka MkIII #088249	Y	O.K
Standards Thermometer SBE35 #3515759-0005		
Standards Thermometer SBE35 # 3527735-0024		
Standards Thermometer SBE35 # 3535231-0047	Y	Changed, failing to record; seaterm ADC fail
Standards Thermometer SBE35 # 3538936-0051	Y	O.K
Altimeter PA200 #2130.26993		
Altimeter PA200 #2130.27001	Y	O.K
Transmissometer C-Star #CST-396DR		
Transmissometer C-Star #CST-527DR	Y	O.K
Transmissometer C-Star CST 846DR		
Oxygen sensor SBE43 #0242		
Oxygen sensor SBE43 #0245		
Oxygen sensor SBE43 #0620		
Oxygen sensor SBE43 #0676	Y	O.K
PAR sensor #7235	Y	O.K
PAR sensor		

#7252		
PAR sensor #7274		
PAR sensor #7275		

Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc.		50m of cable removed. Slip rings cleaned. Cable jammed and damaged, approx 10m removed. Re-terminated (potted)

16.2.5 AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	Used?	Comments
EA600 (bridge and UIC remote)	Y	O.K
Anemometer	Y	O.K
Gyro	Y	O.K
DopplerLog	Y	O.K
EMLog	Y	O.K
CLAM winch monitoring system	Y	O.K

At the end of the cruise, please ensure

- 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	no
EM120, TOPAS, NEPTUNE UPSs	no
Seatex Seapath	no
EM120 Tween Deck	no
TOPAS Tween Deck	no

16.2.6 Additional notes and recommendations for change / future work

DWNM MkIII U.W.U.

Swopped internal +ve and –ve seacable connections. Internal connections were opposite to document diagram. Working o.k

Replaced pressure connector on same UWU, ingress of water led to erroneous readings. Working o.k

Same unit later suffered water ingress. Short circuit on P4 of motor control board damaged track etc. All boards replaced inside unit. Working o.k

Net release motor connection pinout different to diagram. Rewired and working o.k.

CTD

Original supply of mastic based heat-shrink has been found in the cage (x5 1 meter lengths of 1" diameter and x10 1meter lengths of approx' 12mm diameter reinforced tubing.

Use of encapsulated resin for termination has highlighted advantages, basically impervious to moisture.

Thoughts over using potted termination as and when time allows for curing, i.e. beginning of cruise or between CTDs, if time allows. Use of heat-shrink in emergencies and where time does not allow curing of resin.

Might be worth investigating availability of rapid curing polyurethane resin for terminations?

At present CTD termination is potted.

16.3 ICT Report

Johnnie Edmonston

16.3.1 Acquisition machines

SCS

ACQ Stopped At 03/14/2009, 12:44:13 – data streams still running from previous cruise, stopped acquisition to add netmonitor
ACQ Started At 03/14/2009, 12:50:22

ACQ Stopped At 03/14/2009, 14:23:14 acquisition stopped – wrong netmonitor config
ACQ Started At 03/14/2009, 14:23:49 acquisition restarted – correct netmonitor config added

ACQ Stopped At 03/22/2009, 21:58:00 - tsshrp grown too large, file renamed tsshrp0
ACQ Started At 03/22/2009, 22:05:27 restarted to create new tsshrp file

ACQ Stopped At 04/05/2009, 13:47:33 tsshrp grown too large, file renamed tsshrp1
ACQ Started At 04/05/2009, 13:48:16 restarted to create new tsshrp file

ACQ Stopped At 04/07/2009, 20:56:41 – web interface not updating, rvs streams not updating, scs restarted and remounted on jrua and jrub
ACQ Started At 04/07/2009, 21:04:34 -

ACQ Stopped At 04/08/2009, 23:06:34 logging stopped – ashtec data corrupted
ACQ Started At 04/08/2009, 23:06 – logging restarted.

Netmonitor

Serial Card on netmonitor packed up, found serial card in old ctd machine attempted to fit it in to the netmonitor PC, but couldn’t find drivers.

Solution was to leave the serial card in the original machine, and turn into the new netmonitor. This involved installing labview and then just copying the netmonitor files onto the PC, location largely irrelevant, through trial and error, it was discovered that all labview installation options must be selected in the install process.

Suggest keeping a stock of cheap and nasty serial cards, the one which failed in the netmonitor was whizzy and expensive, the price of which would have bought a dozen cheap ones, which do the job adequately.

CTD PC

Performed well with no faults.

XBT PC

Performed well with no faults.

ADCP

Performed well with no faults.

Scintillation Counter

Performed well with no faults.

16.3.2 Servers

JRNA

No real problems, some warnings of low disk space on sys, cleared out tmp files.

JRUA / JRUB

Replaced processor at the start of the cruise, and re-installed original disks, thus putting jrua and jrub back into their respective machines.
Had to reboot jrub later to rebuild device list, was unable to see the Tandberg LTO2 tape drive.

AMS3

Stopped responding, due to problems on JRLA.
JRLA – machine restarted and bind restarted, AMS3 restarted, although the imap and smtp services were ok after jrla problems were fixed, the web management interface was not responding.

16.3.3 PC's

Chief Engineers PC

Chief Engineers PC had the hard disk replaced, problem first of all looked like a simple AMOS reinstall, but multiple reinstalls, and various attempts at moving around dll's it was complaining it needed failed to resolve the problem.

Hard drive image made and placed on new disk, all amos problems vanished, and performance increased.

Suggest keeping an image from time to time of that machine, possibly the most involved PC on the ship.

Also suggest higher spec machine, max memory, perhaps internal raid.

Combined office PC

PSU in combined office blew up, big bang, smoke and flames. Replaced.

Virus ridden laptop

Scientists' personal laptop with suspected rootkit, although it was never found and eliminated, exhibited all the behaviour of a virus.

After 3 days of trying to find and eliminate the virus, the machine was completely rebuilt. It took 3 days to download the drivers for this machine; it would be nice if people brought recovery disks with them, and copies of any personally licenced software that they consider vital.

Earl Grey attacks laptop

Scientists personal laptop attacked by Earl grey, luckily no sugar or milk were involved.
After 2 days of sulking and generally aberrant driver the laptop decided to play nicely and has largely forgiven its owner with only the touchpad being dodgy. Happy laptop owner given a mouse and congratulated on good taste in tea.

16.4 Data Management

Nathan Cunningham

16.4.1 BASNet

BASNet is a major improvement for the JCR. It facilitates the use and interaction of the data streams collect in ways that were previously impossible. It opens up the opportunity to undertake scientific projects remotely and allows the unique and valuable nature of the JCR data to be disseminated quickly into the scientific community. For example, the Met. Office are extremely interested in receiving near-real-time data from the ship to input directly into their GCMs and Ocean models. This will mean that the profile of BAS as a unique data provider is increased, and enhanced in many positive ways. Not only being involved in collaborating with external institutions, but getting acknowledge for doing so. I can not emphasis enough on how this technology is influence the way we work and think about our data.

16.4.2 Near-real-time JCR Data

Project Brief

- Maintain the requirement for anybody on the ship to get at the data easily.
- Facilitate the viewing, access, retrieval of data from the JCR and Cambridge
- Ensure that a non-specialist interface to the JCR data resource.
- Increase the scientific/data output of the JCR.
- Provide a vital link in the long-term management of LTMS data.

Scientific Instrumentation on the JCR

There is interest and consensus across BSD that access to the JCR data streams in near real-time will offer substantial benefits, efficiencies and productivity to the marine based science being undertaken by the division. In addition, with this further functionality it will help to secure the JCRs reputation as one of the best research ships to accomplish world class Antarctic marine science.

This consideration is made with the recent developments on the US research ships, which have started to provide their data in near-real time.

The main impacts are threefold, firstly it will allow the scientist to have an overview of the environmental, oceanographic, discrete equipment and underway data. Secondly, allow the scientist to react to these conditions and suggest alterations to instrument parameters to ensure the best quality data is collected. Finally, dramatically reduce the turn around time of raw data to proceed data can be, especially if the specialist scientist is not on that particular cruise; for example, anoceanographer to process the ADCP data.

With the implementation of near real time data streaming from the JCR it is understood that it is limited by the narrow bandwidth currently available, but with a coordinated effort most aspects of the JCR instrumentation could be summarised and binned into data packets suitable for streaming back. The instruments that are currently logged to the central SCS system could be streamed backimmediately as a low priority process over BASnet.

A proof of concept, targeting instrumentation used by for physical oceanography has been achieved. It is complex enough to cover all the aspects of near real time data streaming by initially targeting three instruments and the underway SCS data. These are the CTD, the ADCP and the XBT data and the following things need to be implemented:

1. Develop the reduced data sets that are suitable for streaming back.
    a. ADCP – already summaries its data into 2 minute bins.
    b. CTD – this will output another data stream a reduce level (1-2 seconds) from the default 1/25th of a second and provide an initially overview of the cast.
    c. XBT – produce small ASCII file suitable for streaming back.

2. Develop the interface for streaming back data
    a. Work closely with PSD project for streaming back Halley data and develop knowledge and information transfer working practice.

3. Scientist/data manager works on streamed data to check that it can be used to
    a. Provide a succinct overview
    b. Enough detail to perform initial analysis and suggest alteration to the collection parameters
    c. c. Does improve the turn around time of the raw data and the overall scientific output. It is important to emphasis that this project should work closely with Peter Kirsch and the Halley data-streaming project.

Implementation

The project was successfully implemented and the proof of concept worked. Data is now streamed back to the UK in near real time. I would like to extend my gratitude to Jeremy Robst, Peter Kirsch, Paul Breen and Dave Judge for all their efforts. This work will help bring about a step change on how BSD can use and interact with the JCR.

16.4.3 Using Google Earth to Visualise Underway Data

The uptake of Google Earth as a quick and easy data visualisation tools has been good and levels of interest are high. Working with a number of scientist onboard the JCR serval useful data discovery products were produced. For example Martin Collins king penguin data was plotted using Google Earth and overlays of sea surface temperature and chlorophyll (from Beki Korb) were combined to help identify where the last polar front process station should be located.

David Judge developed an impressive range of Google Earth tools to help visualise ship data. These tools will be invaluable to how BSD scientist can discover which data sets are of interest. I would like to thank Dave Judge, Peter Kirsch and Paul Breen for all their work, help and support.

16.4.4 Polar View Project

Working with Andrew Fleming a number of Polar View products were available for use on the ship. The most impressive is the high quality sea ice images. These were used by the JCR

Officers to help inform them of the conditions around Signy. The Polar View Project uses Google Earth as its deliver technology and again will help form the suite of scientific tools utilising BASNet. We are successfully streaming in up-to-date Modis images from PML, NEODASS. Many thanks to Andrew Fleming and Peter Miller for getting this to work so well.

16.4.5 Web Based Data Tools

The event logs and integration tools were updated and widely utilised by all on the ship. Many thanks to Jeremy Robst for his hard work.

16.4.5 Utilities

Many thanks to Jeremy and Johnnie for setting up the software utilities (many of which where developed by Jeremy) to bring the processing of the underwaydata etc. into the 21st Century. These include the Google cruise track and the net monitor util. Details of how to use the net_transect.sh utility below.

```
Hi Nathan,

Ok, I think I've got it all fixed.

You need to change your qry_ input files so that they just contain the
event, Net Type (though this can be any string - it detects LHPR/RMT based
on the mot0,1 variables so you could have both net types in one file if
you want) and then start time, end time - (see ~jpro/jr200a for samples).

Then just run (after doing setup scs)

/nerc/packages/dps/current/utils/net_transect.sh input_filename > stats.csv

and it'll produce the output file with all the stats, net events etc in
one go.

Jeremy
--
jpro@bas.ac.uk | (work) 01223 221402 (fax) 01223 362616
Unix System Administrator
```

17. PUBLIC UNDERSTANDING OF SCIENCE

José Xavier

17.1 Introduction

During the JR200, numerous education and outreach activities were carried out. Their main objective was to promote polar science, educate the younger generations of the importante of the polar regions and provide various perspectives of the life of a scientist, or of a crew member, onboard of the James Clark Ross during the cruise, as part of the International Polar Year 2007-2009 (IPY). To our knowledge, this is the first time that education and outreach activities are described as part of a cruise report of the British Antarctic Survey.

17.2 Results

In order to reach a wide range of the public, various ways of communication between the James Clark Ross and the world were carried out:

17.2.1 WORLD WIDE WEB (Blogs and websites)

Two blogs were highly active during the cruise. The bi-lingual blog of José Xavier was created for the International Polar Year (www.cientistapolarjxavier.blogspot.com), and was already used on the previous cruise (JR177, between December 2007 and February 2008). The objective of the blog was to provide, on a regular basis in English and Portuguese, interesting information on the science and the living onboard of the James Clark Ross during the JR200 cruise. The great majority of the scientists and crew participated on the blog, either by accepting to be photographed or interviewed, or providing photographs or input in writing.

During the duration of the cruise, more than 1500 hits from more than 50 countries worlwide were recorded. The top 10 countries visiting the blog were: UK, Portugal, USA, France, Brazil, Spain, Belgium, Malaysia, Ireland and Australia. The UK was the country with most interest on the blog.

Another blog was maintained by Anton Van de Putte (www.antonarctica.be), whose focus was transmitting his personal views of the cruise. Although hosted in Belgium this blog is written in English in order to reach a wide audience. With about 65 visits per week the blog received less attention but managed to reach a different audience. The blog received the most interest from within Belgium, but also had visits from the UK, Portugal, Australia, The Netherlands and Czech Republic. Both blogs, clearly advertised each other on their webpage, allowing visitors to get a broad perspective on life and science at sea in the Southern Ocean

.

José Xavier also wrote weekly to another blog (www.cgd.pt) and an Internet portal (www.portalpolar.pt) about the cruise and its living experiences. Both blog and website are part of the Portugal´s polar education and outreach initiatives on promoting polar science, during the new national Antarctic programme, PROPOLAR that initiated during IPY.
The cruise has also been mentioned in various websites to show the science that was carried out: www. antarctica.ac.uk (UK), www.ipy.org (Canada), www.apecs.is (Iceland).

17.2.2 EDUCATION, OUTREACH and MEDIA

Scientists have been highly active on Education and outreach activities for the cruise in relation to the International Polar Year. José Xavier joined the International Programme Office of the International Polar Year (IPY-IPO) to participate on the IPY Polar Oceans Day. The objective of IPY Polar Oceans Day (week between 16-20 March) was to link polar scientists related to marine disciplines (e.g. marine biology, oceanography) from the Arctic and Antarctic and provide a forum of discussion between scientists, students, professors, teachers and the general public from all over the world.

José Xavier was interviewed 3 times during the cruise by phone during the IPY Polar Oceans initiatives: twice to Brazil, including a radio interview (Figure 1), and once to Malaysia live during a conference on polar issues.

Figure 17.1. Student on the radio station Claretiana in Brazil asking a question to José Xavier in the Southern Ocean, onboard of the James Clark Ross.

José Xavier was also interviewed by a Portugal national newspaper “Jornal de Notícias” on the work he has been carrying out, when the initial meeting that gathered the 47 countries that signed the Antarctic treaty started in USA, including UK.

17.2.3 CONTACT DIRECTLY WITH SCHOOLS

During the cruise, José Xavier participated in various projects with schools from UK (Cambridge and Derbyshire), from Portugal (Algarve and Lisbon) and Brazil (Rio de Janeiro; Figure 2). The interactions ranged from skype interviews, email questions from students about the cruise, participate on school projects related to polar research and human health. José Xavier performed various interviews of scientists and crew to produce another education and outreach film to educate the younger generations the basic information about polar research, particularly the marine disciplines.

Figure 17.2. Prof. Miriam Almeida with colleagues and students from the college Puríssimo coração de Maria (Brazil).

17.3 CONCLUSIONS

The JR200 was the first cruise to report a number of very productive on education and outreach activities that complemented well with the science. As part of the International Polar Year initiatives, the British Antarctic Survey and other world organizations/committees (e.g. Portugal IPY committee), have been active in linking the polar science carried out by its scientists and the general public. The activities done during this cruise are good examples of how the general public can be easily informed, in a exciting and interesting way, while providing basic knowledge about the polar regions and its importance to the planet.

Appendix 1. Event log. Some descriptions have been modified from the original page to allow table to fit in this document.

Time	Event	Event Code	Stn Code	Lat	Lon	Description
12/03/2009 11:38:00	1	NTOW	UND	-53.87666	-55.1322	NOC towfish deployed
12/04/2009 21:36:00	1	NTOW	SGS	-53.00139	-37.33904	Iron fish recovered (starboard quarter).
13/03/2009 11:21:00	2	BON	TEST	-57.68535	-50.44152	Bongo nets deployed
13/03/2009 11:57:00	2	BON	TEST	-57.69171	-50.42993	Bongo net recovered on deck
13/03/2009 12:24:00	3	CTD	TEST	-57.69173	-50.42984	CTD deployed
13/03/2009 12:24:00	3	CTD	TEST	-57.69173	-50.42984	CTD deployed
13/03/2009 12:30:00	3	CTD	TEST	-57.69194	-50.42947	CTD @ 150m commence hauling
13/03/2009 12:47:00	3	CTD	TEST	-57.69429	-50.42515	CTD recovered on deck
13/03/2009 13:21:00	4	CTD	TEST	-57.69426	-50.42517	CTD deployed
13/03/2009 13:34:00	4	CTD	TEST	-57.69512	-50.42363	CTD @ 400m commence hauling
13/03/2009 14:05:00	4	CTD	TEST	-57.70222	-50.41069	CTD recovered on deck
13/03/2009 15:11:00	5	LHPR	TEST	-57.70126	-50.41304	Commence deployment of LHPR
13/03/2009 15:38:00	5	LHPR	TEST	-57.68611	-50.42705	Commence hauling LHPR wire out 1093m
13/03/2009 16:15:00	5	LHPR	TEST	-57.66536	-50.44269	LHPR recovered on deck
13/03/2009 16:35:00	6	MOC	TEST	-57.65751	-50.44797	Commence deployment of MOCNESS
13/03/2009 16:40:00	6	MOC	TEST	-57.65522	-50.44906	MOCNESS in the water being lowered
13/03/2009 16:53:00	6	MOC	TEST	-57.64891	-50.45255	Commence hauling MOCNESS wire out 431m
13/03/2009 17:18:00	6	MOC	TEST	-57.6355	-50.46043	MOCNESS recovered on deck
13/03/2009 18:58:00	7	RMT8	TEST	-57.61881	-50.46671	Commence deployment of RMT 8
13/03/2009 19:06:00	7	RMT8	TEST	-57.61299	-50.46818	RMT 8 deployed.
13/03/2009 20:08:00	7	RMT8	TEST	-57.56813	-50.48395	RMT 8 recovered.
14/03/2009 09:39:00	8	RMT8	R1	-59.46934	-49.04181	RMT 8 deployed.
14/03/2009 10:00:00	8	RMT8	R1	-59.45341	-49.04152	RMT 8 recovered.
14/03/2009 13:38:00	9	RMT25	R1	-59.9007	-48.65419	RMT 25 deployed
14/03/2009 14:20:00	9	RMT25	R1	-59.87131	-48.66813	Net out of the water
14/03/2009 14:26:00	9	RMT25	R1	-59.86624	-48.66949	Net recovered on deck
14/03/2009 19:08:00	10	CTD	R1	-60.4993	-48.19411	CTD deployed depth 1419m
14/03/2009 19:36:00	10	CTD	R1	-60.49868	-48.19313	CTD at 1371m wire out
14/03/2009 20:08:00	10	CTD	R1	-60.49868	-48.19302	CTD recovered.
14/03/2009 20:34:00	11	CTD	R1	-60.49865	-48.19308	CTD deployed.

14/03/2009 20:43:00	11	CTD	R1	-60.49868	-48.19309	CTD stopped at 245 metres wire out. Wire off sheave in traction winch room.
14/03/2009 21:22:00	11	CTD	R1	-60.49869	-48.19304	CTD recovered. Deck crew spooling off damaged wire for retermination.
14/03/2009 22:32:00	12	MOC	R1	-60.46931	-48.16303	Commence Mocness deployment.
14/03/2009 22:36:00	12	MOC	R1	-60.47164	-48.16429	Mocness deployed. Course over ground approx. 190 to reduce rolling caused by heavy swell.
15/03/2009 01:24:00	12	MOC	R1	-60.55651	-48.18685	MOCNESS recovered on deck
15/03/2009 10:54:00	13	ACO	R1	-60.40145	-48.28587	Commence first leg of acoustic transect. Course 245T. Constant power ~9 knots into wind.
15/03/2009 12:33:00	13	ACO	R1	-60.51989	-48.68636	Transect complete
15/03/2009 13:02:00	13	ACO	R1	-60.59382	-48.60538	Commence 50K downwind transect at constant power giving 10Kts.
15/03/2009 15:46:00	13	ACO	R1	-60.40317	-47.77637	Transect line complete
15/03/2009 16:29:00	13	ACO	R1	-60.50081	-47.68545	Commence transect line 50K Course 245(T)
15/03/2009 19:17:00	13	ACO	R1	-60.6903	-48.5126	Complete 50k transect. Reduced speed to allow positioning of RMT8 net.
15/03/2009 23:54:00	14	BON	R1	-60.50015	-48.19233	Bongo nets deployed
16/03/2009 00:25:00	14	BON	R1	-60.49931	-48.19224	Bongo net recovered on deck
16/03/2009 00:27:00	15	BON	R1	-60.49933	-48.19235	2nd Bongo Net deployed
16/03/2009 01:00:00	15	BON	R1	-60.49932	-48.19233	Bongo net recovered on deck -- being swapped for Mini-Bongo
16/03/2009 01:07:00	16	MON	R1	-60.49931	-48.19235	Mini-Bongo net deployed
16/03/2009 01:07:00	16	MON	R1	-60.49931	-48.19235	Mini-Bongo net deployed
16/03/2009 01:38:00	16	MON	R1	-60.49931	-48.19235	Mini-Bongo net recovered on deck
16/03/2009 02:33:00	17	RMT25	R1	-60.49768	-48.20241	RMT 25 deployed - Shallow trawl (400m)
16/03/2009 04:01:00	17	RMT25	R1	-60.48444	-48.31625	RMT 25 at the surface recovering net
16/03/2009 04:13:00	17	RMT25	R1	-60.48404	-48.32592	RMT 25 recovered on deck
16/03/2009 04:38:00	18	RMT25	R1	-60.48179	-48.3522	RMT 25 deployed
16/03/2009 06:46:00	18	RMT25	R1	-60.46061	-48.51692	RMT 25 at the surface recovering net
16/03/2009 06:54:00	18	RMT25	R1	-60.46019	-48.52359	RMT 25 recovered on deck
16/03/2009 08:48:00	19	CTD	R1	-60.49846	-48.19192	CTD deployed.
16/03/2009 09:16:00	19	CTD	R1	-60.49845	-48.19199	CTD stopped at 1371 metres wire out.
16/03/2009 10:09:00	19	CTD	R1	-60.49846	-48.19196	CTD recovered.
16/03/2009 10:50:00	20	CTD	R1	-60.49848	-48.19199	CTD deployed.
16/03/2009 11:07:00	20	CTD	R1	-60.49843	-48.19194	CTD @ 400m commence hauling
16/03/2009 11:22:00	20	CTD	R1	-60.49847	-48.19202	CTD recovered on deck
16/03/2009 11:40:00	21	LHPR	R1	-60.49668	-48.19298	Start deploying LHPR
16/03/2009 11:43:00	21	LHPR	R1	-60.49489	-48.19649	LHPR deployed

16/03/2009 12:40:00	21	LHPR	R1	-60.46736	-48.26402	LHPR @ 2435m commence hauling
16/03/2009 14:11:00	21	LHPR	R1	-60.41977	-48.3865	LHPR recovered
16/03/2009 15:18:00	22	FRRF	R1	-60.49822	-48.19192	FRRF deployed
16/03/2009 15:52:00	22	FRRF	R1	-60.49823	-48.19197	FRRF recovered on deck
16/03/2009 15:56:00	23	BON	R1	-60.49823	-48.19199	Bongo nets deployed
16/03/2009 16:25:00	23	BON	R1	-60.4982	-48.19196	Bongo net recovered on deck
16/03/2009 16:28:00	24	BON	R1	-60.49822	-48.19194	Bongo nets deployed
16/03/2009 17:00:00	24	BON	R1	-60.4982	-48.19194	Bongo net recovered on deck
16/03/2009 17:07:00	25	MON	R1	-60.4982	-48.19196	Mini Bongo nets deployed
16/03/2009 17:40:00	25	MON	R1	-60.49822	-48.19192	Mini Bongo nets recovered on deck
16/03/2009 17:49:00	26	MOC	R1	-60.49752	-48.19282	Commence deploying MOCNESS
16/03/2009 17:52:00	26	MOC	R1	-60.49601	-48.19486	MOCNESS deployed
16/03/2009 20:34:00	26	MOC	R1	-60.42557	-48.30618	MOCNESS recovered.
16/03/2009 21:41:00	27	LHPR	R1	-60.52935	-48.16703	LHPR deployed. Course over ground approx. 338T. Head to wind.
16/03/2009 23:56:00	27	LHPR	R1	-60.45701	-48.2219	LHPR recovered
17/03/2009 00:24:00	28	RMT8	R1	-60.45798	-48.22112	RMT 8 deployed for target fishing
17/03/2009 00:50:00	28	RMT8	R1	-60.43492	-48.2264	RMT8 Net recovered on deck
17/03/2009 01:22:00	29	RMT8	R1	-60.44005	-48.22249	RMT8 Net in the water
17/03/2009 01:53:00	29	RMT8	R1	-60.41116	-48.22121	RMT8 Nets finished Finished target fishing
17/03/2009 02:55:00	30	FRRF	R1	-60.49851	-48.19047	FRRF deployed
17/03/2009 03:28:00	30	FRRF	R1	-60.4985	-48.19044	FRRF recovered on deck
17/03/2009 14:25:00	31	CTD	D1	-60.43122	-44.59307	CTD deployed
17/03/2009 14:48:00	31	CTD	D1	-60.43095	-44.59289	CTD @ 990m - commence hauling
17/03/2009 15:22:00	31	CTD	D1	-60.43095	-44.59292	CTD recovered on deck
17/03/2009 17:55:00	32	MOC	C2	-60.28737	-44.42419	Vessel at 2.0 knots head to wind commence deploying MOCNESS
17/03/2009 17:58:00	32	MOC	C2	-60.28552	-44.42521	MOCNESS deployed
17/03/2009 20:21:00	33	CTD	C2	-60.2085	-44.40808	CTD deployed. Water depth 5452 metres.
17/03/2009 20:58:00	33	CTD	C2	-60.20851	-44.40805	CTD stopped at 2000 metres wire out.
17/03/2009 21:40:00	33	CTD	C2	-60.2085	-44.40804	CTD recovered.
17/03/2009 22:05:00	34	CTD	C2	-60.20848	-44.40802	CTD deployed.
17/03/2009 22:16:00	34	CTD	C2	-60.20849	-44.40804	CTD stopped at 400 metres.
17/03/2009 22:38:00	34	CTD	C2	-60.20849	-44.40803	CTD recovered.

17/03/2009 23:16:00	35	MOC	C2	-60.22908	-44.42512	MOCNESS deployed
18/03/2009 00:32:00	35	MOC	C2	-60.18069	-44.38355	Commence hauling MOCNESS wire out 2300m
18/03/2009 01:52:00	35	MOC	C2	-60.12757	-44.33571	MOCNESS recovered on deck
18/03/2009 04:29:00	36	LHPR	C2	-60.24056	-44.43009	Commence deploying LHPR
18/03/2009 04:34:00	36	LHPR	C2	-60.23783	-44.42946	LHPR deployed head into the wind 011(T)
18/03/2009 06:41:00	36	LHPR	C2	-60.16825	-44.39415	LHPR recovered on deck
18/03/2009 07:32:00	37	CTD	C2	-60.20865	-44.40853	CTD deployed.
18/03/2009 09:09:00	37	CTD	C2	-60.20864	-44.40849	CTD stopped at 5402 metres wire out.
18/03/2009 09:20:00	37	CTD	C2	-60.20862	-44.40849	CTD stopped at 5328 metres for spooling gear checks.
18/03/2009 09:28:00	37	CTD	C2	-60.20863	-44.40848	Resume hauling.
18/03/2009 12:25:00	37	CTD	C2	-60.33694	-44.3846	CTD recovered on deck
18/03/2009 13:11:00	38	ACO	C2	-60.45533	-44.35989	Commence acoustic survey
18/03/2009 15:51:00	38	ACO	C2	-60.03461	-44.05089	Vessel completed transect line
18/03/2009 16:32:00	38	ACO	C2	-59.99649	-44.25503	Commence transect line 200(T) x 50K
18/03/2009 19:15:00	38	ACO	C2	-60.42009	-44.56588	End of transect line. Alter course to 290T towards next line.
18/03/2009 19:56:00	38	ACO	C2	-60.38096	-44.76794	Commence 3rd. transect line. Course 020T at 10 knots.
18/03/2009 21:00:00	38	ACO	C2	-60.21454	-44.64483	Complete acoustic survey. Speed reduced. Setting up RMT8.
18/03/2009 22:07:00	39	RMT8	C2	-60.20081	-44.49495	RMT8 deployed.
18/03/2009 22:18:00	39	RMT8	C2	-60.20227	-44.48004	Commence slow haul to bring net close to surface.
18/03/2009 22:48:00	39	RMT8	C2	-60.2059	-44.43854	Commence recovery.
18/03/2009 22:53:00	39	RMT8	C2	-60.20638	-44.43149	RMT recovered.
18/03/2009 23:04:00	40	RMT8	C2	-60.20763	-44.41573	RMT 8 deployed.
18/03/2009 23:34:00	40	RMT8	C2	-60.21079	-44.37525	Net recovered on deck
18/03/2009 23:51:00	41	RMT8	C2	-60.21286	-44.34809	RMT 8 deployed.
19/03/2009 00:31:00	41	RMT8	C2	-60.21687	-44.28741	Net recovered on deck
19/03/2009 02:15:00	42	RMT25	C2	-60.19162	-44.30925	RMT 25 deployed
19/03/2009 04:36:00	42	RMT25	C2	-60.29139	-44.22708	RMT 25 recovered on deck
19/03/2009 05:45:00	43	RMT25	C2	-60.23875	-44.30179	RMT 25 deployed
19/03/2009 08:07:00	43	RMT25	C2	-60.32771	-44.33306	RMT 25 recovered. Moving net aside on deck.
19/03/2009 09:39:00	44	BON	C2	-60.20818	-44.40801	Bongo nets deployed.
19/03/2009 10:10:00	44	BON	C2	-60.20818	-44.408	Bongo nets recovered.
19/03/2009 10:11:00	45	BON	C2	-60.20817	-44.408	Bongo nets redeployed.

19/03/2009 10:45:00	45	BON	C2	-60.20816	-44.40798	Bongo nets recovered.
19/03/2009 10:52:00	46	MON	C2	-60.20817	-44.40798	Mini-bongos deployed.
19/03/2009 11:22:00	46	MON	C2	-60.20818	-44.40801	Mini Bongo nets recovered on deck
19/03/2009 11:33:00	47	GOF	C2	-60.20817	-44.40805	Go-Flo bottles deployed
19/03/2009 14:00:00	47	GOF	C2	-60.20819	-44.40796	Bottles max. depth 540m
19/03/2009 14:12:00	47	GOF	C2	-60.20819	-44.40798	Go-Flo bottles recovered on deck and operation complete
19/03/2009 14:21:00	48	FRRF	C2	-60.20819	-44.40802	FRRF deployed
19/03/2009 14:57:00	48	FRRF	C2	-60.20816	-44.40799	FRRF recovered on deck
19/03/2009 15:01:00	49	BON	C2	-60.20817	-44.408	Bongo nets deployed.
19/03/2009 15:32:00	49	BON	C2	-60.20815	-44.40801	Bongo net recovered on deck
19/03/2009 15:38:00	50	BON	C2	-60.20816	-44.40803	Bongo nets deployed
19/03/2009 16:03:00	50	BON	C2	-60.20816	-44.40802	Bongo net recovered on deck
19/03/2009 16:08:00	51	MON	C2	-60.20816	-44.40802	Mini-Bongo net deployed
19/03/2009 16:37:00	51	MON	C2	-60.20816	-44.40799	Mini Bongo nets recovered on deck
19/03/2009 18:35:00	52	CTD	C2	-59.93473	-44.23675	CTD deployed. EA600 depth 4731 metres.
19/03/2009 19:57:00	52	CTD	C2	-59.93593	-44.23929	CTD stopped at 4674 metres wire out.
19/03/2009 21:45:00	52	CTD	C2	-59.93594	-44.2392	CTD recovered. Securing deck and preparing for target fishing.
19/03/2009 22:25:00	53	RMT8	C2	-59.92152	-44.23014	RMT 8 deployed for target fishing
19/03/2009 22:44:00	53	RMT8	C2	-59.9332	-44.24468	RMT 8 recovered. (Net not opened. Target missed.)
19/03/2009 23:30:00	54	RMT8	C2	-59.87916	-44.21005	RMT 8 deployed for target fishing
19/03/2009 23:50:00	54	RMT8	C2	-59.89426	-44.20996	Net recovered on deck
20/03/2009 02:00:00	55	RMT25	C3	-59.66591	-44.05377	RMT25 Deployed
20/03/2009 04:11:00	55	RMT25	C3	-59.7563	-44.10856	RMT 25 recovered on deck
20/03/2009 05:05:00	56	RMT25	C3	-59.66878	-44.01003	RMT 25 deployed
20/03/2009 08:16:00	56	RMT25	C3	-59.76412	-44.22846	RMT 25 recovered. Proceeding approx. 7 miles to station for bongo nets.
20/03/2009 09:09:00	57	BON	C3	-59.6879	-44.05422	Bongo nets deployed.
20/03/2009 09:39:00	57	BON	C3	-59.68793	-44.05424	Bongo nets recovered.
20/03/2009 09:40:00	58	BON	C3	-59.68792	-44.05424	Bongo nets redeployed.
20/03/2009 10:10:00	58	MON	C3	-59.68791	-44.05424	Bongo nets recovered.
20/03/2009 10:16:00	59	MON	C3	-59.68792	-44.05423	Mini bongos deployed.
20/03/2009 10:47:00	59	MON	C3	-59.6879	-44.05425	Mini bongos recovered.
20/03/2009 12:20:00	60	ACO	C3	-59.93783	-43.9919	Commence acoustic survey

20/03/2009 15:00:00	60	ACO	C3	-59.51386	-43.7185	Complete 50k transect.
20/03/2009 15:43:00	60	ACO	C3	-59.47876	-43.92123	Commence transect line 198(T) x 50k
20/03/2009 18:24:00	60	ACO	C3	-59.90593	-44.19647	Complete 50k transect.
20/03/2009 19:03:00	60	ACO	C3	-59.87399	-44.39925	Commence 3rd. transect line. Course 018(T) x 50K
20/03/2009 21:38:00	61	RMT8	C3	-59.60604	-44.16973	RMT 8 deployed.
20/03/2009 22:17:00	61	RMT8	C3	-59.57834	-44.16928	RMT recovered. Ship heading towards previous acoustic track.
20/03/2009 23:14:00	62	RMT8	C3	-59.66554	-44.26022	RMT 8 deployed for target fishing
20/03/2009 23:40:00	62	RMT8	C3	-59.63923	-44.25915	RMT 8 recovered.
21/03/2009 00:11:00	63	RMT8	C3	-59.65737	-44.24646	RMT 8 deployed for target fishing (trawled greater depth to catch fish not krill)
21/03/2009 01:20:00	63	RMT8	C3	-59.58962	-44.24277	Net recovered on deck - returning to stn. @ 10K for FRRF
21/03/2009 02:32:00	64	FRRF	C3	-59.68855	-44.05462	FRRF deployed
21/03/2009 03:06:00	64	FRRF	C3	-59.68857	-44.05463	FRRF recovered on deck
21/03/2009 04:03:00	65	LHPR	C3	-59.68665	-44.06748	LHPR deployed
21/03/2009 06:13:00	65	LHPR	C3	-59.64255	-44.19678	LHPR recovered on deck
21/03/2009 07:22:00	66	CTD	C3	-59.68871	-44.05498	CTD deployed. EA600 depth 4143 metres.
21/03/2009 08:34:00	66	CTD	C3	-59.6887	-44.05499	CTD stopped at 4085 metres.
21/03/2009 10:21:00	66	CTD	C3	-59.68871	-44.05498	CTD recovered.
21/03/2009 10:40:00	67	LHPR	C3	-59.6891	-44.06439	LHPR deployed.
21/03/2009 11:32:00	67	LHPR	C3	-59.69453	-44.12427	Commence hauling LHPR
21/03/2009 12:54:00	67	LHPR	C3	-59.70443	-44.22295	LHPR Recovered
21/03/2009 14:05:00	68	GOF	C3	-59.68842	-44.0548	Go-Flo bottles deployed
21/03/2009 14:05:00	68	GOF	C3	-59.68842	-44.0548	Go-Flo bottles deployed
21/03/2009 14:40:00	68	GOF	C3	-59.68851	-44.05494	Go-Flo bottles stopped at 500m
21/03/2009 14:40:00	68	GOF	C3	-59.68851	-44.05494	Go-Flo bottles stopped at 500m
21/03/2009 15:00:00	68	GOF	C3	-59.68853	-44.05515	Commence hauling Go-Flo bottles
21/03/2009 15:00:00	68	GOF	C3	-59.68853	-44.05515	Commence hauling Go-Flo bottles
21/03/2009 15:27:00	68	GOF	C3	-59.68859	-44.05462	Go-Flo bottles recovered on deck
21/03/2009 15:27:00	68	GOF	C3	-59.68859	-44.05462	Go-Flo bottles recovered on deck
21/03/2009 15:35:00	69	BON	C3	-59.68863	-44.05491	Bongo nets deployed
21/03/2009 16:06:00	69	BON	C3	-59.68839	-44.05487	Bongo net recovered on deck
21/03/2009 16:07:00	70	BON	C3	-59.68842	-44.05482	Bongo nets deployed
21/03/2009 16:38:00	70	BON	C3	-59.68839	-44.05481	Bongo net recovered on deck

21/03/2009 16:43:00	71	MON	C3	-59.68838	-44.05483	Mini Bongo nets deployed
21/03/2009 17:13:00	71	MON	C3	-59.6884	-44.05481	Mini Bongo nets recovered on deck Preparing MOCNESS
21/03/2009 17:44:00	72	MOC	C3	-59.68887	-44.06058	MOCNESS deployed
21/03/2009 20:34:00	72	MOC	C3	-59.73502	-44.22752	MOCNESS recovered. Ship on transit to station (approx 6 miles).
21/03/2009 21:27:00	73	CTD	C3	-59.68875	-44.05391	CTD deployed.
21/03/2009 22:06:00	73	CTD	C3	-59.68872	-44.05396	CTD stopped at 2000 metres.
21/03/2009 22:47:00	73	CTD	C3	-59.68875	-44.05396	CTD recovered.
21/03/2009 23:10:00	74	CTD	C3	-59.68876	-44.0539	CTD deployed for 400m cast
21/03/2009 23:22:00	74	CTD	C3	-59.68877	-44.05393	CTD @ 400m commence hauling
21/03/2009 23:50:00	74	CTD	C3	-59.68872	-44.05397	CTD recovered on deck
22/03/2009 00:25:00	75	MOC	C3	-59.71809	-44.03558	MOCNESS deployed
22/03/2009 01:50:00	75	MOC	C3	-59.65158	-44.04379	MOCNESS deployed with 2214m of wire commence hauling
22/03/2009 03:25:00	75	MOC	C3	-59.56872	-44.01022	MOCNESS recovered on deck
22/03/2009 05:15:00	76	CTD	D5	-59.35584	-43.83652	CTD deployed depth 3160m
22/03/2009 06:09:00	76	CTD	D5	-59.35619	-43.83571	CTD at 3098m wire out commence hauling
22/03/2009 07:36:00	76	CTD	D5	-59.35548	-43.8326	CTD recovered. Ship proceeding to D6.
22/03/2009 10:01:00	77	CTD	D6	-59.0254	-43.62105	CTD deployed. EA600 depth 3105 metres.
22/03/2009 10:57:00	77	CTD	D6	-59.02537	-43.62107	CTD stopped at 3050 metres wire out.
22/03/2009 12:10:00	77	CTD	D6	-59.0254	-43.62101	CTD recovered on deck
22/03/2009 13:50:00	78	RMT8	D7	-58.86866	-43.51018	RMT 8 deployed for target fishing
22/03/2009 14:11:00	78	RMT8	D7	-58.85073	-43.49841	Net recovered on deck
22/03/2009 15:23:00	79	CTD	D7	-58.69432	-43.4042	CTD deployed depth 2949m
22/03/2009 16:17:00	79	CTD	D7	-58.69362	-43.4049	CTD at 2890m wire out commence hauling
22/03/2009 17:27:00	79	CTD	D7	-58.69364	-43.4049	CTD recovered on deck
22/03/2009 19:44:00	80	CTD	D8	-58.362	-43.18885	CTD deployed.
22/03/2009 20:38:00	80	CTD	D8	-58.362	-43.18887	CTD at depth. 2934 metres wire out.
22/03/2009 21:50:00	80	CTD	D8	-58.36195	-43.18882	CTD recovered.
23/03/2009 00:28:00	81	RMT25	C4	-58.04266	-43.00365	RMT 25 deployed
23/03/2009 02:30:00	81	RMT25	C4	-57.99769	-42.90715	RMT 25 recovered on deck
23/03/2009 04:19:00	82	RMT25	C4	-58.07108	-43.01567	RMT 25 deployed head to wind 036(T) at 2.5 knots
23/03/2009 07:22:00	82	RMT25	C4	-57.97851	-42.82636	RMT 25 recovered. Securing deck.
23/03/2009 08:19:00	83	BON	C4	-58.03071	-42.97144	On station for Bongo nets.

23/03/2009 08:23:00	83	BON	C4	-58.03072	-42.97145	Bongo nets deployed.
23/03/2009 08:54:00	83	BON	C4	-58.03071	-42.97146	Bongo nets recovered.
23/03/2009 08:55:00	84	BON	C4	-58.0307	-42.97145	Bongo nets redeployed.
23/03/2009 09:27:00	84	BON	C4	-58.0307	-42.97146	Bongo nets recovered.
23/03/2009 09:31:00	85	MON	C4	-58.03071	-42.97145	Mini bongo nets deployed.
23/03/2009 10:04:00	85	MON	C4	-58.03072	-42.97142	Mini bongos recovered. Securing gantry.
23/03/2009 11:38:00	86	ACO	C4	-58.27975	-42.92745	Commence acoustic survey
23/03/2009 14:20:00	86	ACO	C4	-57.85506	-42.63519	First transect complte - steaming to commence next transect
23/03/2009 15:02:00	86	ACO	C4	-57.81907	-42.8272	Commence 2nd transect line course 200(T)
23/03/2009 17:44:00	86	ACO	C4	-58.24062	-43.11593	Completed 2nd 50k transect line
23/03/2009 18:28:00	86	ACO	C4	-58.20551	-43.30966	Commence 3rd. transect line. Course 020T at 10 knots.
23/03/2009 21:10:00	86	ACO	C4	-57.78155	-43.01966	End of transect. Ship running back down line at 10 knt seeking targets.
23/03/2009 22:48:00	87	RMT8	C4	-57.98952	-43.16397	RMT 8 deployed for shallow tow.
23/03/2009 23:17:00	87	RMT8	C4	-58.00308	-43.18536	RMT 8 recovered.
24/03/2009 00:00:01	88	RMT8	C4	-58.0236	-43.04427	RMT 8 deployed for shallow target.
24/03/2009 00:30:00	88	RMT8	C4	-58.01791	-43.0908	RMT 8 recovered.
24/03/2009 02:41:00	89	MOC	C4	-58.02334	-43.05244	MOCNESS deployed with 2219m of wire commence hauling
24/03/2009 04:16:00	89	MOC	C4	-58.00657	-43.17925	MOCNESS recovered on deck
24/03/2009 05:20:00	90	FRRF	C4	-58.03151	-42.97235	FRRF deployed
24/03/2009 05:54:00	90	FRRF	C4	-58.03051	-42.97186	FRRF recovered on deck
24/03/2009 06:11:00	91	LHPR	C4	-58.02357	-42.97293	LHPR deployed
24/03/2009 08:21:00	91	LHPR	C4	-57.94572	-42.97008	LHPR recovered. Securing deck.
24/03/2009 09:10:00	92	CTD	C4	-58.0309	-42.9713	CTD deployed.
24/03/2009 10:03:00	92	CTD	C4	-58.03092	-42.97127	CTD stopped at 2770 metres wire out.
24/03/2009 11:12:00	92	CTD	C4	-58.03091	-42.97129	CTD recovered on deck
24/03/2009 11:24:00	93	LHPR	C4	-58.02913	-42.97685	LHPR deployed
24/03/2009 12:17:00	93	LHPR	C4	-58.01066	-43.04837	LHPR @ 2139m commence hauling
24/03/2009 13:43:00	93	LHPR	C4	-57.97778	-43.14725	LHPR recovered on deck
24/03/2009 15:07:00	94	MOC	C4	-58.03705	-42.92493	MOCNESS deployed head to wind 276(T) at 2 knots
24/03/2009 18:05:00	94	MOC	C4	-58.0393	-43.16156	MOCNESS recovered on deck
24/03/2009 19:02:00	95	CTD	C4	-58.03004	-42.97094	CTD deployed depth 2834m
24/03/2009 19:13:00	95	CTD	C4	-58.03004	-42.97102	CTD stopped at 400 metres.

24/03/2009 19:35:00	95	CTD	C4	-58.03004	-42.97104	CTD recovered to deck.
24/03/2009 19:42:00	96	BON	C4	-58.03003	-42.97099	Bongo nets deployed.
24/03/2009 20:17:00	96	BON	C4	-58.03006	-42.97109	Bongo nets recovered.
24/03/2009 20:19:00	97	MON	C4	-58.03008	-42.97105	Mini bongos deployed.
24/03/2009 20:54:00	97	MON	C4	-58.03004	-42.97103	Mini bongos recovered.
24/03/2009 21:02:00	98	GOF	C4	-58.03005	-42.971	Go-Flo weight deployed.
24/03/2009 21:37:00	98	GOF	C4	-58.03005	-42.97104	Go-Flo stopped at 510 metres for 15 minutes.
24/03/2009 22:20:00	98	GOF	C4	-58.03003	-42.97104	Go-Flo complete and weight recovered.
24/03/2009 22:36:00	99	CTD	C4	-58.03005	-42.97101	CTD redeployed.
24/03/2009 23:13:00	99	CTD	C4	-58.03004	-42.97104	CTD @ 2000m commence hauling
24/03/2009 23:56:00	99	CTD	C4	-58.03005	-42.97104	CTD recovered on deck
25/03/2009 00:50:00	100	RMT25	C4	-58.02862	-42.98119	RMT 25 deployed
25/03/2009 02:30:00	100	RMT25	C4	-58.00497	-43.10199	RMT 25 recovered on deck
25/03/2009 04:15:00	101	RMT25	C4	-58.02868	-42.98153	RMT25 deployed
25/03/2009 07:30:00	101	RMT25	C4	-57.98771	-43.24232	RMT 25 recovered. Rearranging deck for target fishing.
25/03/2009 11:11:00	102	CTD	D10	-57.58539	-42.7023	CTD deployed.
25/03/2009 12:06:00	102	CTD	D10	-57.5854	-42.70228	CTD @ 2969m - commence hauling
25/03/2009 13:17:00	102	CTD	D10	-57.58537	-42.70233	CTD recovered on deck
18/03/2009 03:23:00	103	FRRF	C2	-60.20881	-44.40881	FRRF deployed - Event number out of sequence due to duplication with e036
18/03/2009 03:56:00	103	FRRF	C2	-60.20881	-44.40884	FRRF recovered on deck - Event number out of sequence due to duplication with e036
25/03/2009 16:20:00	104	CTD	D11	-57.13992	-42.43367	CTD deployed depth 3683m (Event 103 got assigned to the duplicated FRRF e036)
25/03/2009 17:26:00	104	CTD	D11	-57.13966	-42.43374	CTD wire out 3628m Commence hauling
25/03/2009 18:50:00	104	CTD	D11	-57.13965	-42.43378	CTD recovered on deck
25/03/2009 19:36:00	105	RMT8	D11	-57.07375	-42.39842	RMT 8 deployed back down ship's track.
25/03/2009 20:02:00	105	RMT8	D11	-57.09232	-42.4115	RMT 8 recovered. Resume passage towards station.
25/03/2009 21:13:00	106	RMT8	D11	-56.95708	-42.33135	RMT 8 deployed back down ship's track.
25/03/2009 21:52:00	106	RMT8	D11	-56.98429	-42.34974	RMT 8 recovered. Resume passage towards station.
25/03/2009 23:35:00	107	CTD	R2	-56.76359	-42.22131	CTD deployed for 400m cast
26/03/2009 00:13:00	107	CTD	R2	-56.76532	-42.21993	CTD out of the water
26/03/2009 00:17:00	107	CTD	R2	-56.76531	-42.21988	CTD recovered on deck
26/03/2009 00:50:00	108	MOC	R2	-56.76507	-42.22898	MOCNESS deployed
26/03/2009 03:31:00	108	MOC	R2	-56.75799	-42.3962	MOCNESS recovered on deck

26/03/2009 04:38:00	109	LHPR	R2	-56.76482	-42.21775	Commence deploying LHPR
26/03/2009 04:40:00	109	LHPR	R2	-56.76498	-42.22062	LHPR deployed head into the wind 265(T) at 3 knots
26/03/2009 07:09:00	109	LHPR	R2	-56.7864	-42.40056	LHPR recovered.
26/03/2009 08:10:00	110	CTD	R2	-56.76367	-42.21759	CTD deployed.
26/03/2009 08:45:00	110	CTD	R2	-56.76439	-42.2169	CTD returned to deck for fault investigation.
26/03/2009 10:17:00	111	ACO	R2	-56.83041	-41.78017	Commence acoustic survey
26/03/2009 13:00:00	111	ACO	R2	-56.90762	-42.58259	First transect complete - steaming to commence next transect
26/03/2009 13:47:00	111	ACO	R2	-56.802	-42.61938	Commence next transect
26/03/2009 16:27:00	111	ACO	R2	-56.72442	-41.81821	Second transect line complete
26/03/2009 17:11:00	111	ACO	R2	-56.6182	-41.84996	Commence 3rd. transect line. Course 260(T)
26/03/2009 20:02:00	111	ACO	R2	-56.69561	-42.65119	End of transect. Slowing down for CTD test station.
26/03/2009 22:20:00	112	RMT8	R2	-56.74829	-42.33647	RMT 8 deployed.
26/03/2009 22:57:00	112	RMT8	R2	-56.73958	-42.38287	RMT 8 recovered.
26/03/2009 23:13:00	113	CTD	R2	-56.73978	-42.39034	CTD deployed for 1000m test cast
26/03/2009 23:21:00	113	CTD	R2	-56.73975	-42.39033	Fault with CTD reported - commence recovery for inspection
26/03/2009 23:42:00	113	CTD	R2	-56.74045	-42.39076	Off station - proceeding to station
27/03/2009 00:58:00	114	CTD	R2	-56.79551	-42.18476	CTD deployed
27/03/2009 01:17:00	114	CTD	R2	-56.80234	-42.19066	Commence hauling
27/03/2009 01:22:00	114	CTD	R2	-56.80329	-42.19207	CTD recovered on deck - preparing RMT 25 for fishing
27/03/2009 02:19:00	115	RMT25	R2	-56.80961	-42.2164	RMT 25 deployed
27/03/2009 03:37:00	115	RMT25	R2	-56.79356	-42.28816	Commence recovery of RMT 25
27/03/2009 04:02:00	115	RMT25	R2	-56.7909	-42.30344	RMT 25 recovered on deck
27/03/2009 06:09:00	116	CTD	R2	-56.76306	-42.2186	CTD deployed for testing
27/03/2009 06:18:00	116	CTD	R2	-56.76303	-42.21865	CTD recovered on deck Still fault with CTD. Holding station for further instuctions
27/03/2009 07:20:00	117	BON	R2	-56.76306	-42.2187	Bongo nets deployed.
27/03/2009 07:51:00	117	BON	R2	-56.76307	-42.21864	Bongo nets recovered.
27/03/2009 07:53:00	118	BON	R2	-56.76308	-42.21864	Bongo nets redeployed.
27/03/2009 08:24:00	118	BON	R2	-56.7631	-42.21866	Bongo nets recovered.
27/03/2009 08:29:00	119	MON	R2	-56.7631	-42.21864	Mini bongos deployed.
27/03/2009 09:05:00	119	MON	R2	-56.7653	-42.21647	Mini bongos recovered. Securing gantry.
27/03/2009 09:24:00	120	LHPR	R2	-56.76566	-42.22125	LHPR deployed. Heading WNW course over ground W x S because of current.
27/03/2009 12:00:00	120	LHPR	R2	-56.75833	-42.37994	LHPR recovered on deck

27/03/2009 13:00:00	121	MOC	R2	-56.76638	-42.21262	MOCNESS deployed
27/03/2009 14:18:00	121	MOC	R2	-56.75741	-42.28815	Commence hauling MOCNESS wire out 2180m
27/03/2009 15:34:00	121	MOC	R2	-56.74799	-42.37293	MOCNESS recovered on deck
27/03/2009 16:39:00	122	BON	R2	-56.76343	-42.21859	Bongo nets deployed
27/03/2009 17:12:00	122	BON	R2	-56.76346	-42.2186	Bongo nets recovered on deck
27/03/2009 17:20:00	123	MON	R2	-56.76345	-42.21855	Mini Bongo nets deployed
27/03/2009 17:50:00	123	MON	R2	-56.76343	-42.21858	Mini Bongo nets recovered on deck
27/03/2009 18:00:00	124	GOF	R2	-56.76342	-42.2186	Go-Flo bottles deployed
27/03/2009 18:34:00	124	GOF	R2	-56.76343	-42.2186	Go flo bottles all stopped at 510m
27/03/2009 18:54:00	124	GOF	R2	-56.76342	-42.21861	Commence hauling Go-Flo bottles
27/03/2009 19:17:00	124	GOF	R2	-56.76343	-42.2186	Go-Flo wire recovered.
27/03/2009 19:42:00	125	CTD	R2	-56.76341	-42.21862	CTD deployed for test and for 2000 metre samples.
27/03/2009 19:53:00	125	CTD	R2	-56.764	-42.21777	CTD stopped at 408 metres wire out.
27/03/2009 20:03:00	125	CTD	R2	-56.76487	-42.21658	CTD recovered for examination.
27/03/2009 20:16:00	126	GOF	R2	-56.76556	-42.21556	Go-Flo wire deployed.
27/03/2009 20:54:00	126	GOF	R2	-56.76815	-42.21289	Go-Flo recovered and securing gantry.
27/03/2009 22:09:00	127	RMT25	R2	-56.76504	-42.15945	RMT 25 deployed. Towing west.
27/03/2009 23:13:00	127	RMT25	R2	-56.76473	-42.23495	Commence hauling RMT 25 wire length 2100m
28/03/2009 01:15:00	127	RMT25	R2	-56.7605	-42.35733	RMT 25 recovered. Securing deck.
28/03/2009 02:34:00	128	RMT25	R2	-56.76817	-42.16734	In position 2miles downwind - RMT 25 deployed
28/03/2009 03:50:00	128	RMT25	R2	-56.76436	-42.23176	Commence recovery of RMT 25
28/03/2009 04:12:00	128	RMT25	R2	-56.76338	-42.24125	RMT 25 recovered on deck
28/03/2009 05:58:00	129	RMT8	D13	-56.77894	-42.0968	RMT 8 deployed head to wind 287(T) x 2.5knots
28/03/2009 06:23:00	129	RMT8	D13	-56.78083	-42.12109	RMT 8 recovered on deck
28/03/2009 06:36:00	130	RMT8	D13	-56.7819	-42.13314	RMT 8 deployed
28/03/2009 07:00:00	130	RMT8	D13	-56.78409	-42.15456	RMT 8 recovered on deck. Securing.
28/03/2009 12:27:00	131	GOF	D13	-56.76802	-42.21877	Go-Flo bottles stopped at 127m - commence hauling
28/03/2009 12:36:00	131	GOF	D13	-56.77002	-42.21881	Go-Flo bottles recovered on deck
28/03/2009 13:00:00	132	GOF	D13	-56.77534	-42.21998	Go-Flo bottles deployed for second cast on station
28/03/2009 13:14:00	132	GOF	D13	-56.77841	-42.22089	Go-Flo bottles stopped at 60m - commence hauling
28/03/2009 13:26:00	132	GOF	D13	-56.78104	-42.22177	Go-Flo bottles recovered on deck
28/03/2009 13:40:00	133	XBT	D13	-56.77997	-42.22077	XBT deployed @ 6Kts STW

28/03/2009 13:45:00	133	XBT	D13	-56.77057	-42.21497	XBT OK - increase power and commence passage to D13
28/03/2009 16:21:00	134	CTD	D14	-56.38808	-42.00091	CTD deployed depth 3916m
28/03/2009 17:31:00	134	CTD	D14	-56.38727	-42.00391	CTD wire out 3868m commence hauling
28/03/2009 19:05:00	134	CTD	D14	-56.38728	-42.00395	CTD recovered.
29/03/2009 14:21:00	135	CTD	D15	-55.63445	-41.5711	CTD deployed on the way down to near bottom
29/03/2009 15:24:00	135	CTD	D15	-55.63444	-41.57108	CTD wire out 3420m commence hauling
29/03/2009 16:46:00	135	CTD	D15	-55.63442	-41.57107	CTD recovered on deck
29/03/2009 19:41:00	136	BON	P2	-55.25906	-41.3581	Bongo nets deployed.
29/03/2009 20:13:00	136	BON	P2	-55.25903	-41.35804	Bongo nets recovered.
29/03/2009 20:14:00	137	BON	P2	-55.25903	-41.35808	Bongo nets redeployed.
29/03/2009 20:47:00	137	BON	P2	-55.25903	-41.35809	Bongo nets recovered.
29/03/2009 20:51:00	138	MON	P2	-55.25906	-41.3581	Mini bongos deployed.
29/03/2009 21:20:00	138	MON	P2	-55.25902	-41.35804	Mini bongos recovered.
29/03/2009 21:35:00	139	CTD	P2	-55.25902	-41.35806	CTD deployed.
29/03/2009 22:13:00	139	CTD	P2	-55.25905	-41.35808	CTD stopped at 2000 metres.
29/03/2009 22:53:00	139	CTD	P2	-55.25905	-41.35808	CTD recovered.
29/03/2009 23:23:00	140	CTD	P2	-55.25899	-41.35807	CTD deployed for 400m cast
29/03/2009 23:40:00	140	CTD	P2	-55.25899	-41.35805	CTD @ 400m commence hauling
30/03/2009 01:30:00	141	RMT25	P2	-55.27757	-41.33828	RMT 25 deployed
30/03/2009 02:06:00	141	RMT25	P2	-55.25601	-41.35567	Commence hauling RMT 25 wire length 700m
30/03/2009 03:02:00	141	RMT25	P2	-55.22283	-41.38627	Commence recovery of RMT 25
30/03/2009 03:11:00	141	RMT25	P2	-55.21863	-41.39015	RMT 25 recovered on deck
30/03/2009 04:03:00	142	RMT25	P2	-55.28035	-41.32766	Commence deploying RMT 25
30/03/2009 04:10:00	142	RMT25	P2	-55.27576	-41.33224	RMT 25 deployed heading 328(T) x 2.5knots
30/03/2009 07:12:00	142	RMT25	P2	-55.17808	-41.43135	RMT 25 recovered. Securing deck and removing science mooring ropes from hold.
30/03/2009 10:06:00	143	ACO	P2	-55.36664	-40.96523	Commence acoustic survey at 10 knots. Course over ground 270T.
30/03/2009 12:47:00	143	ACO	P2	-55.36641	-41.74676	Transect complete shift to next transect.
30/03/2009 13:39:00	143	ACO	P2	-55.25876	-41.75107	Commence 2nd transect line course 090 (T)
30/03/2009 16:21:00	143	ACO	P2	-55.25849	-40.9616	Completed 2nd 50k transect line
30/03/2009 17:06:00	143	ACO	P2	-55.15099	-40.96642	Commence 3rd. transect line. Course 270(T)
30/03/2009 19:49:00	143	ACO	P2	-55.15087	-41.75267	End of acoustic transect. Heading into wind, speed reduced, positioning RMT 8 on deck.
30/03/2009 21:34:00	144	RMT8	P2	-55.29734	-41.54048	RMT 8 deployed.

30/03/2009 22:17:00	144	RMT8	P2	-55.27818	-41.58126	RMT 8 recovered.
30/03/2009 22:26:00	145	RMT8	P2	-55.274	-41.59041	RMT 8 redeployed.
30/03/2009 23:02:00	145	RMT8	P2	-55.25823	-41.62629	RMT 8 recovered.
31/03/2009 00:50:00	146	MOC	P2	-55.28061	-41.31706	MOCNESS deployed
31/03/2009 02:16:00	146	MOC	P2	-55.24404	-41.37872	Commence hauling MOCNESS wire out 2100+ m's
31/03/2009 03:44:00	146	MOC	P2	-55.20795	-41.44617	Commence recovering MOCNESS
31/03/2009 03:49:00	146	MOC	P2	-55.20593	-41.45032	MOCNESS recovered on deck
31/03/2009 05:02:00	147	LHPR	P2	-55.28031	-41.32149	LHPR deployed head into the wind 305(T) x 3.5knots
31/03/2009 07:18:00	147	LHPR	P2	-55.23963	-41.4356	LHPR recovered.
31/03/2009 08:08:00	148	CTD	P2	-55.25886	-41.35758	CTD deployed. EA600 depth 3576 metres.
31/03/2009 09:18:00	148	CTD	P2	-55.25883	-41.3576	CTD stopped at 3528 metres.
31/03/2009 10:48:00	148	CTD	P2	-55.25884	-41.35757	CTD recovered.
31/03/2009 10:57:00	149	BON	P2	-55.25886	-41.35755	Bongo nets deployed.
31/03/2009 11:10:00	149	BON	P2	-55.25885	-41.35755	Commence hauling Bongo's
31/03/2009 11:28:00	149	BON	P2	-55.25886	-41.35757	Bongo net on deck
31/03/2009 11:29:00	150	BON	P2	-55.25884	-41.35753	Bongo nets re-deployed for second cast
31/03/2009 11:35:00	150	BON	P2	-55.25885	-41.35756	Commence hauling Bongo's
31/03/2009 12:00:00	150	BON	P2	-55.25883	-41.35756	Bongo net recovered on deck
31/03/2009 12:05:00	151	MON	P2	-55.25883	-41.35754	Mini Bongo nets deployed
31/03/2009 12:18:00	151	MON	P2	-55.25884	-41.35752	Commence hauling Mini-Bongo's
31/03/2009 12:36:00	151	MON	P2	-55.25888	-41.35751	Mini Bongo nets recovered on deck
31/03/2009 13:03:00	152	MOC	P2	-55.26176	-41.35286	MOCNESS deployed
31/03/2009 14:18:00	152	MOC	P2	-55.30359	-41.29611	MOCNESS @ 2242m
31/03/2009 15:43:00	152	MOC	P2	-55.35621	-41.23788	MOCNESS recovered on deck
31/03/2009 17:13:00	153	LHPR	P2	-55.23271	-41.38247	LHPR deployed head to wind 150(T) x 3.5knots
31/03/2009 18:05:00	153	LHPR	P2	-55.26782	-41.33945	LHPR wire out 2273m commence hauling
31/03/2009 19:41:00	153	LHPR	P2	-55.32299	-41.25746	LHPR recovered. Securing deck.
31/03/2009 20:38:00	154	GOF	P2	-55.25845	-41.35762	Go-Flo weight deployed.
31/03/2009 21:03:00	154	GOF	P2	-55.25843	-41.35762	Go-Flos stopped at 510 metres for 20 minutes.
31/03/2009 21:45:00	154	GOF	P2	-55.25847	-41.35762	Go-Flos recovered.
31/03/2009 22:18:00	155	GOF	P2	-55.25844	-41.35769	Go-Flo weight redeployed.
31/03/2009 22:29:00	155	GOF	P2	-55.25843	-41.35768	Go-Flos stopped at 90 metres for 10 minutes.

31/03/2009 22:46:00	155	GOF	P2	-55.25847	-41.35769	Go-Flos recovered.
01/04/2009 01:50:00	156	CTD	D17	-54.91186	-41.17407	CTD deployed
01/04/2009 02:52:00	156	CTD	D17	-54.91188	-41.17402	CTD @ 3374m - commence hauling
01/04/2009 04:20:00	156	CTD	D17	-54.91189	-41.174	CTD recovered on deck
01/04/2009 08:10:00	157	SWA	P2	-55.19762	-41.12445	Ship passes over mooring position heading S, logging swath at 8 knt. Old mooring at 3226 m.
01/04/2009 08:25:00	157	SWA	P2	-55.23067	-41.1238	Ship turned west for swath coverage.
01/04/2009 08:34:00	157	SWA	P2	-55.23335	-41.15524	Ship turned north for swath coverage.
01/04/2009 11:33:00	158	MOO	P2	-55.17664	-41.15241	Start moving ahead @ 0.3K
01/04/2009 11:35:00	158	MOO	P2	-55.17681	-41.15222	Buoy deployed - increasing speed to 0.6K - streaming 1200m of rope
01/04/2009 12:14:00	158	MOO	P2	-55.19067	-41.13499	Connecting TRIMSIN floats + 20m of rope
01/04/2009 12:16:00	158	MOO	P2	-55.19123	-41.13431	TRIMSIN floats deployed - connecting Sediment Trap
01/04/2009 12:23:00	158	MOO	P2	-55.19265	-41.1326	Connecting AQUADOOP
01/04/2009 12:24:00	158	MOO	P2	-55.19284	-41.13236	Sediment Trap & AQUADOOP deployed - streaming 1700m of rope
01/04/2009 12:49:00	158	MOO	P2	-55.19999	-41.12391	Passing original position (55'11.99S 041'07.42W)
01/04/2009 13:19:00	158	MOO	P2	-55.2086	-41.1238	Connecting weight & acoustic releases
01/04/2009 13:23:00	158	MOO	P2	-55.2087	-41.12381	Weight suspended over stern (ready to drop)
01/04/2009 13:25:00	158	MOO	P2	-55.20875	-41.1238	Weight Let-Go in position 55'12.522S 041'07.428W water depth by EA600 3213m
01/04/2009 13:43:00	158	MOO	P2	-55.20874	-41.12381	Start tracking 000 to re-trace path of deployment
01/04/2009 14:21:00	158	MOO	P2	-55.19978	-41.12378	Stopped on original mooring Position looking for signal with overboard hydophone
01/04/2009 14:27:00	158	MOO	P2	-55.19975	-41.12379	Signal identified - start moving East to follow signal
01/04/2009 14:43:00	158	MOO	P2	-55.1998	-41.10815	Stopped on DP 0.5' East of
01/04/2009 14:50:00	158	MOO	P2	-55.19982	-41.10816	Moving 0.5' NW to further identify signal
01/04/2009 15:07:00	158	MOO	P2	-55.19353	-41.11797	Vessel all stopped approx NNE to mooring hydrophone deployed
01/04/2009 15:15:00	158	MOO	P2	-55.19354	-41.11797	Hydrophone recovered on deck vessel off D.P proceeding to site D18
01/04/2009 18:44:00	159	CTD	D18	-54.58972	-40.99616	CTD deployed depth 3277m
01/04/2009 19:43:00	159	CTD	D18	-54.59052	-40.99764	CTD stopped at 3245 metres out.
01/04/2009 21:00:00	159	CTD	D18	-54.59051	-40.99762	CTD recovered.
01/04/2009 23:08:00	160	RMT8	D19	-54.30872	-40.85921	Deploy RMT 8 for shallow water trawl
01/04/2009 23:52:00	160	RMT8	D19	-54.28059	-40.84381	RMT 8 recovered on deck
02/04/2009 00:39:00	161	CTD	D19	-54.21951	-40.81332	CTD deployed
02/04/2009 01:28:00	161	CTD	D19	-54.2195	-40.81333	CTD @ 2443m - commence hauling
02/04/2009 02:26:00	161	CTD	D19	-54.21947	-40.8133	CTD recovered on deck

02/04/2009 04:50:00	162	CTD	D20	-53.89687	-40.64405	CTD deployed depth 1212m
02/04/2009 05:18:00	162	CTD	D20	-53.89769	-40.6442	CTD wire out 1244m commence hauling
02/04/2009 06:08:00	162	CTD	D20	-53.89764	-40.64417	CTD recovered on deck
02/04/2009 06:50:00	163	CTD	D20	-53.89767	-40.64417	CTD deployed
02/04/2009 06:56:00	163	CTD	D20	-53.89766	-40.64417	CTD wire out 120m commence hauling
02/04/2009 07:16:00	163	CTD	D20	-53.89765	-40.64413	CTD recovered. Securing deck.
02/04/2009 08:43:00	164	RMT8	D21	-53.75368	-40.59014	RMT 8 deployed.
02/04/2009 09:12:00	164	RMT8	D21	-53.74542	-40.6194	RMT 8 recovered.
02/04/2009 12:00:00	165	CTD	D21	-53.35126	-40.37429	CTD deployed
02/04/2009 12:07:00	165	CTD	D21	-53.35122	-40.37422	CTD @ 120m commence hauling
02/04/2009 12:21:00	165	CTD	D21	-53.35123	-40.37426	CTD recovered on deck
02/04/2009 15:59:00	166	BON	P3	-52.811	-40.11518	Bongo nets deployed
02/04/2009 16:30:00	166	BON	P3	-52.81	-40.11482	Bongo nets recovered on deck preparing MOCNESS deployment
02/04/2009 17:06:00	167	MOC	P3	-52.81268	-40.11107	MOCNESS deployed Head to wind 150(T) x 2 Knots
02/04/2009 18:08:00	167	MOC	P3	-52.84053	-40.07076	MOCNESS wire out 1991m commence hauling
02/04/2009 19:38:00	167	MOC	P3	-52.88455	-40.02855	MOCNESS recovered.
02/04/2009 20:58:00	168	CTD	P3	-52.80837	-40.11558	CTD deployed.
02/04/2009 21:36:00	168	CTD	P3	-52.8084	-40.11558	CTD stopped at 2000 metres wire out.
02/04/2009 22:16:00	168	CTD	P3	-52.80855	-40.11451	CTD recovered.
02/04/2009 22:40:00	169	CTD	P3	-52.80856	-40.11446	CTD redeployed.
02/04/2009 22:54:00	169	CTD	P3	-52.80858	-40.11457	CTD stopped at 400 metres.
02/04/2009 23:18:00	169	CTD	P3	-52.80855	-40.1145	CTD recovered on deck
03/04/2009 00:35:00	170	RMT8	P3	-52.9306	-40.14952	Deploy RMT 8 for shallow water trawl
03/04/2009 00:52:00	170	RMT8	P3	-52.94506	-40.14674	RMT 8 recovered on deck
03/04/2009 01:27:00	171	RMT8	P3	-52.92635	-40.14797	RMT 8 deployed for shallow target.
03/04/2009 02:00:00	171	RMT8	P3	-52.95639	-40.14732	RMT 8 recovered on deck returning to P3
03/04/2009 03:39:00	172	LHPR	P3	-52.78014	-40.1091	LHPR deployed
03/04/2009 06:01:00	172	LHPR	P3	-52.8671	-40.04871	LHPR recovered on deck
03/04/2009 06:54:00	173	CTD	P3	-52.80801	-40.11445	CTD deployed depth 3786m
03/04/2009 08:04:00	173	CTD	P3	-52.80862	-40.11386	CTD stopped at 3729 metres.
03/04/2009 09:36:00	173	CTD	P3	-52.80865	-40.11382	CTD recovered.
03/04/2009 09:48:00	174	BON	P3	-52.80861	-40.11385	Bongo nets deployed.

03/04/2009 10:19:00	174	BON	P3	-52.80818	-40.11504	Bongo nets recovered.
03/04/2009 10:20:00	175	BON	P3	-52.80817	-40.11505	Bongo nets redeployed.
03/04/2009 10:55:00	175	BON	P3	-52.80773	-40.11641	Bongo nets recovered.
03/04/2009 11:02:00	176	MON	P3	-52.8077	-40.1165	Mini Bongo nets deployed
03/04/2009 11:14:00	176	MON	P3	-52.80726	-40.11789	Commence hauling Mini-Bongo's
03/04/2009 12:54:00	177	MOO	P3	-52.72304	-40.21406	On station - deployment position for 3700m mooring EA600 sounding 3856m
03/04/2009 13:00:00	177	MOO	P3	-52.72355	-40.21409	Start moving ahead - building up speed to 2Kts SOG
03/04/2009 13:04:00	177	MOO	P3	-52.72354	-40.21342	Buoy deployed - paying out 1700m Kevlar line
03/04/2009 13:45:00	177	MOO	P3	-52.72345	-40.17991	Connecting TRIMSIN floats + 20m of rope
03/04/2009 13:49:00	177	MOO	P3	-52.72342	-40.17786	TRIMSIN floats deployed
03/04/2009 13:51:00	177	MOO	P3	-52.72343	-40.17719	Connecting sediment trap & AQUADOOP
03/04/2009 13:56:00	177	MOO	P3	-52.72341	-40.1758	Sediment Trap & AQUADOOP deployed - streaming 1700m of rope
03/04/2009 14:46:00	177	MOO	P3	-52.72335	-40.15053	Connecting acoustic release
03/04/2009 14:49:00	177	MOO	P3	-52.72335	-40.14999	Connecting weight
03/04/2009 14:53:00	177	MOO	P3	-52.72335	-40.14901	Weight let go - EA600 sounding 3850m
03/04/2009 15:23:00	177	MOO	P3	-52.72332	-40.14853	Hydrophone deployed commence triangulating mooring
03/04/2009 15:27:00	177	MOO	P3	-52.72332	-40.14852	Hydrophone recovered on deck vessel moving 270(T) x 0.5nm
03/04/2009 15:52:00	177	MOO	P3	-52.72333	-40.16213	Hydrophone deployed
03/04/2009 15:56:00	177	MOO	P3	-52.72334	-40.16218	Hydrophone recovered on deck vessel moving 045(T) x 0.5nm
03/04/2009 16:24:00	177	MOO	P3	-52.71757	-40.15284	Hydrophone deployed
03/04/2009 16:29:00	177	MOO	P3	-52.71756	-40.15281	Hydrophone recovered on deck completed triangulating mooring preparing for bongos
03/04/2009 16:37:00	178	BON	P3	-52.71759	-40.15284	Bongo nets deployed.
03/04/2009 17:08:00	178	BON	P3	-52.71759	-40.15281	Bongo net recovered on deck
03/04/2009 17:12:00	179	MON	P3	-52.71758	-40.15279	Mini Bongo nets deployed
03/04/2009 17:43:00	179	MON	P3	-52.71757	-40.15281	Mini Bongo nets recovered on deck
03/04/2009 18:06:00	180	LHPR	P3	-52.73693	-40.16579	LHPR deployed head to wind 125(T) x 3.5knots
03/04/2009 18:57:00	180	LHPR	P3	-52.75969	-40.12262	LHPR wire out 2251m commence hauling
03/04/2009 20:19:00	180	LHPR	P3	-52.78962	-40.06432	LHPR recovered.
03/04/2009 20:57:00	181	GOF	P3	-52.80847	-40.11455	Go-Flo weight deployed.
03/04/2009 21:25:00	181	GOF	P3	-52.80852	-40.11459	Stopped at 510 metres for 15 minutes.
03/04/2009 22:02:00	181	GOF	P3	-52.80854	-40.11459	Go-Flos recovered.
03/04/2009 22:31:00	182	GOF	P3	-52.80856	-40.11458	Go-Flo weight redeployed.

03/04/2009 22:40:00	182	GOF	P3	-52.80851	-40.11457	Go-Flos stopped at 70 metres for 10 minutes.
03/04/2009 22:58:00	182	GOF	P3	-52.80854	-40.11458	Go-Flos recovered.
03/04/2009 23:21:00	183	MOC	P3	-52.81017	-40.10674	MOCNESS deployed
04/04/2009 02:10:00	183	MOC	P3	-52.81344	-39.93569	MOCNESS recovered on deck - Moving RMT 25 into Position
04/04/2009 03:26:00	184	RMT25	P3	-52.80751	-40.05762	RMT25 deployed
04/04/2009 05:08:00	184	RMT25	P3	-52.81134	-39.93183	Commence recovery of RMT 25
04/04/2009 05:17:00	184	RMT25	P3	-52.81148	-39.92056	RMT 25 recovered on deck
04/04/2009 06:01:00	185	RMT25	P3	-52.80781	-40.00894	RMT 25 deployed
04/04/2009 08:58:00	185	RMT25	P3	-52.83403	-39.81452	RMT 25 recovered.
04/04/2009 09:38:00	186	ACO	P3	-52.84797	-39.74729	Commence acoustic survey middle leg downwind. 280(T) at 10 knots.
04/04/2009 12:21:00	186	ACO	P3	-52.76918	-40.47853	Middle transect completed - Proceeding to begin 2nd leg of survey
04/04/2009 13:08:00	186	ACO	P3	-52.87565	-40.51009	Commence 2nd transect line course 100 (T)
04/04/2009 15:52:00	186	ACO	P3	-52.95365	-39.77749	Completed 2nd 50k transect line
04/04/2009 17:14:00	186	ACO	P3	-52.74147	-39.71847	Commence 3rd. transect line. Course 280(T) x 50K
04/04/2009 19:55:00	186	ACO	P3	-52.66389	-40.44097	Completed 3rd transect line completed acoustic survey
04/04/2009 22:46:00	187	RMT8	P3	-52.68378	-40.2655	RMT 8 deployed.
04/04/2009 23:08:00	187	RMT8	P3	-52.68492	-40.24336	RMT 8 recovered. Securing deck for passage to R3.
06/04/2009 09:08:00	188	BON	R3	-52.85054	-37.10159	Bongo nets deployed.
06/04/2009 09:42:00	188	BON	R3	-52.85061	-37.10013	Bongo nets recovered.
06/04/2009 09:44:00	189	BON	R3	-52.85064	-37.10002	Bongo nets redeployed.
06/04/2009 10:19:00	189	BON	R3	-52.85068	-37.09842	Bongo nets recovered.
06/04/2009 10:23:00	190	MON	R3	-52.85069	-37.09819	Mini bongos deployed.
06/04/2009 10:57:00	190	MON	R3	-52.85077	-37.09667	Mini bongos recovered.
06/04/2009 11:15:00	191	CTD	R3	-52.85069	-37.09668	CTD deployed
06/04/2009 11:58:00	191	CTD	R3	-52.85073	-37.09669	CTD @ 2210m - commence hauling
06/04/2009 13:00:00	191	CTD	R3	-52.85076	-37.09669	CTD recovered on deck - preparing for Go-Flo deployment
06/04/2009 13:10:00	192	GOF	R3	-52.85077	-37.09668	Go-Flo bottles deployed
06/04/2009 13:20:00	192	GOF	R3	-52.85076	-37.0967	Go-Flo's all stopped at 70m - waiting to haul for 10mins
06/04/2009 13:33:00	192	GOF	R3	-52.85076	-37.09671	Start hauling Go-Flo's
06/04/2009 13:40:00	192	GOF	R3	-52.85074	-37.09675	Weight back on deck preparing bottles
06/04/2009 14:11:00	193	GOF	R3	-52.85072	-37.09669	Go-Flo bottles deployed for second cast on station
06/04/2009 14:37:00	193	GOF	R3	-52.85076	-37.0967	Bottles @ 510m - waiting 15mins to haul

06/04/2009 14:54:00	193	GOF	R3	-52.85077	-37.09666	Commence hauling Go-Flo's
06/04/2009 15:17:00	193	GOF	R3	-52.85075	-37.09668	Go-Flo bottles recovered on deck
06/04/2009 15:27:00	194	CTD	R3	-52.85075	-37.09668	CTD deployed depth 2261m
06/04/2009 15:39:00	194	CTD	R3	-52.85078	-37.09668	CTD wire out 400m commence hauiling
06/04/2009 16:01:00	194	CTD	R3	-52.85074	-37.09669	CTD recovered on deck
06/04/2009 16:28:00	195	MOC	R3	-52.85086	-37.09506	Vessel off D.P Head to wind at 2knots commence deploying MOCNESS
06/04/2009 16:31:00	195	MOC	R3	-52.85007	-37.09207	MOCNESS deployed head to wind 080(T) x 2 knots
06/04/2009 17:28:00	195	MOC	R3	-52.84312	-37.04761	MOCNESS wire out 1667m commence hauling
06/04/2009 18:56:00	195	MOC	R3	-52.83841	-36.9764	MOCNESS recovered on deck preparing for LHPR
06/04/2009 19:16:00	196	LHPR	R3	-52.83708	-36.96365	LHPR deployed.
06/04/2009 20:00:00	196	LHPR	R3	-52.84356	-36.91633	LHPR at depth. 1839 metres wire out.
06/04/2009 21:23:00	196	LHPR	R3	-52.85311	-36.8295	LHPR recovered. Rearranging deck for RMT 8 fishing.
07/04/2009 01:36:00	197	RMT8	R3	-52.89351	-37.25558	RMT 8 deployed
07/04/2009 01:43:00	197	RMT8	R3	-52.89203	-37.24729	RMT 8 cancelled due to swell
07/04/2009 01:58:00	197	RMT8	R3	-52.89035	-37.23276	RMT 8 recovered on deck
07/04/2009 09:08:00	198	ACO	R3	-52.81191	-36.73398	Commence acoustic survey heading downwind 260T at 10 knots.
07/04/2009 11:49:00	198	ACO	R3	-52.88952	-37.46295	Transect complete
07/04/2009 12:55:00	198	ACO	R3	-52.7739	-37.4082	Commence 2nd transect line course 080 (T)
07/04/2009 15:21:00	198	ACO	R3	-52.70096	-36.76632	Completed 2nd 50k transect line proceeding to start of 3rd transect line
07/04/2009 16:40:00	198	ACO	R3	-52.91767	-36.70321	Commence 3rd transect line course 260(T) x 50k
07/04/2009 16:40:00	198	ACO	R3	-52.91767	-36.70321	Commence 3rd transect line course 260(T) x 50k
07/04/2009 19:22:00	198	ACO	R3	-52.99612	-37.43849	End of transect.
07/04/2009 19:39:00	199	XBT	PF	-52.97047	-37.41742	XBT completed.
07/04/2009 21:36:00	200	XBT	PF	-52.72153	-37.0434	XBT completed.
07/04/2009 23:27:00	201	RMT8	PF	-52.49709	-36.75229	RMT 8 deployed
07/04/2009 23:50:00	201	RMT8	PF	-52.49386	-36.73119	RMT 8 recovered on deck. Securing aft deck.
08/04/2009 00:22:00	202	XBT	PF	-52.45524	-36.67047	XBT deployed on passage @ 10Kts SOG
08/04/2009 02:23:00	203	XBT	PF	-52.19388	-36.32715	XBT deployed on passage @ 10Kts SOG
08/04/2009 04:19:00	204	XBT	PF	-51.9529	-35.99668	XBT deployed on passage @ 10Kts SOG
08/04/2009 06:12:00	205	XBT	PF	-51.71457	-35.67293	XBT deployed on passage @ 10Kts SOG
08/04/2009 08:22:00	206	XBT	PF	-51.44895	-35.29366	XBT completed.
08/04/2009 10:20:00	207	XBT	PF	-51.22403	-34.8956	XBT deployed (failed).

08/04/2009 10:34:00	208	XBT	PF	-51.1984	-34.85023	XBT second attempt successfully completed.
08/04/2009 12:16:00	209	XBT	PF	-51.00669	-34.50729	XBT deployed on passage @ 10Kts SOG
08/04/2009 14:21:00	210	XBT	PF	-50.76726	-34.08173	XBT deployed on passage @ 10Kts SOG
08/04/2009 15:45:00	211	XBT	PF	-50.59459	-33.79891	Vessel at PF site proceeding 000(T) x 100K XBT deployed
08/04/2009 16:15:00	212	XBT	PF	-50.50089	-33.79922	XBT deployed
08/04/2009 16:47:00	213	XBT	PF	-50.40565	-33.84007	XBT deployed
08/04/2009 17:19:00	214	XBT	PF	-50.30865	-33.89181	XBT deployed
08/04/2009 17:47:00	215	XBT	PF	-50.2292	-33.93982	XBT deployed
08/04/2009 18:17:00	216	XBT	PF	-50.15478	-33.98654	XBT deployed
08/04/2009 18:58:00	217	XBT	PF	-50.06748	-34.02443	XBT deployed
08/04/2009 19:36:00	218	XBT	PF	-49.98422	-34.13905	XBT completed.
08/04/2009 20:02:00	219	XBT	PF	-49.92924	-34.2191	XBT completed.
08/04/2009 20:34:00	220	XBT	PF	-49.86238	-34.31717	XBT completed.
08/04/2009 21:12:00	221	XBT	PF	-49.78427	-34.43614	XBT completed.
09/04/2009 10:00:00	222	ACO	PF	-50.08762	-33.82234	Commence acoustic survey middle leg 280T x 30km at 10 knots.
09/04/2009 11:37:00	222	ACO	PF	-50.04092	-34.23478	Middle transect completed - Proceeding to begin 2nd leg of survey
09/04/2009 11:39:00	222	ACO	PF	-50.04107	-34.2424	a/c 230(T) running obliquely across swell to avoid heavy rolling
09/04/2009 12:16:00	222	ACO	PF	-50.10776	-34.34206	a/c 130(T) - heading towards 2nd leg with swell on port bow
09/04/2009 12:40:00	222	ACO	PF	-50.14383	-34.25723	2nd leg of acoustic survey - 100(T) @ 2000kW (set power used due to ships motion)
09/04/2009 14:18:00	222	ACO	PF	-50.19234	-33.85911	transect complete
09/04/2009 14:21:00	222	ACO	PF	-50.19259	-33.8481	a/c 060(T) to run obliquely to swell en route to 3rd leg of survey
09/04/2009 16:20:00	222	ACO	PF	-49.98255	-33.79194	Commence 3rd transect line course 280(T) x 30k
09/04/2009 17:58:00	222	ACO	PF	-49.93464	-34.20506	Completed 3rd trasect line completed acoustic survey
09/04/2009 18:27:00	223	CTD	PF1	-49.9358	-34.20789	CTD deployed depth 5089m
09/04/2009 18:43:00	223	CTD	PF1	-49.93544	-34.20603	CTD wire out 600m commence hauling
09/04/2009 19:10:00	223	CTD	PF1	-49.93468	-34.20114	CTD recovered.
09/04/2009 20:47:00	224	CTD	PF2	-50.06312	-34.02866	CTD deployed. EA600 depth 5020 m. Moving 065T x 0.5 knt to follow wire. Current 1.8 knt
09/04/2009 21:17:00	224	CTD	PF2	-50.0615	-34.02308	CTD at 1500 metres wire out.
09/04/2009 22:03:00	224	CTD	PF2	-50.059	-34.01306	CTD recovered.
09/04/2009 22:35:00	225	RMT25	PF3	-50.05577	-33.99707	RMT 25 deployed. Towing just north of east at ~4 knt to maintain water speed of 2 knots.
09/04/2009 23:50:00	225	RMT25	PF3	-50.0447	-33.87206	Commence hauling - wire length 2000m (approx)
10/04/2009 01:48:00	225	RMT25	PF3	-50.03587	-33.66515	RMT 25 recovered on deck. Securing aft deck.

10/04/2009 02:58:00	226	RMT25	PF3	-50.04993	-33.78966	RMT 25 deployed
10/04/2009 05:01:00	226	RMT25	PF3	-50.04396	-33.58064	Commence recovery of RMT 25
10/04/2009 06:07:00	227	RMT25	PF3	-50.04935	-33.67103	RMT 25 deployed.
10/04/2009 08:33:00	227	RMT25	PF3	-50.0517	-33.41084	RMT 25 recovered.
10/04/2009 11:11:00	228	BON	PF3	-50.06647	-33.9102	Bongo net in the water
10/04/2009 11:41:00	228	BON	PF3	-50.06395	-33.89274	Bongo recovered
10/04/2009 11:42:00	229	BON	PF3	-50.06384	-33.89201	Bongo nets recovered to deck and re-deployed
10/04/2009 12:15:00	229	BON	PF3	-50.05957	-33.87317	Bongo net recovered on deck -- being swapped for Mini-Bongo
10/04/2009 12:18:00	230	MON	PF3	-50.05917	-33.8717	Mini Bongo nets deployed
10/04/2009 12:50:00	230	MON	PF3	-50.05444	-33.85118	Mini Bongo nets recovered on deck
10/04/2009 14:28:00	231	CTD	PF3	-50.24275	-33.95258	CTD deployed for 500m cast
10/04/2009 15:08:00	231	CTD	PF3	-50.23598	-33.94505	CTD recovered on deck
10/04/2009 16:28:00	232	CTD	PF5	-50.4208	-33.87981	CTD deployed depth 4774m
10/04/2009 16:43:00	232	CTD	PF5	-50.42096	-33.87829	CTD wire out 600m commence hauling
10/04/2009 17:03:00	232	CTD	PF5	-50.42119	-33.87749	CTD recovered on deck
10/04/2009 17:19:00	233	RMT25	PF5	-50.42119	-33.87742	Conducting wire deployed
10/04/2009 17:27:00	233	RMT25	PF5	-50.42119	-33.87741	251m wire out commence hauling
10/04/2009 17:37:00	233	RMT25	PF5	-50.42119	-33.8774	Conducting wire and weight recovered on deck
10/04/2009 17:54:00	234	LHPR	PF5	-50.4212	-33.8774	LHPR ready vessel off D.P proceeding to PFS
10/04/2009 19:02:00	234	LHPR	PF5	-50.60102	-33.92624	LHPR deployed.
10/04/2009 21:11:00	234	LHPR	PF5	-50.60112	-33.81264	LHPR recovered. Preparing RMT 25 net.
10/04/2009 21:55:00	235	RMT25	PF5	-50.6017	-33.8599	Commence RMT 25 deployment.
10/04/2009 22:01:00	235	RMT25	PF5	-50.60146	-33.8561	RMT 25 deployed. Towing east towards PFS.
10/04/2009 23:55:00	235	RMT25	PF5	-50.59577	-33.7556	RMT 25 recovered on deck
11/04/2009 00:40:00	236	RMT25	PF5	-50.60091	-33.83574	RMT 25 deployed (deep trawl)
11/04/2009 03:16:00	236	RMT25	PF5	-50.58435	-33.72111	Commence recovery of RMT 25
11/04/2009 03:24:00	236	RMT25	PF5	-50.58349	-33.71848	RMT 25 recovered on deck
11/04/2009 04:15:00	237	RMT25	PF5	-50.59529	-33.84731	RMT 25 deployed
11/04/2009 06:15:00	237	RMT25	PF5	-50.60756	-33.74788	Commence recovery of RMT 25
11/04/2009 06:25:00	237	RMT25	PF5	-50.60723	-33.74334	RMT 25 recovered on deck
11/04/2009 07:24:00	238	CTD	PF5	-50.59993	-33.80173	CTD deployed.
11/04/2009 07:51:00	238	CTD	PF5	-50.59985	-33.80176	CTD stopped at 1500 metres wire out.

11/04/2009 08:42:00	238	CTD	PF5	-50.59872	-33.80584	CTD recovered.
11/04/2009 08:54:00	239	BON	PF5	-50.59933	-33.80372	Bongo nets deployed.
11/04/2009 09:29:00	239	BON	PF5	-50.59807	-33.80712	Bongo nets recovered.
11/04/2009 09:31:00	240	MON	PF5	-50.59804	-33.80711	Mini bongos deployed.
11/04/2009 10:04:00	240	MON	PF5	-50.59665	-33.81091	Mini bongos recovered.
14/04/2009 13:15:00	241	NTOW	SGS	-53.79134	-37.92952	NOC towfish deployed
14/04/2009 18:14:00	241	NTOW	SGS	-53.96351	-37.32031	Towfish recovered
14/04/2009 16:59:00	242	RMT8	SGS	-53.92067	-37.29464	RMT 8 deployed
14/04/2009 17:57:00	242	RMT8	SGS	-53.9601	-37.31959	RMT 8 recovered on deck
14/04/2009 23:29:00	243	CTD	Stromness	-54.15969	-36.69636	Net monitor lowered from stern gantry for CTD profile (in lieu of m.ships gantry CTD)
14/04/2009 23:35:00	243	CTD	Stromness	-54.15968	-36.69635	Net monitor recoverd and being swapped for alternate unit
14/04/2009 23:44:00	244	CTD	Stromness	-54.15969	-36.69636	Deploy 2nd net monitor over stern
14/04/2009 23:50:00	244	CTD	Stromness	-54.15962	-36.6965	Net monitor recovered on deck
15/04/2009 00:00:01	245	ACO	Stromness	-54.15978	-36.69614	Forward calibration messenger (belly rope) rigged
15/04/2009 00:30:00	245	ACO	Stromness	-54.15912	-36.69423	Fore and Aft line rigged
15/04/2009 01:19:00	245	ACO	Stromness	-54.15927	-36.69337	Calibration sphere in position
15/04/2009 06:57:00	245	ACO	Stromness	-54.16013	-36.69563	Completed calibration
15/04/2009 18:14:00	245	ACO	Stromness	-53.79273	-37.93128	Vessel on D.P mode for recovering mooring
15/04/2009 18:20:00	245	ACO	Stromness	-53.79267	-37.93018	Hydrophone deployed
15/04/2009 18:23:00	245	ACO	Stromness	-53.79265	-37.93018	Buoy released
15/04/2009 18:26:00	245	ACO	Stromness	-53.79263	-37.9302	Mooring sighted at the surface
15/04/2009 18:35:00	245	ACO	Stromness	-53.79592	-37.93592	Mooring alongside vessel
15/04/2009 18:43:00	245	ACO	Stromness	-53.79562	-37.93747	Trimsin buoy recovered on deck
15/04/2009 18:48:00	245	ACO	Stromness	-53.79553	-37.93817	2 Trimsin buoys recovered on deck
15/04/2009 18:58:00	245	ACO	Stromness	-53.79533	-37.93934	Main buoy recovered on deck
15/04/2009 20:05:00	245	ACO	Stromness	-53.79605	-37.9325	Ready for redeployment. Increasing speed to 2 knots.
15/04/2009 20:07:00	245	ACO	Stromness	-53.79594	-37.93293	Commence redeployment.
15/04/2009 20:08:00	245	ACO	Stromness	-53.7958	-37.93344	Buoy in the water and released.
15/04/2009 20:13:00	245	ACO	Stromness	-53.79515	-37.93578	Weight released.
15/04/2009 20:33:00	246	NTOW	SGS	-53.7953	-37.93536	Iron fish deployed. Commence making way for CPR deployment.
15/04/2009 20:36:00	247	CPR	SGS	-53.79496	-37.93693	CPR deployed. Increasing speed.

The End!

Sunrise somewhere in the Scotia Sea

Invasion of the cattle egrets

The perfect storm

Bird obs S. Ocean style

PSO penguin kissing

And finally………a hairy night at the races.